UNITED STATES OF AMERICA

BEFORE THE

DEPARTMENT OF ENERGY

In the Matter of

Addressing Policy and Logistical Challenges
To Smart Grid Implementation

To: Office of Electricity Delivery and Energy Reliability

COMMENTS OF
THE AMERICAN PUBLIC POWER ASSOCIATION

The American Public Power Association ("APPA") appreciates this opportunity to respond to the U.S. Department of Energy's ("DOE") Request for Information ("RFI"), published September 17, 2010 in the *Federal Register*,[1] on addressing policy and logistical challenges to the implementation of smart grid technologies.

APPA is a national service organization that represents the interests of more than 2,000 publicly owned, not-for-profit electric utilities located in all states except Hawaii. Many of these utilities developed in communities that were left unserved as private-sector electric companies pursued more lucrative opportunities in larger population centers. Residents of these communities banded together to create their own power systems, recognizing that electrification was critical to their economic development, educational opportunity, and quality of life. Public power systems also emerged in several large cities – including Austin, Jacksonville, Los Angeles, Memphis, Nashville, San Antonio, Seattle and Tacoma – where residents believed that competition was necessary to obtain lower prices, higher quality of service, or both. Currently,

[1] 75 Fed. Reg. 57,006 (September 17, 2010).

over 70 percent of APPA's members serve communities with less than 10,000 residents, and approximately 45 million Americans receive their electricity from public power systems operated by municipalities, counties, authorities, states, or public utility districts.

APPA recognizes that successful utility implementation of smart grid technologies hinges, in part, on creating and maintaining customer confidence that utilities can continue to provide reliable, safe, and secure service. Furthermore, customers must be educated about the benefits of any particular smart grid technology their community elects to implement. APPA member utilities are in a good position to address the needs of their communities because of the inherent nature of public power utilities – they are overseen by members of the communities they serve, through the medium of government.

For public power utilities, implementation of smart grid technologies is fundamentally a local decision. Public power utilities rely on state law, legal precedents, local ordinances, and guidance from their governing bodies to set policy, and input from customers and local officials to determine their communities' needs and preferences.

The decision whether, when, and how to implement smart grid technology will depend on many utility-specific factors, including the utility's load profile, the age and operational efficiency of its existing equipment, the financial health of the system, community receptivity and input, and the cost of different options compared to the prospective benefits. The utility must comply with existing state and local laws concerning data access, and the local regulatory body – typically either a city council or independent utility board – must approve the utility's capital investment, strategic plans, and any revisions to associated utility policies.

APPA expects that there will be considerable diversity in how public power utilities move forward with the implementation of smart grid technologies. Some utilities will elect to

make incremental investments in smart grid technology, with the first steps aimed at improving digital communication within the distribution system. Smart meter implementation may come later and may focus initially on industrial and commercial customers. Other utilities will adopt more ambitious smart grid plans providing for a broad roll out of smart meters for all customers while also pursuing improved distribution system efficiencies.

While implementation decisions are made at the state or local level, there is still an important role for the federal government. For example, DOE's current RFI process will be helpful in identifying logistical challenges that confront smart grid implementation. Also, DOE could provide continued support by compiling examples of logistical challenges and best practices through projects funded by the Smart Grid Investment Grant ("SGIG") program. As outlined in Title XIII of the Energy Independence and Security Act of 2007 ("EISA"), the SGIG program is meant to "support the modernization of the nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure."[2] EISA also directed the U.S. Commerce Department's National Institute of Standards and Technology ("NIST") to coordinate the development of a framework to develop protocols and standards to achieve interoperability of smart grid devices and systems. The development of these standards will help guide utilities as they make decisions on smart grid investments.

The RFI's questions on policy and logistical challenges are truly exhaustive. Thus APPA has not responded to all of the topics or questions, but instead has concentrated on those areas where APPA has the most to contribute. APPA's answers follow.

[2] P.L. 110-140, Title XIII, Sec. 1301.

Definition and Scope

What is the best way to define smart grid? What significant policy challenges are likely to remain unaddressed if we employ Title XIII's definition?

As technology has become increasingly advanced, the boundaries between the electric and advanced communications worlds are starting to meld into the generic concept of a "smart grid." Investments in smart grid technologies have been highlighted by the national news media, Congress and the Administration, and by the $4.5 billion in funding made available to DOE through the American Recovery and Reinvestment Act of 2009 ("ARRA" or "Stimulus Bill"). However, there is often confusion about what the term smart grid means. Misuse of the term implies that electric utilities and the electric power delivery system are not functioning well now, when in fact the industry has an outstanding record of reliability. In the past, technological advances have been focused on actual assets like transmission lines, substations and power plants, while more recent advances have been made at the customer level – at the meter. APPA has not attempted to dictate one definition or vision of the "smart grid" to its members, recognizing that for different members in different circumstances, the needs – and the investments required to meet them – will be different. APPA has, however, published a "Smart Grid Essentials" manual for our members to use in assessing their needs.

APPA believes that "smart grid" should be defined in broad terms, allowing it to develop at the "speed of value" to each community served, instead of the "speed of hype" from manufacturers or vendors. While advancing technologies have great potential to do more and make the industry "smarter" about events on the bulk electric system (comprised of higher voltage transmission and generation assets) and at the distribution level, the industry does not often get credit for many of the concepts and investments that are already in place that make the grid "smarter." While speed and impact are often considered "best" in relation to advances in

information technology, the best advances for the electric utility industry are centered on safety and reliability. Though technological advancements can often significantly improve the response to any disruption on the grid, safety for employees and the public are still of the utmost importance to utility operations.

Title XIII's characterization of a "smart grid" allows utilities and communities across the United States the flexibility to optimize the electric grid for their individual needs. As mentioned earlier in these comments, some utilities may start by improving the digital communication within their distribution systems, while others may deploy smart meters to every customer and provide real-time data; both systems should be considered part of the "smart grid." APPA firmly believes "smart grid" is no one thing, but rather a combination of elements to develop a "smarter" grid designed to meet a specific community's needs.

At the state and local level, a broad definition of smart grid allows policymakers to consider several key issues – system reliability, employee and customer safety, infrastructure security, and consumer privacy – in developing implementation strategies. On the national level, the NIST Smart Grid Interoperability Panel ("SGIP"), which is composed of key stakeholders, is creating standards to ensure the continued development and integration of technologies to support a smarter grid. Once they are approved under the NIST process, the standards are submitted to the Federal Energy Regulatory Commission ("FERC") for rulemaking. The first such set of standards was recently submitted by NIST to FERC, and FERC has indicated it will soon commence a rulemaking proceeding to consider them.[3]

[3] *Smart Grid Interoperability Standards*, Docket No. RM11-2-000, Notice of Docket Designation for Smart Grid Interoperability Standards (issued October 7, 2010).

Interactions With and Implications for Consumers

The following section addresses some of the questions included in the first four bullet points listed under this heading.

The RFI includes numerous questions on consumer education and customers' reaction to smart grid technology. APPA has not conducted research on these consumer questions nor made a comprehensive review of reports and case studies on consumer issues. However, APPA can provide information on its members' experiences.

The following examples show how some public power utilities use the Internet to communicate with their customers about the utilities' smart grid programs:

- The Sacramento Municipal Utility District ("SMUD") in California is installing smart meters for all customers. The home page of the utility's website features a prominent link to the smart meter page, which includes a description of the program, a "What should I expect?" sidebar detailing how the meter installation will occur, and a "flash" presentation outlining the project.[4] SMUD also produced a video, available from both its home page and its smart meter page, that describes why SMUD is installing smart meters, how customers benefit from the program, what customers should expect, and comments from customers signed up for the pilot program.[5]
- Glendale Water and Power, serving Glendale, California, produced a video showing its smart grid implementation in the context of the utility's 100-year history. The video contrasts traditional water and power equipment with the reliability and customer service benefits available with its smart grid. It also describes programs (such as time-of-use pricing) that will be offered once smart meters and home area network equipment are

[4] Link to SMUD's smart meter page: http://www.smud.org/en/smartmeter/Pages/default.aspx.

[5] Link to SMUD's smart grid video: http://www.smud.org/en/video/Pages/cc_tabbed.html?bclid=769701255&bctid=48209137001.

fully deployed.[6] The smart grid page of Glendale's website includes a customer brochure describing smart grid and the meter installation process.[7]

- The public power utility in Leesburg, Florida, received a federal stimulus award to implement portions of its smart grid program, which includes smart meters and home energy management systems. The home page of the city's website features a "Get Smart" logo and a list of reasons why Leesburg is among Florida's most progressive cities – number one on the list is "Smart Grid." The "Get Smart" logo links to the utility's website, which in turn focuses on the utility's smart grid implementation. Thus, whether they come to the city or the utility website, a customer is immediately introduced to the smart grid concept. All pages of the city's website include a "Smart Grid City" logo at the top – a reference to the utility's stimulus award.[8]
- Memphis Light, Gas, and Water ("MLGW"), the public power utility in Memphis, Tennessee, is implementing smart grid technology, including a three-year demonstration smart meter program. The utility's website includes a "Smart Grid FAQ" section[9] to explain the utility's program, and also uses social media to reach the more technology-oriented, typically younger, customers. The utility's blog has a smart grid section; blog entries include announcement of the smart grid pilot program (with links to the participation application), updates on the status of the project, and an article on energy consumption during peak times.[10]

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6 Link to Glendale's video: http://www.glendalewaterandpower.com/GWPAMIProject.aspx.

