SMART GRID

Today's electrical systems have been so reliable and affordable that they are often taken for granted until electric service is lost.

According to industry experts, the average American consumer thinks about electricity a total of six minutes per year when they are experiencing uninterrupted electrical service. It is the loss of electrical service that causes consumers to think about electrical power and realize firsthand how electricity impacts their lives.

The "Smart Grid" can play a key role in shifting customer focus from the loss of electrical service to managing electrical service.

What is the "Smart Grid"?

The term "Smart Grid" does not have a precise definition and there are no exact specifications for the equipment, devices, software, processes and procedures required for a Smart Grid.

The Smart Grid can best be described in terms of the functions it will perform:

-- The ability to develop, store, send and receive digital information concerning electricity use, cost and price.

-- The ability to program appliances and heating, ventilating and air conditioning systems.

-- The ability to manage and modify electricity usage.

-- The ability to sense service disruptions enabling proactive efforts to limit outages.

-- The ability to detect, prevent, respond to, and recover from security threats to the electrical system.

The smart grid can empower consumers. A "smart thermostat" allows customers to manage energy use. A power company can remotely collect data to help ensure reliability.

The Smart Grid:
What are the customer benefits?

Savings will be a natural by-product of customers having knowledge about their electricity usage and being empowered to control that usage through a choice of options best suited for each individual customer.

Implementation of Smart Grid technologies, and specifically advanced metering infrastructure (AMI), will enable customers to more closely monitor their energy usage in "real time", either through applications in the home or remotely using the Internet or a mobile phone. Monitoring energy usage in real time, versus receiving a historical report of usage, allows customers to shift their energy usage from times when energy is expensive because it is in high demand— "peak" times—to times when energy is less expensive because it is in less demand — "off-peak" times. Dynamic pricing, or time of use (TOU) pricing, sends proper pricing signals for electricity to customers and allows them to save money by shifting energy consumption from peak to off-peak times. Electricity rates are set for the different time periods, and customers can manage their energy costs by shifting usage to a lower cost period or reducing overall consumption.

Customers who own their own homes are generally more likely to spend extra money for energy efficient and smart appliances to realize energy savings over time. Customers who rent their homes will generally be more interested in actions they can take that require minimal investment.

One popular application that is available with AMI is "prepay accounts or prepaid metering." Customers on a fixed budget find these types of accounts attractive because they allow customers to view their daily electricity usage, receive e-mail and/or phone notifications about things such as when prepaid balances are running low or when payments are received. Prepaid metering offers customers the opportunity to pay when they want in the amounts they want or can afford. Prepaid accounts may reduce or eliminate the need for deposits, disconnect/reconnect fees and late charges.

Reaching out to customers and customizing the educational approach to customer needs, resources and capabilities is a key issue to realizing customer benefits.

Customer education for successful Smart Grid deployment

Studies indicate the experience of the customer must be positive, and balance both the rational (price incentive, multiple forms of relaying information) and emotional (normative comparisons, environmental advantages, social implications) relationships in order to be successful. Managing customer expectations is crucial to program success. If customer savings are much lower than anticipated, the whole program could receive negative feedback.

There are many means currently available to communicate energy usage to customers. Single socket plug-ins, whole-home energy trackers, energy ratings, etc. are currently being used to inform customers of their energy usage, either for a specific device such as the personal computer or for an entire home. All of Missouri's investor-owned utilities (IOUs) and many of the state's electric cooperatives and municipals maintain websites where customers can obtain information concerning their electrical usage and receive useful information on how to reduce energy

