MARCH 2014 | A Landis+Gyr Publication

FutureReady

WHERE THE SMART GRID IS HEADING

Bidirectional Energy
Real-World Success at the Grid Edge

Battery Power:
How Energy Storage Solutions Benefit Smart Grid

Advanced Grid Analytics
for Distribution Grid Management

Data Management in the Cloud
Fits Utilities of All Sizes

Building a Smart Community:
Los Alamos Explores Viability of New Grid Management Approaches

News from Landis+Gyr

TABLE OF CONTENTS

Cover photo:
courtesy of Kyocera Corporation

looking ahead in 2014

a message from Prasanna Venkatesan

At Landis+Gyr, we expect to see ongoing changes in how distribution grids are managed. As a company, we are thinking ahead to how that will impact our customers' business.

In this issue, we take another look at distributed energy resources and adapting to new bi directional energy flows. Major projects to integrate roof top solar are now underway at commercial scale, presenting both challenges and opportunities for utilities to balance new loads.

These projects bring the need for energy storage systems that can adapt very quickly to changes on the grid. This is one of many reasons why the knowledge gained from an ongoing grid management project at Los Alamos, NM is so exciting. Sponsored by the New Energy and Industrial Technology Development Organization of Japan, the Los Alamos project is testing viability of a solar-fed micro grid with battery storage as part of a wider demand response program involving variable pricing and consumer engagement.

Advanced grid analytics play a large role in helping utilities plan for and manage distribution systems. As you'll read in this issue, the information now available from grid sensing devices at all points along the grid is enabling utilities to monitor and protect infrastructure, while improving reliability and customer service.

Landis+Gyr has aligned our global leadership team to best address the future challenges confronting our customers. This includes some recent executive changes in North America. I have replaced former President and CEO of the Americas, Richard Mora, who is leading our strategic development initiatives from our European headquarters. I'm excited to build upon the work Richard started in helping our customers adapt to and benefit from a smarter, more efficient energy delivery system. As always, I appreciate your feedback on how we are doing and look forward to working together to manage energy better.

Prasanna Venkatesan

Landis+Gyr, Executive Vice President, Americas

Building a Smart Community

The future design of the electrical distribution grid is the subject of much speculation. Research projects are more frequently focusing on distributed generation, and at times, using utility-scale photovoltaic systems. Such is the case with a project at Los Alamos, New Mexico sponsored by New Energy and Industrial Technology Development Organization (NEDO) of Japan. NEDO was looking for sites to host a distributed solar system and demand response research. Los Alamos entered itself into the running as the perfect place to conduct such a study.

Los Alamos County is built upon several mesas of the Pajarito Plateau. It is home to 18,000 residents and the Los Alamos National Laboratory. "We thought this made us a perfect fit for the study," says Bob Westervelt, Deputy Director for Los Alamos County Department of Public Utility.

NEDO agreed and selected Los Alamos County as one of its research sites in the United States.

As the world population increases toward a projected total of more than 9 billion by 2050, that in 2014, some 15 percent of cities around the world will be in the "opportunistic phase" of smart city maturity, meaning these cities may invest in projects for various reasons. For example, a smart metering project for the purpose of improving utility operations could be coupled with an investment in city-wide Wi-Fi technologies to reduce the technology divide to move a city toward "smart community status." In addition, research projects, like the one in Los Alamos, will also provide cities with a template or a starting point for informing investment decisions.


© Leslie Bucklin

Los Alamos Explores Viability of New Grid Management Approaches

concerns about reliable clean generation to meet growing energy demands will remain on the forefront of the energy policy agenda. To ensure prosperous and healthy communities, cities will increasingly need to embrace innovative technologies and renewable energy. In fact, IDC Government Insights predicts

Los Alamos County is certainly interested in the opportunities new distribution technologies might offer. Along with NEDO and several of its partners including Toshiba and Landis+Gyr, the community embarked on a $52 million project aimed at demonstrating how to introduce a significant

(continued on the next page)

portion of renewable energy on a residential distribution grid.

NEDO and partners built a 1-Megawatt solar array and installed sodium sulfur and lead acid batteries capable of storing 1 MW and 0.8 MW, respectively, and connected them to a single feeder that supplies electricity to a neighborhood of 1,600 customers.

To ensure steady, reliable power, electric loads are stabilized on the supply side with battery storage controlled through Toshiba's Micro Energy Management System (µEMS). Landis+Gyr advanced meters are installed, and the Gridstream® RF network and Gridstream Meter Data Management System enable the flow of information between the utility and the consumer.

