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FutureReady

WHERE THE SMART GRID IS HEADING

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Smart Grid Services Do the Job

AMI and Load Management:
Why They're Made for Each Other

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Most business innovation

is the product of necessity — the need to change practices, increase productivity or expand offerings to grow and thrive.

A MESSAGE FROM PRASANNA VENKATESAN

Small utilities are often on the forefront of innovation, early adopters of new technology and business practices. Addressing challenges like reliability, peak power costs and data management requires the ability to automate processes and do more with less. At the same time, smaller size usually brings the advantage of quicker decision making and response times.

Cooperative and publically owned utilities make up 88 percent of the U.S. utility market and provide service to 28 percent of electric consumers. In this issue of *FutureReady*, we focus on how these utilities are approaching change and addressing new challenges.

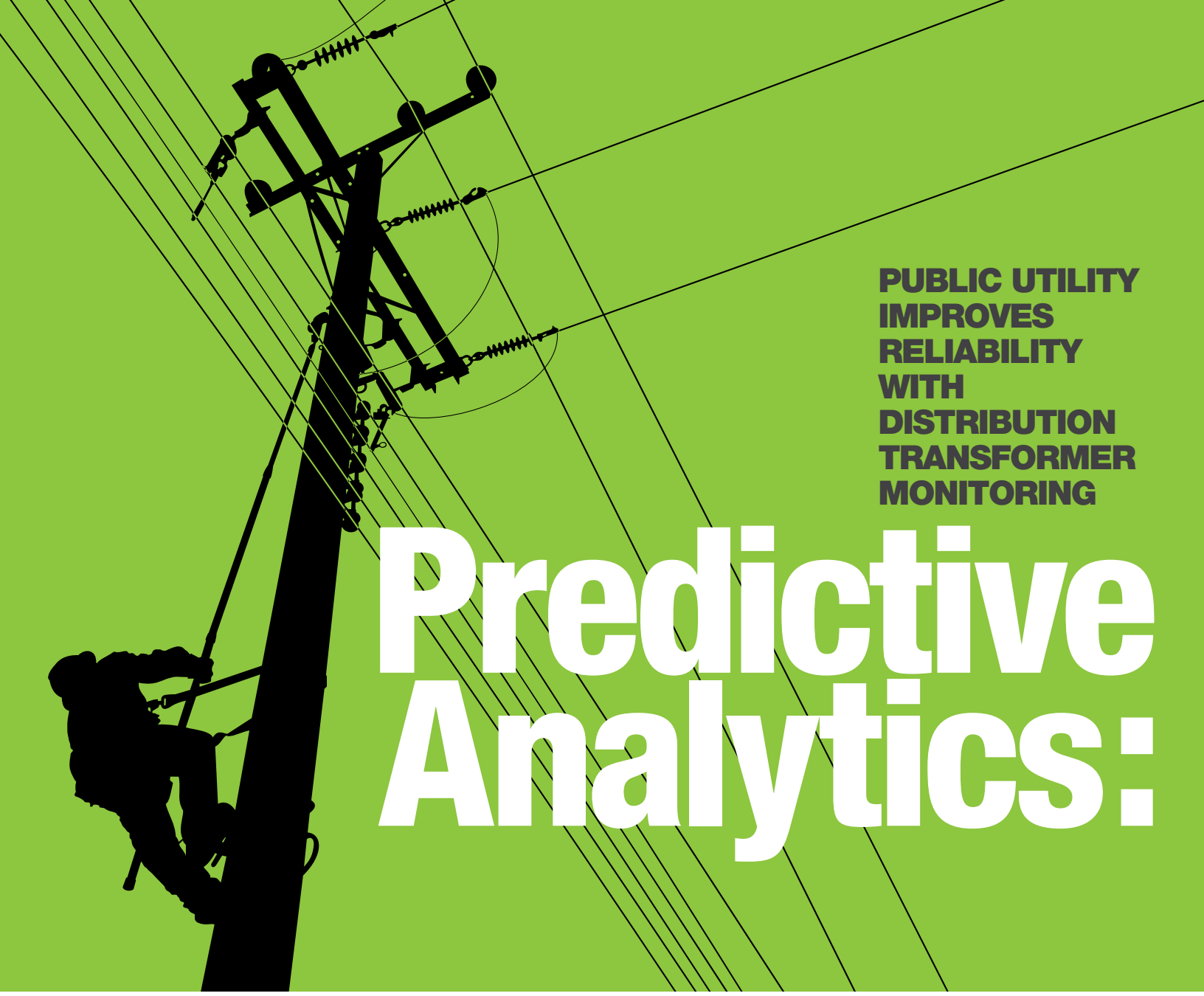
The growing importance of analytics for grid management and maintenance is highlighted by the experience of Burbank Water and Power. In 2014, the utility eliminated unplanned outages with a transformer monitoring initative to identify and replace overloaded infrastructure.

