



In the Heart of America: Smart Grid Demonstration

Kansas City's Smart Grid Takes Shape

For most Americans, the Smart Grid remains an abstract and overly complicated concept — the stuff of *Popular Science* to debut in some distant, high-tech future. But for many residents of the Ivanhoe and Manheim Park neighborhoods in Kansas City, Mo., the Smart Grid made real means saving energy and money — and participating in a unique initiative to modernize the nation's power grid.

Making this effort possible in the heart of the city's urban core is a \$24 million U.S. Department of Energy (DOE) grant awarded to Kansas City Power & Light (KCP&L) — an amount matched by the utility and its technical partners for a total investment of more than \$48 million. With its SmartGrid

Demonstration project, KCP&L gains knowledge about customer needs and usage patterns, while improving service reliability and power delivery, resulting in more efficient energy delivery and consumption for an entire district within the city.

Launched on Oct. 18, 2010, with installation of its first smart meter, KCP&L's SmartGrid Demonstration project has since deployed more than 14,000 smart meters to residential and commercial customers. Other elements of the program include distribution of more than 1,600 in-home displays (with 800 already in place), 1,600 smart thermostats, 400 advanced home area network devices and access to an enhanced web portal for all customers

in the district. The MySmart Display, in particular, provides real-time information on a customer's electricity use, offering information necessary to effectively reduce consumption and save money. So far, 800 of these devices have already been deployed as part of the project, which is believed to represent the highest concentration of this technology anywhere in the world, according to KCP&L.

Intelligent Monitoring, Communication, Reporting

Supporting each of these customer-facing applications is an advanced infrastructure designed to share real-time, or near real-time, data between power plants and local electric transmission and distribution systems as

well as customers. The advanced metering infrastructure (AMI) rollout and subsequent phases required KCP&L to rely on its project partners, including Burns & McDonnell, for expertise in information technology, telecommunications, power and project management.

By definition, a Smart Grid enables enhanced, two-way communication between a utility and its customers. This information allows utilities to better monitor and manage electricity supply and demand, improving security, reliability and efficiency. In turn, it provides consumers with improved reliability (fewer outages) and tools to make better decisions about their energy use.

"It's really complicated to define, but not that hard to understand once you see some of its working parts," says Bill Menge, director, SmartGrid at KCP&L. "I relate it to what's happened in the last 25 years in computing and telecommunications. Once heavy and centralized, computing has shrunk down to personal computers and now to your phone. It's that type of technological change that we're looking to infuse into the electric delivery system."

End-to-End Demonstration

KCP&L's DOE award, like many other Smart Grid initiatives nationwide, originated with the American Recovery and Reinvestment Act of 2009. The two largest elements from this funding include the Smart Grid Investment Grant program and the Smart Grid Demonstration Program. The latter focuses on 32 projects demonstrating new, more cost-effective Smart Grid technologies, tools, techniques and system configurations. Of these, half are energy storage demonstrations; the other half, including Kansas City's, are regional Smart Grid demonstrations "to verify Smart Grid viability, quantify Smart Grid costs and benefits, and validate new Smart Grid business models at scales that can be readily replicated across the country," according to a DOE statement.

While each demonstration grant is designed to test cutting-edge technologies or new customer pricing concepts, KCP&L's initiative stands out nationally as a fast-tracked, end-to-end effort. The utility conceived its SmartGrid Demonstration project around an upgraded smart substation that features a local distributed control system based on IEC 61850 protocols and control processors. Created as a framework for the

design of electrical substation automation, IEC 61850 addresses the requirements for interoperability of intelligent electronic devices. When complete, the KCP&L system will feature advanced generation, distribution, energy storage and smart customer end-use programs, in addition to co-located renewable energy sources, such as solar and other parallel generation, feeding into the energy grid.