From this neighborhood, Los Alamos solicited volunteers to participate in a demand-side research project to gauge how people would respond to varying pricing strategies. Nine hundred residents volunteered.

The neighborhood, known locally as North and Barranca Mesas, was selected for the micro grid, "as it is fairly representative of most American communities. We have new homes and older homes, a community pool, apartment buildings and commercial buildings, everything that would make this project relevant to mainstream America," says Westervelt.

Throughout the demand response study period, Gridstream advanced meters and MDMS will monitor the demand-side usage pattern and provide this information to the µEMS system.

During clear, sunny days, the photovoltaic arrays collect energy and either put it directly on the grid to meet demand, or store it in batteries. Energy stored within the batteries stands in reserve, ready to be discharged by the µEMS to absorb fluctuations in the photovoltaic output, or to smooth peak loads when there are constraints on the grid and electricity is more expensive. Forecasting and scheduling abilities allow the µEMS to identify when such constraints will occur. When conditions are right, such as a cold winter day causing home owners to turn up their electric heaters, the µEMS may discharge the batteries to smooth load, or initiate a simulated, special pricing event to the neighborhood volunteers, encouraging them to shift their electric load.

The job of the µEMS is to control energy flow between traditional generation sources and the stored generation capacity that feeds energy to the study volunteers. µEMS

keeps the power flow along the feeder stable, so that the switch between the generation sources is unnoticeable to the consumers.

When the µEMS initiates a pricing event, the responses of the four groups are then measured by how much they shift their consumption patterns during the period when energy prices are higher than normal. Participants are notified of pricing events through cell phone texts, in-home display messages or emails. In addition, participants are able to view their power consumption through a web portal in real time.

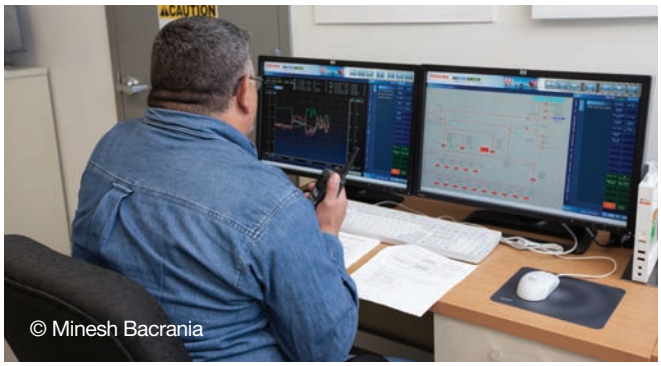
Volunteer Response to Special Pricing Conditions

The demand response study volunteers are divided into three groups:

1. **Critical-Peak Pricing: opt-in**
2. **Critical-Peak Pricing: opt-out**
3. **Peak-Time Rebate: opt-out**

A fourth group, used as a control group, is not informed of special pricing conditions.

Throughout the study, volunteers are given points to incent participation. Each volunteer has the opportunity to earn an average of $180 each year.



