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FutureReady

WHERE THE SMART GRID IS HEADING

Innovations

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The Next Big Thing?

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NEW WAYS OF thinking about familiar problems

A MESSAGE FROM PRASANNA VENKATESAN

What we call innovation might be less about new products and more about new ways of thinking about familiar problems.

Grid modernization, for example, is as much an evolution of process as it is about technology. The information was always there, we just had to collect it more efficiently and learn how to use it better.

That's why the real innovation behind the smart grid happens inside the utility office, as engineers and operators ask the question, "What if?"

What if we used meter data to get an accurate picture of asset loading throughout the day? What if there was a simple way to detect and monitor the impact of reverse power flows from rooftop solar? What if intelligent line sensors could predict future faults?

At Landis+Gyr, we thrive on having these conversations with our customers and taking away the best ideas to do more with the solutions being developed and those already available.

In this issue of *FutureReady*, we look at some recent areas of innovation and their impacts. The Internet of Things is a growing industry theme, but for utilities this concept is finding life as an "intranet of things."

We also take a look at innovations in the energy storage business that are opening the door to battery applications not previously considered.

Smart meters are not often talked about as being grid sensors, but the proof is there in applications both at the end consumer and other places on the grid. And speaking of grid sensors, the next generation of faulted circuit indicators–a valuable outage response tool utilities have used for 70 years–demonstrate how product evolution can turn a legacy application into a valuable monitoring device that can help prevent future outages.

Finally, we consider the impact of smart grid innovation on cities and discover how vital smart grids are to improving urban efficiency worldwide.

Whatever the challenge, we know from experience that those closest to the problem are better prepared to think of a solution. The innovative thinking in the minds of grid and utility operators is what fuels the change we see taking place every day.

Prasanna Venkatesan

Landis+Gyr, Executive Vice President, Americas

Smart Communities Need Smart Grids

Imagine a city that offers its citizens free public Wi-Fi and interactive digital kiosks. Taxis with touch payments enabled by GPS technologies or smart parking sensors that provide information about accessible on-street parking spaces. Smart meters that measure water consumption and even detect and isolate leaks. Or how about a networked smokestack that cuts emissions when the wind blows in the direction of schools or a residential area?

Some or all of these things are already happening in locations as far-flung as Boston, Bogota, Kansas City and Seoul. They are part of initiatives in cities across the globe working to leverage technology to improve the lives of their citizens.

The smart city, once a topic of discussion among academics, urban planners and technology experts, is now a hot media topic with a wide range of definitions. According to global information company IHS Technology, smart cities are "cities that have deployed—or are currently piloting—the integration of more functional areas of a city."[1]

The smart cities concept received a real boost this year with the launch of a new "Smart Cities" initiative by the Obama administration that will invest more than $160 million in federal research and launch a number of important technology collaborations. These projects are designed to help local communities find solutions for critical economic and quality of life challenges, including reducing traffic congestion, energy efficiency, combatting crime and improving the delivery of city services.

Among the infrastructure initiatives is the Department of Energy's Office of Electricity Delivery and Energy Reliability Smart Grid Integration Challenge for Cities, which is offering $1 million in funding to city governments with action plans and targets for reducing energy consumption.

[1] IHS Technology http://press.ihs.com/press-release/design-supply-chain-media/smart-cities-rise-fourfold-number-2013-2025

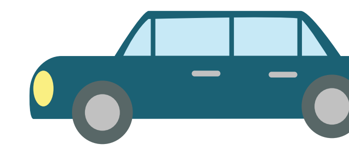
Why smart cities need smart grids

Of all the smart city projects being tracked by Pike Research, nearly one-third are focused on smart grids, with nearly half focused on energy-centered projects. These smart grid investments are critical because they contribute to an intelligent infrastructure that can support a wide range of city operations and provide a platform for new benefits, services and energy efficiencies.

Smart city projects are serving as pilot environments for smart grid technologies and innovations that promise to support renewables integration, electric vehicle (EV) charging and demand management programs. After all, the connection between smart grids and smart cities is undeniable. A city served by infrastructure connected to an intelligent, automated network gains new capabilities for addressing a range of challenges.

Smart Transportation

In many cases, a smart city initiative begins with a single area, expanding and integrating other areas as they evolve. Most often, smart city planners in the United States start by focusing on energy consumption and transportation. One notable aspect of the transportation function is smart street lighting programs, because street lighting consumes significant portions of a city's energy budget.



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In the United States, smart grid vendors are leveraging their networks of connected endpoints to communicate with networked devices, enabling the use of smart parking meters, traffic sensors and smart street lighting programs.

Many cities are also looking to implement smart technologies to manage traffic to reduce the environmental impact of traffic congestion. In Portland, OR, for example, the city is working with the local Climate Trust to leverage information and communications technology (ICT) solutions to achieve real-time traffic signal timing adjustments and transit signal priority systems that may reduce delays, congestion and pollution.

