MISSOURI SMART GRID REPORT

Missouri Public Service Commission

Working Document

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"PROCEED AT THE RATE OF VALUE"[1]

[1] Theme from NARUC Summer conference, July, 2010.

I. EXECUTIVE SUMMARY

In this report Staff discusses the various Smart Grid technologies, provides a status update on various Smart Grid opportunities in Missouri and presents issues and concerns related to Smart Grid deployment. Staff ultimately recommends the Missouri Public Service Commission (MoPSC) hold semi-annual workshops to engage stakeholders in meaningful Smart Grid-related discussions. Following is a summary of points highlighted in the report.

- Smart Grid is a rapidly developing, evolving technology with significant promise in several areas for utilities and consumers. Most of the activity in past years has been on the utility grid system but presently there is a major focus and emphasis on smart meter deployments and pilot projects stimulated by American Recovery and Reinvestment Act (ARRA) funding.
- A truly 'Smart' Grid requires in-home and outside-the-home communications systems. This should provide incentives to consumers to reduce energy consumption through demand response (DR).
- Smart Grid technology applied to the electric system transmission and distribution grid should be integrated with two-way communications systems and sensors to allow grid operators to optimize grid performance in real-time and allow the integration of renewable energy sources and distributed generation into the grid.
- Many benefits of the Smart Grid can be realized prior to full Advanced Metering Infrastructure (AMI) smart meter deployment but a complete Smart Grid system includes two-way communications between meters and utilities.
- Missouri is currently ranked high in advanced meter reading (AMR) deployment and tenth in the nation for AMI deployment penetration.
- Missouri currently has several Smart Grid projects underway in various degrees of development and implementation.
- Communications with customers, consumer education and customer empowerment are just as important as the implementation of new technology in realizing the projected Smart Grid benefits.
- Industry standards for this evolving technology are still currently under development and are expected to be finalized in the next couple of years. The expectation of

seamless integration of new 'smart' technologies with legacy systems and devices cannot be achieved without great attention to the principal of interoperability. Standards-based communications protocols and open architecture must be used. The Federal Energy Regulatory Commission (FERC) initiated a formal rulemaking proceeding on October 7, 2010, by creating docket RM11-2-000 for consideration of the five groups of Smart Grid operability standards identified by the NIST.

- There are several communications technologies available to support Smart Grid implementations.

II. INTRODUCTION

Smart Grid is the integration of advanced metering, communications, automation, and information technologies on the electric distribution system to provide an array of energy saving choices and integration of distributed generation while lowering operating costs and maintaining or improving service.[2] A Smart Grid system could be the enabling technology to allow curtailment of electric usage at critical times, thus, reducing peak demand by not using the most expensive energy sources.

The term 'Smart Grid' does not have a precise definition and there are not exact specifications for the quantity or arrangement of components that make up the Smart Grid deployment, including the equipment, devices, software, processes and procedures required to make the Smart Grid operational in the various unique geographical and cultural locations. The Smart Grid can best be described in terms of the following functionalities:

- The ability to develop, store, send and receive digital information concerning electricity use, costs, prices, time of use, nature of use, and storage, to and from the electric utility system.
- The ability to program any end-use device such as appliances and heating, ventilating and air conditioning (HVAC) systems to respond to communications automatically.
- The ability to sense and localize disruptions or changes in power flows on the grid and communicate such information instantaneously and automatically for purposes of enabling automatic protective responses to sustain reliability and security of grid operations.

[2] CNN report "U.S. electricity blackouts skyrocketing", August 2010.

- The ability to detect, prevent, respond to, and recover from system security threats such as cyber-security threats and terrorism, using digital technology.
- The ability to use digital controls to manage and modify electricity demand, enable congestion management, assist in voltage control, provide operating reserves, and provide frequency regulation.[3]

History

During the past two decades, non-disaster related outages affecting at least 50,000 consumers increased by 124 percent.[4] The historic August 2003 blackout was initiated by trees falling on power lines causing a cascading set of faults to travel across the overloaded regional grid which left 50 million people without power in eight northeastern states and Canada. [5]

On December 19, 2007, the U.S. Energy Independence and Security Act of 2007 (EISA) was signed into law.[6] Title XIII of EISA is dedicated to the Smart Grid, which according to EISA, is a "modernization of the country's electric power transmission and distribution (T&D) system aimed at maintaining a reliable and secure electricity infrastructure that can meet the increasing demand for electricity." A fundamental assertion of EISA is that the existing T&D infrastructure is capable of delivering greater efficiencies, and simply adding more generators and transmission lines is not the sole answer to America's energy needs going forward.[7] The goal is to use advanced, information-based technologies to increase power grid efficiency, reliability, and flexibility and reduce the rate at which additional electric utility infrastructure needs to be built.[8]

In 2009, the U.S. Congress passed the American Recovery and Reinvestment Act (ARRA), which allocated approximately $3.4 billion in stimulus grant funding for Smart Grid investments. The ARRA provided awarded entities up to 50 percent of the cost of deployment of Smart Grid technologies, including AMI, with a cap of $200 million.

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[3] Energy Independence and Security Act of 2007, Section 1306(d)
[4] CNN report U.S. electricity blackouts skyrocketing, August, 2010 http://www.cnn.com/2010/TECH/innovation/08/09/smart.grid/index.html
[5] Id.
[6] United States Congress (H.R. 6, 110th), Energy Independence and Security Act of 2007 (GovTrack.us database of federal legislation: December 19, 2007); http://www.govtrack.us/congress/bill.xpd?bill=h110-6 (accessed Dec 2, 2008). (U.S.Congress-1)
[7] NEMA. Standardizing the Classification of Intelligence Levels and Performance of Electricity Supply Chains. Rosslyn, VA: December 2007.
[8] Overview of the Smart Grid-Policies, Initiatives, and Needs, ISO New England, Inc., February 17, 2009.

Also in 2009, Congress directed the Federal Communications Commission (FCC) to develop a National Broadband Plan to ensure every American has "access to broadband capability." The National Broadband Plan has recommendations for state regulators that include: [9]

- Requiring electric utilities to provide consumers access to, and control of, their own digital energy information, including real-time information from smart meters and historical consumption, price and bill data over the Internet.
- Carefully evaluating a utility's network requirements and commercial network alternatives before authorizing a rate of return on private communications systems and consider letting recurring network operating costs qualify for a rate of return similar to capitalized utility-build networks.