Load management has long been a concern of utilities with substantial peak power cost differentials. We take a look at how two utilities with different program requirements are addressing load control. We also compare the benefits of multi-purpose networks for load control with other dedicated network options.

Finally, we explore the business case for technology upgrades. Early adopters of advanced metering have been migrating to new network technology at a fast pace. Lessons learned show a variety of benefits for existing and new utility initiatives.

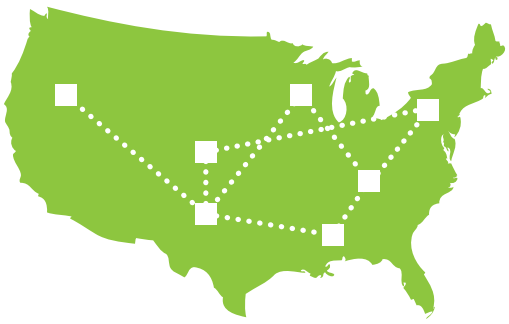
A commitment to continual innovation and the ability to respond quickly to change has always defined market leaders. From our work on some of the largest smart grid projects in the world, to our long history supporting public power utilities, Landis+Gyr is ready to open new doors to an exciting future.

Prasanna Venkatesan
Landis+Gyr, Executive Vice President, Americas



PUBLIC UTILITY IMPROVES RELIABILITY WITH DISTRIBUTION TRANSFORMER MONITORING

Predictive Analytics:



The United States endures more blackouts than any other developed nation. As the number of U.S. power outages lasting more than an hour have increased since 1984, so have losses to American businesses — as much as $150 billion per year, according to the Department of Energy.

There are many causes for the high number of power outages, with weather disturbances cited as number one. Another top cause is the aging U.S. electric infrastructure, which could be considered the largest machine on earth.

Utilities like Burbank Water and Power (BWP) are turning to predictive analytics to meet infrastructure challenges head-on. Implementing a new way to monitor infrastructure, BWP is taking action to catch potential outages before they happen

by proactively diagnosing distribution transformer issues. As a result, the utility experienced no outages due to transformer failure during a September 2014 heat wave.

"Burbank is using analytics to tackle old problems in new ways," says Kelly Dietz, Director of Industry Solutions Sales at Landis+Gyr. "Harnessing Landis+Gyr's Advanced Grid Analytics

AMERCIAN BUSINESS LOSSES DUE TO POWER OUTAGES

software solution, BWP leveraged their investment in AMI and other smart grid data to proactively visualize, plan and operate their network, making them a leader in reliability and enabling BWP to provide one of the most energy-efficient electrical systems in the nation."

Located just north of Los Angeles, BWP operates 17 switching stations and substations, which equates to about one substation per square mile. The utility was founded in 1913 and manages distribution transformers with a typical life expectancy of about 40 years. While asset aging is inevitable, BWP strives to ensure distribution transformers are in top performance and age "gracefully," while balancing reliability and costs.

Underutilized distribution transformers result in wasted energy, while overloading creates a high risk of failure, causing outages. With the goal of operating energy-efficient transformers and solving performance issues, BWP turned to grid analytics as the most practical solution.

The utility developed a business case for a complete software solution to perform detailed analysis and visualization on transformer performance. BWP sought to use advanced metering data to gain insights into how transformers on each circuit reacted during peak periods.

Before turning to analytics, BWP tried multiple methods to determine the life span and performance of transformers. Prior to their AMI investment, the utility used estimation spreadsheets that applied the only data available—monthly meter reads. This provided the utility with a "best guess" analysis of transformer performance. BWP needed the ability to analyze coincident data from each consumer on the circuit, which required more data. By using data acquired from their AMI network, the utility was able

U.S. POWER OUTAGES LASTING MORE THAN AN HOUR HAVE INCREASED SINCE 1984

to manually graph data and make visual determinations of transformer performance.