© Minesh Bacrania

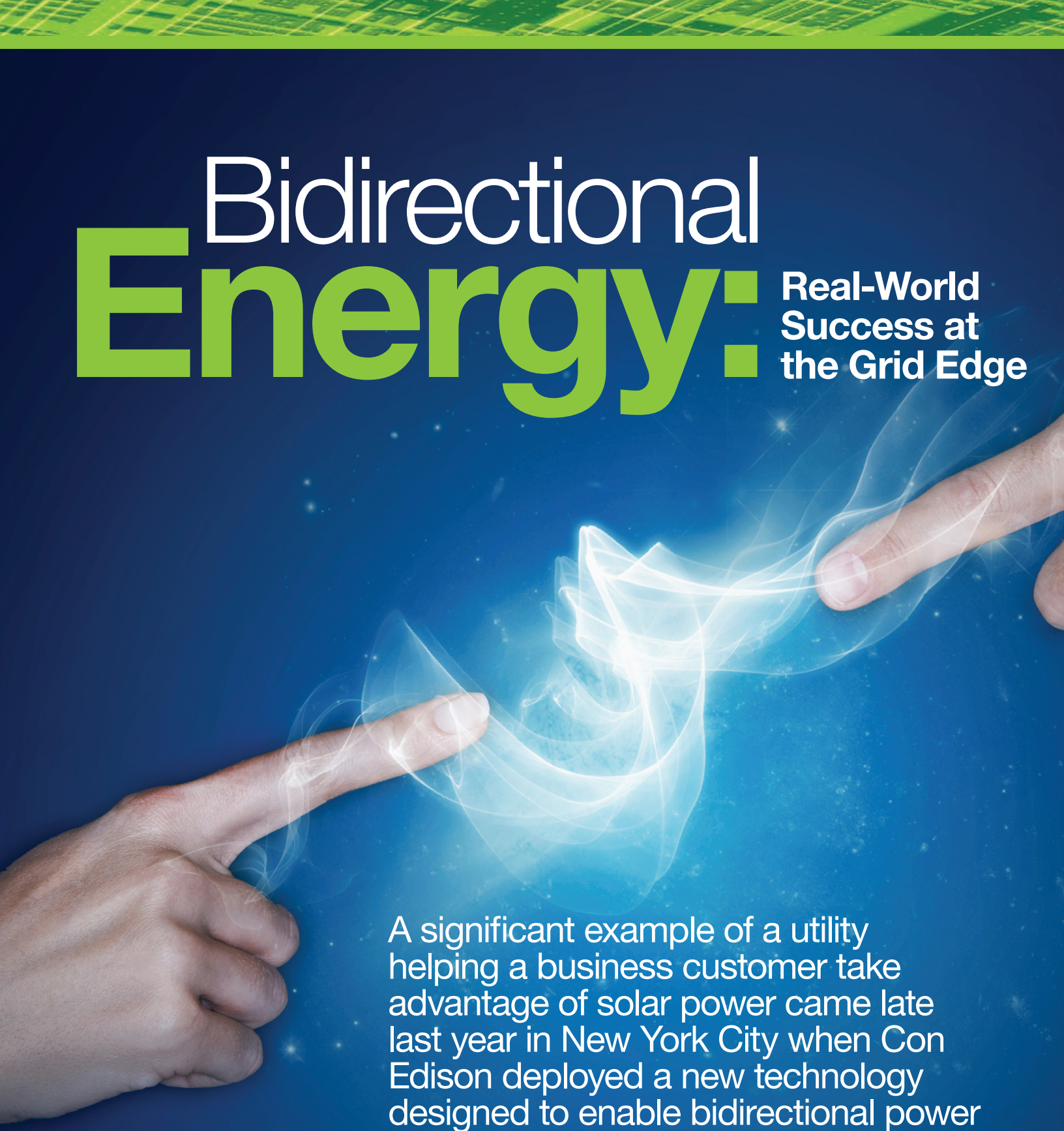
"The critical-peak pricing, opt-in group was the most engaged during the pricing events," says Julie Williams-Hill, Public Relations Manager, Los Alamos County Department of Public Utility. "The preliminary results show this group shifting electric load by approximately 20 percent."

Meanwhile, the critical-peak pricing opt-out and the peak-time rebate opt-out groups each shifted electric load by 13 percent.

"At this point in the study, we are seeing that disincentives, such as higher pricing and opt-in requirements, are engaging fewer volunteers in each study group. But the level of participation by these volunteers has been greater," says Williams-Hill.

The initial phase of the demand response study concluded at the end of February, with the second year of the study to begin in July 2014. The collection of data and analysis of customer behavior is expected to provide insights that will help define the future of demand response and energy efficiency programs. ■

Bidirectional Energy: Real-World Success at the Grid Edge



A significant example of a utility helping a business customer take advantage of solar power came late last year in New York City when Con Edison deployed a new technology designed to enable bidirectional power flow from a major new solar panel installation at a large foodservice business and warehouse in the Bronx.

The customer will rely on the installation to power refrigeration and other equipment at the warehouse, while Con Edison plans to offer the new smart grid technology to other customers exploring solar deployments.

Bidirectional Energy Flow: Benefits and Challenges

Bidirectional energy flow programs like the one Con Edison and its customer implemented offer cost savings to energy consumers who have invested in distributed generation.

Utilities also benefit. "Bidirectional energy programs help utilities better manage outages by enabling them to isolate the damage from storms and other causes, then draw on distributed generation sources to power the grid," says Kent Hedrick, Director of Grid Management Solutions at Landis+Gyr.

"These programs help defray the cost of adding new generation," he continues. "In fact, with the right rate structure in place, it can provide incentives for renewables owners to supply energy to the grid when demand peaks."

However, bidirectional energy also creates new safety, grid reliability and power quality challenges for utilities. The reverse flow of a large volume of excess energy from a customer may cause network protectors to open as if they recognize a fault, stopping the flow of power.

Technology Challenges

Although most North American utilities are years away from implementing large-scale bidirectional energy flow programs, there are technology issues every utility should address now to prepare for the future. These include ensuring that meters able to measure bidirectional energy flows are in place.