7 Link to Glendale's brochure: http://www.glendalewaterandpower.com/pdf/GWP_POC_AMI_FAQ_Brochure.pdf.

8 Link to City of Leesburg website: http://www.leesburgflorida.gov/.

9 Link to MLGW "Smart Grid FAQ": http://www.mlgw.com/SubView.php?key=misc_smartgrid&x=2).

10 Link to the MLGW smart grid blog: (http://www.mlgw.com/frameset.php?head=res&content=mlgwblog).

- Auburn Electric, serving the City of Auburn, Indiana, is building its smart grid network using fiber to the premises. This is an expansion of the broadband services that it began offering to centrally-located business customers in 2005. The utility's website provides customers with a description of the project, and how the ongoing underground installation work will affect them.[11]
- Lakeland Electric, serving Lakeland, Florida, highlights its smart grid project on its home page, with links to a description of the project and frequently asked questions.[12]
- Salt River Project ("SRP"), serving customers in the Phoenix, Arizona, area, has deployed 500,000 smart meters and is doubling that amount with the help of a DOE Smart Grid Investment Grant. According to an SRP press release, participation in time of use rate programs has increased by 20 percent with the smart meter installations.[13] SRP also provides customers with information on smart meter technology and benefits via its website.[14]

In another example, the Iowa Association of Municipal Utilities ("IAMU") used employee training to ensure effective customer education. IAMU developed for its member utilities a smart thermostat program that uses technology allowing the utility to communicate with the thermostat. IAMU produced a video for utility personnel installing the thermostats. The goal was for installers to build on the face-time with the customer to not only install the thermostat, but to conduct a quick energy audit. Customers also receive a video explaining thermostat features.[15]

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11 Auburn Electric's smart grid link: http://www.ci.auburn.in.us/departments/electric/SmartGrid/Index.htm.
12 Link to Lakeland's home page: http://www.lakelandelectric.com/Home/tabid/38/Default.aspx.
13 Link to SRP press release: http://www.srpnet.com/newsroom/releases/051810.aspx.
14 Link to SRP smart grid page: http://www.srpnet.com/electric/home/smartmeter.aspx.
15 Jeanne LaBella, "Iowa Ideas," published in *Public Power*, September 2010 issue. The article is included attached in the appendix to these comments.

Earlier this year, APPA published an article on public power utilities' pilot programs on home energy monitoring systems.[16] Some of the utilities covered in the article found that initial reductions in energy use were not sustained, as customers lost interest in the program. A common conclusion was that providing information was not enough. Customers needed continued education and reminders, and responded to different motivations.

This conclusion, that providing information alone is not enough, is consistent with lessons learned in the recent DOE-funded study on motivating customers to invest in energy efficiency. The report's number one lesson is: "It is not enough to provide information; programs must sell something people want – High home energy use is not currently a pressing issue for many people; find a more appealing draw such as health, comfort, energy security, competition, or community engagement to attract interest."[17] While this report's subject is energy efficiency, much of its subject matter concerns communicating with and motivating customers, and so many of its conclusions are highly relevant to smart grid customer programs. Of particular relevance are the sections on behavioral research, identifying the target audience, and selling something people want (parts 6, 7, and 8 of the report).

Are education or communications campaigns necessary to inform customers prior to deploying smart grid applications? If so, what would these campaigns look like and who should deploy them? Which related education or public relations campaigns might be attractive models?

Education and communication campaigns are crucial to the success of any smart grid deployment, and utilities should be the primary education source. A public power utility's relationship with its community allows the utility to involve customers from the beginning of the

[16] Alice Clamp, "Putting Home Energy Monitoring Systems to the Test," published in *Public Power*, May 2010. The article, included in the appendix, describes many details of the pilot programs. These include lessons learned on what motivates customers and on designing an effective pilot program.

[17] Lawrence Berkeley National Laboratory, "Driving Demand for Home Energy Improvements: Motivating Residential customers to invest in comprehensive upgrades that eliminate energy waste, avoid high bills, and spur the economy," September 2010, p.2.

smart grid deployment process. Because of public power's local governance (typically by a city council and/or independent utility board), customers can provide input as smart grid implementation decisions are made, and the utility can work with local officials to educate consumers.

Some utilities have found that smart grid deployment without strong community involvement or good education programs can undermine the program. The Pacific Gas and Electric ("PG&E") Bakersfield deployment case is the poster child for poor customer communications. At one point, the San Francisco's City Attorney asked the California Public Utilities Commissions to halt PG&E's smart meter installations because of concerns over the accuracy of the meters.[18]

DOE could help utilities develop effective education campaigns by compiling best practices and lessons learned from the SGIG projects. Providing a variety of options will give utilities ideas on how best to communicate with their individual communities. For example, smaller utilities may find that bill inserts or community meetings are most effective, while larger utilities may find it worthwhile to engage their technology-oriented customers via YouTube videos.

APPA created its "Smart Grid Essentials" guidebook to help its members educate their customers, employees, governing boards, and city councils on smart grid technologies. The guidebook was written in layman's terms so consumers (and members of governing bodies of public power systems, such as city council members) could readily understand the difficult concepts involved with the evolution to a smarter grid. The guide breaks the electric delivery supply chain into smaller, understandable parts, and focuses on how the digital overlay will make that portion of the electric supply chain smarter.

[18] http://gigaom.com/cleantech/san-francisco-city-attorney-calls-for-halt-on-pge-smart-meters/.

APPA has also developed a series of webinars on smart grid issues; consumer topics included "Smart Grid: Educating Your Boards, Staff and Customers" and "Get Smart – The Consumer Side of Smart Meters." In addition, APPA's research and development program, Demonstration of Energy-Efficient Developments ("DEED"), has funded a number of smart grid related public power projects.

How should insights about consumer decision-making be incorporated into federal-state collaborative efforts such as the Federal Energy Regulatory Commission's (FERC) National Action Plan on Demand Response?

One of the three major focuses of the National Action Plan on Demand Response ("NAP-DR") is a communication plan that includes broad-based customer education and support. Insights about consumer decision-making are a key input into developing an effective communications plan. However, the degree to which the NAP-DR will be able to achieve this goal – or any of its numerous goals – will depend on adequate federal funding. DOE can help by allocating funds to sponsor some of the NAP-DR's communications tasks.

FERC was required to develop the NAP-DR as a requirement of EISA. The FERC report, published in June 2010, noted the strong linkage between demand response ("DR") and smart grid technologies. For example, many smart grid benefits (such as customer management of electricity use in response to price signals) are a form of DR. Thus, the report notes:

> In recognition of this linkage, the actions identified in the National Action Plan are designed to be consistent, and in coordination, with smart grid policies implemented at the federal, state, and local levels. Furthermore, as discussed in Part 2, the National Action Plan calls for developing terminology and messages that emphasize smart energy use, and not artificially separating smart grid actions from demand response actions.[19]

Under EISA, FERC and DOE are now required to submit to Congress a proposal to implement the NAP-DR, and the proposal is to include budget amounts. The plan itself calls for

[19] Federal Energy Regulatory Commission Staff, *National Action Plan on Demand Response,* published in Docket No. AD09-10, June 17, 2010, p. 4.

the formation of a Coalition to coordinate the efforts of various stakeholder groups (including state and local regulators, utilities, DR providers, customers, and federal entities). A group of associations has formed a coalition, the National Action Plan Coalition ("NAP Coalition"), and have met bi-weekly since June to develop a work plan to address priority items in the NAP-DR.

The NAP Coalition's work plan envisions coordinating with existing demand response and smart grid projects, such as the National Energy Technology Laboratory's ("NETL") Smart Grid Implementation Strategy ("SGIS"), and the Smart Grid Information Clearinghouse ("SGIC"), to identify existing tools and materials. These would include articles, case studies, reports on pilot programs, and other research on consumer behavior, including how consumers make decisions. This RFI on policy and logistical challenges to smart grid implementation could capture additional consumer research materials. Once existing materials are identified, the NAP Coalition can identify best practices, lessons learned, and research gaps, and use the information in developing the communications component of the plan. The NAP Coalition's work plan recognizes that consumers' motivations to adopt new technology will vary. Therefore, the coalition hopes to use research on consumer motivations to develop effective messages to reach different consumer segments.

Interactions With Large Commercial and Industrial Customers

Large commercial and industrial customers behave differently than residential consumers and small businesses. They regularly use sophisticated strategies to maximize their energy efficiency, to save money and to assure reliable business operations. Indeed, some already are or others are seeking to participate directly in wholesale energy and ancillary services markets. Please identify benefits from, and challenges to, smart grid deployment that might be unique to this part of the market and lessons that can be carried over to the residential and small business market. Please identify unmet smart grid infrastructure or policy needs for large customers.

Public power systems work closely with their community's economic development departments to attract and retain large commercial and industrial customers within their municipalities. These groups of customers are continually looking for ways to lower electric bills, improve reliability, and maintain high standards of power quality; a smarter grid may be the answer for some of these customers. However, because of the economic downturn, large commercial and industrial customers are hesitant to employ energy efficient technologies because the payback is realized over the course of several years. Currently, businesses are primarily investing in technologies that realize savings in less than twelve months; most energy saving technology does not meet this guideline.

Public power utilities attempt to overcome these roadblocks through their inherent nature of being community-owned consumer advocates. They encourage large commercial and industrial customers to maintain energy efficiency programs by offering unique billing structures and incentives, public recognition, and free audits of customers' operations. APPA assists by offering its members two separate certificate programs – one is aimed at training utility key account representatives and the other educates members on development and implementation of energy efficiency programs.

In regard to federal and state policies on encouragement of demand-side resources, APPA is concerned that conflicting policies could interfere with Load-Serving Entities' ("LSEs") cost recovery of smart grid infrastructure and require some retail customers (likely residential) to subsidize other retail customers (large commercial and industrial). More specifically, federal policies calling for implementation of potentially uneconomic financial incentives to entities providing wholesale DR in regions with centralized markets operated by Regional Transmission Organizations ("RTOs") could adversely impact LSEs' retail-level smart grid deployments and associated demand response programs in those regions. APPA hopes that the Administration considers the cumulative impact of all federal demand-side related policies and attempts to better harmonize them.

FERC has evinced a strong interest in fostering direct participation of DR resources in wholesale capacity and energy markets. Among other things, it is currently proposing in its Notice of Proposed Rulemaking in Docket No. RM10-17-000[20] to require RTOs to pay wholesale-level DR providers the full Locational Marginal Price ("full LMP") in all hours in RTO-run centralized energy markets. Suffice it to say here that there is a raging debate ongoing before FERC as to whether this pricing protocol would be economically efficient, or whether it would result in overpayments to DR providers, in turn leading to uneconomic demand reductions and investments.

Among the entities taking the view that paying wholesale DR providers the full LMP would be economically inefficient is the Federal Trade Commission ("FTC"). In recent comments filed with FERC, the FTC noted:

> We encourage FERC to adopt efficient pricing for demand response compensation. If FERC does so, it can avoid the need to devise administrative

[20] *Demand Response Compensation in Organized Wholesale Energy Markets*, 75 Fed. Reg. 15362 (March 29, 2010) ("DR Pricing NOPR").