The next step was interpreting what this information meant for each transformer. BWP utilized IEEE standard C57.91-2011 to calculate the transformer's adjusted insulation life, or how long the insulation would theoretically last until failure. BWP used these equations to determine the temperature of the transformer at various loading levels. Based on the transformer's temperature, BWP was able to calculate how quickly it would age. This "loss of life" calculation allowed engineers to calculate an expected lifetime of the transformer based on a given load profile. By also factoring the total cost of ownership, which considers material, labor

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and expected electrical losses, the utility was able to ensure that all future transformer sizing decisions would be done in the most cost-effective way possible. The last step in this data analytics journey was to find a means of visualizing the data throughout the city.

Utilizing Landis+Gyr's Advanced Grid Analytics modules for asset loading and voltage visualization, the utility was able to retrieve data from its AMI network, and then synchronize all the data across a distribution feeder.

"We were able to get a highly accurate picture of transformer loading and see this mapped out across our system. This was a big first step to get where we wanted to be," says Calvin Clark, Electrical Engineering Associate at BWP.

"Burbank has ushered in the new era of prediction utilizing data analytics," Clark says. "The days of taking best-guess estimates to manage grid assets is over. Utilizing predictive analytics has truly changed the operations in Burbank."

After only six months of using the software, the utility got a real test of its value. In September 2014, Southern California was hit with a heat wave that sent temperatures soaring over 100 degrees multiple days in a row. Since installing the software in March 2014, BWP proactively released more than 50 work orders to replace or adjust transformers identified with the highest potential for failure. During the heat wave, BWP experienced zero outages due to transformer failure, an impressive feat for a Southern California utility.

BWP attributes its success last year to predictive analytics.

"Predictive analytics gives us the opportunity to avoid unnecessary overtime spent on responding to transformer outages. We can reduce the amount of spare inventory we normally would keep to prepare for summer heatwaves," Clark says. "We can now run detailed analysis on transformers, and balance the load when needed to extend its life span." ■

"Burbank has ushered in the new era of prediction utilizing data analytics"

Expert Resources:
Smart Grid Services Do the Job

Smart grid services are gaining popularity with utilities of all sizes as a way to reduce maintenance and management requirements. Cloud services, such as hosted meter data and software applications, are commonplace solutions. In addition to IT support, many smaller utilities are engaging outside expertise for strategic projects that add value to grid data. In fact, Navigant Research expects the market for smart grid services to jump to $11 billion over the next eight years.

Using hosting services, utilities benefit from reduced costs for licensing, hardware and maintenance while staying compliant with security and disaster recovery requirements. But utilities are also outsourcing planning, reporting and maintenance tasks to analysts that have native knowledge of the systems and applications.

"Contracting for smart grid services enables smaller utilities to lock into the expertise and technology resources available to the largest utilities — all at an affordable cost," says Keith Ahonen, Director of Software Services at Landis+Gyr. "The industry is undergoing rapid change and having the expertise and capabilities within the utilities to support this change will be a challenge in coming years."

Workforce constraints can make it difficult for some utilities to build the knowledge base needed to not only maintain new systems but, just as importantly, put the data to use.

With the advanced analytics and load management capabilities now available, grid data can drive any number of operational improvements. At right are a few examples where utilities have outsourced the job of putting that data to work.

1 Distribution planning

A utility seeking optimized placement of faulted circuit indicators (FCI) on its distribution system outsourced the analysis portion of the project. This involved tracking historical fault and outage information to determine locations and numbers of FCI's to place along a feeder and obtain maximum CAIDI benefits. The analysis helped build the business case for the purchase and deployment of FCI's.

2 Capacity contributions

Load management programs often attempt to recruit participants without first knowing which consumers bring the value for peak load savings. Analyzing data from meters and substation devices helps the utility pre-select the ideal consumers for recruitment. This not only lowers program costs, but also improves the ability to meet load-shedding targets.