In recent decades there has been a growing trend toward energy conservation in all aspects of society. Major energy providers have been out in front, minimizing their energy usage through the implementation of energy efficiency measures. Recently, minimizing energy usage and maximizing efficiency has trickled down to end-use industrial, commercial, and residential customers who have implemented measures that include utilizing energy-efficient appliances, equipment and devices. In addition to lowering energy usage, there is an increased awareness of the amount of carbon dioxide released into the environment and an interest in moving away from fossil fuels utilized for electric generation and transportation. There is also movement to shift to renewable energy sources (solar, wind, biomass, etc.) that will produce electricity in smaller quantities in more diverse, geographically distributed locations than the traditional central power stations common today. As these trends mature and gain greater acceptance and implementation, they will place a substantially higher demand on an electric grid system that has aged and was not designed to accommodate an increasing amount of smaller, distributed renewable energy power sources.

III. SMART GRID IMPACT ON THE ELECTRIC POWER GRID

The electric transmission and distribution grid is evolving into a more reliable system through the integration of two-way communications systems and sensors that allows the optimization of the grid operations in real-time. Staff's research indicates that the current

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[9] Connecting America; The National Broadband Plan; http://www.broadband.gov/plan/

design of the existing grid is based upon the concept of 'one-way' power flow from a generating source, to a transmission line, to a distribution system and then to a commercial, industrial or residential load.

Today, with the emphasis on distributed generation and renewable energy sources, the original design basis for the electric grid system will require changes to accommodate these distributed generation sources. Distributed generation sources may include smaller fossil-fueled generation, Combined Heat and Power (CHP), solar power, wind power, stored energy sources (batteries, flywheels, compressed air, etc.), plug-in hybrid electric vehicles (PHEVs), Electric Vehicles (EV), etc. PHEVs and EVs are currently being deployed in ever increasing numbers throughout the world today.

Modernizing the electric power grid to improve grid operations can include the following enhancements.

A. <u>Installation on the transmission system of Phasor Measurement Units (PMU)</u>

After the August 2003 blackout, the New York State Reliability Council (NYSRC) created a Defensive Strategies Working Group (DSWG) to evaluate ways to mitigate major disturbances on the New York control area. It was determined that under frequency load shedding (UFLS) should be a first line of defense to mitigate major disturbances. NYSRC advocated for the installation of Phasor Measurement Units (PMU) on the transmission system because such devices may offer a simpler method, at reduced costs, for separating sections of the transmission system. Benefits of a PMU network include enhancements to: network situation alarming; oscillation detection; power plant integration, monitoring and control; planned system separation, reclosing and restoration; and post-event analysis.[10]

B. <u>Overhead and Underground Distribution Sectionalizing Switches</u>

The scope of this enhancement includes the installation of supervisory control and data acquisition (SCADA), or controlled, primary sectionalizing switches on targeted network feeders, to improve the reliability of the overhead distribution systems by enabling rapid isolation of faulted segments of primary feeders and re-energizing the non-faulted portion of the feeder.

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[10] "Order Authorizing Recovery of Costs Associated with Stimulus projects", Cases 09-M-0074 and 09-E-0310, July 27, 2009, by the New York Public Service Commission.

C. Capacitor Bank Installations and Phase Monitoring

Installation of automatically controlled or switched capacitor banks will reduce system losses by correcting the power factor and thereby reducing the flow of reactive power through transmission lines, cables, and transformers. Installation will also improve reliability by improving system voltage profile, increasing generator reserve, and improving interface transfer capability to optimize distribution system VAR support for both on-peak and off-peak conditions.

D. Distribution Grid Modernization

This enhancement will modernize the distribution backbone and will include additional distribution capacitor banks, installation of central transformer load tap change (LTC) controller software, installation of SCADA equipment and the development of grid modeling software. These modifications will increase efficiency by reducing losses and increasing reliability by mitigating grid cascades through automated load shedding.

E. Remote Monitoring System (RMS) and High Tension (HT) Feeders

This enhancement includes installation of RMS transmitters on network transformer vault locations to allow operators and engineers to dynamically monitor transformer tank pressure, oil temperature and the oil level that will enable rapid operator response to changes in system conditions. The remote monitoring of the HT feeders includes upgrading the existing meters with a radio frequency (RF) communications module, which enables improved system planning, remote metering of HT customers and critical load data during contingency situations.

F. Dynamic Secondary Network Modeling and Visualization

This enhancement includes the integrated development and operation of distributed secondary network load flow models that provide near real-time load profiles for customer locations and validates model load flows from secondary models, utilizing the data provided by new remote devices at strategic customer locations. This will help system operator situational awareness and minimize secondary cable failures during peak loading conditions and network outages due to secondary events in the summer.

G. Demand Response Initiatives

This enhancement includes the implementation of a DR monitoring system and deployment of innovative controllable technologies. The DR monitoring system will be a comprehensive software deployment that will aggregate all DR participation in real-time during events. The second component of the DR program will include the installation of equipment and devices such as controllable room and rooftop air conditioning units, Home Area Network (HAN) systems and automatic enabled systems.

IV. ELECTRIC USAGE METERS

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, automated metering infrastructure.

A. Electro-mechanical Meters.

The most common type of electricity meter 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, using an induction disk whose rotational speed was made proportional to the power in the circuit.[11] The electro-mechanical induction meter operates by counting the revolutions of an aluminum disc which is made to rotate at a speed proportional to the power. The meter is reportedly very robust and reliable with accuracy typically of 1 percent and a range of 1 percent - 2 percent as governed by American National Standards Institute (ANSI) standard C12.1. In 1998, there were primarily four vendors offering electro-mechanical meters. By the end of 2010, it is projected that US vendors will quit offering these types of meters.[12]

B. Automated Meter Reading (AMR).

Automated meter reading, or 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

[11] Wikipedia
[12] Accuracy of Digital Electricity Meters, Electric Power Research Institute (EPRI) white paper, May 2010

network technologies based on telephony platforms (wired and wireless), RF, or power-line transmission for communications of the data.

C. Advanced Metering Infrastructure (AMI).

Advanced Metering Infrastructure or 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.

The Department of Energy (DOE) reports an increasing amount of collaboration and alliance between smart meter vendors and other vendors providing software and hardware that support smart meter deployment.[13] "The meter is very accurate with an accuracy of typically .5 percent and a range of .5 percent -1 percent as governed by ANSI standard C12.20." Today there are at least six vendors offering these types of meters.

According to a national survey to determine the percentage of deployment of AMI-capable residential meters, the electric cooperatives had nearly 19 percent deployment, the municipals had 11 percent deployment and the investor-owned utilities (IOUs) around 7 percent deployment. Overall AMI meter penetration is nearly 9 percent.[14] FERC believes that AMI deployment is a key enabler for DR programs.[15]

According to a 2008 FERC report, Missouri ranked tenth best in the nation for AMI penetration at 6.6 percent deployment. Since the 2008 report, it is likely that Missouri's national ranking is lower due to the heavy deployment of AMI meters in several states and indications that Missouri's deployment is relatively stagnant.