Because many of the overcurrent protection devices used by utilities today are designed for one-way power flow, it is important to have equipment designed to backfeed. And, to ensure safety for workers on isolated

(continued on the next page)

power line sections, it is critical that utilities have controls in place to prevent bidirectional power from energizing that line section.

Business Issues

Utilities must also consider a number of business issues when implementing a bidirectional energy flow program. "Business issues, especially for IOUs (investor-owned utilities) are a huge concern," Hedrick says. "In fact, IOUs are very concerned about the prospect of bidirectional energy. It could be very disruptive to their business models."

Utilities have a mandate to serve customers and build the infrastructure to do so. "When consumers supply energy [via distributed generation], utilities must 'earn back' the funds needed to cover their infrastructure investment," says Hedrick. Yet, the fact is, there is currently no clear and sustainable regulatory model for compensating generators.

"In North America today, there is no single solution for this," Hedrick continues. The primary model currently being discussed and gaining traction is decoupling, a rate adjustment mechanism that breaks the link between the amount of energy a utility sells and the revenue it collects to recover the fixed costs of providing service to customers.

The rise of bidirectional and even multi-directional energy sales is predicted to only increase. The GridWise® Architecture Council is one group addressing these changes by creating a Transactive Energy framework to identify and manage the new transactions on the grid brought about by changing energy markets, proliferation of distributed generation and adoption of smart grid technology.

In light of the increase in customers self-generating power, and at times selling it back to the utility, many utilities are seeing flat or even declining volumes of electricity sales. This challenges the traditional rate recovery methods for many IOUs that are based on volumetric throughput to recover infrastructure costs. Protecting utility cost recovery with a fixed variable charge for utility assets is one possibility. But many in the industry are looking at the European RIIO model that rewards the utility for innovation and reliability improvements, not just the amount of energy a utility delivers.

In some states, regulatory requirements can impact and should be considered in the program design. "Utilities should be proactive in supporting these programs and use their influence with their regulatory commissions," says Hedrick. "Now is the time to shape the future."

Paving the Way for the Future

The European Union has long supported the implementation of distributed generation. However, in North America, cost issues have slowed widespread adoption. "Power from distributed generation sources is just more expensive," says Hedrick. "Technology needs to evolve to bring down the cost so that, at a per-kWH level, it's more comparable to what the utility would spend to generate or buy it elsewhere."

Utilities see bidirectional energy as coming, but are struggling to adopt it. As they continue to contend with new demands on their networks, technology partners like Landis+Gyr are working to help pave the way for bidirectional energy flow and advanced grid analytics.

Landis+Gyr is currently working with a major U.S. electric utility on a pilot project designed to integrate storage and transformer monitoring into its grid for demand response and reliability. To prevent transformer overload caused by the growing demand for power to charge electric vehicles (EVs) and use of air conditioning units in the summer, the utility will install EV controllers at the premise level. In addition, sensors installed at the transformer level enable data to be fed back into the Gridstream® platform, even without an AMI system.

This pilot is another demonstration of the sophistication, flexibility and technology that Landis+Gyr delivers utility partners — even those without an AMI infrastructure — when helping them pave the way for bidirectional energy flow and advanced grid analytics. ■

This pilot is another demonstration of the sophistication, flexibility and technology that Landis+Gyr delivers utility partners — even those without an AMI infrastructure — when helping them pave the way for bidirectional energy flow and advanced grid analytics.

Advanced grid analytics

FOR DISTRIBUTION GRID MANAGEMENT

In the wake of devastating storms like Hurricane Sandy, which caused historic power outages throughout New York City in 2012, North American electric utilities realize the urgent need to shore up grid resiliency and reliability.

Unlike Europe and Asia where most power lines are underground, the U.S. grid is more vulnerable to weather-related outages. But the challenges don't end there. The proliferation of electric vehicles (EVs) and distributed generation could also have destabilizing effects if not properly planned and managed. As a result, more utilities are seeing the value of advanced grid analytics to "keep the lights on" by providing new capabilities for identifying grid enhancements to support these kinds of business and regulatory drivers.

Today more than ever, utilities must leverage advanced analytics capabilities to address business challenges and ensure grid reliability. A circuit-by-circuit analysis of grid activity determines the impact of new sources of demand — such as EVs — on each circuit, then determine cost-effective plans to address these impacts. These analytics can also help utilities optimize grid performance for key metrics such as system outage duration and frequency, extend asset life, and plan for future needs without having to rely on cookie-cutter engineering models.