3 Workforce transitions

In smaller utilities employees often wear many hats, especially when it comes to advanced metering and IT positions. Workforce transitions, such as retirements, can leave remaining staff struggling to implement or maintain systems. Smart grid services can aid this transition by providing resources for data management, consulting and training.

Rural Routes:

How 3 Rural Utilities Made the Move to AMI Technology

Would you be surprised to learn that rural electric cooperative utilities are leading the industry in penetration of advanced metering infrastructure (AMI)? That's the case, according to a 2012 Federal Energy Regulatory Commission (FERC) report indicating that U.S. cooperatives represent 31 percent of total AMI penetration, compared with 25 percent for investor-owned utilities.

Cooperatives are more directly accountable to their customers because their customers are also members of the organization engaged in day-to-day operations. Therefore, it is no surprise that cooperatives are often early adopters of smart grid technologies. Their smaller size often makes decision-making — and demonstration of the return on investment (ROI) for a rural AMI system—quicker and simpler.

New Needs, New Challenges

Because of highly dispersed service territories, cooperatives were among the first to deploy fixed-network automated meter reading — as early as 1994. Aging systems and introduction of new metering and network technology provided the foundation for a new cooperative business case relying less on billable reads and more on grid management benefits.

Rural Success Story 1

The factors driving the decision to upgrade are often as diverse as the regions they serve. Take **Holy Cross Energy**, a member-owned cooperative serving over 57,000 environmentally conscious customers in Aspen, Snowmass, Vail and areas in between. Its service territory includes a wide expanse of mountainous terrain and hard-to-reach areas.

An aging metering infrastructure and a meter reading staff retiring in greater numbers recently created a need to automate meter reading, improve billing and customer service and upgrade outage management. "Our goal was to expand our existing, not-completely-deployed AMR system by making the inevitable move to AMI," Senior Manager of Information Technology at Holy Cross, Farshideh Jahani, says. Following the decision to transition to Landis+Gyr's Gridstream® RF solution, plans are in place for full system deployment by early 2016.

In addition to operational improvements, Holy Cross will also realize added value by integrating a transformer monitoring solution with the Gridstream RF network to transmit data and remotely diagnose issues.

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[1] FERC, "Assessment of Demand Response and Advanced Metering," Staff Report, 2012

Rural Success Story 2

For **Central Electric Membership Corporation (EMC)**, a North Carolina cooperative serving more than 22,000 mostly residential member customers, growth of the utility's prepay program was the driver for the decision to upgrade to a Gridstream RF network. Central EMC uses a software-based prepay system with a variety of options to push account balance information and receive payment. "To get timely usage information and confirmation on service connections, our existing AMI system simply wasn't adequate," Manager of Information Technology at Central EMC, Angela Hare, says. "We needed faster, more reliable data."

With the new Gridstream RF system, Central EMC now gets near-real-time usage data and verifications from the head-end system. Information about power usage is immediately available at the portal and the system quickly sends out connect and disconnect commands. "Prepay works seamlessly," Hare says. "We now get hourly and 15-minute interval data, voltage and demand data on all meters. There are no lost reads when line work is performed."

Besides improved billing and customer service, the new AMI technology provides new, value-add benefits to Central EMC. "We're able to perform remote disconnects and reconnects on a 24/7 basis," says Hare. "And, because billing takes so much less time, our office staff can spend more time troubleshooting customer issues."

Rural Success Story 3

Alaska Power & Telephone (AP&T), an employee-owned utility, experiences many challenges similar to those of rural utilities, only more so. AP&T personnel travel by boats, floatplanes, snow machines, helicopters and all-terrain vehicles to serve 20,000 diverse customers spread out in communities located above the Arctic Circle, deep in the Wrangell Mountains and throughout the islands of southeast Alaska. In some cases, there can be as many as 50 miles from one meter to the next.

Alongside its widespread service territory, AP&T has a unique energy generation portfolio that includes 70 percent renewable energy (hydroelectric).

The mix of power generation sources, including diesel generation, and a customer base of sawmill operations and other electric motor loads, all contribute to noise levels on the power lines. The noise created interference for the utility's legacy PLC technology. In 2014, AP&T began deploying Gridstream PLX, which uses a broad channel spectrum to communicate more reliably and send more data. The network continuously streams 15-minute intervals of demand, or voltage data, and provides connection to other devices on the network.

