Addressing Policy and Logistical Challenges to smart grid Implementation:
Response to Department of Energy RFI
November 1, 2010

eMeter Strategic Consulting

Background

eMeter is a smart grid software company that provides smart network application platform (SNAP) software to integrate smart meters and smart grid communications networks and devices with utility IT systems. eMeter also provides smart grid application software such as meter data management (MDM) and consumer engagement software. Being vendor-neutral toward all meter, hardware, and legacy utility software systems (e.g. CIS and Billing), eMeter has a unique, unbiased and global perspective on smart grid IT issues. In addition, eMeter's principals have participated in the definition and development of the smart grid for nearly three decades, including leading advanced metering working groups in state commission proceedings in a half dozen states, participating in a wide variety of industry standards groups, founding the Demand Response and Smart Grid Coalition (DRSG), being on the board of directors of the Demand Response Coordinating Committee (DRCC), managing consumer-oriented award-winning smart grid pilots (e.g. PowerCentsDC) that have been recognized for demonstrating best practices, and testifying before Congress and various state legislatures on these issues. In addition, eMeter's software is in use in smart grid projects around the world, including several ARRA-funded projects in the U.S.

Introduction

eMeter's comments reflect its extensive and broad experience with smart meters, demand response, energy efficiency, rate design, consumer engagement and education, and distribution automation. For the purpose of interpreting our responses below, readers may assume the relevant smart grid technologies include the following:

- Smart meters (having two-way communications, recording usage at intervals of an hour or less, including a shut-off switch, having a two-way communications interface – e.g. radio – into a home area network/premise area network, sensing outage and voltage, and communicating data back to the utility at least daily),
- Appliances and equipment equipped with home/premise area network communication devices and the ability of end users to have one or more of their devices communicate to the smart meter to receive usage, cost, and energy price data,

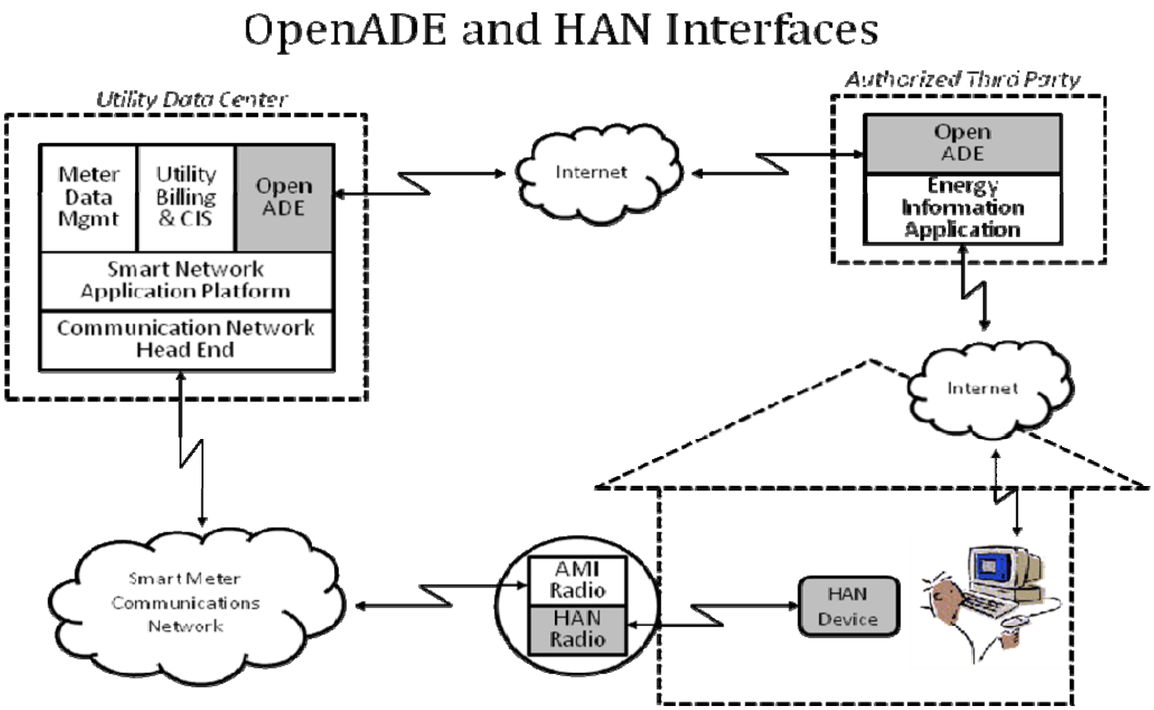
- Sensors and controllers on electricity distribution feeders and substations,
- Online access by energy end users to their consumption data on websites provided by utilities or third parties with explicit customer authorization, and
- Software within the utility to enable all of the above technology to provide functionality in dynamic pricing, automated control (including electric vehicle charging), voltage optimization, line loss reduction, outage and restoration management, energy efficiency support, and advanced energy information feedback.

eMeter has answered only some of the questions in the RFI. eMeter would be pleased to provide supporting documentation or further elaborate on any of this information. eMeter appreciates the opportunity to comment.