To date, 26 states/territories have smart metering legislation or policies: Alabama, California, Colorado, Delaware, District of Columbia, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Louisiana, Maine, Maryland, Michigan, Nebraska, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, Vermont, Virginia, Washington, and West Virginia.[16]

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[13] http://www.energy.gov/news/documents/Smart-Grid-Vendor.pdf

[14] Based upon FERC's Demand Response and Advanced Metering Survey and data collected by Parks Associates for 2010.

[15] Table II-3, Pg 12 of 2008, FERC, Assessment of Demand Response & Advanced Metering: Staff Report, December 2008, available at http://www.ferc.gov/industries/electric/indus-act/demand-response.asp.

[16] National Conference of State Legislatures Report, http://www.ncsl.org/?tabid=20672

1. Issues with AMI implementation

According to various press reports, issues with smart meter deployment have involved customer outrage directed at PG&E in California and ONCOR in Texas. Further, the Maryland Public Service Commission (MdPSC) recently rejected Baltimore Gas and Electric's (BG&E) plan for deployment.[17] In April 2010, a state senate hearing forced PG&E to disclose information concerning problems with smart meters. PG&E found issues with faulty installations, loss of customer usage information and trouble sending information back to the utility[18]. Only a very small percentage of meters had accuracy issues.[19] The Texas Public Utility Commission ordered an independent investigation into the accuracy of installed meters. Independent accuracy tests were conducted by Navigant Consulting, LLC, which found that 99.96 percent meters were determined to be accurate to ANSI standards.[20]

In Order No. 83410, Case NO. 9208, the MdPSC noted the following involving the rejection of BG&E's $835 million smart-meter installation plan.

- BG&E ratepayers should not be exposed to all the financial risk of an unproven and evolving technology and the accuracy of the assumptions used in the BG&E business case.
- The MdPSC will not approve cost recovery by way of a surcharge and prefers recovery through a regulatory asset because the project is viewed as a classic utility infrastructure investment.
- Before implementing time of use rates, it is critical that customers be provided sufficient education to understand the new tariff and how their behavior and decisions will impact their bill.
- Customers need to be provided sufficient enabling technology such as in-home displays (IHDs), energy orbs, messaging, etc., to provide the information that will trigger behavior changes aimed at reducing their electric bill.

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[17] Anti-Meter Fever Spreads as Regulator and Customer Mistrust Grows, SmartGridNews.com, February, 2010

[18] Consumers wary of smart meters, stateline.org story, July 23, 2010.

[19] "PG&E Advanced Metering Assessment" report, September 2, 2010, by the California Public Utilities Commission prepared by Structure Consulting Group, LLC.

[20] Evaluation of Advanced Metering System (AMS) Deployment in Texas, Report of Investigation, July 30, 2010. http://www.puc.state.tx.us/electric/reports/ams/PUCT-Final-Report_073010.pdf

The MdPSC approved a revised BG&E submittal that incorporates its direction that the Smart Grid project be treated as a regulatory asset, similar to a new power plant, and BG&E should recoup its costs through base-rate increases, not through surcharges. The MdPSC said it would perform an ongoing review of BG&E's costs and recovery, allowing the company to raise rates, once it has 'delivered a cost-effective AMI system.'[21] The Hawaii Public Utilities Commission (HPUC) denied a request by Hawaiian Electric Company (HECO) to extend pilot testing for its AMI project to 5,000 smart meters because of cost concerns. HECO said that additional pilot testing would be necessary to understand, in detail, how advanced metering would work with a new customer information system.

The HPUC said that HECO could not proceed with the plans outlined in its original application without engaging in the extended pilot testing and wrote that "any new AMI or, preferably, AMI/Smart Grid application should include or be preceded by an overall Smart Grid plan or proposal filed with the [HPUC]."[22]

A logistical area of concern is that, traditionally, electric utilities have no precedent or demonstrated skill at successfully building and operating telecommunications networks comprised of vast numbers of nodes that are required to provide high-accuracy and reliability for daily transport of meter-derived power consumption data.

The protocol debate promises to become one of the dominant issues in Smart Grid over the next several years. Various vendors have proposed solutions for linking homes, substations, transformers and all of the other machines that bring electricity to the house. Some companies have also proposed licensable proprietary standards that potentially could become de facto standards. Utilities have responded by either adopting these technologies for commercial Smart Grid deployments or at least agreeing to test them in trials.

Several electric cooperatives in Missouri utilize the MultiSpeak® Initiative for efficient communication integration, including Boone Electric Cooperative, CO-MO Electric Cooperative, Laclede Electric Cooperative, Platte-Clay Electric Cooperative, Southwest Electric Cooperative and White River Valley Electric Cooperative. The MultiSpeak® Initiative is a collaboration of the National Rural Electric Cooperative Association (NRECA)

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21 "Maryland Regulators Approve BGE's Revised Smart Grid Proposal", August 17, 2010, SustainableBusiness.com News; http://www.sustainablebusiness.com/index.cfm/go/news.display/id/20873

22 Power news article, August 10,2010, http://www.powermag.com/smart_grid/Hawaii-PUC-Rejects-Smart-Grid-Proposal_2917.html

and software vendors supplying the utility market and utilities, and is a project that is gaining national and international acceptance. (NIST, ANSI, IEC Wg14)[23] NRECA's MultiSpeak® is an industry-wide software standard that facilitates interoperability of diverse business and automation applications used in electric utilities. The MultiSpeak® Initiative has developed and continues to modify the specification that defines standardized interfaces among software applications commonly used by electric utilities so that software products from different suppliers can interoperate without requiring the development of extensive custom interfaces.[24] MultiSpeak® provides the following functions:

a. Distribution System Monitoring that includes meter reading, load profile creation and connect/disconnect functions.
b. Business Functions External to Distribution Management that includes meter data management, finance and accounting, customer billing, customer relationship management, end device testing and receiving, payment processing and prepaid metering.
c. Distribution Operations that include call handling, outage detection and management, load management, distribution automation data, supervisory control and data acquisition, and distribution automation control.
d. Distribution Engineering, Planning, Construction, and Geographic Information Systems that include engineering analysis and field design.[25]

2. Communication Systems & Networks of AMI Meters

Several network infrastructures and information technologies are available to support AMI deployment that include Microwave, Wireless Metropolitan Area Network (WIMAX), Outdoor Wireless Mesh Network (WMN or MESH), Long Term Evolution (LTE), 3G Cellular, Power Line Carrier, Wireline Broadband, Wireless Local Area Network (WLAN) and Zigbee.[26] While there are several technologies to consider, there are basically two separate communications systems required: one outside and one inside the residential home, commercial business or industrial facility.