> means to trim excess demand response. *Excess demand response is likely if FERC compensates demand response at the level of the full locational marginal price (LMP) for retail customers who pay flat retail rates*.[21]

APPA itself expressed concerns in comments filed in the same FERC docket that paying wholesale DR providers the full LMP could require the LSEs providing retail electric service to such reducing customers to incur costs that would eventually have to be absorbed by other retail customers, including the costs of LSE-initiated demand-side reduction programs.[22] Among the demand response programs in which LSEs are investing, with strong federal encouragement and in some cases ARRA funds, are smart grid installations.

Ohio Public Utilities Commissioner Paul Centolella, testifying at a FERC Technical Conference held on September 13, 2010, in this same docket, summarized the potential adverse impacts of overcompensating wholesale DR providers on retail DR programs:

> . . . I think one of the assumptions that is out here is that the only way, you know, that demand is going to respond is somehow if we get it bid into the wholesale market.
>
> And I have a significant concern that we are putting a big weight on one side of the scale here of how Demand Response develops, and ignoring potential others ways in which demand could simply respond to price and develop much more efficiently. I mean, we have got appliance manufacturers out there who tell us, who are working on SmartGrid, that if they could simply see prices they would have their appliances automatically respond to them.
>
> We have controls vendors. We have companies like MicroSoft and Google who are ready to automate people's houses. We have buildings that are being automated to provide regulation in PJM, you know, that don't depend on having an intermediary come in and be subsidized by this extra incentive in order to bid into a wholesale market program.
>
> And I am concerned that we are potentially distorting innovation on the demand side of this market if what we do is selectively say we're going to pay an additional incentive to people who participate in economic RTO programs when

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[21] Comment of the Federal Trade Commission, filed October 13, 2010 in Docket No. RM10-17-000, at 1 (emphasis supplied).

[22] Post-technical Conference Comments of the American Public Power Association, filed October 13, 2010, in Docket No. RM10-17-000, at 8-9.

> that same incentive is not available to consumers who are simply responding to a dynamic retail price.
>
> And I think that ought to be a significant concern in terms of the competitiveness of the U.S. economy and where we are in terms of encouraging innovation in this country going forward. And so I think if we're going to talk about additional incentives, we need to think about how we do this in a more neutral fashion and in a way that will potentially get us further ahead, rather than assuming the only way we're going to do this is by having an aggregator bid that into a wholesale market. Because we may be passing up even more Demand Response benefits by putting a weight on that side of the scale. [[23]]

APPA, like Commissioner Centolella, is concerned that making lucrative (and potentially uneconomic) payments to larger retail customers (or groups of such customers aggregated by third-party for-profit aggregators) participating directly in wholesale markets will lead to subsidization of retail electric service to these customers by other retail customers who are not participating in such programs. Among the LSE investment costs that might be under-recovered due to such wholesale pricing programs are the costs LSEs incur to install smart grid devices, supporting telecommunications platforms, and associated demand response programs at the retail/distribution level.

APPA therefore urges the Administration to take a more "holistic" approach to DR policy at the federal level, encouraging specific policies that work together with retail level state and local programs to foster cost-effective and economically efficient smart grid installations and DR. The Administration should strive to avoid federal policies that result in uneconomic DR payments at the wholesale level, to the potential detriment of smart grid/DR programs at the retail level.

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[23] Transcript, September 13, 2010 Technical Conference held in Docket No. RM10-23-000 at 232-33.

Assessing and Allocating Costs and Benefits

How should the benefits of smart grid be quantified? What criteria and processes should regulators use when considering the value of smart grid applications?

Benefits can be calculated in many ways, but are most realistic if quantified by project and situation. A first step in accomplishing this is to ask questions to establish the usefulness of the technology in relation to the specific utility's circumstances. The second step in quantifying benefits involves a rigorous engineering-level analysis.

Utilities can address four general questions as a first step in evaluating benefits from implementing a new technology: Does the technology increase electric system reliability? Is the technology safe to operate and maintain? Is the technology cost effective compared to alternatives? Does the technology result in lower environmental impacts than alternative options? These questions provide an outline assessment of the potential for any smart grid technology or project to deliver benefits and should be addressed in the context of the individual utility's situation and priorities. The utility may also want to consider benefits of not investing in smart grid technology, for example, other potential uses for the utility's capital.

If the implementation of smart grid can be characterized as logical progress following the technological learning curve across many manufacturing disciplines, then installations should only occur at the rate at which they can provide tangible benefits. In other words, if technological progress proceeds at its current pace, the "smartening" of equipment will continue along at the rate at which it is cost justified. Or in economic terms, if a manufacturer can sell smart technology based on some benefit, then they will make their technology offerings smart. In that sense, the adoption of smart grid relies on vendors and manufacturers asserting that there is a

quantifiable benefit to their new technology. In many cases that may be true. However, that benefit should be quantified and real.

Smart grid technologies can improve the use of electric resources by giving customers signals to adjust their consumption patterns to better match regional and temporal generation capabilities. This type of load shaping through pricing signals results in an overall more efficient use of the electrical network. However, these benefits are difficult to quantify and may not be sustainable if customers do not maintain the new behavior patterns. In addition, the consumer may view certain customer-facing technologies that provide consumption information (Home Area Networks ("HANs"), for example) as an added cost.

Quantifying the fringe benefits of adding service capability to a network is much more difficult than quantifying the benefits of the network itself. There are some cases where smart grid technologies may be said to provide greater benefits to the network than can be seen in typical cost benefit analyses. This presumes that as more customers use a smart technology the overall benefit to the network increases. However, it is extremely difficult to accurately define benefits in these cases because calculations rely on projected adoption and use scenarios. In modeling projected scenarios, it is easy to generate conditions where the net benefit from a smart technology could be negative or positive depending on the model's assumptions. In these cases, broadly defined network externalities can become the basis for manufacturers' arguments for and against adoption of a particular technology solution. Because of the wide range of results that can occur when making multiple assumptions about network benefits, it is exactly these fringe benefits that must be scrutinized.

In addition, the possible benefits of smart grid technologies should be evaluated differently for use in mission critical versus non-mission critical facets of utility operations. If

the application is mission critical, then there is a strong possibility that many of the network-wide operations benefits might not be achieved because of evolving security concerns associated with communications systems operating on routable protocols.

How do the costs and benefits of upgrading existing AMR technology compare with installing new AMI technology?

A key consideration in a utility's (especially a public power utility's) decision to stay with its AMR technology or install new AMI technology is the sunk cost of the AMR system. Typically, a public power utility makes an investment decision in capital related to its network and then operates that capital until the end of its useful life. Moving from an AMR system to AMI technology will likely result in a utility (via its customers) paying twice to add relatively small degrees of additional functionality. While investor-owned utilities may see financial benefits in replacing such equipment prior to the end of its useful life, because of the increase in rate base, and hence the rate of return, public power utilities are not-for-profit, and often approach such equipment replacement decisions with different decisional frameworks.

In general, commercial communications systems follow short update and replacement cycles. For example, in the cell phone industry, customers regularly upgrade to new phones because they want advanced software capabilities or some other additional functionality beyond traditional voice communications. Similarly, a utility will realize new benefits from the installation of new communications systems and components, such as AMI. However, there is a key difference: the sunk cost of a customer's cell phone is quite small, while sunk costs of an AMR system can be in the millions of dollars.

AMI equipment will have more functional capabilities than AMR technology, but the marginal benefits from moving from AMR to AMI may not outweigh the costs of the new equipment plus the remaining costs from the utility's prior investment in AMR technology.

These sunk costs for AMR technology must still be recovered through customers' rates. Thus a public power utility's decision to move from AMR to AMI should be based on a careful examination of benefits compared to costs, including accounting for any sunk costs of the current equipment.

There are some AMR systems that have been designed to be upgraded, but there are likely few instances where it will make sense to change communications paths once a decision has been made and an effective operations strategy has been developed. This calls into question the benefits to upgrading from AMR before it is deemed cost effective in an engineering level analysis.

> **When should ratepayers have the right to opt out of receiving and paying for smart grid technologies or programs like meters, in home displays, or critical peak rebates? When do system-wide benefits justify uniform adoption of technological upgrades? How does the answer depend on the nature of the offering? How should regulators address customer segments that might not use smart grid technologies?**

Meters are an integral part of a utility's infrastructure and its operating structure. Some utilities may choose to implement smart meters and other control programs with larger customers only, and these programs could be voluntary, with customers deciding whether they want to participate. These targeted programs are most often implemented to achieve demand reductions, rather than to improve system operations.

However, once a utility decides on a system-wide deployment of smart meters (or a class-wide deployment, e.g., all industrial or large commercial customers), it would be administratively burdensome for the utility to allow individual customers to opt out. A public power utility that deploys smart meters to all customers in a class is making the investment in order to achieve substantial operational benefits. The deployment includes many other investments in addition to the meters, for example, contracting for data management systems and

upgrading the utility's billing system to handle the large amount of data produced by the smart meters. If individual customers could opt out, the utility would not get the maximum operational benefits from its data management and billing systems, and the utility would have to continue to employ personnel to read and maintain the alternate meters.

Some utilities have mandatory time-of-use pricing for large commercial and industrial programs, but utilities generally offer time-of-use pricing to residential customers on a voluntary basis. Critical peak rebate programs are also voluntary. The voluntary programs can still be effective because participation from all customers is not needed to achieve the programs' main benefits: reducing demand at specific hours. Such voluntary programs can also lay the foundation for public acceptance of time-differentiated rates, so that more ambitious rate regimes can be implemented in the future.

Utilities, Devices Manufacturers and Energy Management Firms

> **How can state regulators and the federal government best work together to achieve the benefits of a smart grid? For example, what are the most appropriate roles with respect to development, adoption and application of interoperability standards; supporting technology demonstrations and consumer behavior studies; and transferring lessons from one project to other smart grid projects?**

As noted in response to the last set of questions above, APPA believes that state and federal energy regulators need to work together to promote economic investments in demand response, including smart grid installations. Federal regulators should take care to avoid enacting wholesale pricing or other policies that could have adverse impacts on retail demand response/smart grid programs.

APPA believes that the National Association of Regulatory Utility Commissioners ("NARUC") and the Administration should work closely together to disseminate the results of smart grid pilots and best practices in smart grid installations. The SGIC being developed by

Virginia Polytechnic Institute and State University ("Virginia Tech") with funds from DOE could serve a very useful function in this regard. Once the smart grid installations funded by DOE become operational, and experience is gained from these programs, this information could be disseminated through the SGIC.