I. Definition and Scope

1) Should smart grid technologies be connected or use the same communications standard across a utility, state, or region?

To achieve efficient and active market participation by consumers, the interfaces to non-utility-owned devices need to be the same nationally. There are two key interfaces (see figure): 1) the interface between the utility meter and home area network (HAN) devices, and 2) the interface between the utility data center and third parties assisting consumers with their energy usage data (but only with the consumer's authorization!). For the first interface, the goal is ubiquitous availability of appliances with a built-in HAN radio, just as all computers have built-in wi-fi radios and all smart phones have built-in bluetooth radios. For the second interface, the goal is a standard interface for use by, ultimately, over 3,000 electric utilities. On the NIST list of acceptable smart grid standards published in January 2010, ZigBee is an example of the former and OpenADE of the latter.



Having said this, neither federal nor state regulators should specify the standard. The market – utilities – should be free to decide which standard to use from among a list of standards that have been vetted for suitability from technical and security perspectives by NIST.

2) <u>How does this vary between transmission, distribution, and customer-level standards?</u>
Where consumer-owned devices or interfaces to third parties are involved, a national standard, decided by the market within regulatory guidelines, is essential to achieving the vision of the smart grid.

a) <u>For example, is there need to go beyond ongoing standards development efforts to choose one consumer-facing device networking standard for states or regions so that consumers can take their smart appliances when they move and stores' smart appliance will work in more than one service area?</u>

Government should specify acceptable and non-exclusive standards and allow the market – utilities – to decide which standard to adopt. Where utilities diverge from a standard adopted by their peers for the critical smart meter to home/premise area network interface, utilities should have to justify their divergence and show how their solution will result in the same benefits at lower cost or greater benefits at the same cost. In this regard, the vast majority of smart meters either installed or planned for installation in the U.S. have a ZigBee radio for this interface. (Note that eMeter has absolutely no commercial interest in ZigBee radios or devices.)

II. Interactions With and Implications for Consumers

1. For consumers, what are the most important applications of the smart grid?

For consumers, the most important applications of the smart grid are those that achieve the greatest economic benefits while increasing reliability. The smart grid should increase the reliability and lower the cost of electricity delivery while empowering consumers to better manage their own consumption. Consumers will participate in energy efficiency programs if the choices are rich and broad in scope. Consumers will want to use tools provided from utilities as well as consumer products such as devices, software, internet portals, and mobility products. These products must be based on familiar and easy to use technologies. The most important consumer-facing smart grid application in the early stages of smart grid deployments will be demand response and electric vehicles.

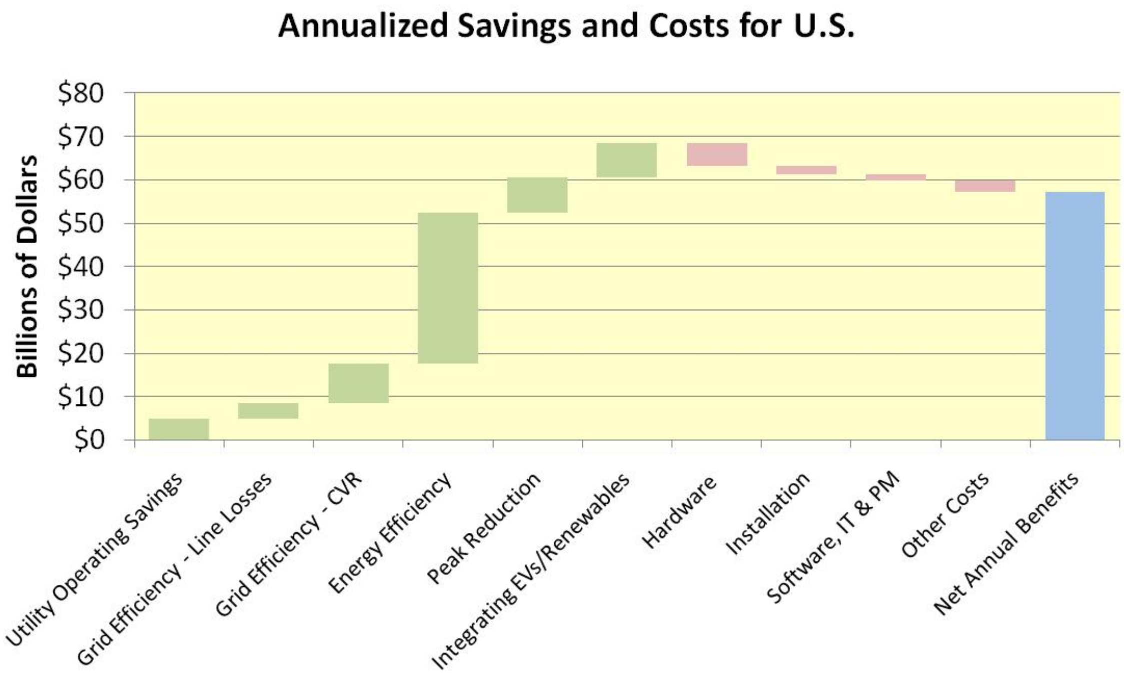
To summarize, the consumer benefits of the smart grid are