Leveraging Smart Grid Technology for Grid Optimization

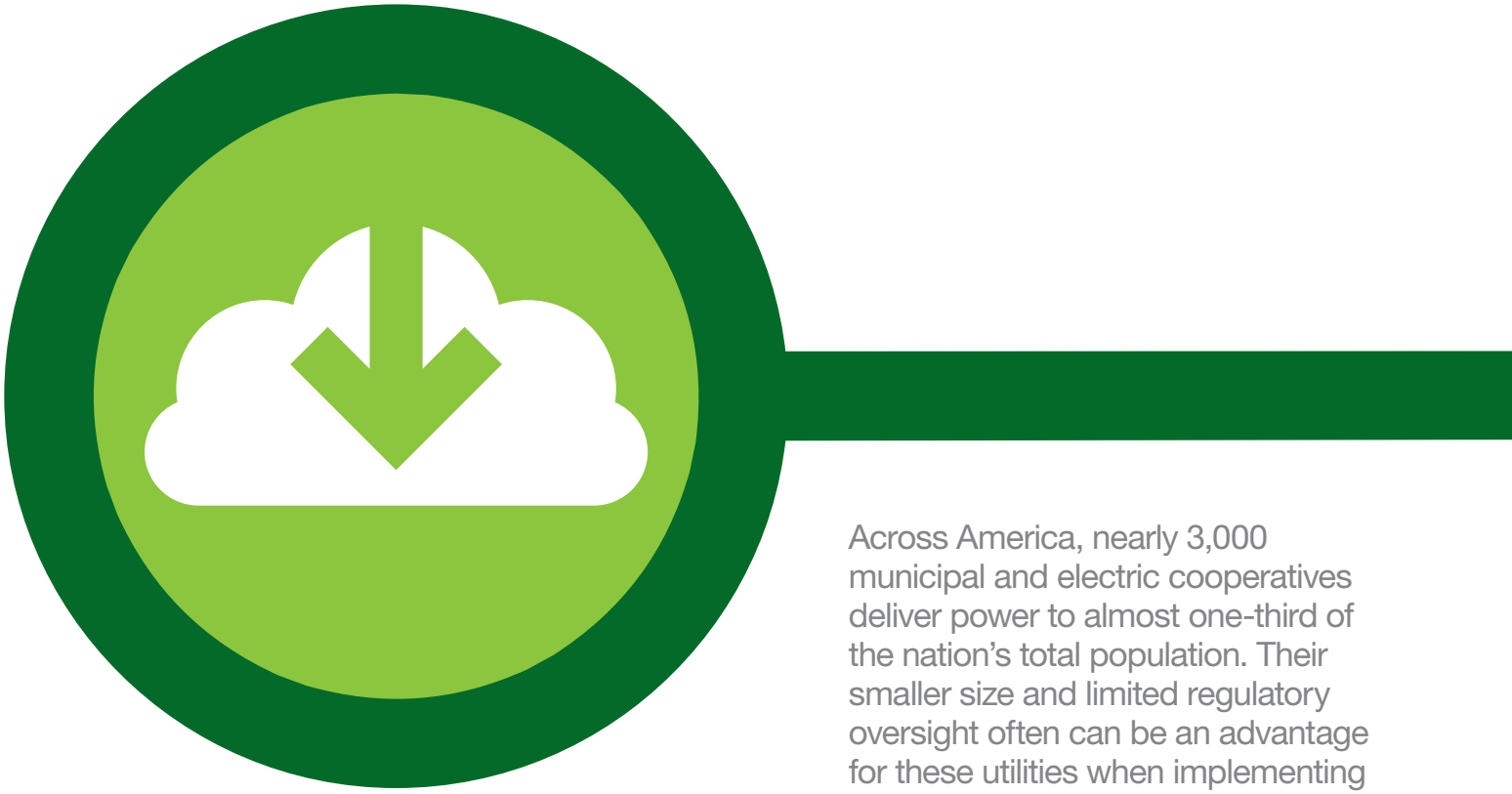
Smart grid technology is an important component of a resilient and reliable energy grid. “Before smart grid and advanced metering, utilities didn’t always have a clear understanding of what was happening on their distribution grid,” says Kent Hedrick, Director of Grid Management Solutions at Landis+Gyr. “Now, data from smart meters are making real-time grid performance more visible and actionable.”

With the right tools, utilities can do even more. Some smart meters are engineered to function as sensors at the grid edge, truly serving as a multi-purpose device. According to Hedrick, intelligence is what’s really important. “Utilities don’t necessarily need more hardware beyond Landis+Gyr’s smart meters,” he says. “It’s having the right backend software that is key to improving grid operations and feeding more intelligent control. And the more data, the better for providing a more complete view of performance and informed analysis.”