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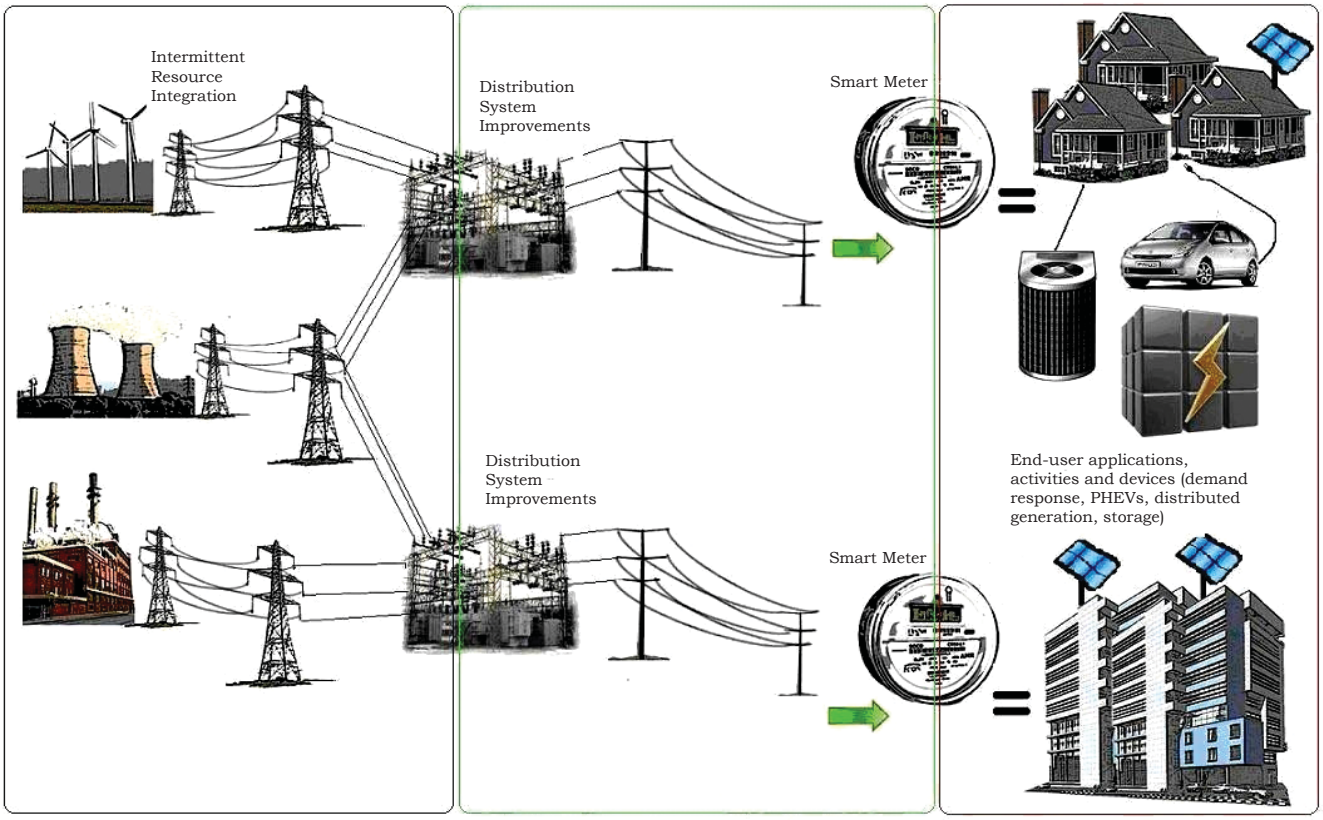

Smart Grid Components

Illustration by Miles Keogh/NARUC

consumption. Making these tools readily available and user-friendly will encourage customer participation. It is not necessary to have a Smart Grid in place to enable significant and positive behavior changes.

There is also an increased awareness of the amount of carbon dioxide released into the environment and an interest in moving away from fossil fuels such as coal, oil or natural gas to renewable energy sources (solar, wind, biomass, etc.) As these trends mature and gain greater acceptance and implementation, they will place a substantially higher demand on the electric grid system. The future of energy management is likely to involve a complex network of wireless, customer-controlled, home automation systems that provide two-way communications between the electric utility and the customer.

How secure and private is the data being transmitted?

With the introduction of a two-way communications system, comes concern about security and data privacy. A safe and reliable network is paramount for customer confidence and acceptance of the Smart Grid. Although security and data privacy are currently in the news and on the minds of many customers,

these issues have been addressed in several industries that include financial, defense, telecommunications, broadband wireless, Internet, Internet commerce, medical, etc.