Smart Buildings

Buildings are also a high priority for smart city planners. Because they consume 40 percent of all energy in the United States, the National Academy of Sciences has stated that if buildings fully deploy energy efficiency technologies and programs, the nation could postpone construction of new electricity-generating plants until 2030.

The good news is that smart technologies are being developed to enable building owners to serve the needs of occupants and control heat, ventilation and lighting, while balancing electricity supply and demand. New smart building solutions will also integrate EVs into the management of a building. EVs will communicate with charging stations, providing information that can be used to enable the EVs to deliver electricity to the building when needed. Other technology innovations are also in development to connect entire buildings into microgrids that can serve as cost-effective peak power suppliers.

Wi-Fi Networks

Smart cities that deploy Wi-Fi networks for their citizens are able to provide a communications platform for their smart grid operations. The Chattanooga Electric Power Board, a city-owned utility, is now known as "Gig City," largely because of the fiberoptic network it built accessible by every home and business in its service territory. The smart grid that serves the city is the foundation for the fiberoptic network and, with its ability to automatically reroute power, it has reportedly enabled utility customers to avoid or reduce outages (up to 124.7 minutes of electric interruptions, according to utility estimates).

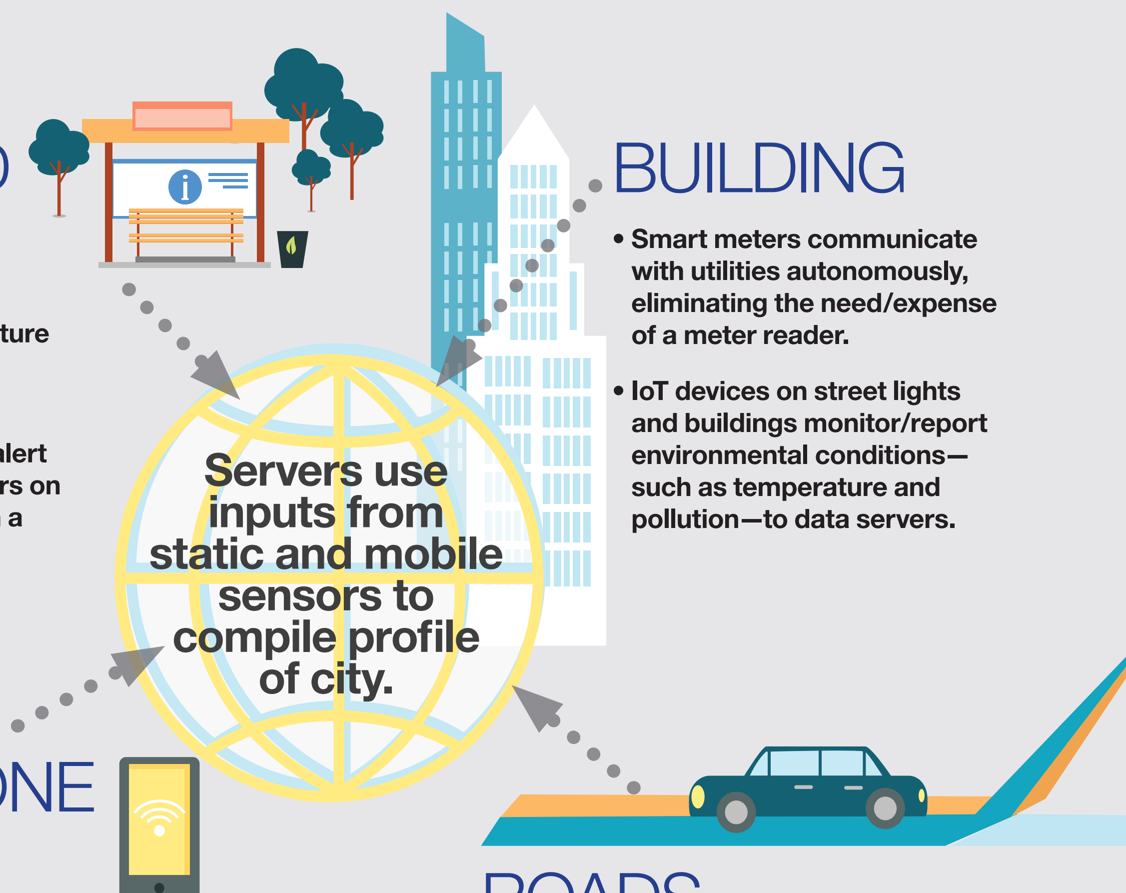
The future of smart cities

IHS Technology projects the number of smart cities will increase from 21 (in 2013) to 88 by 2025, with Asia-Pacific accounting for the most (32), followed closely by Europe (31), and the Americas (25). In the United States, where smart city projects typically have a single focus, many are seeing progress in making their infrastructures smarter and more efficient.