- increased utility operating efficiency through automation of manual functions,
- greater energy efficiency through consumer information feedback,
- peak reduction through dynamic pricing and automated control,
- better renewable integration through sensing and automated control,
- support for electric vehicles through dynamic pricing and automated sensing and controls, and
- greater support of intermittent renewable distributed generation through automated sensing and controls.

The smart grid should be designed and built to achieve these goals.

2. What are the implications, costs and benefits of these applications?

From a purely economic perspective, the greatest benefits of the smart grid are on the consumer side: energy efficiency savings of 5-15% (according to Oxford University), peak demand reductions of 10-20% (according to a wide variety of dynamic pricing pilots, including the attached Washington DC, PowerCentsDC program report), and improved utility operations (line loss reductions of 15% and conservation voltage reductions of up to 2 ½ % according to McKinsey and others). Sensing transformers and other devices improves reliability, but the economic benefits are only a fraction of the previous items listed. The following chart summarizes potential costs and benefits of a fully-deployed smart grid in the U.S.



Source: eMeter Strategic Consulting.

3. <u>What new services enabled by the smart grid would customers see as beneficial?</u>

There are potential new services enabled by the smart grid for consumers. These include the potential for lower energy usage and increased comfort and convenience through automated appliance and HVAC control. Beyond energy savings, home automation increases comfort and convenience through automated monitoring and control of lighting, doors and windows (for security), entertainment equipment, sprinkler systems (saving water as well), and other applications.

4. <u>What approaches have helped pave the way for smart grid deployments that deliver these benefits or have the promise to do so in the future?</u>

Adaptation of standards and strong certification programs allow for delivery of these benefits for consumers. In the smart grid space, in Texas, several devices have been tested and approved for compatibility with the ZigBee interface in smart meters, following the Smart Energy Protocol 1.0 standard.

5. How well do customers understand and respond to pricing options, direct load control or other opportunities to save by changing when they use power?

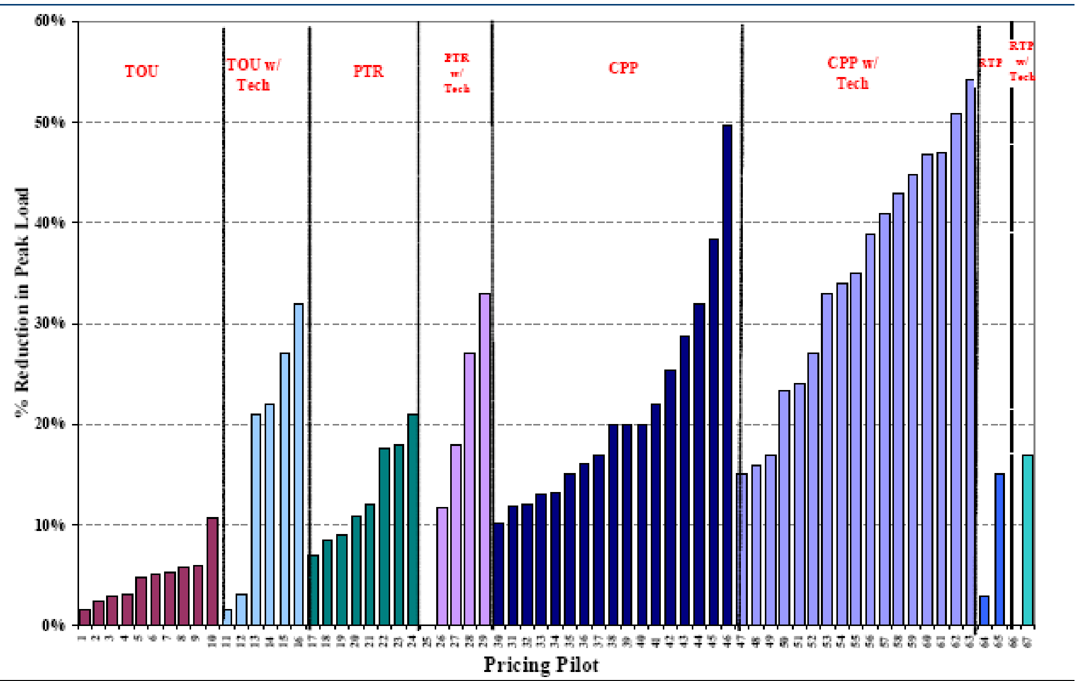
   a. What evidence is available about their response?