"It's a truly comprehensive Smart Grid program," says Matt Olson, Smart Grid project manager for Burns & McDonnell. "A lot of utilities are just doing an AMI rollout or substation or distribution automation, and they're not necessarily deploying all of these technologies all at once." Lucas McIntosh, a Burns & McDonnell Smart Grid consultant, adds: "Essentially, you could say that KCP&L is setting up a mini-utility within a utility."

Green Impact Zone

What also makes this particular demonstration project different is its emphasis on disadvantaged neighborhoods in midtown Kansas City known as the Green Impact Zone. This 150-block area has experienced extreme economic decline and abandonment. As a national model for

Smart Grid Parlance

Advanced Metering Infrastructure

(AMI): Consists of electricity meters, two-way communication technologies, meter data management systems and customer devices used to measure, record, analyze and share energy use data — upon request or on a pre-defined schedule — between residential/commercial consumers and the utility.

Demand-Side Management (DSM):

Advanced load-control programs to reduce demand and/or electricity use, such as utility rebates and shared savings activities for installation of energy-efficient appliances and weatherization materials. Load reduction strategies for utilities may include assistance with balancing authority regulations, reducing distribution system loss, security enhancements, etc.

Distribution Automation (DA): Allows real-time monitoring, control and automated operation of distribution networks through high-speed communication technology to optimize utility operation and directly improve the reliability of its distribution power system.

Home Area Network (HAN): Essential to Smart Grid performance, this real-time monitoring system allows users to manage multiple in-home appliances and devices based on a utility's time-of-use rate structures.



For more details on Smart Grid elements, go to www.burnsmcd.com/smartgrid.

For more on Smart Grid:

- www.burnsmcd.com/smartgrid
- www.burnsmcd.com/smartgridcontest
- www.burnsmcd.com/smartgridrelevance



Growing the Smart Grid

Burns & McDonnell teams from Telecommunications & Network Engineering and Business & Technology Services groups continue to support utilities across the U.S. on the design and deployment of Smart Grid initiatives. These include:

- **FirstEnergy**, the nation's largest investor-owned electric system: Supporting this diversified energy company on adaptive relaying as part of its Smart Grid Demonstration grant in targeted areas of its Pennsylvania, Ohio and New Jersey service territories.
- **PEPCO Holdings Inc.**, one of the largest energy delivery companies in the mid-Atlantic region: Upgrading its entire communications backbone to

support a Smart Grid AMI and distribution automation rollout in the District of Columbia.

- **Southern Mississippi Electric Power Association** and its 11 member-owner electric power cooperatives, representing nearly two-thirds of the state: Building an entire new communications backbone to support its AMI and distribution automation rollouts — plus integrated resource planning to evaluate demand-side management offerings.
- **Naperville Electric**, serving more than 141,000 residential and commercial customers in north-central Illinois: Assisting the public utility with rates and strategic approach for the Naperville Smart Grid Initiative.

- **Lincoln Electric System**, servicing more than 137,000 customers in Nebraska's capital city and surrounding areas: Providing Smart Grid business cases and an educational forum.
- **Rochester Public Utilities**, the largest municipal utility in the state of Minnesota: Presented a business case and community meetings on Smart Grid deployment.
- **CenterPoint Energy**, an electric transmission and distribution utility serving the Houston metropolitan area: DOE grant-supported upgrade and integration of distribution substation relaying, communications and monitoring systems to enable Smart Grid functions through its distribution management system.

place-based investment, the Green Impact Zone strategy aims to concentrate resources — through public and private partnerships — to transform homes and businesses into a thriving, sustainable community. In addition to housing rehab and property maintenance, efforts include community policing and services, job training and placement, and health and wellness programs. The Smart Grid, therefore, serves an essential function in this transformation, as do programs for low-income weatherization assistance, energy audits, water conservation and urban agriculture.