Envision America, an outgrowth of the Obama administration's Smart City initiative, is a nonprofit program committed to accelerating deployment of innovative technologies for energy, water, waste and air challenges. The effort, which is scheduled to launch in January 2016, will begin with a workshop at which industry and academia representatives, as well as leaders from 10 urban communities will come together to diagnose needs, discover solutions and develop new smart initiatives. Landis+Gyr is a corporate sponsor of the program. ■

Smart technologies can automate and orchestrate the operation and maintenance of city infrastructure and services

Less energy/use, pollution and congestion—and more efficient service delivery—are among the goals of the smart city



PARKS AND GARDENS

- **Sensors deployed in parks monitor moisture, temperature and humidity to automate/regulate irrigation.**
- **Sensors on garbage cans alert collectors when full; sensors on street lamps activate when a person approaches.**

BUILDING

- **Smart meters communicate with utilities autonomously, eliminating the need/expense of a meter reader.**
- **IoT devices on street lights and buildings monitor/report environmental conditions—such as temperature and pollution—to data servers.**

SMARTPHONE USERS

- **Smartphone users/subscribers receive alerts of events occurring in the city and can retransmit information to others.**
- **Smartphone app delivers contextually useful data to users, e.g., point phone at a bus stop to learn when the next bus will arrive.**
- **Citizens use phones to capture and report infrastructure problems, such as potholes, to the city for repair.**

ROADS

- **Devices positioned on roads and at intersections measure/report traffic volumes and road speeds.**
- **Sensors buried beneath parking areas detect available spaces.**
- **Panels at main intersections relay data from parking sensors to guide drivers to available spots.**

Source: IHS Technology

The ascent of machine-to-machine communication has created a lot of buzz about the Internet of Things. The promise of networked, intelligent devices sharing information and automating processes is driving growth in many industries. But how far those connections will extend to consumer technology is still being questioned.

Utilities and the Internet of Things

What exactly is the IoT? According to Gartner, a leading IT research company, the IoT is "the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment."[1]

The IPSO Alliance, an industry organization promoting the use of Internet Protocol for connecting smart objects, describes the advent of IoT being driven by low cost, two-way sensors that enable a wide range of applications in healthcare, transportation, factory monitoring, home automation and energy management.

Internet of Things vs. Intranet of Things

Within the context of utilities and the smart grid, the IoT refers to all smart devices that can potentially communicate with utility devices, from thermostats and smart appliances to magnet switches and solar panels. These devices come together to form a connected network of devices that utilities can access to optimize their distribution systems.

But what about the devices the utility owns that comprise a closed network of sensors—in a substation, along the feeder or at the meter—that the utility can use to make operational decisions? In this scenario, it might be more realistic for utilities to think of their networks as an *Intranet*—as opposed to an Internet—of things.

"When it comes to managing the flow of energy and optimizing it, a utility will not allow devices to arbitrarily come on and off their network," says John Radgowski, Vice President, Solutions Product Management at Landis+Gyr. "In reality, utilities would have an 'intranet of things'—assets they own and control—closer to the data, as well as the Internet of things that is bridged by way of data exchange with third parties."

Challenges & Opportunities

As the industry works to import the IoT concept into the utility business model, there are a number of challenges ahead. "There are cyber security regulations they must follow," says Radgowski. "You can't simply take unknown devices and connect them to utility systems and expect utilities to use them to make reliable operational decisions. There are also consumer information protection issues that must be considered."

Among the most significant challenges the industry faces are the interoperability issues stemming from the vast number of communications protocols—a challenge that the industry has been attempting to meet for many years. One promising initiative is the Open Field Message Bus (OpenFMB) project, a utility-led project coordinated by the Smart Grid Interoperability Panel (SGIP), whose objective is to create a framework for true, scalable and secure interoperability. The goal is to develop a flexible, secure Application Programming Interface (API) solution by next year.

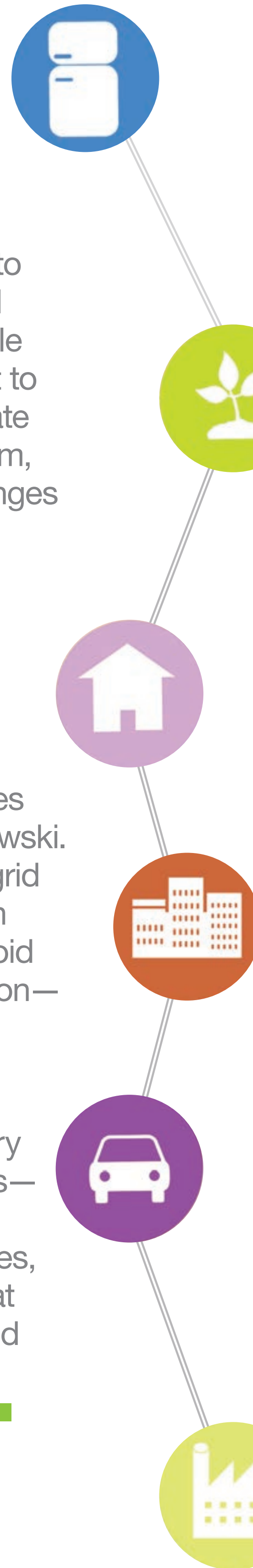
The Future Grid: A Real-World Vision

When envisioning what will happen at the intersection of the smart grid and IoT, Radgowski offers up the example of Apple vs. Google Android operating systems.