   b. To what extent have specific consumer education programs been effective?

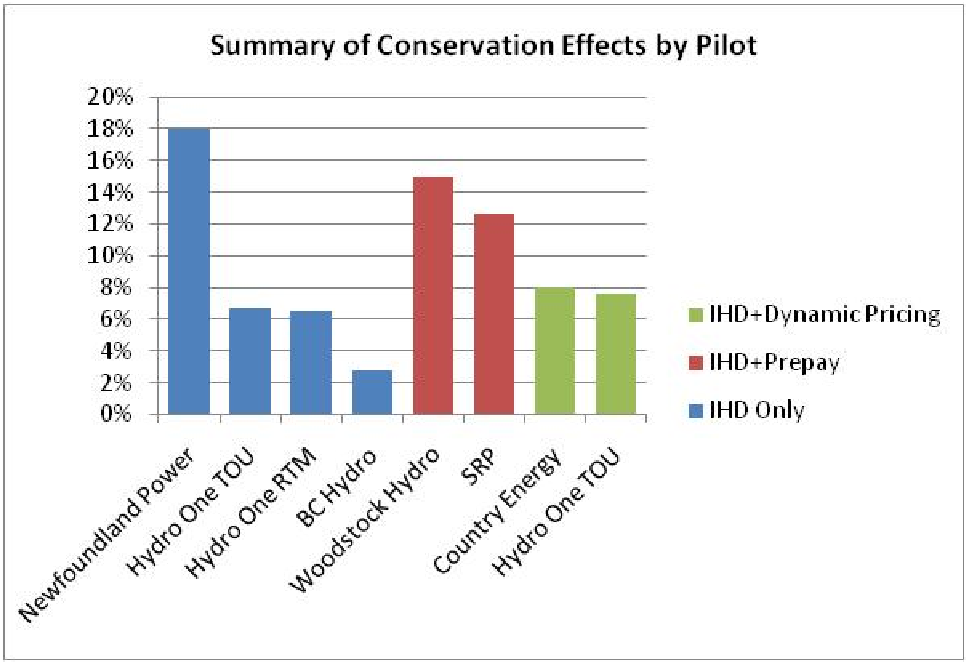
   PowerCentsDC had a consumer education program that resulted in high levels of customer satisfaction in the Washington, D.C. smart meter pilot. Toronto Hydro (Ontario) and San Diego Gas & Electric have received awards for their consumer education programs as well.

   c. What tools *(e.g.* education, incentives, and automation) increase impacts on power consumption behavior?

   Education, pricing incentives, and automation all increase the amount by which consumers reduce their energy consumption overall and during peak times. The first chart below shows the results of approximately 60 pricing pilots. The second chart shows the results of energy information feedback displays. The third shows consumer preferences for receiving data to educate them about their energy use.