[23] Technical Presentation by Gregory Wolven, WinEnergy, at Tech Advantage 2010 Conference and Expo.
[24] http://www.multispeak.org/About/whatIsMultiSpeak.html
[25] http://www.multispeak.org/About/whatIsMultiSpeakcovers.htm
[26] Smart Grid Wireless Technology Comparison Chart from Aviat Networks; http://www.aviatnetworks.com

D. Outside the residential home or business.

One communications system with two different networks is required to transmit data between the meter and the utility's collection or infrastructure support system. The first network supports communications between the meter and the utilities data collection point and is commonly referred to as a Neighborhood Area Network (NAN).

E. Inside the residential home or business

Inside the home or business, a second communications system is required. Commonly referred to as the Home Area Network (HAN), it also has some options for network architecture and communications protocols.

The current in-home applications, which utilize smart thermostats, individual receptacle switches, and specific device switches for water heaters, central air conditioners and smart appliances, require low speed and bandwidth. For these types of applications, a HAN Device Portal Architecture consisting of a communication gateway with a Zigbee Smart Energy Profile is the most widely used.[27] The Zigbee Smart Energy Profile has been endorsed by NIST as a national, U.S. Smart Grid standard.[28]

F. The Communication Gateway

A communication gateway device is required to facilitate communication between the NAN and HAN networks. The gateway device serves as a 'translator' for the two-way communications that are required between the NAN and HAN networks, which have different communication protocols or 'speak different languages'. This separate device should be external to the Smart Meter so communication protocol changes can be made without changing out the installed Smart Meter.[29]

Open technology and open non-discriminatory access to data can lead to new levels of services to consumers in the areas of demand response, information technology and price offerings.[30] While there is a lot of attention on the electric meter, a June 29, 2010 American

[27] PennEnergy report; "The Home Area Network; Architectural Considerations for Rapid Innovation." http://www.pennenergy.com/index/power/smart-grid/display/3151828412/articles/pennenergy/ugc/smart-grid/the-home-area-network-architectural-considerations-for-rapid-innovation.html
[28] Smart Grid Watch, "Is it Game Over for the Winning Home Area Network Wireless Standard" http://www.emeter.com/2010/is-it-game-over-for-the-winning-home-area-network-wireless-standard/
[29] PennEnergy report; "The Home Area Network; Architectural Considerations for Rapid Innovation. http://www.pennenergy.com/index/power/smart-grid/display/3151828412/articles/pennenergy/ugc/smart-grid/the-home-area-network-architectural-considerations-for-rapid-innovation.html
[30] "Order Authorizing Recovery of Costs Associated with Stimulus projects", Cases 09-M-0074 and 09-E-0310, July 27, 2009, by the New York Public Service Commission.

Council for an Energy-Efficient Economy (ACEEE) report indicates in its opinion, smart meters alone are not sufficient for customers to realize energy savings; customer education is required to meet projected energy savings goals.[31] As an example of the importance of consumer education, the Denmark energy company SEAS-NV initiated a competition where customers submit monthly meter readings via the internet or cellular phone text for a chance to win a monthly prize. The readings were also used to classify each contestant in an energy class in order to raise awareness of their energy consumption and provide customers individualized consulting on how to reduce their consumption. Customers who participated in this project reduced their consumption by an average of 17%.[32]

V. CUSTOMER EDUCATION AND INDUSTRY STANDARDS

A. Customer Education

In the emerging Smart Grid, many studies have been done that are leading to the same general conclusion. A rational, technical, and one sided approach, alone, will not be effective in driving Smart Grid customer engagement. 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.

The customers' experiences with the IOUs will appeal predominately to the rational side, and the utilities must push these experiences because the customers will, more than likely, not. But in these experiences a relationship must form where a positive emotional connection also occurs.

There are multiple ways to build and foster this positive relationship and as the engagement and relationships evolve, the utility has to be willing to enhance its customer care to maintain these relationships. The utilities must also receive and give persistent feedback to evaluate where they are and in which direction their ideas/pilots/projects need to go. Some customer segments will react well to certain approaches, some segments to other

[31] Special Report Number E105, Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities by ACEEE on Advanced Metering, June, 2010.
[32] European Utility Awards; http://www.european-utility-awards.com/EUA/Past_Winners_2290.aspx

approaches.[33] The utilities should evolve the approaches that work using a positive feedback loop, alternate approaches, or cut the ineffective approaches.[34]

There are many means currently available to communicate energy usage to consumers. Single socket plug-ins, whole-home energy trackers, energy ratings, etc. are currently in the market ready to be used, and are being used in many cases. Making these tools readily available and informing the public are the two main hurdles. It is not necessary to have a Smart Grid in place to enable a significant and positive behavior change. Right now, statistical methods that analyze existing utility and other available data can be used to provide useful and educational consumer feedback. … Another existing technology approach that can enable both demand response and a more compelling energy efficiency behavior is to tap into mobile phone technology. Conservative estimates in 2007 were that 40 percent of Americans have a mobile phone with even higher penetrations around the world. If even 20 percent of homeowners managed their energy load using their mobile phone, it could result in a major reduction in electricity waste.[35]

The estimated amount of consumer energy cost savings are often quite different than the actual savings realized by the customer. Benefits are often stated in the 10-14 percent range while, once implemented and measured, the savings are more in the 5-8 percent range. Managing customer expectations is crucial to program success. If savings are much lower than anticipated, the whole program could receive very negative feedback.

Some key communication lessons include:

- AMI represents just one of several means of providing households with real-time feedback.
- The success of the Smart Grid, advanced metering, and energy management and home automation technologies depends heavily on consumer acceptance and participation.
- Third-party providers are likely to be important players in feedback solutions, whether working in conjunction with or independently of utilities.
- Feedback gadgets alone are unlikely to maximize household energy savings.

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[33] Customers as Co-Creators of Value: A Social Roadmap for the Smart Grid Peter C. Honebein | © 2010 Customer Performance Group | IEE Webinar August 16, 20101

[34] The OPOWER Approach: Advanced Customer Engagement (ACE)

[35] Special Report Number E105, Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities by ACEEE on Advanced Metering, June, 2010.

- The best feedback approaches are likely to be incremental in nature and will 'evolve' as technologies become more sophisticated.
- The future of home energy management is likely to involve a complex network of wireless, consumer-controlled, home automation systems; although less sophisticated automation devices can be supported presently.[36]

B. Industry Standards

The National Institute of Standards and Technology (NIST) is the governing body charged with developing nation-wide standards for all areas of Smart Grid. NIST is currently involved with more than 100 organizations and stakeholders. NIST developed the Smart Grid Interoperability Panel (SGIP) to guide and nurture the long-term Smart Grid evolution. NIST also developed 17 priority action plans (PAPs). The PAPs define the problem, establish the objectives, and identify the likely standards bodies and user associations pertinent to standards modifications, enhancements, and harmonization.[37] Standard(s) development began in 2007. PAP #17 (Facility Smart Grid Information Standard), the final PAP as of this date, is slated to be complete in April 2011.[38] The FERC initiated a formal rulemaking proceeding on October 7, 2010 by creating docket RM11-2-000 for consideration of the five groups of Smart Grid operability standards identified by the NIST.[39] These five groups of standards will address open and non-proprietary communications protocols and cyber security.