"To enable various devices to come onto the networks, we must maintain control of the operating system [much like Apple does]," he says. Yet, it is also important to enable third-party devices to interoperate with each other, like the Android platform, which introduces other potential challenges including OS fragmentation.

In reality, what utilities may need is a compromise that enables a wide range of devices to come onto their networks while also maintaining control of the operating system. "The Landis+Gyr Distributed Intelligence platform provides just such an environment," says Radgowski. "By enabling nearly 50 types of smart grid devices to join the network, our solution meets the same objectives of the Android platform while avoiding OS fragmentation—and also provides an application environment similar to Apple."

Today, more than ever, the utility industry strives to serve the needs of two worlds—their customers and their distribution systems. In response to these challenges, Landis+Gyr has developed a model that provides a wide selection of devices and applications to enable utilities to derive optimum benefits from their networks. ■



[1] Gartner Inc. http://www.gartner.com/it-glossary/internet-of-things/

LINE SENSING MAKES SENSE

BEYOND OUTAGE MANAGEMENT

The archaic expression "trip the light fantastic" is still used today to describe dancing. It also comes to mind when thinking of a tool line crews have used since the Big Band Era to locate faults during an outage.

Faulted Circuit Indicators (FCIs) date back to 1948 and even today most FCIs essentially act as a beacon, lighting up when a fault trips a breaker and serving as a visual cue to line crews trying to locate the problem.

The next generation of line sensors offers an opportunity for utilities to go beyond outage response and gain insights for monitoring power quality and guiding preventive maintenance.

"Intelligent line sensors are a big opportunity for the utility. They more accurately pinpoint faults, and also provide information for analyzing the circuit and assessing distribution grid health," says Anthony Hawkins, Solutions Product Marketing Manager at Landis+Gyr. "As part of a larger distribution automation and grid analytics program, they are a cost-effective way to get great information."

While the first FCIs required visual inspection by utility personal, integrated communication capabilities have been available for many years. What's changed today is the added intelligence that, combined with two-way connection to smart grid networks, provides value to the utility on a daily basis.

Line sensors, like the S610 line sensor from Landis+Gyr, provide measurements of fault current, direction and magnitude of the fault. This allows the utility to pinpoint fault location quickly to significantly reduce outage duration. This benefit is captured in the System Average Interruption Duration Index (SAIDI) performance metric used by utilities to measure reliability performance. SAIDI is calculated in minutes and many utilities report this index to their regulatory agency. A five percent reduction in SAIDI can equate to hundreds of man-hours and associated cost savings for the average utility.

Additionally, these sensors capture high-resolution waveform measurements and offer interval load logging to help diagnose conditions on the line that could cause or contribute to future outages. For instance, if a tree branch occasionally brushes a line without causing a fault, the waveform of this event can be captured and used to locate similar events on all monitored circuits so crews can address the problem before a fault happens. Using analytics to drive this type of preventive maintenance can greatly reduce operating costs as well.

The harmonic and power quality data available from the sensor can essentially replace a power quality meter on critical customer accounts, such as government buildings, data centers and hospitals. What's more, line sensors collect power quality measurements on a circuit serving multiple customers, not just a single critical customer.

These same capabilities make line sensors invaluable for monitoring the impact of residential solar installations on a circuit. The logging capability of the sensor—delivering real-time circuit load, conductor temperature and direction of flow—provides insights into how these distributed resources impact the grid. A large number of renewables on a circuit could have an adverse impact on grid reliability if backflows disrupt protection equipment. The ability to track and analyze this data throughout the day can aid a utility in developing mitigation strategies.

"An intelligent line sensor serves multiple roles in a larger network, in addition to being crucial for outage restoration," says Hawkins. "The information delivered on an ongoing basis can be used in conjunction with sensing data from other points on the system to analyze the circuit in depth and realize immediate benefits in reliability and operational efficiency."

The evolution from yesterday's FCI to today's line sensor showcases another way utilities are modernizing the grid by adding intelligence and connectivity to legacy applications. And the results might even cause a lineman to dance. ■

Innovations in Energy Storage: THE NEXT BIG THING?