APPA urges the federal government, via DOE, to provide funding to support high quality studies and research in the area of consumer behavior and acceptance of smart grid technology and time-differentiated rates. The NAP-DR, a private-public collaborative, may be a good vehicle for DOE to provide such funding.

How can federal and state regulators work together to better coordinate wholesale and retail power markets and remove barriers to an effective smart grid (e.g. regional transmission organization require that all loads buy ''capacity'' to ensure the availability of power for them during peak demand periods, which makes sense for price insensitive loads but requires price sensitive loads to pay to ensure the availability of power they would never buy)?

APPA strongly supports cooperative action by state public utility commissions, RTOs (in those regions that have them) and FERC to address issues such as the capacity requirement issue noted in this section of the RFI. Unfortunately, APPA sees differences of opinion between state and federal regulators that, if not resolved, could hinder coordination of wholesale and retail policies on demand response.[24] APPA requests the Administration to foster federal policies in the DR area that work in tandem with state and local policies. At bottom, DR is a retail activity,

[24] In response to Commissioner Centolella's comments at the FERC Technical Conference (quoted above), FERC Chairman Jon Wellinghoff noted: ". . . [W]ith all due respect, I believe the complete opposite. I think wholesale markets for Demand Response have in fact fostered technology, and in fact will foster it much faster than the states will, because I have no assurances as to when the states will put in dynamic retail prices with the controversies that are going on, all the political problems with getting those in place. I think the only way we are going to get this technology in place and we're going to move forward with it is to move forward with it in the wholesale markets." Transcript, September 13 Technical Conference in Docket No. RM10-17-000 at 233-34. However, FERC Commissioner Philip Moeller indicated a different opinion, stating ". . . [a]nd I have the opposite view. I am all with you, Paul. I think without dynamic pricing we have the serious potential of residential consumers subsidizing wholesale consumers, and that worries me greatly. And I think the key is shifting demand, and we've got to do it through dynamic pricing. If we do this wrong, we will have the opposite effect. So I respectfully disagree with my Chairman."). *Id.* at 234.

as it is the decision of a retail customer to refrain from taking retail electric service at any moment that enables DR in the first instance. Retail electric service is regulated at the state and local levels. Hence, efforts to "federalize" DR because of impatience with the pace of state- and local-level DR developments in the long-run could be more destructive than constructive.

How will programs that use pricing, rebates, or load control to reduce consumption during scarcity periods affect the operations, efficiency, and competiveness of wholesale power markets? Will other smart grid programs have important impacts on wholesale markets? Can policies improve these interactions?

APPA believes that economically efficient time-differentiated retail pricing which reflects the actual cost of providing service during different intervals holds great promise to reduce consumption during periods of peak demand, thereby improving the operation of wholesale markets. This does not necessarily require an immediate "flash cut" to full time-of-use pricing at the retail level. Peak period pricing, rebates and other related rate design measures might well find better initial public acceptance at the retail level, and do not require associated equipment installations. Such programs could well pave the way for subsequent full time-of-use pricing, supported by new metering technology. Time-differentiated rates can rely on direct price-related responses by individual retail customers, or use intermediaries (utility/LSE or third party) to coordinate and initiate such responses. Federal policies should foster and support such policies, which should originate at the state and local levels.

Such ability by retail customers to reduce demand in response to higher prices of providing service eventually will act as a disciplining force on wholesale market prices, at least during peak periods. The Administration, however, should not presume that increased demand

response alone will result in competitive wholesale market prices.[25] The basic structures of wholesale power markets in both RTO and non-RTO regions make it very difficult for competition to discipline prices. Demand response is no substitute for effective regulation at both the wholesale and retail levels.

Do electric service providers have the right incentives to use smart grid technologies to help customers save energy or change load shapes given current regulatory structures?

Public power's governance structure allows utilities the flexibility to tailor their programs and incentives to the needs of their communities. Public power utilities have been encouraging customers to conserve energy for over 30 years. Such conservation programs include rebates, home energy audits, DR incentives, and time-of-use rates. To assist its members, APPA established its DEED program in 1980; the program was, in part, an outgrowth of APPA's Energy Efficiency Committee. More recently, APPA developed the Energy Efficiency Resource Central ("EERC") program, which offers a wide variety of education, policy, and advocacy resources and services to help public power utilities promote energy efficiency.

APPA and its members are looking forward to seeing the results of DOE's consumer behavioral studies being conducted in connection with the SGIG program. Utilities will be able to take advantage of the "lessons learned" and "best practices" identified by DOE to improve their program design and customer outreach efforts.

[25] In fact, it is possible for a DR provider to use its bids of DR services to manipulate wholesale market prices. *See* FERC's "Order Approving Stipulation and Consent Agreement," in *North America Power Partners*, Docket No. IN09-6-000, issued October 28, 2010. North America Power Partners agreed to pay a civil penalty of $500,000 and to disgorge unjust profits of $2,258,127, plus interest, for violating sections of the PJM RTO's tariff. Violations included offering DR resources into the synchronized reserve market at times when the resources were unavailable, and registering DR resources as DR capacity products (in PJM's annual ILR program) before obtaining the DR resources' authorization.

What is the potential for third-party firms to provide smart grid enabled products and services for use on either or both the consumer and utility side of the meter? In particular, are changes needed to the current standards or standard-setting process, level of access to the market, and deployment of networks that allow add-on products to access information about grid conditions? How should the interaction between third-party firms and regulated utilities be structured to maximize benefits to consumers and society?

APPA generally supports the current NIST smart grid standard-setting process. The process is consensus-driven, includes a cyber security review, and is designed to support interoperability, including the evolution of the grid and the integration of new technologies. Workable interoperability standards will give third-party firms the opportunity to develop products for both end-use customers and regulated utilities.

NIST is required under the EISA to develop standards for interoperability of smart grid devices. As noted previously, NIST recently sent to FERC five sets of standards on smart grid interoperability, and FERC has opened a docket to consider the standards via a rulemaking process. As described by NIST, these standards provide a common information model for exchanges of data between devices and networks in the transmission and distribution domains; facilitate substation automation, communication, and interoperability through a common data format; facilitate exchanges of information between control centers; and address cyber security of these communication protocols.[26]

NIST said that these standards were "essential to uniform and interoperable communication systems throughout the grid and will accommodate the evolution of the grid and the integration of new technologies."[27] The standards were developed through a collaborative process, and all stakeholders will have an additional opportunity to provide input through the

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[26] Letter of George Arnold, National Coordinator for Smart Grid Interoperability, National Institute of Standards and Technology, to Jon Wellinghoff, Chairman, Federal Energy Regulatory Commission, October 6, 2010.

[27] *Id.*

FERC rulemaking process. These standards will provide sufficient access to third-party firms to offer smart grid enabled products.

There is no need to "structure" the interaction between third-party firms and regulated utilities. With the oversight of their state or local regulators, utilities will develop business plans to implement smart grid technologies. Third-party energy service providers can market products and services to the utility to use as part of the implementation and can offer additional products or services to end use customers. Effective interoperability standards should foster competition among third-party providers and encourage product innovation.

Third-party firms that wish to provide products or services to end use customers may want access to customers' energy usage data, but each customer must have the right to decide whether or not to share its usage data with these third party firms. Thus any interaction between the utility and third party energy service providers on data access must start with the customer's authorization. State and local regulators are likely to adopt consumer protection rules that will govern these data transactions.

How should customer-facing equipment such as programmable communicating thermostats, feedback systems, energy management systems and home area networks be made available and financed? Are there consumers behavior or incentive barriers to the market achieving efficient technology adoption without policy intervention?

Smart grid deployment is primarily a distribution utility issue. Deployment decisions should accordingly be made on the state or local level. Decisions on utility provision of customer-facing equipment will be developed by utilities as part of their business plans. If a utility makes the decision to install smart meters, the utility's business plan guiding the deployment will include details on how to share energy usage information with its customers and on how the meters and any other utility-supplied smart devices will be financed. In the case of a

public power system, the local governing body approves the business plan, and this approval process includes opportunities for input from utility customers. The resulting plan therefore should reflect the needs and desires of the community.

Some public power utilities that deploy smart meters will elect to provide energy usage information via existing customer portals, as this is likely to be the most cost-effective option. In this case, customers who want more detailed information could purchase energy management products and services from third-party firms. Other communities may opt for their utilities to provide all customers with in-home energy displays or HAN energy management systems.

Public power utilities may also offer programs – such as installation of programmable communicating thermostats or in-home monitoring devices that connect to an analog meter – that do not rely on smart meters. A utility's decision to implement these types of programs is a business decision, based on utility infrastructure, community needs, and the assessment of benefits, and subject to approval by the local regulatory body. The business plan for implementing these programs will include details on how the programs will be financed.

Customers will adopt new technology when they believe it will benefit them. Right now, it is likely that most residential customers have little knowledge of what smart grid is or how it might benefit them. Thus, APPA supports information programs, such as the NAP-DR, that educate consumers on the smart use of energy and show them the potential benefits of smart grid technologies and other demand response and energy efficiency programs. Since customers have varied motivations, education programs must include messages that will reach different types of customers, for example, the cost-conscious, the techno-savvy, or the environmentalists.

Given the current marketplace and NIST Smart Grid Interoperability Panel efforts, is there a need for additional third-party testing and certification initiatives to assure that smart grid technologies comply with applicable standards? If there is a need for additional certification, what would need to certified, and what are the trade-offs between having public and private entities do the certification? Is there a need for certifying bodies to oversee compliance with other smart grid policies, such as privacy standards?

The NIST Smart Grid Interoperability Panel provides the best framework for determining applicable standards that allow for interoperability and innovation as smart grid technologies mature. The standards provide a common information model for exchanges of data between devices and networks in the transmission and distribution domains; facilitate substation automation, communication, and interoperability through a common data format; facilitate exchanges of information between control centers; and address cyber security of these communication protocols.

In the case of privacy standards, state law has the strongest role in setting basic protections for customers of public power utilities, because these utilities are units of government and are often subject to information disclosure statutes applicable to governmental entities. Public power utilities will interpret state statutes as they relate to the additional information provided by smart meters. Some jurisdictions may elect to revise public disclosure statutes to specifically address smart meter data. (For example, when Texas enacted its electricity restructuring law in 1999, the state also revised public disclosure laws to allow public power utilities to keep confidential information that was deemed competitive.) As smart grid installations become more prevalent, some jurisdictions may adopt specific laws regarding the release of customer information to third parties to address issues surrounding customer consent and privacy.