The New York Public Service Commission stated, "The expectation of seamless integration of new 'smart' technologies with legacy systems and devices cannot be achieved without great attention to the principal of interoperability. … Interoperability promotes technology innovation, operational efficiency and facilitates the scalability, security, and reliability of Smart Grid deployments.

Although development of a comprehensive set of Smart Grid standards is not entirely complete, the principals of interoperability, standards-based communications protocols, and open architecture must be incorporated in current Smart Grid deployments.

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[36] Special Report Number E105, Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities by ACEEE on Advanced Metering, June, 2010.
[37] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/WebHome
[38] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP17FacilitySmartGridInformationStandard
[39] FERC Docket No. RM11-2-000, "NOTICE OF DOCKET DESIGNATION FOR SMART GRID INTEROPERABILITY STANDARDS"

It is essential that the concept of interoperability not be limited to informational compatibility between Smart Grid systems. Greater interoperability and standards development should also drive innovation and competition among device manufacturers, increasing vendor choice and communications technology alternatives, ultimately leading to more cost-effective deployments."[40]

VI. PROCESSES, ISSUES & GOALS FOR MISSOURI

There are many processes in the Smart Grid discussion with each process having unique issues and goals. Openly discussing these issues with all stakeholders is key to developing a pathway that is best for the state of Missouri.

Planning and implementation are the key foundational processes that must be addressed before any significant progress can be made. There are key planning and implementation issues that many IOUs in Missouri are addressing.

- AmerenUE[41] has done cost benefit studies that indicate replacing AMR meters and transitioning to an AMI implementation would, at this point in time, not be cost effective.
- Kansas City Power & Light has finished the planning phase for its pilot project and has begun implementation in the Kansas City area.
- Empire District Electric is currently working on the planning stages of its Smart Grid initiatives.
- The MoPSC has held stakeholder meetings to begin dialogue between businesses, customers, utilities and regulators.

Major goals of the planning and implementation phases are to consider all alternatives and select the alternatives that would be beneficial to the most customers without having negative consequences in the areas of reliability, costs or availability. Different IOUs are in different stages of implementation, and as implementation begins, issues arise. Cost recovery, security, customer relations, benefits with the new systems, and reliability are all major concerns for new systems. These concerns should be addressed in workgroups now and as

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[40] "Order Authorizing Recovery of Costs Associated with Stimulus projects", Cases 09-M-0074 and 09-E-0310, July 27, 2009, by the New York Public Service Commission.
[41] As used in this report, AmerenUE is the same as Ameren Missouri.

they are happening in the future. The overall goal of implementation is to smoothly deploy Smart Grid and all necessary hardware and software without any loss of reliability. Another goal would be to have an idea, before implementation, about how to deal with the issues mentioned above.

Semi-annual workgroups are suggested to address new issues as they arise, and to resolve any current or past conflicts that have not been properly addressed. The semi-annual workshops should bring in a wide variety of experience, solutions and/or ideas that can help navigate the ever-evolving Smart Grid.

VII. SMART GRID PILOT/DEMONSTRATION PROJECTS IN MISSOURI

A. The City of Fulton

The City of Fulton municipal electric utility was one of 100 recipients of the DOE's Smart Grid Grant awards on October 30, 2009. The City's share of the grant award is just over $1.5 million, which was matched by the city. 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. The project is expected to take 18 months to implement once the final award is received and currently the City is in the final stages of getting the project implementation plan approved with the DOE.

(See: http://www.mpua.org/_template_blog.php?blog_id=32)

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

The KCP&L Smart Grid demonstration project (Project) is included in the Department of Energy (DOE) and Electric Power Research Institute (EPRI) demonstration programs.[42] 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. Project funding consists of approximately $48.1 million to be spent from 2010 through 2014, of which $13.8 million (29%) is KCP&L-funded, $10.2 million (21%) is partner/vendor-funded and $24.1

[42] Smart Grid Demonstration Project presentation to EEI Strategic Issues Roundtable, October 20, 2010.

million (50%) is federally-funded through the ARRA.[43] KCP&L teamed with Siemens Energy, Inc., Open Access Technology, Inc. (OATI), Landis&Gyr AG, GridPoint, Inc., Kokam America, Inc., EPRI and Honeywell International, Inc.[44]

The Project is being promoted as an end-to-end Smart Grid that will include 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. The Project will focus on the area served by KCP&L's Midtown Substation across 2 square miles, impacting about 14,000 commercial and residential customers across ten circuits with total electric demand of 69.5 Mega Volt Amperes (MVA). The Smart Grid Project includes over 25 stakeholder groups including: Mid-America Regional Council (MARC), Missouri Electric Cooperative (MEC), Missouri Gas Energy (MGE), University of Missouri at Kansas City (UMKC), the Missouri Public Service Commission, The Kansas Corporation Commission, City of Kansas City, Missouri and several local neighborhood groups.[45] Within the Smart Grid Project boundaries lies the Green Impact Zone project, a 150 square block area of inner-city neighborhoods in Kansas City. The primary goal of the Green Impact Zone Project is to transform distressed urban neighborhoods into a sustainable community.[46]

The Project will be based upon the guidance found in the proposed National Institute of Standards (NIST) interim Smart Grid Interoperability Standards Roadmap, the EPRI IntelliGrid Architecture and the GridWise Architectural Council recommendations.[47]

The primary, overall focus for the Project will be to implement next-generation, end-to-end Smart Grid components that will include Distributed Energy Resources (DER), enhanced customer facing technologies, and a distributed-hierarchical grid control system that includes the following key elements:

- Upgrade the Midtown Substation to create a next generation "SmartSubstation";
- Upgrade multiple distribution circuits with a variety of feeder-based instrumentation and control devices for monitoring and control;

[43] KCP&L Green Impact Zone Smart Grid Demonstration submitted to the DOE, August 26, 2009.
[44] Id.
[45] Smart Grid Demonstration Project presentation to EEI Strategic Issues Roundtable, October 20, 2010.
[46] KCP&L Green Impact Zone Smart Grid Demonstration Abstract.
[47] KCP&L Green Impact Zone Smart Grid Demonstration submitted to the DOE, August 26, 2009.