The PLX system improved system reliability and delivered more volumes of available data from every endpoint for engineering analysis and troubleshooting equipment.

The Business Case for AMI

Cooperatives are lean organizations, with small staffs and close relationships with customers, making it easier to build the case for AMI metering infrastructure and other smart grid technologies. The case for the AMI investment is simple, due to the direct benefits particularly important to cooperatives, including:

- **AMI lowers the cost of meter reading—a significant expense for rural electric cooperatives serving customers over a wide geographic area**
- **AMI can verify outages and assist with restoration. It can also perform remote service switching, minimizing personnel time in the field.**
- **AMI provides interoperability and standardization for greater efficiencies—eliminating the need for custom software integration**

Conclusion

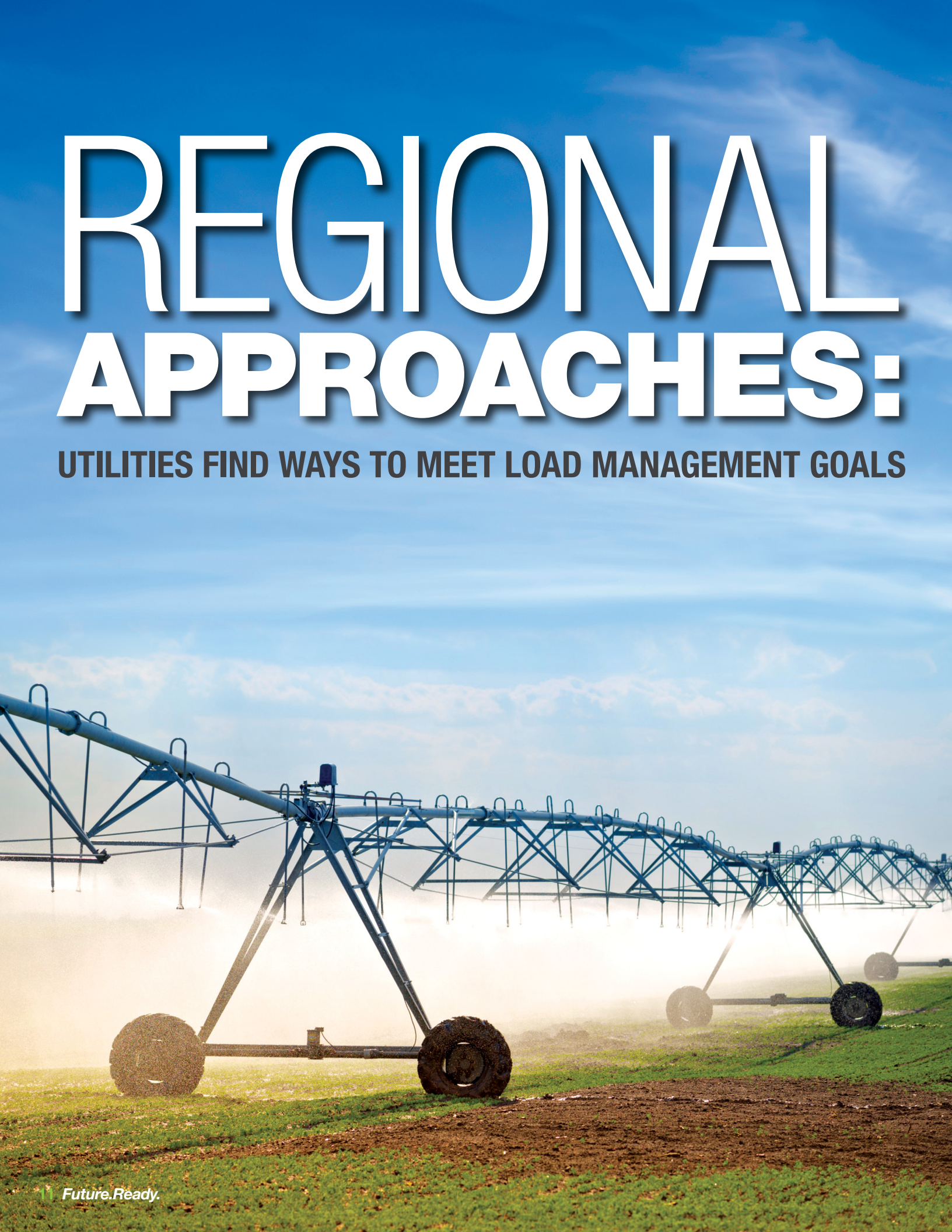
Cooperative and public power utilities, like their investor-owned counterparts, are migrating to the next generation of AMI technology to solve operational issues. Yet, along the way, they're realizing added business value from the transition. Holy Cross Energy, for example, has improved customer service, billing accuracy and reliability — all while improving decision-making. Central EMC has added value to its customer programs, while also improving outage detection, maintenance and troubleshooting.