APPA does not see the need for additional third-party testing and certification at this time. Such activities, whether public or private, could interfere with state laws and regulations currently in place and complicate the work being done in the consensus-driven NIST process.

Reliability and Cyber-Security

> **What policies are needed to facilitate the data sharing that will allow sensors (e.g., phasor measurement units) and grid automation to achieve their potential to make reliability and performance improvements in the grid? Is there a need to revisit the legal and institutional approaches to generation and transmission system data collection and interchange?**

Any policies employed to facilitate data sharing should encourage interoperability between sensors and grid automation devices, while ensuring compatibility with legacy equipment currently in use on the electric grid. Given the large amounts of the customer data flowing through these devices, data security must be maintained through encryption methodologies such as those proposed by the NIST SGIP process.

The NIST process, which takes into account various industry standards on grid reliability, is carefully reviewing the currently-applicable regulations and standards to enable grid automation. APPA believes the currently applicable legal and institutional approaches to generation and transmission system data collection and interchange should suffice while the NIST process is underway.

> **What is the role of federal, state, and local governments in assuring smart grid technologies are optimized, implemented, and maintained in a manner that ensures cyber security? How should the Federal and State entities coordinate with one another as well as with the private and nonprofit sector to fulfill this objective?**

The tension between the policy goals of speedy deployment of retail-level smart grid technology and maintenance of the cyber security of such installations is one of the biggest smart-grid related challenges the electric utility industry faces. Electric utilities (especially those

that have been awarded ARRA grants) are expected to deploy smart grid installations swiftly, while the associated detailed cyber security standards have yet to be developed,[28] and the nature of cyber security threats and vulnerabilities is constantly changing. As Annabelle Lee, FERC's Critical Infrastructure Protection Advisor (who previously oversaw NIST's effort to develop its smart grid-related cyber security guidelines), recently noted, "[t]he smart grid is a combination of the IT, communications and electric sectors," each with its own culture for decision-making. As she explained, the NIST cyber security panel concluded that "[y]ou had to assume that devices [on the grid] are going to be compromised. That's your going in scenario. You have to go in with the philosophy that systems and data are going to be compromised, and the data is going to be bad, and you have to do security based on that."[29]

Given this state of play, APPA believes that state and local utility regulators need to work with federal entities with expertise in information technology, communications and utility infrastructure to encourage and help electric utilities deploying smart grid installations to adopt a "defense in depth" posture towards cyber security. This should start at the equipment and vendor levels, with an insistence that vendors supplying smart grid components to utilities take all reasonable measures to ensure that their equipment is resistant to cyber intrusions. Utilities installing smart grid deployments need to take reasonable and cost-effective measures to keep equipment and the data produced secure.[30]

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28 The National Institute of Standards and Technology ("NIST") issued on September 2, 2010 its *Guidelines for Smart Grid Cyber Security*, but they do not include definitive standards. http://www.nist.gov/public_affairs/releases/nist-finalizes-initial-set-of-smart-grid-cyber-security-guidelines.cfm.

29 Climate Wire, "Cyber threats are a fact of life for utilities, experts say," by Peter Behr, October 20, 2010 issue.

30 The need to keep data produced by smart grid installations secure is one of the major factors that electric utilities must consider when selecting a communications platform for their smart grid installations. Some APPA members have concluded that the best way to do this is to employ their own proprietary networks, e.g., their own fiber installations, as opposed to commercial wireless networks.

Finally, and most importantly, there need to be robust physical or electronic "moats" between distribution-level smart grid installations and upstream bulk power system facilities. While it would no doubt be unfortunate for distribution-level smart grid installations to be hacked or disabled, as Ms. Lee notes, there could be such events. The ability to segregate any such problems at the distribution level and to prevent their upstream transmission to the bulk power system is absolutely essential.

APPA believes that this is an area in which federal government expertise at departments such as DOE, the Department of Homeland Security ("DHS") and the Department of Defense ("DOD") could be extremely helpful to electric utilities deploying retail level smart grid installations. In particular, the funding of high quality research in this area would be an important step. APPA understands that DOE's Office of Electricity Delivery and Energy Reliability has recently announced the award of funds to a newly formed industry group, the National Electric Sector Cybersecurity Organization ("NESCO"), which includes the Electric Power Research Institute ("EPRI") as a research entity. APPA believes that this group, or another like it, should be tasked to conduct research in this area, and to assist electric utilities implementing retail level smart grid installations to incorporate measures that make their smart-grid installations more cyber-secure.

Managing Transitions and Overall Questions

> **What are the best present-day strategies for transitioning from the status quo to an environment in which consumer-facing smart grid programs (e.g., alternative pricing structures and feedback) are common? What has been learned from different implementations? What lessons fall into the ''it would have been good to know that when we started'' category? What additional mechanisms, if any, would help share such lessons among key stakeholders quickly?**

APPA's two "bumper sticker" messages in managing transitions associated with smart grid installations would be "education before implementation" and "crawl before you walk."

There are many opportunities for consumer misperceptions, and even distrust, when utilities install smart meters. Consumers' concerns range from "big government/brother" type suspicions regarding smart meters[31] to the prospect of associated rate increases due to the new meters themselves[32] to even adverse health effects associated with the new equipment.[33] There is no real substitute for "on the ground" consumer education regarding smart grid installations, preferably in advance of the deployment. The use of pilot programs is also one way to build consumer acceptance; if local citizens and neighbors can speak to the benefits of a successful smart grid pilot, this will go a long way to defusing possible opposition in that community. If there are problems, they can be ironed out before full deployment.

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[31] *See, e.g.*, http://www.rushlimbaugh.com/home/daily/site_032609/content/01125111.guest.html (Transcript from Rush Limbaugh radio show of March 29, 2009: "RUSH: All right so you have smart meters, Google is building them. "Smart" meters will be installed in your house by newly hired electricians (working for the government, obviously.) I got a note during the break from a friend who is very closely connected to an industry expert in the electrical power-generation business. It's an incredible statistic if it's true, and that's that 40% of all electrical power is stolen now, that 40% of people have found a way to bypass the meter outside their house so that not all the electricity they use is showing up! It's like back in the old days people were able to go outside in a telephone poll and insert a box and fool the cable company. They were able to steal the cable signal. And this is exactly what will happen, if they ever did this, put these smart meters inside people's houses, they would just find a way around them. It's what we Americans do! It is how we react to onerous control and regulations, after we've stupidly elected the people who want to impose them. We then go out and find ways around it.").

[32] As noted previously, concerns about rate increases associated with the installation of smart meters has caused serious consumer backlash regarding the PG&E smart grid pilot in Bakersfield, California. A study conducted for the California Public Utilities Commission ("CPUC") and released in September 2010 revealed that the problem was not primarily with the meters themselves, but with PG&E's customer service and education practices. http://docs.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/122937.htm As noted in the CPUC press release: "The Structure report makes clear that the transition to a Smart Grid is not just a technological event," said Commissioner Nancy E. Ryan. "Consumers won't fully realize the many potential benefits of Smart Meters and other grid upgrades unless utilities and regulators place more emphasis on the human side of the equation," she added. "Better communication and customer service will help ensure that consumers see Smart Meters as something that is done for them, not to them." The CPUC consultant's report and press release outlining their findings is available at www.cpuc.ca.gov/PUC/energy/Demand+Response/solicit.htm.

[33] *See, e.g.*, http://www.necn.com/10/22/10/Maines-largest-utility-company-installs-/landing.html?blockID=337159&feedID=4213 (Story dated October 22, 2010, regarding retail customers of Central Maine Power ("CMP") opposing the installation of smart meters because of alleged adverse health effects, including dizziness, nausea and muscle spasms; according to the article, the Scarborough, Maine town council voted unanimously to ask CMP to hold off on installing meters in the town for 90 days, believing there were enough unanswered questions about adverse health impacts to warrant more discussion.).

Public power systems have some advantages in this regard, since they are not-for-profit and locally-controlled. Since they are units of state and local governments, they can work with their ratepayer/citizens to let them know what to expect. They also have more credibility, since they are not providing retail electric service as a profit-making activity. For example, arguments that the utility is only installing the new meters to "gold plate" its system or increase its profits do not apply.[34] But even public power systems need to be able to make the business case for smart meter installations to their customers. Many public power systems are able to do so based on the operational benefits to the utility (quicker outage identification, fewer line truck rolls) and its customer response (quicker outage restoration and better power quality) in addition to potential bill savings for customers if they correctly manage their power usage.

> **Recognizing that most equipment on the electric grid, including electric meters, can last a decade or more, what cyber security, compatibility and integration issues affect legacy equipment and merit attention? What are some strategies for integrating legacy equipment into a robust, modernized grid? What strategies are appropriate for investing in equipment today that will be more valuable if it can delay obsolescence by integrating gracefully with future generations of technology?**

Utilities typically can use their communications systems for decades if the equipment is properly maintained. (Of course, equipment must be replaced and added as electric load grows and as the network is reconfigured over time.) This keeps operations costs low for customers and provides time to observe the performance of emerging technologies both in terms of compatibility and usefulness before adopting them as a part of any upgrade.

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[34] "ComEd Seeks Rate Fix In Wake of Smart Grid Ruling," *The Energy Daily*, October 20, 2010 issue at 1 (Commonwealth Edison is being forced to seek a "temporary" ratemaking fix for its smart grid pilot after an appellate court in Illinois found that the utility's attempt to recoup the cost of its pilot through a "single issue rate case" violated relevant state ratemaking requirements. State Attorney General Lisa Madigan is quoted as saying that "[t]he court's ruling ensures consumers throughout our state are paying for the true cost of electricity service—not just paying for the increases in the cost of doing business but also sharing in the savings." Com Ed noted that the decision puts its smart grid pilot program in "serious jeopardy.").

Utilities must consider new issues in connection with the implementation of technologies that use open protocols and standardized communications software. As previously noted, cyber security is a significant concern for any smart grid technology. Despite reassurances by most major large software companies, there are relatively few that can truly claim that their software, or communications protocol by which it exchanges information, is secure. Considering the evolution of cyberwarfare technology, especially as developed by nation-states to disrupt infrastructure and industrial control systems, it is realistic to constrain mission critical systems from having outside connections to public communications networks. Even the most up-to-date software packages are subject to zero-day type attacks if left facing the Internet. This means that the push by many entities to install advanced communications technologies to connect all points of the electric system must be met with thoughtful restraint when it comes to critical systems and systems used to convey decision making information to operators. In addition, the probability for the risk of information loss or loss of system control can increase with the prevalence of smart grid technologies on the system.