Source: Brattle Group



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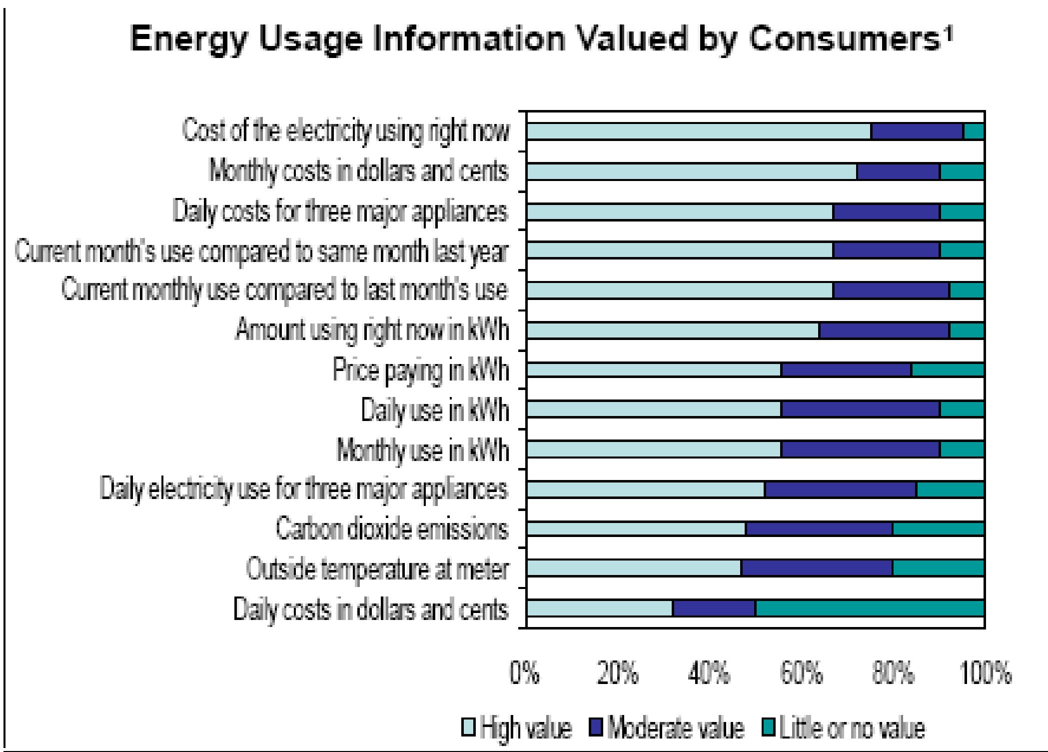


Source: Energy Insights

d. <u>What are reasonable expectations about how these programs could reshape consumer power usage?</u>

The extensive literature on pricing and information feedback pilots – cited and illustrated above – provide reasonable expectations.

Consumers in general do not understand the details of electricity pricing but do understand the basic concepts. For example, in surveys, customers with inverted tier rates are aware that their price goes up the more power they use. This is similar to cell phone rates, where consumers know peak rates are higher, but few could say exactly how much . Younger generations will be more apt to adopt these changes.

Tying electricity cost directly to power generation or congestion-related charges (peak demand) will require that the consumer be informed that prices change hourly and be given notifications of high price periods in advance. Residential consumers in Illinois and District of Columbia programs have shown that such consumers can understand and successfully utilize even hourly pricing (though most residential consumers likely do not desire such pricing).

6. <u>To what extent might existing consumer incentives, knowledge and decision-making patterns create barriers to the adoption or effective use of smart grid technologies?</u>

   a. <u>For instance, are there behavioral barriers to the adoption and effective use of information feedback systems, demand response, energy management and home automation technologies?</u>

   Barriers may include:

   - Lack of incentive -- Consumers have no incentive to shift consumption from peak to other hours, because, except for a small minority, they do not have time-varying prices.

   b. <u>What are the best ways to address these barriers?</u>

   One of the best ways to address these barriers is to create appropriate incentives. Pricing has been the best motivator for behavior change. In addition, customers need more information about their energy use and presented in convenient and easily understood ways (e.g. consumers prefer that data be sent to them rather than having to log into a website, though they desire both options). On the privacy side, policymakers should provide clear consumer protections. For example, California has adopted legislation that protects both the privacy and security of consumer energy information, unless the consumer voluntarily chooses to provide the data to a third party chosen by the consumer.

   c. <u>Are steps necessary to make participation easier and more convenient, increase benefits to consumers, reduce risks, or otherwise better serve customers?</u>

ZigBee, which dominates utility smart meter deployments, should be the backbone of home area networking technology for the smart grid.

d. Moreover, what role do factors like the trust, consumer control, and civic participation play in shaping consumer participation in demand response, time-varying pricing, and energy efficiency programs?

Trust, consumer control, and civic participation are all important factors in these programs. Consumers have a high level of trust in information from their utilities; it is important to maintain this trust and take advantage of it in providing new data and programs to consumers. Consumers expect to control their own homes and businesses, but are very open to utility load control in well-implemented programs. For example, FPL has nearly a million households that voluntarily allow the utility to control air conditioners in critical peak conditions. Such programs should be voluntary. Regarding civic participation, focus group results in the PowerCentsDC program showed that joint participation in program marketing by the utility with other civic organizations – consumer groups, public service commission, and labor unions – was seen as beneficial by consumers.

e. How do these factors relate to other factors like consumer education, marketing and monthly savings opportunities?