And for AP&T: "The business value of our AMI system has been significant for a huge territory like ours," Vice President of Power Operations at AP&T, Greg Mickelson, said. "With our old technology, reporting was difficult. Now, we have a much higher read percentage over our previous PLC system."

These utilities, and many like them, are finding the benefits of new technology rise above initial expectations. And as the solutions to operational challenges increase, so does the return on investment. ■

REGIONAL APPROACHES:

UTILITIES FIND WAYS TO MEET LOAD MANAGEMENT GOALS



In Nebraska, irrigation is the lifeblood of many farms. And with a nation-leading total of 8.56 million irrigated acres, irrigation is a critical component of the state's economy. In fact, a recent report from the Nebraska Farm Bureau[1] concludes that water for irrigation provides benefits that go well beyond the state's farms, playing a critical role in Nebraska's economy.

Cornhusker Public Power District, a not-for-profit electric distribution system that serves customers in east central Nebraska's rich farming country, gets wholesale power from Nebraska Public Power District (NPPD). Like most power purchasing utilities, Cornhusker pays more the higher its peak demand. That's why, when the peak load during irrigation season reaches 150 MW or higher, Cornhusker turns to its demand response program to solve load management challenges.

Cost Effective Solutions

Even in an era of flat load growth across the country, many electric utilities like Cornhusker are looking to demand response to meet a wide range of load management challenges. In regions where supply constraints exist, demand side management and load control solutions continue to be a cost-effective solution for lowering energy costs.

Cooperatives and public power utilities have a long history of engaging consumers as partners in promoting demand response and load control. And they're leading the industry in the implementation of smart grid technologies to facilitate those initiatives. According to the U.S. Energy Information Administration, while cooperatives represent only 10 percent of U.S. retail electricity sales and 25 percent of the nation's peak load management capacity, they are actually responsible for 20 percent of the nation's peak reduction.[2]

Regional Business Cases

The value of load management is often driven by regional factors. The service territory of Baldwin EMC, a member-owned electricity cooperative serving more than 70,000 members in southwestern Alabama ranges from a densely populated section of the Gulf Coast that includes a number of resort communities, to rolling hills and pine forests farther inland.

Recently, Baldwin kicked off a new load management program designed to reduce peak load and excess demand cost. This "Centsible Power" program includes monthly incentives for participating consumers based on the number of appliances controlled. Average total monthly rebates range from $7.25 to $9.50. One customer segment Baldwin believes will particularly benefit from the new program are

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Cooperatives Represent

10%

retail electricity sales

25%

nation's peak load management capacity

20%

nation's actual peak reduction

resort area homeowners. With the new mobile app that enables consumers to remotely monitor and control thermostat settings from their devices, these users will have much more insight and real-time control over their energy usage.

"Our goal is to have 20,000 water heaters, air conditioners and heaters under control by 2019. This should result in nearly 20 MW of peak reduction," says Alan Schott, Vice President of Finance and Accounting at Baldwin EMC.