The capabilities made possible by these new levels of intelligence will not only improve gird operations now, but also enable more intelligent control in years to come. Distributed intelligence in devices on the grid — devices that “know” what’s available for peak load control and what renewables are on the network — will enable decisions from the substation level all the way down to the premise.

According to Hedrick, advanced grid management promises to be a dominant topic for utilities over the next few years. “I think we’ll see a lot of interest focused at the distribution level,” he says. For utilities interested in getting started with analytics, Hedrick recommends a utility begin by understanding the business case and regulatory drivers, followed by the development of specific use cases.

When seeking smart grid vendors, it’s important to find one with robust solutions, not just products, Hedrick adds. Landis+Gyr smart meters can perform grid sensing, collecting much more voltage and other power quality information than other systems and, when paired with advanced grid analytics, deliver a comprehensive understanding of network-wide activity. Integrated with the Gridstream® platform, utilities can leverage historic and real-time data to both plan and manage distribution grids — for the most proactive response. ■



DATA MANAGEMENT IN THE

cloud fits utilities of all sizes

Across America, nearly 3,000 municipal and electric cooperatives deliver power to almost one-third of the nation's total population. Their smaller size and limited regulatory oversight often can be an advantage for these utilities when implementing new technologies and business strategies. But more operational freedom usually comes with fewer resources to manage programs and systems on an ongoing basis.

This is prompting some utilities to take a new look at smart grid service offerings, such as cloud-based software and data hosting. In December, Central Lincoln People's Utility District (PUD), Oregon's fourth largest electric utility, signed a five-year agreement with Landis+Gyr for Gridstream® Meter Data Management System, one of the software solutions available with its cloud service offerings.

Solution hosting is not a new concept. Managed services for advanced metering has been an integral part of the Landis+Gyr porfolio for nearly two decades. But recently, the company added Gridstream MDMS to its cloud solutions delivered from its Network Operations Center in Lenexa, Kansas. For MDMS customers, like Central Lincoln, the move ensures operational simplicity at an attractive price point.

"We are pleased to expand our relationship with Landis+Gyr with the selection of the Gridstream MDMS for our smart grid operations," says Bruce Lovelin, Chief Engineer and Manager of Systems Engineering for Central Lincoln.

As this class of customer moves from daily registers to 15-minute interval data, the data volume increases by nearly 100 times. And the increased frequency and granularity of the data opens the utility to new smart meter use cases, such as early outage detection and theft detection.

"When it became clear we needed a scalable MDMS to support our increase in data volume, the cloud-based Gridstream MDMS was the right fit for our operations," Lovelin added.

Central Lincoln PUD serves some 700 square miles and approximately 55,000 people in portions of Coos, Douglas, Lane and Lincoln counties. Over the years, it has deployed many technologies from Landis+Gyr, including advanced meters, the Gridstream RF network, a dynamic voltage management solution and now, Gridstream MDMS via the cloud. ■

Battery Power:

HOW ENERGY STORAGE SOLUTIONS BENEFIT SMART GRID

Concerns about grid resilience, reliability and integration of renewables are driving serious interest in energy storage.

Recognizing the potential storage has for improving the resiliency of the energy grid, government and industry are moving to support its implementation. "Grid Energy Storage," a recent report by the U.S. Department of Energy, outlined a number of strategies for expanding installed storage.

A recent landmark decision by the California Public Utilities Commission (CPUC) made history by placing new requirements on the state's utilities to procure additional energy storage equipment by 2020, while momentum continues to build across the country.

Clearly, many utilities recognize the benefits energy storage solutions offer in helping them store electricity, control power quality, support renewable energy integration, and increase power generation efficiency.

Best-in-Class Battery Solutions

One challenge related to widespread deployment of energy storage cited by the DOE is the availability of cost-competitive energy storage technologies. For distributed grid storage, lithium-ion battery storage systems offer a cost-effective solution that can integrate seamlessly into the network and provide virtually instantaneous power. "Generally speaking, batteries today are very configurable," says Takahiro Kase, Manager of Toshiba International's Energy Solutions Center in North America. "Depending on the storage application or objectives, size and power requirements will differ. In addition, many factors can impact the battery configuration, such as available space and other environmental considerations. So the more configurable a system is, the easier it is to deploy."