For well-planned electric systems, there may be few integration, security, or legacy problems. Working with new "smart" equipment, such as automated relays, reclosers, broadband over powerline, and separate non-routable communications networks can offer a number of benefits to utility operations. The integration issues will occur where technology decisions have been made that trap a utility inside of a communications style investment cycle. In such cases, a utility may be left with Internet-connected, "outward facing" technologies that are susceptible to multiple forms of cyber attack. These systems typically need more frequent updating and replacing to maintain some semblance of security. This could be a very costly scenario for any entity despite the perceived benefits.

APPA believes cyber security decisions rest with each utility based on its own communications system choices. DOE, working with the information provided by the NIST SGIP process, can assist utilities by compiling and disseminating information on cyber security resources.

In many ways, the electric grid is already robust and modern.[35] It has been designed to accommodate equipment and generation failures in a way that strongly minimizes losses to overall service. Yet, the electric grid uses many pieces of equipment that might be considered legacy by analytical standards developed for the computer equipment industry. Additional communications technologies, where integrated properly, can benefit operations, but that does not imply that the current electric infrastructure is outdated.

There are many strategies for picking a winning technology, including waiting for a need to arise and best practices to emerge. This approach allows planners to adapt based on needed, cost-justified capabilities and field proven results. This development paradigm is in line with the "evolutionary, not revolutionary" smart grid message advanced by EPRI.[36]

How will smart grid technologies change the business model for electric service providers, if at all? What are the implications of these changes?

The business model for non-profit, community-owned utilities is not likely to change with the availability or adoption of new communications capabilities. In contrast to the way cellular telephones greatly reduced the need for land telephone lines, the adoption of smart technologies will still require physical delivery of electricity to the end user. Typically, public

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35 For example, a recent survey of public power utilities found that the median Average Service Availability Index (ASAI) for the surveyed utilities was 99.99%. See American Public Power Association, "2009 Distribution System Reliability & Operations Survey Evaluation of Data," June 2010.

36 For example, see 2009 EPRI presentation, "Industry Smart Grid Demonstrations Overview," available at http://www.narucmeetings.org/Presentations/Wakefield%20-%20Smart%20Grid%20and%20Retail%20Regulation.pdf.

power utilities will adopt new technologies to provide operational benefits to the existing service model. Utilities may also implement new rate strategies to incentivize behavior that will help the community to lower overall power costs. In addition, utilities may identify new customer services they can provide based on more detailed data collection, and third party providers may step in to offer value-added services.

The implications for an effective overlay of communications technologies on top of electric system operations are enhanced operations and more automated interaction with customers. However, public power's primary purpose – the provision of reliable power supply – will not change.

What should be the priority areas for federally funded research that can support smart grid deployment?

As explained in the answers to prior questions, APPA believes that federally funded research to improve the cyber security of distribution-level smart grid installations, and to prevent migration of distribution-level cyber security problems to the bulk electric system level, should be a top priority. Gathering and dissemination of information about smart grid pilots and installations, especially "lessons learned" through the Virginia Tech SGIC is also very important, so that utilities deploying smart grid technology can learn from earlier adopters and avoid making the same mistakes. Finally, research regarding customer attitudes and the best way to provide education regarding smart grid installations and related topics, such as time-differentiated rates, would be a very useful activity that could be funded at the federal level through the NAP-DR.

What are the costs and benefits of delaying investment in metering and other smart grid infrastructure while the technology and our understanding of it is rapidly evolving? How does that affect the choice of an appropriate time to invest?

Each decision to adopt smart grid technology is different, so the costs and benefits of delaying investment in various communications technology projects are best defined on a case-by-case basis. In addition, many of these technologies establish completely new performance trajectories from the old communications technologies. For instance, in the disk drive industry, as in most industries, two types of technological change exist. The standard type of change is characterized by a sustained rate of improvement in the existing storage technology, and a second type is characterized by complete disruption of existing technology, replacing it with something else performing the same function.[37] If this is indeed a historical moment of the second type of technological change for utility communications technology, there could be great costs associated with investing before the winners are established. Utilities may benefit by delaying large infrastructure investments until new technologies and their respective forms and deployments are tested.

[37] Clayton M. Christensen, "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail," Harvard Business School Press, 1997.

APPA would like to thank DOE for initiating this RFI on policy and logistical challenges of smart grid implementation. APPA believes there is a valuable role for smart grid technologies as long as they are proven, secure, and cost effective. The way public power utilities define "smart grid" and address the logistical challenges to its implementation is dictated by the "speed of value" to each community. Thus public power utilities must keep reliability, safety, and security as priorities, all the while keeping costs low for consumers.

WHEREFORE, APPA submits these comments for DOE's consideration.

Respectfully submitted,

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APPENDIX

Public Power Magazine Articles

1. Iowa Ideas
2. Putting Home Energy Monitoring Systems to the Test

Iowa ideas

By Jeanne LaBella

IAMU's office structure is an award-winning example of sustainable design. Along with an adjacent 11-acre safety & training field, it serves the association's member utilities in many ways.

IAMU's office building consumes less than 50% of the electricity of a conventional building of its size, with further improvements planned. Use of daylighting, automatically adjusting lights, a geothermal heating and cooling system, an on-site wind turbine and more all contribute to make the property a "living laboratory" of energy efficiency.

Visitors driving through Iowa during the summer months are often awed by the seemingly endless fields of tall cornstalks. People may think of Iowa as flyover country, but it is the state that gave a caucus victory in 2008 to the unlikely but ultimately successful presidential campaign of a first-term U.S. senator from neighboring Illinois. It's also the state that said yes to same-sex marriage, while "left-coast" Californians said 'no' to the country's latest progressive initiative.

Like their ideas or not, Iowa is fertile territory for ideas and innovation. The state's municipal electric utilities have long been leaders in energy efficiency, wind energy and community broadband. The innovation bubbling from the modest headquarters of the Iowa Association of Municipal Utilities is dizzying. For years, utilities in the state have investigated the viability of compressed air energy storage, an effort that is now in development. IAMU members are engaged in three cutting-edge programs this year—an investigation of dynamic pricing of electricity, a demand response program using smart thermostats, and whole-city energy audits.

Time-of-use pricing of electricity might seem best left to large, wealthy utilities with sophisticated smart grid technology. In fact, 30 of the 1,200 customers of the Sumner Municipal Light Plant in northeastern Iowa have participated in a voluntary time-of-use rate program for at least three years. The participants are mostly residential, but include some commercial and industrial.

Utility Manager Alan Junkers implemented the program and had a similar one at a Wisconsin municipal utility where he worked before moving to Sumner, said Bob Haug, executive director of IAMU.

"He has tons of data," Haug said. "Some of those customers are shifting close to 90 percent of their demand off peak. There is no automated response; they are just doing it. They have a 3.5 cents off-peak rate and a 10 cents on-peak rate."

IAMU has a $200,000 grant from the Iowa State Energy Office to implement and study dynamic pricing of electricity. In addition to Sumner, the cities of Algona, Spencer and Waverly will work with rate consultants Jerry McKenzie and John Kelly on the dynamic pricing project. Kelly, who was chief economist of the American Public Power Association for 27 years, is encouraging the cities to consider a three-part time-based rate that would have about 20 components over the year.

Spencer is just completing full deployment of smart meters and Spencer and Waverly will install smart meters on a pilot project basis in over 1,000 customer locations as part of the project. Spencer and Algona are also participating in IAMU's demand response program, as is Sumner. Customers of the municipal utilities who participate in the smart thermostat program have access to an Internet portal that gives them information about the thermostat and allows them to control the thermostat online.

The smart thermostat program is IAMU's low-cost alternative to the smart grid. Without dynamic pricing, there isn't much of a business case for installing smart meters, Haug said.

"There is a business case for using smart grid technology to reduce peak demands."

Participants in the program use Cooper Power System's Yukon software platform, which handles metering functions, load control, capacitor control and other operations. IAMU was awarded $5 million in federal stimulus funds to help pay the cost of installing 32,000 smart thermostats, made by Honeywell. The devices include a communication chip that allows the utility to communicate with the thermostat."

"When a utility is approaching a peak pricing period and wants to control load, a signal will be sent to the thermostat in advance of the control period to pre-cool the home or business by two degrees," Haug said. "If the thermostat was set at 76, the signal would drop it to 74 in advance of the critical peak, then allow the temperature to rise about 2 degrees above the set-point during the control period. The four degrees of temperature

IAMU's Whole Town Energy Audit program for member utilities often includes taking part in local energy events. Here, IAMU Executive Director Bob Haug mans the association's Pedal Power unit, which demonstrates energy demands via hookups to a bicycle.

Through IAMU's Whole Town Energy Audit program, energy use in participating member communities is evaluated. Here, IAMU Energy Service Engineer Joel Logan checks equipment.

control gives us about 1.5 kilowatts of control for each thermostat, compared to about 1.2 kilowatts with a traditional compressor control, the type that some of our members have been using since the mid or early '80s.

"By controlling the temperature, we can keep customers in a comfort zone they are willing to accept," he said.

While the immediate value of the thermostat project is the avoided cost of capacity and transmission, participants will enjoy many other advantages, including a robust platform for other smart grid technologies. Besides avoiding peak demands, thermostat control can also be a useful tool for other purposes, such as dropping load during short-term spikes in the energy market or staging air conditioning load in an area-wide service restoration. There is also an opportunity to aggregate the demand response of many participants and bid it into a demand response market. The Midwest Independent Transmission System Operator (MISO) is currently developing such a market. Baltimore Gas & Electric, which uses the same technology, has successfully bid in the PJM market.

IAMU hopes to install smart thermostats sufficient to control half of the residential and a quarter of commercial and industrial air conditioners in each participating community. Utility customers may opt out of the program. For a typical municipal utility in Iowa, the program will cost $110,000, with 40 percent of that investment covered by the federal grant. The utility will save money by avoiding capacity or demand costs and transmission charges and will recover its investment in two to three years or less. .