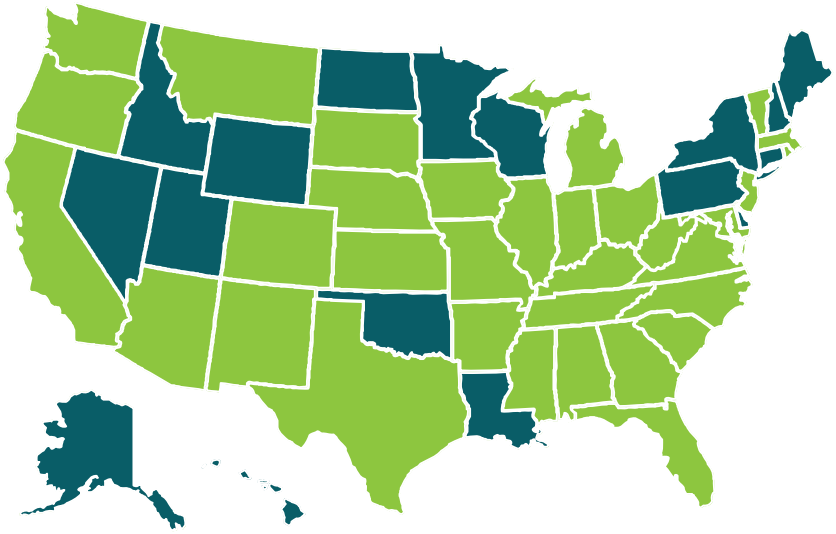
> "It's important for us to be able to verify that things are operating the way they should,"
>
> **Brett Olson, IT/SCADA/Communication Supervisor at Cornhusker PPD.**

In Nebraska, Cornhusker Public Power District is already realizing significant savings from its load control program. With 95 percent of irrigation customers participating in the program, the cooperative is reducing peak loads by an average of 90 MW. By controlling 2,100 irrigation pumps, Cornhusker sheds a load equivalent to 30,000 air conditioners. "As a percentage of our typical load, this ability to significantly reduce peak demand represents a major savings," says Brett Olson, IT/SCADA/Communication Supervisor, Cornhusker PPD.

AMI Technology and Load Management

Both Baldwin EMC and Cornhusker Power are deploying advanced load management solutions that operate on Landis+Gyr's Gridstream network. After switching from a one-way system to an RF load control system, Cornhusker PPD is positioned to get real-time, two-way verification. "It's important for us to be able to verify that things are operating the way they should, so we're not subject to penalties," Olson says. "With the new system, we always know what load is available to be shed, which gives us the information we need to meet our objectives."

According to the National Rural Electric Cooperative Association (NRECA), approximately 250 co-ops in 34 states now have voluntary demand response programs designed to reduce demand for electricity during peak hours. In addition to helping meet their specific regional energy challenges, cooperatives are finding that demand response programs are essential to reducing energy costs and engaging customers in playing a part in saving energy. ■



250 CO-OPS **IN** **34** STATES

have voluntary demand response programs designed to reduce demand for electricity during peak hours.

[1] "Study highlights importance of irrigation to Nebraska's economy," July 24, 2013. Find at: http://brownfieldagnews.com/2013/07/24/study-highlights-importance-of-irrigation-to-nebraskas-economy/

[2] "Demand-Side Management," NRECA, http://www.nreca.coop/nreca-on-the-issues/energy-operations/demand-side-management/

AMI and Load Management:

Why They're Made for Each Other

Utilities are leveraging load management initiatives as strategic, real-time operational resources to meet a wide range of challenges. Program requirements that must be met are driving a change to two-way communication technology.

As the following chart demonstrates, load management using a multipurpose AMI network delivers more capabilities than any other available option.

Function	AMI	Paging	Cellular	Wi-Fi
Communication	2-way	1-way	2-way	2-way
Utility-owned communication network	YES	YES	NO	NO
Device price	$$	$	$$	$$
Operational costs	NONE	NONE	Cellular subscription	NONE
Network availability	Always on	Always on	Always on	Depends on customer
Near real-time view to available power	YES	NO	YES	YES
Reliability	Load control messages have predefined higher priority	No feedback loop (impossible to determine whether devices received message)	Data traffic always lower priority	No control over data packet priority (data traffic managed by ISP)
Bandwidth	Max 115 kbs	Only couple kbs	Depends on network (2G <50kbs; 3G <1Mbs)	Depends on customer subscription, typically several mbs
Typical command travel time	5-25 seconds	Up to 30 seconds	Depends on network (2G/3G/4G typically 5-20 seconds)	5-20 seconds
Data security/privacy	YES, end to end	NO	YES, cellular data is encrypted	YES, if turned on by customer
Message broadcast	YES	YES	NO	NO
Message prioritization for load management	YES	YES	NO	NO

To learn more about the capabilities of AMI and other technology solutions for today's demand response programs, download our latest white paper, "Advanced Load Management: Challenges and Solutions."