As more distributed renewable energy resources come online and raise concerns about instability or disruptive effects on the grid, batteries offer an attractive solution to address the intermittency of renewable power and compensate for fluctuations. In addition, batteries can replace or augment demand response applications that may otherwise inconvenience consumers by bringing battery-stored power online at times of high demand.

For utilities considering integrating battery storage solutions into their networks, planning is key. "Control software for managing multiple batteries must be in place before taking the next step," Kase says.

When seeking a battery storage system, utilities should put safety at the top of the priority list. "For example, thermal management strategies must be in place to address potential safety concerns related to heat," Kase continues. "The technology should also have a long cycle life. You don't want batteries that require frequent change-out, as this adds to the cost."

Finally, it's important that the battery system be able to charge and discharge quickly to function in applications such as PV output load balancing or frequency control. "Loss of PV output creates an immediate, high-power demand to compensate for the change, and the battery system must be able to quickly discharge to be effective. For this application, high power is more important than large capacity," Kase says.

Safety, long life and quick discharge/recharge are among the attributes offered by the SCIB™ battery technology now available from Toshiba. In addition, the company's Micro Energy Management System (μEMS) controller supports battery storage systems by monitoring and responding to real-time changes quickly to meet power imbalances. It also forecasts usage and demand, so that utilities can plan when and for how long to charge batteries.

> *"Help from a dedicated partner, makes it possible to start small and still realize value," says Kase.*

No matter the utility size, any utility can begin to quickly reap the benefits of energy storage. "Help from a dedicated partner, makes it possible to start small and still realize value," says Kase. ■

[1] "Grid Energy Storage," U.S. Department of Energy (December 2013): http://www.smartgridnews.com/artman/uploads/2/Grid_Energy_Storage_December_2013.pdf

[2] "Decision adopting energy storage procurement framework and design program," California Public Utilities Commission (October 17, 2013): http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M078/K912/78912194.PDF

Salt River Project Moves Forward with Prepay Expansion and Other Applications

Salt River Project (SRP), the third-largest public power utility in the nation, has signed a long-term agreement with Landis+Gyr to update and expand its advanced metering and prepay technology in a phased, 10-year installation across their service territory.

Based in central Arizona, the utility plans to deploy Landis+Gyr's Gridstream® RF network beginning this summer to support ongoing improvements to the technology used by its 142,000 prepay customers. SRP's M-Power program is the largest electric prepayment program in the United States and has been in operation since 1993. The voluntary program helps customers manage their energy budget and drives high levels of customer satisfaction.

Once the network foundation is established and the prepayment revision has been completed, SRP will begin installing more than one million Landis+Gyr E350 AX-SD meters to provide both credit and prepayment options for all their customers. This flexible approach to customer billing requirements makes this project one of the most unique in the industry and a first within the US.

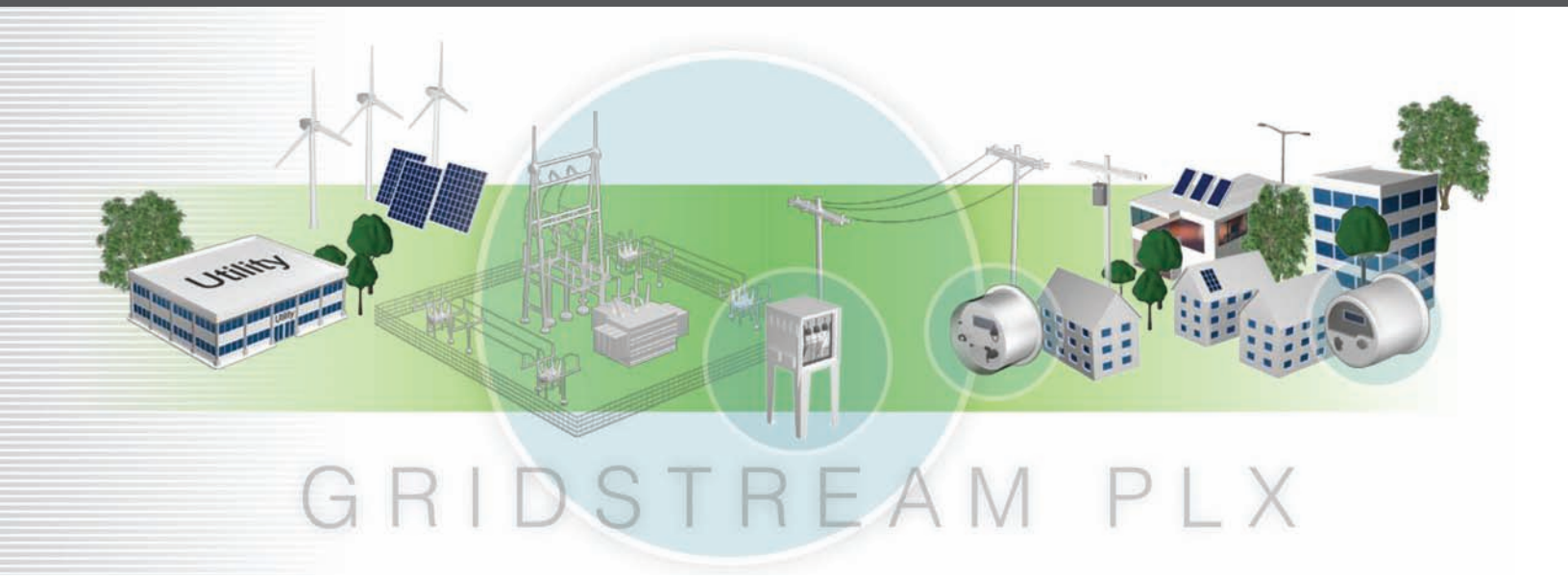
"Our M-Power program has been very successful and we will now have the tools to expand prepayment options to our entire customer base in the coming years," says Michael Mendonca, Senior Director of Revenue Cycle Services at SRP. "This agreement with Landis+Gyr will provide SRP with the technology to deliver our customers convenient access to a broader range of information and support more payment choices than our existing solution. It will be a significant step forward for us." ■