In a Privacy by Design report entitled: *"Achieving the Gold Standard in Data Protection for the Smart Grid,"* several best practices are promoted including making sure that privacy is the default – the "no action required" mode of protecting one's privacy.

What National Activities Led To Smart Grid Implementation?

December 2007

US Energy Independence and Security Act was signed as a guideline for modernizing the country's electric power system.

2009

US Congress passed the American Recovery and Reinvestment Act, which allotted approximately $3.4 billion for Smart Grid investments.

March 2010

The Federal Communications Commission released the National Broadband Plan, which required electric utilities to provide consumers access to and control of their own energy information.

So who is going to pay for all this innovation?

Cost recovery is the "elephant" in the room. The deployment of the Smart Grid will require many resources, and if the customer does not realize the promised benefits, then the Smart Grid system does not achieve the desired results.

The PSC and all stakeholders must work closely together to make sure that the technology being implemented is prudent and beneficial for the IOU and the customer.

What role does the Missouri PSC play in the Smart Grid deployment?

The PSC has initiated several workshops and conferences to discuss the future of the Smart Grid in Missouri. Missouri IOUs, other government organizations, potential vendors, consumer advocates and other stakeholders have been involved in the workshops. There are also multiple pilot projects by IOUs, electric cooperatives and municipals that will provide more information. The PSC has opened a file (EW-2011-0175) as the repository for Smart Grid documentation.

The path forward will be determined to a large extent from the information obtained through these efforts.

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NUTS & BOLTS

What components make up the Smart Grid?

The distribution system consists of the network that brings electricity to the end user. Smart Grid enhancements to the distribution system include the ability to identify and isolate potential trouble on the system and the ability to better control voltage levels. Keep in mind that these are the major components of the Smart Grid distribution system, but there are several other components that are required to have a modern, computer monitored and controlled system.

One of the key components of the Smart Grid that has received a lot of media attention is the electric meter. There are basically three types of electric usage meters in use today – electro-mechanical meters, automated meter reading (AMR) and advanced metering infrastructure (AMI).

A. **Electro-Mechanical Meters**

The most common type of electric meter traditionally used by electric utilities is the Thomson or electro-mechanical induction watt-hour meter, invented by Elihu Thomson of the American General Electric Company around 1889. In 1894 Oliver Shallenberger of the Westinghouse Electric Corporation refined this induction meter to produce a watt-hour meter of the modern electro-mechanical form. The meter is reliable. It is projected that U.S. vendors will soon quit offering these types of meters and only the following two types of meters will be available.