Power Center 4.0 Delivers More Flexibility for Load Management Operations

Power Center 4.0, the latest version of Landis+Gyr's operating software for demand response and load management applications, delivers more flexibility and an enhanced user experience.

Updates to the dashboard provide a concise view of system-wide and group level available load, system and device alarms, and cycling strategies for controlled appliances. The Home Energy Manager interface, used by consumers to schedule and adjust participation in load events also received updates allowing more user control. The release is available for programs operating on either Gridstream or cellular networks.

"New dashboard screens and control settings in Power Center make it easier for utility operators to access information and make decisions before, during and after a conservation event," says Clark Pierce, Vice President and General Manager of Advanced Load Management at Landis+Gyr.

Power Center allows utilities to operate a virtual peak plant by aggregating a large number of loads into a dispatchable resource. Home Energy Manager provides a web portal and mobile application for consumers to schedule and adjust device settings remotely, as well as opt out of control events. ■

Landis+Gyr Named to Greentech Media's Grid Edge 20

Greentech Media recently named Landis+Gyr to the Grid Edge 20, a list of the 20 innovative firms working to build the grid of the future.

"The Grid Edge 20 is an annual benchmark for our industry," says Steve Propper, Director of Grid Edge at Greentech Media. "This year's group is made up of technology vendors making the greatest impact on the market in terms of deploying disruptive solutions commercially. It also

PIDC Selects Gridstream for Smart Grid Deployment at The Navy Yard

PIDC, Philadelphia's public-private economic development corporation and master developer of The Navy Yard, selected Landis+Gyr from its competitive bidding process to lay the foundation for a modern and comprehensive energy infrastructure at The Navy Yard in Philadelphia.

The project includes deployment of advanced metering infrastructure, including both smart meters and a Gridstream communications network, meter data management software and associated cloud-based services.

The scope of work will provide an open platform for follow-on efforts to include adding smart building technology, energy storage systems, integration of renewable energy offerings including wind and solar, distribution automation capability and electric vehicle support.

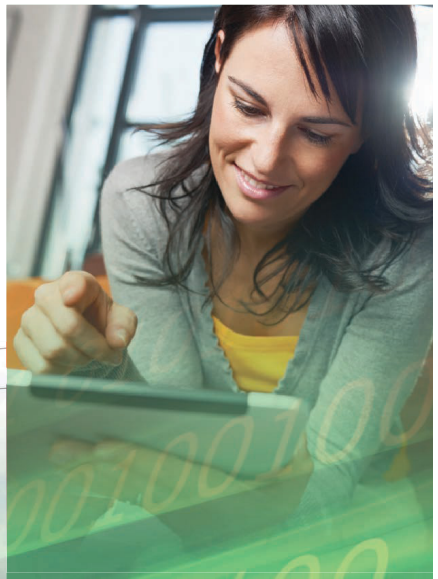
PIDC plans, develops and manages The Navy Yard on behalf of the City of Philadelphia, where more than $1 billion has been invested since the naval base's closure. ■

includes utilities making smart investments to optimize their distribution network architecture and prepare for the future architecture of the grid."

Greentech Media leveraged ongoing interaction with power utilities as well as energy stakeholders and other thought leaders to identify the Grid Edge 20. Greentech Media's Grid Edge Executive Council members also voted to help determine the final award recipients.

Landis+Gyr has proven leadership in the smart grid industry, directing some of the largest advanced metering projects in the world. In addition to being the market leader in deployed advanced metering solutions, Landis+Gyr also provides solutions and services for grid, load and data management that include advanced grid analytics, meter data management, virtual peaking plant applications, distribution automation, microgrid management and battery storage. ■

Be *Future Ready.*



Be grid smart.

Be meter smart.

Step up to a smarter grid.

There's a good reason utilities are stepping up to the next generation of smart grid technology. Gridstream® users can adapt to a changing distribution system like never before. Enabling voltage management as a demand response resource. Integrating renewable energy and storage. Using grid analytics to correctly size and maintain assets. The value goes beyond the grid directly to consumers, who see real benefits with improved service and lower costs.

Landis+Gyr offers an easy migration path from AMR to Gridstream.

Landis+Gyr
manage energy better

www.befutureready.com