Evolving the Grid

Given the complexity of launching automation protocols, distribution system and substation upgrades, and improvements to back office IT networks — all in parallel — KCP&L sought outside assistance. In October 2010, the utility asked Burns & McDonnell to join the team, subsequently playing a vital support role in four contract areas:

Metrics and Benefits Analysis: The DOE requires regular reporting and project updates as well as assessments on value delivered and major issues presented through the KCP&L demonstration grant. As a result,

Burns & McDonnell helped develop a strategic metrics and benefits plan with the utility, detailing key project tasks — for substation upgrades and voltage optimization, for example — along with measuring the benefits of distributing in-home displays to customers and other energy management technologies. Burns & McDonnell continues to lead this information-gathering effort with KCP&L.

Distribution Management System: With Siemens as a partner, Burns & McDonnell assisted with the definition, deployment and integration of a new distribution management system to monitor and control KCP&L's distribution and substation automation architecture for the Smart Grid.

KCP&L's demonstration project includes support of the restoration of a home in the Green Impact Zone to be more energy efficient. The installation includes rooftop photovoltaic panels and wall-mount solar heating panels.



Home Area Networking:

Burns & McDonnell provided KCP&L with technical expertise in deploying the smart meters and radio frequency network (working with manufacturer Landis & Gyr) and the in-home network (with Tendril). In addition, Burns & McDonnell provided assistance to increase customer engagement with the web portal (Home Energy Management Portal), also hosted by Tendril.

“These projects require us to figure out new solutions to new problems ... and a willingness to take on problems that we’ve never seen before.”

Industry Use Cases: KCP&L’s SmartGrid Demonstration project contains approximately 30 systems and interfaces designed to transmit myriad system-to-system messages and data. With the DOE focused on developing Smart Grid standards and interoperability protocols so other utilities can leverage the lessons learned, Burns & McDonnell has been tasked with creating as many as 90 use cases for this project to document functionality, information flow and all other details of intersystem communications.

Further Integration and Coordination

In just a matter of months, the firm’s role expanded to support additional project areas.

“They are providing a critical service to our project team, giving extremely valued, professional input to our project,” observes KCP&L’s Menge. “We’ve been nothing but pleased with the resources and expertise coming from Burns & McDonnell.”

Today, consultants are helping the utility analyze time-of-use rates to be offered in conjunction with several Smart Grid technologies. Equally important, they continue to play a vital role in facilitating

communications among KCP&L engineering, customer relations, energy services, regulatory and other departments — enhancing its ability to deliver multiple new services on an accelerated basis.

A SmartGrid Future

KCP&L believes this project will serve as a blueprint for future Smart Grid implementation and accelerate the possibilities for utilities across the U.S. to deliver safer, more reliable electricity.

As the initiative progresses, more advanced home area networks, a new version of the smart thermostat, an enhanced web portal and new rates will be available to customers in the demonstration area later this year along with the emergence of rooftop solar panels and electric vehicle charging stations. The next major milestones: installing a grid-connected battery and completing substation upgrades by next spring. All Smart Grid technology is slated to be in place and operational in 2012, with all analysis and reporting finalized and a technical report ready for the DOE in early 2015.

“From my perspective,” Olson says, “the biggest thing happening with the grid is that we are applying information technology to help optimize it. What I look most forward to as a consumer is that my power will become more reliable and the grid will become self-healing, so I’m not waiting for a utility to dispatch a



A neighborhood electric vehicle charging station stands outside the demonstration house in the Green Impact Zone.

technician to restore my electrical service. The Smart Grid will be able to recognize the fault and restore it for me automatically.”

McIntosh sees the Smart Grid as a new frontier in power, filled with challenges and opportunities for perpetual learning.

For more information, contact Matt Olson, 913-871-6686.

KCP&L’s SmartGrid Demonstration Project Timeline

Phase 1: Project definition and compliance (2009-2010)

Phase 2: Project performance baseline (2010)

Phase 3: Smart Grid infrastructure deployment (2011-2012)

Phase 4: Distributed energy resource deployment (2011-2012)

Phase 5: Data collection, reporting and project conclusion (2012-2014)



For more on KCP&L’s SmartGrid Demonstration Project, visit <http://www.kcplsmartgrid.com/about/timeline.html>.