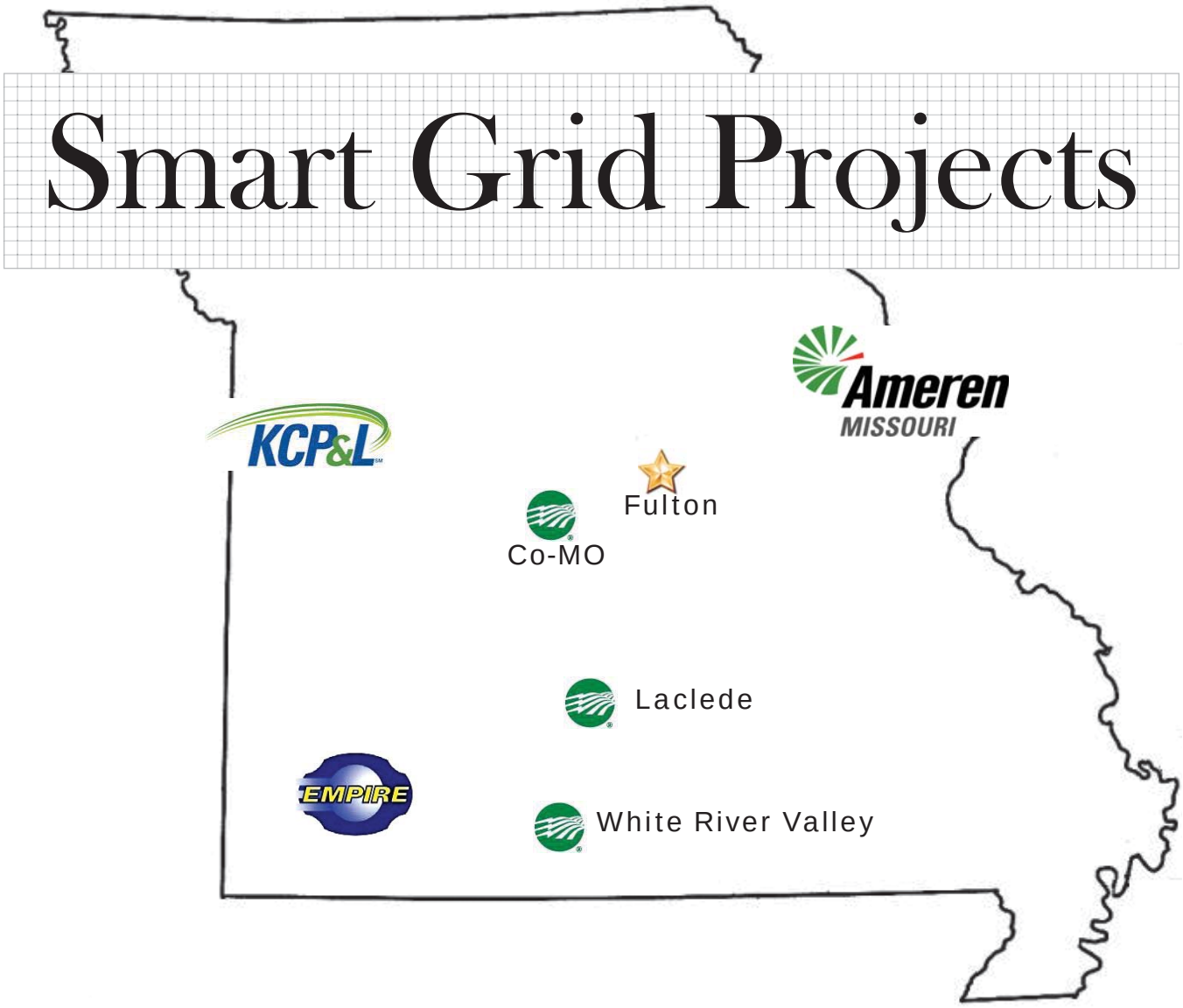
B. **Automated Meter Reading (AMR)**

Automated meter reading (AMR) is the technology of automatically collecting consumption, diagnostic, and status data from electric metering devices and transferring that data via **one-way communication**, to a central database for billing, troubleshooting, and analyzing. This advancement mainly saves utility providers the expense of periodic trips to each physical location to read a meter. AMR technologies include handheld, mobile and network technologies based on wired or wireless telephony, radio frequency, or power-line transmission for communicating data.

C. **Advanced Metering Infrastructure (AMI)**

Advanced Metering Infrastructure (AMI) refers to systems that measure, collect and analyze energy usage, and interact with advanced devices such as electric meters through various **two-way communications** media either on request (on-demand) or on pre-defined schedules. The required infrastructure to support AMI applications includes hardware, software, communications, consumer energy displays and controllers, customer associated systems and communications networks and interfaces.

Smart Grid Projects



The City of Fulton

The City of Fulton, a municipal electric utility, was one of 100 recipients of the Department of Energy's Smart Grid Grant awards on October 30, 2009. The city's project will replace more than 5,000 electric meters with an AMI smart meter network that includes a dynamic pricing program with in-home energy displays to reduce consumer energy use. The City also made an additional commitment of $1 million for gas and water meter improvements and will also include the installation of 2-3 vehicle charging stations.