The energy storage market is poised for considerable growth in the coming decade. That was one of the main takeaways from this year's Energy Storage North America conference. In his keynote address, James Avery, Senior Vice President at San Diego Gas & Electric, predicted that storage is moving from a niche position to a high-profile technology that will soon provide many services traditionally performed with other devices.

Avery isn't the only one who is bullish on energy storage. A 2015 report from the Energy Storage Association and GTM Research estimated that energy storage deployments are on track to double last year's totals. Projections for 2018 are at nearly 600 megawatts (MW), approximately three times more than the current year.

The rise of battery technology

Until recently, batteries have not served as integral components of the utility grid. Today, however, innovations in technology have enabled the development of advanced batteries for utility-scale energy storage applications. As a result, the use of energy storage by utilities, homeowners and businesses is coming on strong, with 40.7 MW of energy storage projects installed in the United States in the second quarter of 2015.

What's driving this growth? The increasing incidence of extreme weather events, for one thing. These events have created urgency among utility customers to demand more resources for backup power. And pressure is building for utilities to do more to ensure a resilient power grid.

Utilities are feeling pressure not just from their customers but also from government agencies and regulators. Examples include the Environmental Protection Agency's (EPA) Clean Power Plan, which was launched to cut carbon pollution from existing power plants, and Renewable Portfolio Standards (RPS) requiring the increased production of energy from renewable energy sources.

In California, a recent mandate from the California Public Utilities Commission is now requiring the state's three investor-owned utilities to add

1.3 GW ENERGY STORAGE by 2024

So, where does energy storage stand today? The technology is quickly overcoming some of the challenges it presented in the past, including its high cost. According to a recent study from Lazard, a global financial advisory and asset management firm, energy storage is quickly becoming cost-competitive with conventional grid electricity in some markets and, with the increase in the adoption of renewables and supportive policies, costs are expected to decline dramatically in the next five years.

Utilities are supportive of energy storage. In a recent Utility Dive survey, more than half of the utility executives who responded said they believe their companies should be investing more in energy storage technologies. One of the promises of energy storage that utilities are particularly interested in is the ability to fill the gap created by otherwise inexpensive, but unreliable, variable energy sources such as solar photovoltaics (PV) and wind.

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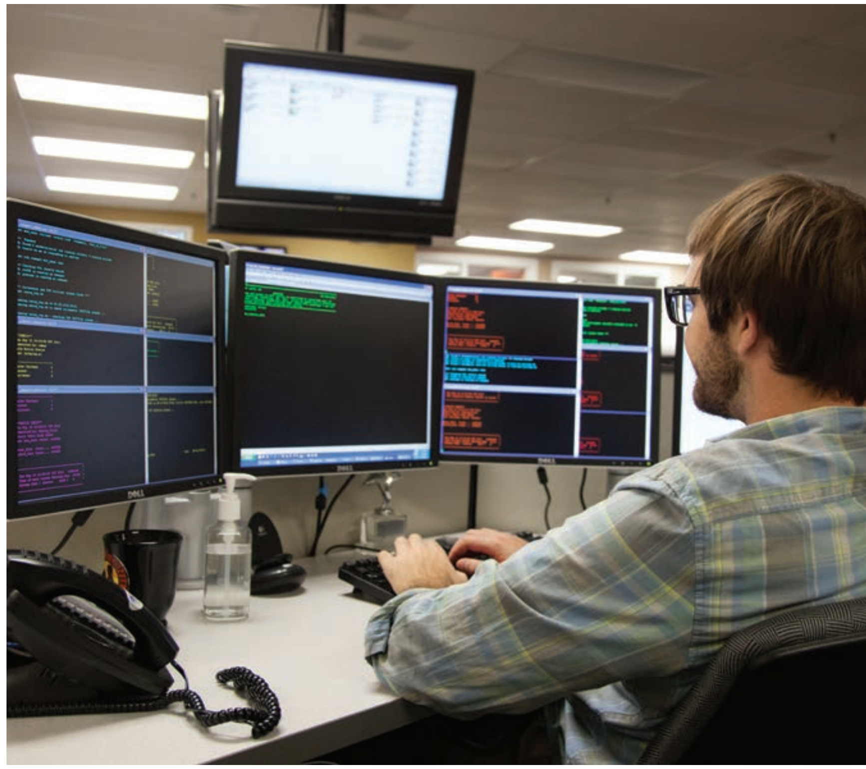

Beyond generation

Because of its flexibility, energy storage can be leveraged to support multiple service needs of the grid, including generation, distribution and transmission—as well as needs on the customer side of the meter.

1 FREQUENCY REGULATION

The increasing penetration of intermittent renewables is creating more and more need for regulation services that fine-tune operations to enable supply and demand balance in real time to maintain a consistent frequency. Because grid imbalances occur most often in spans of seconds rather than hours, energy storage is more effective for frequency regulation than slower-responding resources like generators.