These factors are equally important and synergistic. Recycling is a great example of the interplay of civic participation, consumer education, and consumer behavior. Energy savings and peak demand reductions can benefit from the same interplay and have the added benefit of monthly savings.

7. How should combinations of education, technology, incentives, feedback and decision structure be used to help residential and small commercial customers make smarter, better informed choices?

Consumer surveys and experience in both energy pilot programs and various other services in the marketplace make clear that consumers like to have many methods of obtaining information. In the context of energy, the following are important sources

- Utility bill insert (it's very difficult to modify utility bills, but adding a customer-specific insert with added information has proved highly successful in pilot programs);
- Utility websites;
- Utility emails and text messages;
- Real-time interface to meter with display on computer, smart phone, or other devices; and
- Third-party reports and websites, with proper consumer authorization.

8. What steps are underway to identify the best combinations for different segments of the residential and commercial market?

Many pilot programs using different technologies are currently in play across the country. Feedback on consumer behavior changes brought about by these pilot programs is critical to understand the market and implementation of future, large-scale programs. In addition, the market is being allowed to decide the best means in some major markets. For example, in Texas and California, consumers have (or will have) access to online data via authorized third party providers and real-time data through the HAN interface in smart meters. Regulators should not attempt to identify the best combinations; instead, in exercising free choice in these information markets, consumers will vote with their feet to identify the best combinations.

9. Are education or communications campaigns necessary to inform customers prior to deploying smart grid applications?

   a. If so, what would these campaigns look like and who should deploy them? Which related education or public relations campaigns might be attractive models?

10. What should federal and state energy policymakers know about social norms (e.g. the use of feedback that compares a customers' use to his neighbors) and habit formation?

11. What are the important lessons from efforts to persuade people to recycle or engage in other environmentally friendly activity?

12. What are the implications of these insights for determining which tasks are best automated and which should be subject to consumer control?

The key point is that consumers should be making the determinations of which tasks are best automated or left to manual control; regulators should enable the infrastructure but allow consumers to decide.

13. When is it appropriate to use social norm based tools?

14. 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?

The combination of information, price incentives, and education is the most effective means to modify behavior for recurring usage and demand reductions.

III. Interaction With Large Commercial and Industrial Customers

1. 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.

2. Please identify unmet smart grid infrastructure or policy needs for large customers.

Large customers have the same need for open interfaces to access their data as small customers, if not more so. This refers to the OpenADE and HAN interfaces discussed above. Also, large consumers have the same needs for protection of data privacy and security, with an ability to authorize third parties to receive the data, if desired, to present, report, or analyze the data on the customer's behalf.

IV. Assessing and Allocating Costs and Benefits

1. How should the benefits of smart grid investments be quantified?

Specific suggested metrics are:

- Trends in total electricity consumption per capita
- Trends in peak demand per capita
- Number of customers using the HAN interface with the meter (as distinguished from HAN devices that do not directly interface to the meter; the utility should not be burdened with tracking such devices)
- Trends in utility line losses
- Trends in Conservation Voltage Reduction
- Reliability indicators (SAIDI, SAIFI, MAIFI)
- Customer participation in dynamic pricing or other demand response programs

2. What criteria and processes should regulators use when considering the value of smart grid applications?

3. When will the benefits and costs of smart grid investments be typically realized for consumers?

As seen in the many pilot programs, consumers begin to realize benefits when the applications go live. This applies to both grid-oriented applications, like outage management, as well as consumer-oriented applications, like dynamic pricing and energy information feedback. Importantly, some benefits will grow dramatically over time; for example, Texas consumers can now utilize the HAN interface in smart meters, but it will take years for a wide variety of HAN-equipped smart appliances to be available and for consumers to replace existing appliance stock.

4. How should uncertainty about whether smart grid implementations will deliver on their potential to avoid other generation, transmission and distribution investments affect the calculation of benefits and decisions about risk sharing?

As can be seen in the business case summarized in the graphic above, most smart grid benefits flow directly to consumers in the form of lower costs for energy, better reliability, or better customer service. At the same time, under traditional ratemaking, shareholders bear most of the risk, because they are liable for failed implementations. Accordingly, regulators are encouraged to explore mechanisms other than traditional ratemaking to enable utility shareholders to share in the rewards of successful smart grid investments. In general, first principles should be considered: benefits should flow to those who take the risks, and those who take the risks should receive the benefits.

5. How should the costs and benefits of enabling devices (e.g. programmable communicating thermostats, in home displays, home area networks (HAN), or smart appliances) factor into regulatory assessments of smart grid projects?