- Grid management infrastructure to support the upgraded grid, back office and substation requirements;
- SmartMeters with AMI installed at all customer sites to provide consumers with enhanced information on energy use and the opportunity to utilize residential TOU rate structures with an expected participation level of 426 residential customers; and,
- Integration of distributed generation that includes a large battery storage system and distributed roof-top solar phtovoltaic systems.[48]

Consumers will be offered a wide range of products and services with the following expected level of participation:

- All will have access to real time energy usage through the Internet;
- 1,600 residential and commercial users are expected to have in home/business energy displays and demand response thermostats;
- 400 residential users are expected to utilize an Energy Management System (EMS);
- 2 commercial users are expected to utilize an EMS;
- 10 Light-Emitting Diode (LED) area lights will be installed at UMKC;
- 64 residential users are expected to utilize hyper-efficient appliances;
- 5 commercial and 10 residential users are expected to utilize roof-top solar systems; and,
- 10 distributed vehicle charging stations will accommodate Plug-in Hybrid Electrical Vehicles (PHEV).[49]

KCP&L is proposing to implement its demonstration project in the five following project phases:

1. 2010-2014: Refine project scope, definition and ongoing project management.
2. 2010: Compile and/or collect baseline grid and end-use data for the demonstration area.
3. 2011-2012: Smart Grid infrastructure deployment, implementing the SmartSubstation, Data Management System (DMS) and Advanced Distribution Automation (ADA) components.

[48] Id.
[49] Smart Grid Demonstration Project presentation to EEI Strategic Issues Roundtable, October 20, 2010.

4. 2011-2012: Distributed Energy Resource deployment implementing the Smart End-Use, Smart Generation (Solar, Battery, PHEV) DER/DR Management components and introduce TOU pilots.
5. 2013-2014: Data collection, reporting and project conclusion, operating the integrated Smart Grid demonstration systems, collecting 24 months of grid data, evaluating systems and analyzing performance.

(See: http://ala.kcpl.com/about/policycenter/SmartGridGIZmap.pdf
http://www.kcpl.com/about/policyctr.html)

C. The Boeing Company Smart Grid Regional Demonstration Project

The Boeing Company Smart Grid Regional Demonstration Project will demonstrate an advanced Smart Grid software technology with military-grade cyber security for improving regional transmission system planning and operation. Boeing was selected on November 9, 2009, to receive an $8.5 million DOE grant to lead one project team and is a sub-recipient on two others -- one led by Consolidated Edison of New York and one by Southern California Edison. The project includes PJM, Midwest Independent Transmission System Operator (MISO), and Public Service Electric and Gas Company (PSE&G), a diversified energy company in New Jersey, who collectively serve all or part of 21 states and more than 90 million people.

These projects are designed to achieve the following goals:

- increase grid reliability
- reduce system demands and costs
- increase energy efficiencies
- rapidly allocate energy when and where it is needed
- provide greater network security and flexibility to accommodate new energy technologies

(See: http://boeing.mediaroom.com/index.php?s=43&item=976)

D. White River Valley Electric Co-op

White River Valley Electric Co-op has a full deployment of AMR meters throughout its service area. In 2008, it began a beta testing phase for Google PowerMeters utilizing the MultiSpeak® specification. This approach gives customers access to daily energy usage and allows customers to track energy usage constantly. This provides a way for customers to better understand energy usage throughout the home and to minimize that usage.

(See: http://www.whiteriver.org/default.aspx)

E. Co-Mo Electric Cooperative

Co-Mo Electric Cooperative has been fully deployed with AMI meters since 2002. The company uses multiple avenues to show customers their hourly and daily usage utilizing the MultiSpeak® specification. This has allowed the company to move into prepay electricity accounts with its customers, which would not have been realistic prior to AMI deployment.

(See: http://www.co-mo.coop/usageinfo.aspx)

F. 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.[50] Laclede selected a Tantalus Utility Network (TUNet) for flexibility, scalability, and capability to serve as a single communications backbone that supports the full range of smart grid functionality.[51] The Smart Grid initiative includes a full change-out of approximately 36,000 existing electromechanical meters with Itron CENTRON® solid-state meters.[52] The new meters 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.[53] Laclede also entered into a contract to provide Ft. Leonard Wood with commercial and industrial energy management services.[54]

(See: http://www.lacledeelectric.com/)

G. St. Louis Regional Green Impact Zone (potential Smart Grid project)

In partnership and collaboration with Better Family Life, the St. Louis Regional Green Impact Zone project is designed to include all aspects of energy efficiency, green job training and placement, energy conservation and consumer education efforts within Missouri's first

[50] T-Net News, October 7, 2009.
[51] Tantulus Laclede Electric Case Study: http://tantalus.com/cs_laclede.php
[52] Presentation by Terry Rosenthal, Laclede Electric Engineering Manaager at Tech Advantage 2010 Conference and Expo.
[53] Tantalus News Laclede Electric Press Release, November 4, 2008.
[54] T-Net News, October 7, 2009.

Congressional District, represented by Congressman William Lacy Clay. The project is described as being modeled after the Greater Missouri Green Impact Zone located in Kansas City, but makes no mention of any Smart Grid applications. Staff is not aware of any additional information indicating the proposed scope of Smart Grid technology implementation and, therefore, cannot confirm or deny that this is a Smart Grid demonstration project. However, because of its characteristics, it is worth mentioning and monitoring for additional information.

VIII. MISSOURI INVESTOR-OWNED UTILITIES SMART GRID STATUS[55]

A. AmerenUE Missouri

(See: http://www.ameren.com/sites/aue/Pages/home.aspx)

1. Smart Meters

AmerenUE has been 100 percent deployed with AMR since 2000 with 1.2 million meters in total, all owned by AmerenUE. There are approximately 100 'net metering' applications to date, 18,000 meters are configured for time-of-use/demand reporting and 5,000 are configured for 15-minute interval reporting for industrial and large commercial customer use. The remaining meters report daily kWhs for residential and small commercial customer use. In September 2009, AmerenUE conducted a study comparing the costs and benefits of AMR versus AMI and concluded the following:

- AMR achieves most of the operational benefits of AMI without the two-way communications – automatic 'reads,' outage notification, tamper detection, system load data.
- The operational benefits offered exclusively by AMI include remote connect/disconnect and remote meter programming/configuration.
- Conversion to AMI would require new meters, new communications infrastructure, a new operating system, and billing system integration with a total conversion estimated at over $300 million.

[55] Information for this section was provided by the individual IOU's through presentations, company websites and information provided during workshops and meetings with the MoPSC.

- The benefits of AMI do not outweigh the estimated costs today, but other AMI deployments are being closely monitored with plans to revisit this issue in the future.

2. ELECTRIC VEHICLE AND PLUG-IN HYBRID ELECTRIC VEHICLES

The auto industry has already standardized on 120V and 240V charging characteristics and the plug-in connectors (i.e. 'interfaces'). An August 2009 technology study concluded that there are no significant system effects anticipated until PHEV penetration in the service territory approaches approximately 150,000 vehicles. AmerenUE is taking receipt of two plug-in hybrid bucket trucks in 2011 as part of an Electric Power Research Institute (EPRI) demonstration project and is participating with St. Louis Clean Cities on a Plug-In Readiness Task Force as a means of monitoring initial discussions on how to create a local market for new PHEVs.