Colorado Springs Utilities Initiates Unique Load Management Program

Colorado Springs Utilities has initiated an advanced load management program to reduce load on distribution system assets during peak power consumption.

Over the next four years, the utility will deploy 1,900 smart thermostats and software applications to enable load shedding on specific feeder circuits to protect transformers and other distribution equipment, while maintaining reliable electric service.

The smart thermostats are equipped with Gridstream® communications technology and will utilize the utility's existing smart grid network to communicate with sophisticated



Growing Number of Utilities Select Gridstream PLX

Since the beginning of the year, more than 13 utilities have selected Gridstream® PLX for advanced metering and smart grid applications. The new contracts bring the total number of utilities deploying PLX technology to nearly 30 since the system was released at the end of 2012.

A clear advantage of Gridstream PLX is that it operates on the same head-end operating software, Command Center, as previous systems and provides utilities with a broad range of capabilities for smart gird applications. It also builds on Landis+Gyr's previous PLC offerings to deliver increased data capacity and functionality for today's smart grid networks.

PLX provides utilities with 15-minute interval data from each meter on a continuous basis. The expanded channel capacity also enables remote updating of module firmware, and expanded memory allows storage of 60 days' worth of information at the endpoint.

Landis+Gyr is developing a load management solution for the PLX platform that will utilize the latest load management software for demand response applications. New products also in development include meter options for ANSI markets outside North America. ■

load management software. During peak power events, the software will use accurate load information to determine the number of customer thermostats to control. If a customer opts out of a control period, the software automatically adjusts to find replacement load curtailment to ensure load shedding requirements are met. Consumers who participate in the program will have access to a mobile device application to monitor thermostat settings and make decisions about participation during a peak event.

"This is a unique application of load management technology because our main objective is managing our distribution infrastructure during peak, as opposed to dealing with supply constraints," says Angie Thoma, Smart Grid Project Manager at Colorado Springs Utilities.

Located at the base of Pikes Peak on the front range of the Colorado Rockies, Colorado Springs Utilities is the fourth-largest, four-service utility company in the United States with more than 600,000 combined metered customers. ■

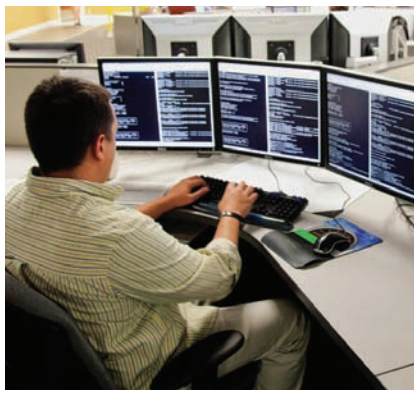
FROST & SULLIVAN

2013 BEST PRACTICES AWARD

GLOBAL ADVANCED METER INFRASTRUCTURE COMPANY OF THE YEAR AWARD

Landis+Gyr's award-winning solutions for a smarter grid






Gridstream

The smart grid is about more than advanced metering. It's about integrating new sources, new uses of energy, building strong partnerships and developing solutions that deliver today — and into the future.

Landis+Gyr

manage energy better