FERC Order 755, enacted in 2011 by the Federal Energy Regulatory Commission (FERC) to require grid operators to create payment structures that reward accurate, fast-reacting resources in frequency regulation markets, has spurred project developers to build energy storage projects. PJM Interconnection, an ISO whose territory includes the near Midwest and Mid-Atlantic states, revamped its wholesale electricity market to meet the FERC mandate in 2012. Since then, PJM has been a leader in the development of fast-responding regulation resources that include grid-scale batteries and flywheels.

2 FREQUENCY RESPONSE

Frequency response is another application for energy storage that counteracts sudden and dramatic changes in generation capacity in order to maintain the stability and system frequency of the grid. "It's sort of a cousin of frequency regulation," says Andy Marshall, Senior Product Manager at Landis+Gyr. "Grid frequency is impacted by major changes such as the sudden loss of a generator or transmission line. Higher penetration of utility-scale PV, which are prone to rapid changes in their output, can create very rapid changes in grid frequency that wreak havoc on other generators on the grid. This is especially acute on isolated or island grids." These instances call for short-duration, high-power bursts from a battery that can pick up the load nearly instantaneously and discharge power until a slower-reacting conventional generator can pick up the load. "Batteries can provide this kind of response better than any other asset that is out there," says Marshall.

3 RENEWABLES INTEGRATION

"Energy storage is a central tool to integrate renewables," Marshall continues. As storage becomes more cost-effective, it can be used to transform intermittent renewable power sources like solar PV into reliable, stable resources at price parity with the grid—making the grid less prone to outages and perhaps less expensive to operate.

The most significant growth is occurring with systems that pair solar and storage to enable customers to store power and participate in demand response programs. SolarCity is one solar installer that has partnered with battery manufacturer Tesla Motors to launch a rooftop solar-battery combination system.

There is significant growth in behind-the-meter battery installations in California, thanks to the state's Self-Generation Incentive Program (SGIP), which reimburses customers half the cost of energy storage projects. In June 2015, Governor Jerry Brown signed off on an extension of SGIP that will provide approximately $415 million for the program through 2019.

The integration of energy storage renewables offers many benefits for utilities, too. According to a 2013 study from Sandia National Laboratories, energy storage-renewable integration "shifts the apparent risk off a utility relative to a standalone system being tied to a renewable generation, while at the same time guaranteeing a revenue stream to the developer. Incentives can also help reduce risk to utilities or developers investing in energy storage systems."[1]

[1] Sandia National Laboratories, "Market and Policy Barriers to Energy Storage Deployment," Sept 2013, Sandia.gov/ess/publications/SAND2013-7606.pdf

4 VIRTUAL POWER PLANTS

One of the unique capabilities of energy storage is its ability to provide a balanced flow of power during periods of high demand. By aggregating batteries as components of large systems, they can act as distributed virtual power plants, providing the same benefits as large-scale storage. "A number of companies and utilities are exploring this, and the technology is there," says Ivo Zehnder, Senior Solutions Product Marketing Manager at Landis+Gyr. "You can think of it as a clean peaking power plant that enables the utility to replace its most expensive capacity."

5 VOLTAGE SUPPORT

Distributed storage is particularly well suited for voltage support applications, because reactive power cannot be effectively transmitted over long distances. "If you have all the storage devices close to communities and residential customers, you are also able to support voltage issues out at the feeder line, right where they occur," says Zehnder. In that way, distributed storage can solve voltage quality issues extremely flexibly when they occur during heavy or light and reverse power flow situations."

6 DISTRIBUTED GENERATION

Distributing batteries in front or behind the meter enables further value streams for both the utility and their customers. Eliminating the need to provide power through the entire feeder line provides a great deal of efficiency. "Imagine a customer consuming an additional megawatt during peak time," Zehnder continues. "If you supply this power from batteries around that consumption point, you can provide it much more efficiently."

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Innovative energy storage – challenges

While there are many ways that energy storage can support grid operations, a few critical hurdles remain before utilities are able to leverage energy storage as a distribution system resource.

One of the barriers for energy storage has been its cost versus alternatives. Until recently, the prevailing belief was that the low cost of natural gas would make widespread deployment of grid-scale energy storage unlikely. Now, the industry is investigating the cost-effectiveness of using energy storage to replace expensive natural gas peaker plants, which operate less than 10 percent of the time, require frequent maintenance and are less efficient than combined cycle natural gas plants.

The economics of grid-level battery storage versus a gas peaker plant are convincing. While the cost of a grid-level battery storage unit is comparable to a gas peaker plant, a battery unit requires no fuel, less maintenance and responds to power demands nearly instantaneously. And, because additional units can be added to a battery system as needed, it is scalable.