Each project should be evaluated independently, with the specific costs and benefits associated with such project included in the analysis. To the extent multiple elements are included – e.g. both smart meters and smart thermostats – the costs and benefits of each should be determined independently to support good policy decisions on each. This separation means that both costs and benefits must be allocated to the separate projects. As more elements are added, complexity goes up, along with risk. One strategy to handle this is to identify a set of minimum implementation that then generates a minimum set of benefits (for example, smart meters alone with only utility operating benefits). Then, if each incremental device or feature (e.g. adding dynamic pricing to smart meters) has a positive cost benefit analysis, risk is minimized. This approach has essentially been the one used by many commissions in evaluating smart meter projects.

6. If these applications are described as benefits to sell the projects, should the costs also be factored into the cost-benefit analysis?

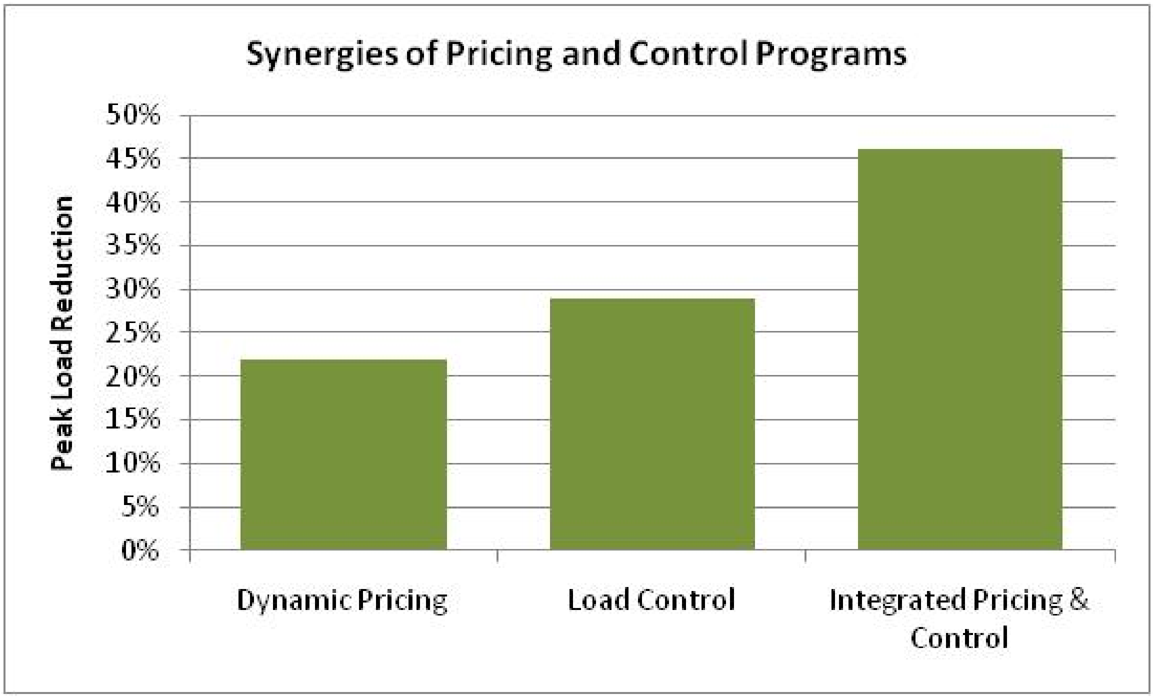
Yes. Sometimes the costs are shared, such as using the same communications network or software application platform for receiving meter reading data and for sending price and control signals to HAN devices.

7. How does the notion that only some customers might opt in to consumer-facing smart grid programs affect the costs and benefits of AMI deployments?

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

9. How does the magnitude and certainty of the cost effectiveness of other approaches like direct load management that pay consumers to give the utility the right to temporarily turn off air conditioners or other equipment during peak demand periods compare to that of AMI or other smart grid programs?

Most importantly, the pilot programs have found that dynamic pricing and load control are synergistic, as seen in the figure below.



Source: eMeter Strategic Consulting

10. <u>How likely are significant cost overruns?</u>

    There have been many large-scale AMR and AMI deployments, with no significant cost overruns. There have also been many feeder and substation automation programs. The challenge tends to come in on the software side, where cost overruns for large IT systems (e.g. CIS and billing) have not been uncommon.

11. <u>What can regulators do to reduce the probability of significant cost overruns? How should cost overruns be addressed?</u>

    Regulators should reward utilities who achieve the required functionality efficiently in their software implementations.