3. Electric Grid

AmerenUE's investments are focused on the electric system grid to improve service reliability, operating efficiency, asset optimization, and a robust energy delivery infrastructure. AmerenUE has approximately 2,300 line capacitors that are automated via one-way radio communications and approximately 800 tap changing substation transformers that are automated to adjust system voltage from commands issued by Distribution Control Offices. System voltage reduction has proven to work and AmerenUE-documented cases over 15 years show 1.0-1.2 percent demand reductions after programmed calls for 2.5 percent voltage reductions. Significant future infrastructure investments are required to take full advantage of this system optimization feature and the 1980s era legacy system of line capacitor control will need to be replaced. A new communications network infrastructure is required to support two-way communications with intelligent line devices like capacitors along with a new distribution management system platform.

4. Customer Electric Usage Information

Customers can view daily usage, create a profile for their house and explore options for energy savings by utilizing the Ameren Energy Savings Toolkit at http://www.ameren.com/sites/aue/csc/Pages/EnergySavingsToolkit.aspx

B. <u>Kansas City Power & Light (KCP&L</u>

(See: http://www.kcpl.com/ and Section VII.B on the KCP&L Smart Grid Demonstration Project)

1. **Smart Meters**

AMR deployment consists of 500,000 one-way communications meters that are read daily and were deployed starting in 1995. KCP&L currently has an 'MPOWER' program for energy curtailment and real-time pricing programs for customers. The Smart Grid Demonstration Project will deploy 14,000 AMI Smart Meters with two-way communications reads on 15-minute intervals, utilizing a single field communications network for the infrastructure required for the project.

The 14,000 AMI Smart Meters will replace existing AMR meters, but there will only be 1,600 energy displays and smart thermostats to utilize the additional information available through the AMI Smart Meters.

2. **Electric Vehicles and Plug-in Hybrid Electric Vehicles**

PHEV charging will be deployed as part of the Smart Grid Demonstration Project. With electric cars expected to soon hit the market, KCP&L plans to have 10 charging stations in place by next summer. The University of Missouri-Kansas City intends to install an electric charging station that will be available to the public. It will also be used to charge the university's first electric truck upon purchase. KCP&L has hybrid electric/E85 fuel vehicles as part of a pilot program with Ford Motor Company.

3. **Electric Grid**

The KCP&L electric grid infrastructure focuses on the pursuit of service reliability, operating efficiency, asset optimization, and building a secure, robust energy delivery infrastructure. KCP&L utilizes line capacitors that are automated via one-way radio communications, and tap-changing substation transformers that are automated to reduce system voltage from remote commands. Within KCP&L's Smart Grid Demonstration Project, as discussed in Section VII.B., the Smart Distribution project will include a smart substation with a Distribution Management System (DMS) and an IP/RF 2-way Field Area Network (FAN). The grid will also include distributed generation that will include Smart Generation consisting of residential/commercial rooftop solar and residential battery storage.

4. **Customer Electric Energy Information**

Customers can view daily usage through home energy web portals, create a profile for their house and explore options for energy savings by utilizing the KCP&L Connections website at http://www.kcplsave.com/residential/connections/default.html. It is noted that not all households have Internet access and there are no libraries in the Green Impact Zone to provide this access.

C. Empire District Electric

(See: **https://www.empiredistrict.com/**)

1. Smart Meters

Currently only electro-mechanical meters are deployed. Smart meter deployment was attempted earlier but abandoned due to failures in the communications infrastructure deployment. In March 2010, Empire District Electric assembled a team to develop a pilot program that would research and test the available metering products and technologies for an advanced metering infrastructure system. The team determined it would need to visit with a number of manufacturers, vendors, and other utility companies. The team determined it was also necessary to identify the required interfaces and to define the corporate resources needed to ensure a successful pilot implementation.

The proposed pilot program will include residential, commercial, and industrial customers, which will cover single-phase and three-phase applications. It is anticipated that implementation will include two different communications technologies via two separate phases. The scale, location, and timeline are pending approval.

2. Electric Vehicles and Plug-in Hybrid Electric Vehicles

No current plans for charging stations to accommodate EV and PHEV vehicles.

3. Electric Grid

Empire District Electric grid infrastructure focuses on service reliability, operating efficiency, asset optimization, and building a secure, robust energy delivery infrastructure. New substation relays and automated recloser switch controls utilize digital communications. Almost all power transformers have automatic load tap changers and those that do not have line voltage regulation in the substation.

4. Customer Electric Energy Information

Customers can view daily usage through home energy web portals, create a profile for their house and explore options for energy savings by utilizing the Empire District Electric website at https://www.empiredistrict.com/login.aspx.

IX. ISSUES REQUIRING FURTHER EMPHASIS BY MISSOURI STAKEHOLDERS

A. Planning

Defining project goals based upon stakeholder input is essential. Stakeholder and customer engagement that leads to some ownership of the project plan are key elements that must be obtained. The MoPSC has initiated several workshops and conferences to discuss the future of Smart Grid in Missouri. All known stakeholders, including the IOUs of Missouri, other government organizations, potential vendors, consumer advocates, and other stakeholders have been involved in the workshops. There are also multiple pilot projects by IOUs and municipals that will provide more information. The path forward will be determined to a large extent from the information obtained through these efforts.

B. Implementation

For any task as large as updating the electric grid, implementation should evolve through the execution of an overall plan in a phased approach. This step can be one of the hardest steps as many efforts may fail for numerous reasons, and many trials may be conducted at great expense. It has been the experience of Staff that the IOUs are trying to implement Smart Grid technology in a piecemeal fashion. They are developing test markets to research the areas of concern. By closely studying the results of workgroups, conferences, and pilots in the state and across the nation, a phased implementation plan can be developed. Taking the time to plan all phases and steps is critical to reducing mistakes and to implementing a Smart Grid that is capable of handling the future energy needs.

C. Cost Recovery

IOUs will need some form of cost recovery in order to be incentivized to deploy Smart Grid technology. The deployment of Smart Grid will include many resources and if the consumer does not realize the promised benefits, the Smart Grid system does not achieve the desired results. The MoPSC and stakeholders must all work closely together to make sure that the technology that is implemented is prudent and beneficial for the IOU and the consumer. Some state commissions have taken positions on the cost recovery aspect.[56] These positions, and the results of these positions, should be taken into consideration as Missouri

[56] The New York Public Service Commission in Case 09-M-0074 issued on April 14, 2009, a proposed framework for the Benefit-Cost Analysis of Advanced Metering Infrastructure to provide a generic approach for guidance to the utilities. The Commissions in California, Texas and Vermont have provided similar guidance.

moves forward and cost recovery becomes a prominent issue. The MoPSC should consider opening a docket to address this issue specifically, as it is one of the most important to all stakeholders.