Regulatory barriers also continue to hamper utility ownership of energy storage. In deregulated markets like Texas, utilities can only deploy energy storage for reliability and grid support functions. The 2013 Sandia Report acknowledges the need for more action in the regulatory arena. In order to enable energy storage to play a key role in the future grid, the report states that "regulatory issues have to be addressed to allow storage resources open market access and compensation for the services they are capable of providing. Progress has been made in this effort, but much remains to be done and will require continued engagement from regulators, policy makers, market operators, utilities, developers and manufacturers." ■

What's happening now

Development of market participating storage assets in the PJM Interconnection accounts for nearly two-thirds of the 62 MW of storage deployed in the U.S. in 2014. Southern California Edison is also actively working to meet the CPUC requirement to deploy 1.3 GW of energy storage by 2024, completing one of the largest energy storage projects in North America last year—a 32 MW lithium-ion facility in Tehachapi, California, as well as leading the single largest energy storage procurement of more than 250MW during its local capacity procurement in 2014.

Clearly, energy storage is fast becoming a practical reality and utilities are taking advantage of the multiple ways storage can provide value for the grid. "Nearly all battery systems are deployed as part of projects today—either as centralized power plants, located at substations or deployed behind the customer meter—I believe that in the not too distant future, batteries will be procured the way that transformers are today," says Andy Marshall, Senior Product Manager at Landis+Gyr. "Utilities will own them. They will be viewed as standard equipment, products fully-integrated with battery, inverter and controls that are designed into the grid as opposed to being built on top of the grid." As an independent operating company of the Toshiba Corp., Landis+Gyr now makes available advanced batteries and energy storage systems for grid applications. We understand that while batteries are critical components of today's energy storage systems, they are just one part of an integrated solution, which can serve as a powerful asset with the potential for both network and generation applications within the grid network.

Is it a meter or a distribution sensor?

Increasingly, the answer is both

Gerald Hilbun remembers a time when voltage regulators came from the factory with a meter socket for attaching a thermal meter. That recollection provided inspiration for a project using advanced residential meters as sensors to monitor line regulators.

A 27-year employee of Northeast Louisiana Power Cooperative (NELPCO), Hilbun decided to give the idea a try after a problem at a three-phase customer was traced back to a malfunctioning regulator. When Hilbun initiated the project, he quickly discovered some transformer taps were off by five percent.

"Regulators can break down like anything mechanical, and the ability to discover that before you get customer calls about voltage issues is important to us," says Hilbun.

The regulator monitoring project involved installing meter sockets and 120-volt E350 FOCUS AX meters on each regulator. Once wired into the regulator controllers, the meters perform like a residential meter and communicate through the utility's AMI network to report both voltage and current readings. Hilbun set thresholds in the AMI operating software to trigger an alarm whenever voltage readings at the regulators indicate a problem.

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Smart Device

Utilities have relied on the basic electricity meter for more than a century to measure consumption and generate a customer bill. But as solid state meters have become increasingly more sophisticated, utility operators are now able to use advanced meters, equipped with communication technology, as distribution sensors.

Advanced meters take on a distribution sensor role when used in a smart grid network for functions outside of logging and retrieving billable consumption. Interval meter data delivered as often as necessary to the utility enables a host of useful monitoring and sensing functions.

For instance, NELPCO is able to use voltage readings from meters on a circuit, along with readings at the regulator, to more rapidly and accurately diagnose the cause and location of voltage complaints at a service and locate other power quality issues more effectively.

In addition to voltage monitoring, NELPCO also found the current readings useful for checking load at regulator sites during peak. Hilbun worked with Tim Hatfield, a sales engineer with Irby Co, to determine a 3S meter can read the low current between the regulator and control current transformer.

"He's [Hatfield] provided invaluable support during installation and getting this system up and running," Hilbun says. "As a result, we've been able to look between the regulator and substation to see where and when load is peaking on a circuit. In one case, we ended up moving a section of line from one substation to another based on the meter information."

Just like an effective distribution automation sensor, advanced meters contain local intelligence to perform operations based upon pre-defined conditions in the network. This "edge" decision-making capability eliminates the need to communicate with a central location for decision processing. The data an advanced residential meter provides and the ability to access that data in near real time is useful for system-wide planning, troubleshooting and preventive maintenance.

Cost-Effective Benefits

In addition to use with voltage regulators, meters are finding a home as distribution sensors to monitor cap banks and other devices.

Advanced meters provide a constant communication link to capacitor bank operation. The information retrieved can help a utility detect blown cutout fuses and current limiting fuses, failing switches and poor electrical connections that prevent proper operation.

Prior to deploying meters in this role, WE Energies, based in Milwaukee, WI, relied on an annual inspection of pole-mounted capacitor banks. Any maintenance to the devices was driven by inspection results.

This approach was costly and ineffective compared to automated alternatives. So the utility deployed 100 meters in 2014 and an additional 170 in 2015 at each capacitor bank using a meter socket specially designed with a current transformer. The CT senses current in the neutral wire of the capacitor bank, which is then measured by an E350 FOCUS AX residential meter. The meter transmits 15-minute interval data on the AMI network that reveals changes to the state of operation.