Kansas City Power & Light Company's Smart Grid Demonstration Project

The KCP&L Smart Grid demonstration project (Project) is included in the DOE and Electric Power Research Institute (EPRI) demonstration programs. The project is located in an economically challenged area of Kansas City, Missouri. The Project's expectations are that the Project will deliver benefits to the immediate targeted end-users and provide valuable experience and lessons for future applications. The Project is being promoted as an end-to-end Smart Grid that includes advanced metering infrastructure (AMI), renewable generation, energy storage resources, leading edge substation and distribution automation and control, energy management interfaces, and innovative customer programs to include time-of-use (TOU) rate structures. TOU rates more closely reflect the actual cost of electricity for peak and off-peak time periods. This allows customers to vary usage in response to those rates, either by shifting usage from peak to off-peak hours or by reducing overall energy consumption.

White River Valley Electric Cooperative

White River Valley Electric Cooperative has a full deployment of AMR meters throughout its service area. This approach gives customers access to daily energy usage and allows them to track energy usage constantly. This provides a way for customers to better understand energy usage throughout the home and to minimize that usage.

Co-Mo Electric Cooperative, Inc.

Co-Mo Electric Cooperative, Inc. has been fully deployed with AMI meters since 2002. This has allowed the company to move into prepay electricity accounts with its customers, which would not have been realistic prior to AMI deployment. Prepay electric accounts offer customers the opportunity to pay for electricity when they want, in the amounts they want or can afford. Prepaid accounts may reduce or eliminate the need for deposits, disconnect/reconnect fees and late charges.

Laclede Electric Cooperative

Laclede Electric Cooperative (Laclede) deployed a wireless advanced metering infrastructure (AMI) system in 2008 as its first step toward the development of a Smart Grid that will enhance customer service, improve overall electrical network efficiencies, reduce operating costs, and automate the way energy is monitored and managed. The Smart Grid initiative includes a full change-out of approximately 36,000 existing meters with meters that will monitor consumption and power quality, pinpoint outages by individual meter or in aggregate and integrate customer data into backend billing, load forecasting, and other applications.

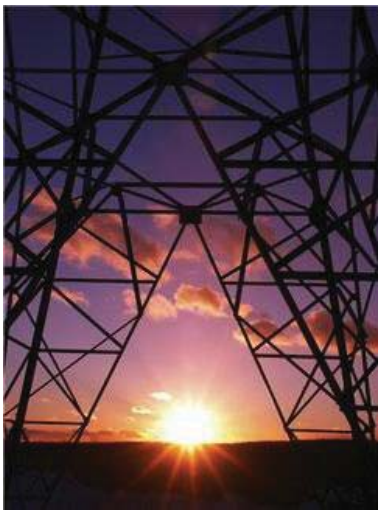
Ameren Missouri

Ameren Missouri has been 100 percent deployed with AMR since 2000 with 1.2 million meters in total, all owned by Ameren Missouri. There are approximately 18,000 meters configured for time-of-use/demand reporting and 5,000 configured for 15-minute interval reporting for industrial and large commercial customer use.

Ameren Missouri's investments are focused on the electric system grid to improve service reliability, operating efficiency, asset optimization, and a robust energy delivery infrastructure. Ameren Missouri has some network components that are automated via one way radio communications and some that are automated to adjust system voltage from commands issued from Ameren Missouri control offices.

The Empire District Electric Company

Currently, The Empire District Electric Company has electro-mechanical meters. Empire's grid infrastructure focuses on service reliability, operating efficiency, asset optimization, and building a secure, robust energy delivery infrastructure. New system components typically utilize digital communications.



Why smart grid?

Our current electric grid was built in the 1890s and consists of more than 9,200 electric generating units with more than 1 million megawatts of generating capacity. It is connected to more than 300,000 miles of transmission lines.

An electricity disruption such as a blackout can have a domino effect—a series of failures that can affect banking, communications, traffic, and security.

When a power outage occurs, Smart Grid technologies will detect and isolate the outages.

The new technologies will also help ensure that electricity recovery resumes quickly and strategically after an emergency—routing electricity to emergency services first, for example.

The Smart Grid is also a way to address an aging energy infrastructure that needs to be upgraded or replaced.

It's a way to address energy efficiency, to bring increased awareness to consumers about the connection between electricity use and the environment. "Smart meters," and other mechanisms, will allow consumers to see how much electricity they use, and when they use it.

(U.S. Department of Energy)