D. Cyber Security and Data Privacy

With the introduction of a two-way communications system, there is a great concern about security and data privacy. A safe and reliable network is paramount for consumer confidence and the acceptance of Smart Grid. Although this issue is currently in the news and on the minds of many consumers, 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," the following "Best Practices" are promoted.

1. Smart Grid systems should feature privacy principles in their overall project governance framework and proactively embed privacy requirements into their designs in order to prevent privacy-invasive events from occurring;
2. Smart Grid systems must ensure that privacy is the default – the 'no action required' mode of protecting one's privacy;
3. Smart Grid systems must make privacy a core functionality in the design and architecture of Smart Grid systems and practices;
4. Smart Grid systems must avoid any unnecessary trade-offs between privacy and legitimate objectives of Smart Grid projects;
5. Smart Grid systems must build in privacy end to end, throughout the entire life cycle of any personal information collected;
6. Smart Grid systems must be visible and transparent to consumers to ensure that new Smart Grid systems operate according to stated objectives;
7. Smart Grid systems must be designed with respect for consumer privacy as a core foundational requirement.[57]

Currently, NIST is developing Cyber Security Standards for Smart Grid applications. All of NIST's work is scheduled to be completed in the second quarter of 2011. It would be beneficial if all IOUs comply with approved NIST standards. The US DOE published a

[57] Privacy by Design report entitled: "Achieving the Gold Standard in Data Protection for the Smart Grid", June 2010; http://www.privacybydesign.ca/content/uploads/2010/03/achieve-goldstnd.pdf

report entitled "Study of Security Attributes of Smart Grid Systems-Current Cyber Security Issues" in April 2009 that concludes that Smart Grid cyber security must be a coordinated and ongoing effort through the full development lifecycle of Smart Grid implementation.[58]

E. Customer Acceptance and Involvement

With Smart Grid deployment in different geographical locations throughout the country, there are various approaches to customer education and communication. A multiple-pronged approach that can be tailored to specific customer types has shown to be the most effective way to maximize customer involvement in energy savings through smart applications. Access to real-time information, daily, hourly, and possibly in smaller increments, in relevant formats, mail, email, Internet portals, cell phone messages, phone calls, in-home monitors, etc., will give the customers the tools necessary to be more aware of their usage levels.

F. Customer Savings and Benefits

Customer savings will be a natural by-product of having knowledge about usage and being empowered to control usage levels through a choice of options best suited for the individual customer.

Customer savings may also be directly linked to demographics, education and income levels. Based on the observation and research of Staff, more affluent and educated customers, and those who own their own home, are generally more likely to spend extra money for energy efficient and smart appliances to realize energy savings over time. Low income, elderly and those customers that rent will generally be less likely to be in a position to spend extra money on energy efficient appliances, but will be more interested in actions they can take that require minimal investment. Reaching out to customers and customizing the approach to the type of customer will be a key issue. Advertised customer benefits should be conservative and realistic. Staff research indicates that energy savings benefits to consumers ranges between 4-12 percent based upon the type of customer feedback provided.[59]

G. Industry Standards

NIST, in partnership with DOE and more than 100 stakeholders, has developed 5 main areas of focus for industry standards as follows:

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[58] http://http://www.inl.gov/scada/publications/d/securing_the_smart_grid_current_issues.pdf

[59] Special Report Number E105, Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities by ACEEE on Advanced Metering, June, 2010.

- Transmission and Distribution
- Building to Grid
- Industry to Grid
- Home to Grid
- Business and Policy

What will smart meters look like? How will they operate? Will smart appliances and smart meters be interoperable? Will smart meters and appliances be transferrable and/or transportable? As shown by the questions above, standards must reach a certain threshold to assuage basic concerns before a Smart Grid deployment makes sense. Smart Grid infrastructure deployment for Missouri should conform to a common set of approved standards to assure compatibility and uniformity across the state.

With proper planning and implementation, which includes standards, customer education programs, and installation and maintenance, research suggests there should be an increase in the reliability of the generation, transmission, and distribution of power to customers.

H. <u>Stakeholder Concerns</u>

Stakeholders have several concerns with regard to Smart Grid implementation. Questions raised by stakeholders including the following:

- Data Privacy-Who owns the data? Who has access to the data? How will the data provided via Smart Meters be used? What consequences are there to unauthorized access to this data? How vulnerable is my personal data?
- Cyper Security-How safe or vulnerable is the Smart Grid to a cyber attack? What are the potential consequences to a cyber attack on the grid or in the home? Can someone access my Smart Meter data without my or the utility's knowledge?
- Cost Benefit-What is the rate of return and cost benefit for the Smart Grid infrastructure investment? Are projected consumer electrical energy savings realistic? Is the consumer paying the majority of the Smart Meter implementation costs while the utility realizes the majority of the benefits? Are consumers not on a Smart Grid paying for the implementation costs for those consumers that are on a Smart Grid?

- Impact on Electrical Rates-How will Smart Grid infrastructure investments impact electric rates? Can the Smart Grid be implemented such that the cost savings offset the implementation costs?
- Reliability Concerns-Will the additional Smart Grid infrastructure equipment, components and devices increase or decrease overall electric system reliability?
- Equipment Ownership-Will the Smart Grid Infrastructure up to and including the Smart Meter be owned by the electric utility and the equipment inside the residence or business be owned by the consumer?
- Technology Obsolescence and Compatibility-What is the realistic life of the equipment? How will it get upgraded? Who pays for what? Will the Smart Grid Infrastructure support software technology upgrades without hardware replacement?
- Technology Standardization and Acceptance-If I move, will my appliances and equipment that I currently have in my home work in my new home with a new electric service provider? How complicated, sophisticated is the equipment that will be installed in my home? Can I just "set and forget" or will the new technology require me to monitor my electric usage and take action on a daily basis?
- Customer Service-If I have a problem, do I make one call or several to resolve my problem? Will I speak with my local electric service provider or be routed to an automated call processing center outside my area?

X. RECOMMENDATIONS FOR REGULATORY INVOLVEMENT

To what extent should the MoPSC be involved in all aspects of the Smart Grid issue? As discussed above, regulatory involvement will be very important in the development of all areas of Smart Grid. Staff recommends the MoPSC hold a Smart Grid workshop every 6 months for information exchange, sharing of best practices and educational purposes. Issues for discussion should include such things as cost recovery, cyber security and industry standards. The MoPSC should consider opening a docket to address the cost recovery issue specifically, as it is one of the most important to all stakeholders.

With proper planning and implementation, which includes standards, customer education programs, and installation and maintenance, research suggests there should be an increase in the reliability of the generation, transmission, and distribution of power to customers.