The process of installing the smart thermostats is itself one of the program's key strategies—face time with customers. Larger utilities would likely hire contractors to handle the installation. But the contact with the customer is too valuable, Haug said. IAMU developed and produced training videos for installers so local utility personnel or an IAMU staff member would visit the home or business to put the smart thermostat in place. During the visit, the utility representative can do a quick assessment of the energy efficiency of the home, install some energy-efficient light bulbs, gather data on the heating and cooling system, check for air infiltration and perhaps even check the attic insulation.

"You aren't going to get that with a third party," he said. Heating and cooling contractors often find it convenient to blame the utility for every little problem, he said.

Before departing each home or business, thermostat installers give the customer an instructional video, also developed by IAMU, explaining the features of the smart thermostat and how to program it on the wall or via the Internet portal.

Financial pressures and resistance from some power suppliers have dampened expected participation in the program. Under terms of the federal grant, participating cities must pay 60 percent of the costs of the project. The IAMU grant proposal envisioned 75 utilities in three states (Iowa, Minnesota and Wisconsin). Only 12 utilities are expected to participate.

Whole town audits—IAMU expects to complete its whole-town energy audits this fall. The program is supported by grants from the state and from APPA's DEED (Demonstration of Energy Efficient Developments) program.

"Our members are mostly small," Haug said. "Half of them have fewer than 1,000 customers. A fourth of them have less than 500 customers. The notion of a whole-town audit is that we bring a group of energy efficiency experts into each of these towns. We audit buildings of the 10 largest energy consumers and look around for as many other opportunities for efficiency as we possibly can. We will look at the municipal infrastructure, because if we can find efficiencies there, the benefits accrue to all the citizens," he said. Nineteen communities are participating in the program. What we learn in one community is likely to be transferrable to others.

"In the future, we hope to be able to identify worst-performing appliances, either through these in-person audits or by analyzing utility bills," Haug said. "We want to develop software that calculates an energy index of Btu per square foot. Concentrating our efforts on the worst-performing buildings will give our members a lot more energy efficiency bang for the buck."

Local water and wastewater facilities offer enormous opportunities for energy savings, with all their motors and pumps. Haug accompanied auditors on one evaluation of a municipal water and wastewater system.

"You've got this old building where water is pumped into open bays for treatment, he said. "All that air-to-water contact inside

this building makes it pretty tough to heat in the winter, especially if the guy on the night shift wants the temperature at 70-something. In that one building, the water utility was spending $12,000 a month on winter heating. Our auditors recommended installation of a small office, a heat exchanger and a little insulation where the operator can hang out when he's not doing his rounds. It's very simple stuff."

Water system auditors also look at opportunities to add variable frequency drives to pump motors and also at the pump schedule. Scheduling adjustments can often achieve huge demand savings, he said.

Economic development—Haug's discussion of whole-town audits shifts seamlessly to concerns about economic development and how municipal utilities will serve the next generation of customers. The state's economy is characterized by a loss of highly compensated manufacturing jobs and displacement of family farms. Iowa agricultural output has evolved to two crops, corn and soybeans, grown on corporate farms that are mechanized, producing commoditized products that generate profits for (mostly) out-of-state investors. Young people educated at the state's excellent colleges and universities are leaving Iowa. Most small cities in the state have declining populations and many are largely populated by elderly residents. Latino immigrants represent the state's one bright spot of population growth.

As part of its "leading by example" philosophy, IAMU has installed its own working wind turbine on its Safety & Training Field.

Part of IAMU's Smart Thermostat program includes an instructional video on installation, which IAMU produced in cooperation with a professional production firm. IAMU Energy Service Engineer Joel Logan demonstrates a step for the camera.

"We have to ask our members, what are you doing to provide a welcoming community where these people can put down roots?" he said. "Many are coming from rural communities in Mexico that look in many ways like the towns they are coming to. The potential is there to hold them for a generation or two and make them a part of the communities and give the towns a chance to survive. The difference is, in the past, they were Norwegians and Germans, now they're Latinos. Where is your Cinco de Mayo plan?"

IAMU members met for two days last April examining the ramifications of the state's changing demographics and other challenges facing municipal utilities. Some communities are developing plans.

"It may be beyond our ability with these grants, but we're talking about models of local economic cooperation for, for example, delivery of groceries," Haug said. "Right now, if you live in a town of 500 people, you don't have a local grocery store. You might have to travel a long way to get your groceries or buy what you can at the [convenience] store—and that is not the right kind of food; there's no fresh vegetables. We're finding examples of community-owned groceries, where residents can pick up items they order in advance. If more of these are developed and if they combine their buying power, it could help make small towns more sustainable and save a lot of transportation energy. The model could also provide opportunities to develop community-supported agriculture and farmers markets, common trends in larger Iowa communities.

"It may be a little too socialist for Iowa," he says, laughing. "I don't know, but we're going to find out." He believes the community-supported agricultural movement could keep more young people from leaving the state.

Energy storage—Seven years ago, several IAMU members began studying the potential for storing energy as compressed air in underground aquifers. That preliminary investigation showed the project to be feasible. In 2005, IAMU turned the project over to the Iowa Stored Energy Plant Agency, with more than 100 municipal utility members in Iowa, Minnesota, North Dakota and South Dakota. Once built, the facility will use off-peak energy to compress air into a dome of an aquifer 3,000 feet beneath Dallas Center, Iowa. On peak, the air is released to drive gas turbines. With wind energy on the rise, the underground energy storage facility will allow municipal utilities to smooth out the intermittent flow of energy from the state's growing fleet of wind turbines, making it a dispatchable resource. One consultant on the project believes Iowa could double its existing wind energy capacity without adding transmission once the storage facility is built, Haug said.

The project, using aquifers for storage, will be the first of its kind in the world, he said. Two other compressed air energy storage facilities are in operation, one uses a salt dome the other a hard walled cavern. Injection tests on an initial well are positive. A second well is now under construction and the contract for a third has been let.

The land of corn and soybeans may be flyover country for some. But those who pay no attention to Iowa are missing a fertile plain of ideas, innovation and common sense management. ■

Putting Home Energy Monitoring Systems to the Test

Will information on energy use spur residential customers to cut back? Several public power utilities are running pilot projects to find out.

By Alice Clamp

If knowledge is power, can knowledge lead customers to power reductions? Some public power utilities are testing systems that are expected to answer that question.

In-home, or whole-house, energy monitoring systems are designed to tell residential utility customers how much electricity they are using—and thus encourage them to use less.

One device, the EnergyHub Dashboard, was number four on *Time* magazine's list of "The 50 Best Inventions of 2009." Inventor Seth Frader-Thompson said his inspiration for the EnergyHub came from the dashboard screen on the Toyota Prius, which shows drivers their gas mileage, remaining range and other data.

Among the public power utilities testing home energy monitoring systems is Omaha Public Power District. "To help meet a sustainability goal, we committed to reduce energy use by 50 megawatts over the next five years," said Denise Kuehn, the utility's manager for demand-side and sustainability management. "That amount was equal to an average of one year's growth in energy use," she said.

The utility explored a wide range of energy efficiency options, including home monitoring systems. In partnership with the University of Nebraska at Omaha, OPPD conducted lab tests on more than 10 systems and decided to use two, Blue Line Innovations' Power Cost Monitor and Aztec Energy Partners' In-Home Display.

Why two systems? Blue Line's PCM was real time, which OPPD considered to be important. Although the Aztec system had about a two-minute delay, it could communicate with the utility's Itron metering system.

"We wanted to see if the information from the monitoring devices would prompt customers to change their behavior," said Kuehn.

OPPD sent letters to approximately 9,000 homes within its network system, inviting customers to participate in a pilot project. It randomly selected 150 from among the respondents, dividing them into three groups. Each group used either the Blue Line or Aztec system, but not both. The utility also created a group of 50 OPPD employees and university researchers as well as a control group.

The pilot, launched in early summer 2008, ran for roughly a year. OPPD surveyed participating customers at the start of the pilot, then conducted on-site visits after six months. At the end of the pilot, the utility did a wrap-up survey.

"In the first month or two, we saw what appeared to be a reduction in energy use," said Kuehn. "But six months into the project, we found that a lot of participants had reverted to their former behavior."

And therein lies the challenge for public power utilities: How to motivate residential customers to sustain a lower level of energy use.

"We've tried various programs," said John Tzimorangas, general manager of Hingham Municipal Light Plant in Massachusetts. "We have a good initial surge from customers, but we don't get sustainability."

Many public power utilities are grappling with this issue, and their experience may help others who want to test energy monitoring systems in the homes of residential customers.

The first step is to find out what systems are out there. It's essential to study the various devices on the market, and identify the best fit. The field is crowded and growing. In addition to the Blue Line and Aztec products are such systems as The Energy Detective, Black & Decker's Power Monitor, Energy Monitoring Technologies' The Meter Reader and the Energy

Owl Electricity Monitoring System. GroundedPower, a Massachusetts company, has developed a real-time interactive customer engagement system, and Google has begun testing its PowerMeter, a software tool designed to work with smart meters.

Compatibility with a utility's meter system is an important consideration. Some energy monitoring systems work only with a certain type of digital meter. The Energy Owl, for instance, works only with the Itron Centron meter.

"We evaluated several systems, including Blue Line," said Marc Tye, vice president of conservation & renewable energy at Santee Cooper. The utility chose Blue Line because it could be installed by the customer, while other models required installation by an electrician. "We were under a time constraint to get the project under way." Some customers were reluctant to install the Blue Line monitor, so the utility did it for them, Tye said.

After attending a presentation on GroundedPower's system at a Massachusetts public power meeting, utility executives from six municipalities in the state got together to discuss a pilot project. "We had just completed a time-of-use pilot," said Richard Joyce, director of Wellesley Municipal Light Plant. A key factor in that pilot's success was behavior change, said Joyce. And the GroundedPower system incorporated the same driver.

Florida-based JEA thought Google's PowerMeter represented a great opportunity to provide an innovative approach to its customers. So it joined a short list of utilities that are partnering with the company. "It's something we couldn't offer to our customers otherwise," said Jane Upton, director of communications and community outreach for the Jacksonville utility.

Customer attention: getting it, keeping it

Once they have chosen a system—or systems—to test, most public power utilities establish a few criteria for participants, such as two years in the same residence or a particular kind of meter. Then, utilities contact a random sample of homeowners who meet those criteria, asking if they want to participate in a home energy monitoring test. In some cases, utilities publicly announce the pilot and ask for volunteers. That's what Massachusetts-based Braintree Electric Light Department did.