Colorado Springs Utilities (CSU) began a similar program in 2014, placing meters on 66 overhead fixed capacitor banks.

The program's first success involved discovery of a blown Current Limiting Fuse. Since this fuse does not provide an indication of being tripped, it was missed during an earlier field inspection. The utility also discovered excessive unfiltered harmonic currents present on some of the capacitor bank's neutral conductors. This led to the utility using a higher amperage threshold to account for non-fundamental frequency currents.

Each Meter is a Sensor

Even as meters are proving to be capable distribution sensors, their value as "sensors" is magnified when used as monitors at each service location. Depending on the sophistication of the meter, capabilities exist to provide quality of service information that the utility can use for a variety of troubleshooting and maintenance functions.

Smart meters are sensors that measure:

- Frequency Monitoring
- Total Harmonic Distortion Measurement
- Power Factor
- Reactive and Apparent Power Measurements
- Individual Phase Voltage and Current
- Voltage Sags/Swells

The information can also be shared with the consumer to validate service performance. Many of these parameters can be recorded as load profile data for further analysis or be measured and retrieved as needed. The parameters may have configurable

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time frequencies which are required for the customer or utility's operational needs. In most cases, this information can be sent over the communications network to present the data in a useful and actionable format. Advanced analytics tools can take the guess work out of the analysis and present a highly-detailed picture of what's happening on the grid.

The proliferation of advanced meters and distribution sensors throughout a distribution network enable utilities to leverage the data and control capabilities like never before. And that's making a daily difference in how utilities approach common maintenance problems, as well as plan for future enhancements to their distribution networks.

For Hilbun and his utility, realizing the sensor potential of advanced meters has been a simple and cost-effective way to improve reliability and customer relations. ■

"You can never have too much information when you're trying to stay on top of system maintenance. [Meter data] only has to save you once to be worth it."

Gerald Hilbun, Northeast Louisiana Power Cooperative

Breaking New Ground in Japan

Most of today's advanced metering infrastructure (AMI) networks blend proprietary and open technologies, a situation that raises concerns about the interoperability of future networks. Tokyo Electric Power Co. (TEPCO), with the help of Landis+Gyr and Toshiba, is rapidly deploying an AMI network that comprises a combination of cellular, G3 PLC, and RF mesh technologies.

The project, which is on the fast track in anticipation of Japan's promised shift to a deregulated market in 2016, is demonstrating how an end-to-end platform linking utility enterprise platforms with smart meters and in-home devices today will connect with the 'Internet of Things' in the future.

Landis+Gyr: Year in Review

2015: A Year of Improvement

Utilities saw improvements in reliability, customer communications and energy prices translate into higher customer satisfaction in 2015, according to J.D. Power's annual survey of the industry.

"Utility companies are doing a better job at the fundamentals—minimizing service interruptions, communicating with customers and improving customer service."

John Hazen, J.D. Power

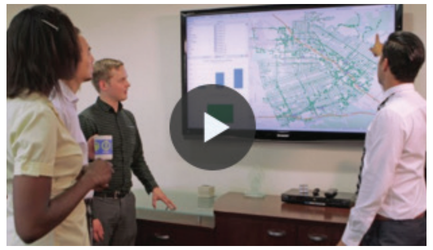
Smart grid technology is helping improve reliability and cut outage times, and it is already factoring as an important piece of integrating the rise in solar—another trend unearthed in this study. The J.D. Power survey found that nearly 3 out of 10 utility customers are considering adding residential solar in the next two years. read more >

Expanding Roles for Demand Response

Load management is once again on the rise, as utilities expand the use cases for demand response. From reducing peak power costs to protecting distribution infrastructure, advanced load management is providing utilities with verifiable data and automated action to ensure results.

Earlier this year, Landis+Gyr offered a comparison of load management technologies in this white paper and also offered a view of the demand response program at Colorado Springs Utilities designed to defer capital expense by targeting individual circuits for peak reduction. read more >

Analytics Drives Reliability



One way utilities are improving outage management is preventative maintenance driven by analytics. Burbank Water and Power instituted a transformer monitoring program using advanced grid analytics to pinpoint overloaded transformers and replace them before weather-related peaks created failures. The success of their program helped them achieve an unprecedented reliability record.

UL Certified

In 2014, Underwriter Laboratories published a Standard for Safety for Electric Utility Meters, providing meter manufacturers with the opportunity for UL certification. Landis+Gyr announced this month that its residential line of FOCUS AX meters, paired with RF communication modules, is now UL 2735 certified.

The certification includes testing for electric shock, fire, mechanical and RF emissions testing to certify compliance. The company plans to complete certification of FOCUS AXe and S4x meters in 2016. read more >