It's important for utilities to make clear that participation in a pilot program is voluntary, said David Schatsky, principal with GreenResearch, a New York consulting company. To market the pilot effectively, utilities should choose messages that are likely to appeal to their customers, he said. "And be careful about promising cost savings."

The discipline of consumer marketing is new for many utilities, said Schatsky. A portfolio approach makes sense, with a range of messages and media.

What motivates customers? "Some people want to save money," said Carl Gustin, the president of GroundedPower. "Others are concerned about the environment. Some thrive on competition, and some want to be good citizens. Learning, too, is a motivator."

In some cases, public utilities have selected a pool of participants that represents a good cross-section of the customer base in terms of energy usage and geographic diversity.

Smaller utilities, such as the Braintree Electric Light Department, have thrown open the doors to volunteers. In its January 2010 newsletter, BELD invited customers to "BGREEN@home" and lower their energy costs by participating in a home energy monitoring pilot.

No matter how they're recruited, the volunteers end up being a self-selecting group, said BELD's Slater. "It's hard to avoid that."

In an effort to create a more diverse group of participants in their home energy monitoring tests, some utilities are reaching out to schools and community groups. Those who are motivated to reduce costs—such as the elderly and lower-income customers—may join a pilot program, especially if it's free, said GreenResearch's Schatsky.

OPPD may use matching funds from the state to install monitors in homes of some low-income customers, said Kuehn.

Several utilities have reported that older customers have responded enthusiastically to their pilots. "There were a lot of seniors in our first test program," said Gary Hurley, an engineer who oversees the pilot program for Springfield, Ill., City Water, Light & Power. "They surprised us with their knowledge."

Hingham's Tsimorangas is not concerned about the technologically challenged. "All our participants need is an Internet connection. If they can send e-mails or get on a Web site, they can run our program. It's simple to use."

Braintree tries to make participation as non-threatening as possible, said Slater.

For OPPD's pilot program, it appears the reduction in the amount of energy used was not enough to keep customers using the systems, said the utility's Kuehn. "The device may have other uses for utilities, such as providing information on time-of-use rates or high bill complaints or as an educational tool. But here in Nebraska, we have low electric rates. The utility's challenge "is to motivate customers to help OPPD keep rates low," she said.

A survey conducted by Green Research's Schatsky in April 2009 found that just over half of the 1,041 respondents said they were extremely or very interested in home energy management systems. "In theory, there's strong demand for the product," he said. "But based on my modeling assumptions, I expect only half of those expressing interest would use a home energy monitoring system."

Still, information can be enlightening. Consumers often do not realize what is driving their usage, said Hingham's Tsimorangas. "If they buy a sec-

ond television set, they don't think about energy use. They don't realize how much electricity a dehumidifier can use—up to $30 a day."

In California, Sacramento Municipal Utility District customers told the utility they liked seeing their energy use in dollars and cents—for different times of the day and the year. There is something to be said for the shock factor, too. "That came into play if a customer was running the air conditioning system and a clothes dryer at the same time, and saw it was costing $1 an hour," said Chris Capra, a SMUD spokesman.

Braintree's Slater said the utility wants customers to have "an 'aha' moment."

Most public power utilities that test home energy monitoring systems survey participants several times—at the start of the project, a few months down the road and when the project wraps up.

Santee Cooper, for instance, plans three surveys over the course of its 12-month pilot, to gauge the benefit to customers. And Hingham Municipal Lighting Plant will poll customers at the end of the one-year pilot—and possibly half way through. "We want feedback on the system's ease of use," said the utility's Tsimorangas.

In lieu of a mid-point survey, OPPD conducted on-site visits. That's when the utility discovered that the batteries in a number of the Blue Line monitors had died. The customers either hadn't noticed or did not install fresh batteries.

When Springfield City Water, Light & Power asked customers about their estimated savings six months into the pilot, the utility saw signs of a loss of interest, said Hurley. That's when the utility discovered that it had a battery problem similar to that experienced by OPPD. "Several of our employees had a device in their home and realized that the batteries had died," said Hurley. Customers who weren't paying attention to their monitors didn't know that they weren't working.

JEA asked the customers participating in Google's PowerMeter program how often they used it and whether it was valuable. "We asked them what they were doing to save energy," said the utility's Upton. A lot of customers had made no-cost changes, such as turning off lights and ceiling fans and adjusting the temperature on their heating and cooling system.

Based on its survey, JEA realized that it had to do more to help customers use the information that they were getting. "We had to help people take the next step," said Upton.

The next step

GroundedPower starts with the premise that information alone will not bring about persistent behavior change, said the company's Gustin. Rather, change is driven by individual consumer interests and motivations.

That's where regular contact with customers comes in. JEA, for instance, sent weekly e-mails to those participating in Google's PowerMeter program. Among the subjects covered was the weather. "We said the area's cold snap would result in a higher utility bill unless they turned down the thermostat on their heating system."

Springfield City Water, Light & Power plans to provide energy-saving tips in a monthly report sent to all participants. "We're taking the results of our social marketing and tailoring them to our customers," said the utility's Hurley. Santee Cooper's energy advisers will talk with customers about time-of-use rates, to educate them about when to use various appliances, such as dishwashers or clothes dryers. In Massachusetts, Braintree Electric Light Department will offer seasonal tips and updates. "We need to keep it fresh," said the utility's Slater.

Most public power utilities agree that motivating customers to consistently use their home energy monitoring systems requires a portfolio of incentives.

Goals. "We have learned that a major driver in achieving energy savings is goal-setting and the feedback process," said GroundedPower's Gustin. "The higher the goal, the more likely the customer is to achieve even greater savings." He suggests daily, weekly or monthly e-mails to let customers know whether they're meeting their goal.

People need something to go after, said Hingham's Tsimorangas. "If we don't encourage customers to set goals, the program is only a novelty."

Competition. A bit of competition can also be an inducement. "We like the idea of customers being able to compare their savings with others in the community," said Tsimorangas. Hingham is one of six municipalities that are collectively testing GroundedPower's system. And in a novel approach, each municipality will com-

pare its savings with those of the five other municipalities. "Four to six months into the program, we'll look at our percentage reduction compared with the other towns," said Wellesley's Joyce.

Shared experience. In its appeal for volunteers, BELD told customers that they would be able to share their experience—via a Web-enabled network—with participants in the towns of Danvers, Hingham, North Attleboro, Wakefield and Wellesley.

Rewards. GroundedPower's Gustin suggests awarding points for reaching various levels of energy reduction. When a participant accumulates a certain number of points, the reward could be a coupon to save money on the purchase of some kind of high-efficiency equipment. In its pilot project, Braintree plans to have contests and offer prizes, said Slater.

Dedicated Web site. Customers taking part in the test of GroundedPower's system can access a Web site—branded with the utility name—that offers tips on how to reduce energy use. "We can send messages to customers via the Web site," said Hingham's Tsimorangas. "The more often they go to the Web site, the more engaged they are likely to be." Florida's JEA plans to develop an extranet Web site for the customers participating in Google's PowerMeter program.

Color-coded monitor. Several utilities have used color-coded monitors to let customers know at a glance how they are doing. Hingham's Tsimorangas thinks it's a good idea. "If you're achieving your goal, the monitor will be green. But if you're slipping, it will be yellow. And then there's red…"

Stanford University's Precourt Energy Efficiency Center is looking at ways of making energy use information more engaging and relevant. Among the options that it is studying are goal-setting, a lottery system, calculating the impact of reduced energy use on carbon emissions and a smart phone interface. Researchers also are developing an online, multi-player game, said Annika Todd, a post-doctoral scholar at the institute. "If you turn off a light in your home, you get points in the online game," she said.

"Our goal is to find what works best. We should have preliminary results in about a year, and we'll share this information on our Web site."

Lessons learned

According to GreenResearch's Schatsky, 2010 is the year in which lessons need to be learned. "Utilities should structure pilots to maximize their own learning and gather information on consumer response, changes in behavior and attitudes," he said.

Although their experience with home energy monitoring systems is still limited, public power utilities are learning quickly. Several have offered suggestions on some of the elements of a successful pilot program.

Set up a control group. Most utilities establish a control group when testing a home energy monitoring system. The group may be non-participating residential customers or a mix of utility employees and customers.

Involve employees. It can be helpful to include some employees in the pilot group. They can spot issues that need to be addressed and help to tweak the program, if necessary. Santee Cooper, for instance, has installed Blue Line monitoring devices in the homes of all senior management and the board of directors.

Keep expectations realistic. In testing Google's PowerMeter, JEA found it is not likely to be as widely used as the utility thought. "It will take a while for mainstream customers to become comfortable with the concept," said Upton. "Through education, we may be able to ramp up participation."

From the planning perspective, a utility needs to be sure that customer behavior changes will endure. "If we are planning for new load, we need to know that people won't revert to their former energy use habits," said Santee Cooper's Tye.

Know your customers. Utilities need to tailor their messages to different customer groups, said Springfield's Hurley. "And to do that, you need to understand your customer base."

Santee Cooper is looking carefully at demographics, said the utility's Tye. "Younger people are more likely to be receptive to home energy monitoring systems and find them easier to install. The customer mix is important."

Run a pilot long enough to get seasonal data. Most public power utilities have run, or plan to run, their pilots for about a year. Not only does a year's worth of data account for seasonal impacts, but it also indicates the sustainability of the program.

Springfield City Water, Light & Power is wrapping up its initial test, but plans to run a second one. "We had a cool summer last year, so we're concerned that the data will have been influenced by the weather," said the utility's Hurley. "If we get similar results from the second test, that will validate the first one."

Consider compatibility with smart meters. As public power utilities move to smart meters, they will want to assess meter compatibility with various home energy monitoring systems. Santee Cooper's Tye noted that Blue Line's system, for instance, will work with some smart meters, but not all.

Looking ahead. At present, both the market and the technology for home energy monitoring are immature, said GreenResearch's Schatsky. "There's a lack of technical standards and a lack of consumer awareness." Nor is a smart metering infrastructure ubiquitous, he noted. "And smart meters both enable this technology and provide a rationale for it, by supporting pricing structures such as time-of-use rates." Looking seven to 10 years out, Schatsky expects to see an adoption rate of 20-25 percent of households. ■

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