12. <u>With numerous energy efficiency and renewable energy programs across the country competing for ratepayer funding, how should State Commissions assess proposals to invest in smart grid projects where the benefits are more difficult to quantify and the costs are more uncertain?</u>

13. <u>What are appropriate ways to track the progress of smart grid implementation efforts?</u>

The FERC's annual survey of smart meter installations and demand response is a good precedent. The challenge with smart grid is defining terms, such as "automated substation." In any case, specific suggested metrics are:

- Trends in total electricity consumption per capita
- Trends in peak demand per capita
- Number of customers using the HAN interface with the meter (as distinguished from HAN devices that do not directly interface to the meter; the utility should not be burdened with tracking such devices)
- Trends in utility line losses
- Trends in Conservation Voltage Reduction
- Reliability indicators (SAIDI, SAIFI, MAIFI)
- Customer participation in dynamic pricing or other demand response programs

14. <u>What additional information about, for example, customer interactions should be collected from future pilots and program implementations?</u>

Importantly, there is no single, enduring "correct" answer to, "What is the best customer interaction?" Customer interactions will continue to evolve in energy, just as they continue to evolve in other areas of society and the economy. Smart companies will continue to explore innovations with consumers on a continual basis, learning from those tests and advancing the efficiency and effectiveness of those interactions.

15. <u>How are State Commissions studying smart grid and smart meter applications in pilots?</u>

The best starting place is the literature, because there is a wealth of information about pilot programs in all aspects of energy. State Commissions usually focus their efforts on applying information to specific projects or proposals being made by utilities. Because this is usually in an adversarial process, the best sharing of information is not always possible. Thus, it may be beneficial for State Commissions to obtain further information from sources such as the Demand Response Coordinating Committee, which conducts regular webinars (free to State Commissions) on smart grid topics utilizing industry experts.

16. <u>In conducting pilots, what best practical approaches are emerging to better ascertain the benefits and costs of realistic options while protecting participants?</u>

There are many practical approaches documented in the literature, a recent example being the final report of the PowerCentsDC Program.

17. <u>How should the costs of smart grid technologies be allocated?</u>

State Commissions should use the same cost allocation principles for smart grid technologies as for other investments. However, as noted above regarding the smart grid business case, most smart grid benefits flow directly to consumers under traditional allocation of *benefits*. To promote the capturing of the greatest possible net benefits of the smart grid, State Commissions should look at measures that would allow utility shareholders a greater return on their investment in return for their shouldering of the investment risk.

18. To what degree should State Commissions try to ensure that the beneficiaries of smart grid capital expenditures carry the cost burdens?

This is a "first principle." Those who benefit should bear the cost – subject to practical limitations regarding allocation. For example, every customer benefits from lower wholesale prices caused by a portion of customers lowering peak demand (see the MADRI study). Yet, there is no practical way to identify benefits and costs at the individual customer level, so, just as the benefits are spread over a large customer group, the costs should also be spread over the group. State Commissions will ensure that, overall, the benefits will exceed the costs or will not approve the project.

19. Which stakeholder(s) should bear the risks if expected benefits do not materialize?

20. How should smart grid investments be aligned so customers' expectations are met?

21. 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?

22. When do system-wide benefits justify uniform adoption of technological upgrades?

This requires a case by case analysis of each project.

a. How does the answer depend on the nature of the offering?

Since a case by case analysis is required, the nature of the offering is necessarily a part of each analysis.

23. How should regulators address customer segments that might not use smart grid technologies?

24. How might consumer-side smart grid technologies, such as HANs, whether controlled by a central server or managed by consumers, programmable thermostats, or metering technology (whether AMR or AMI), or applications (such as dynamic pricing, peak time rebates, and remote disconnect) benefit, harm, or otherwise affect vulnerable populations?

Peak Time Rebates entail no risk for customers who choose not to reduce peak demand and are favored by consumer groups for this reason.

25. What steps could ensure acceptable outcomes for vulnerable populations?

Adoption of Peak Time Rebates (or a related concept, "Peak Time Option") ensures no harm to vulnerable populations while affording the ability to save money (see savings of low income customers as documented in the PowerCentsDC program). In addition, bill inserts with individual energy information in easy to understand formats ensure that all customers get the ability to view their detailed energy usage information. Another possibility is subsidized equipment, such as free in-home displays or smart thermostats for low income consumers (Texas has such a program).

V. Utilities, Device Manufacturers and Energy Management Firms

1. How can state regulators and the federal government best work together to achieve the benefits of a smart grid?

2. 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?

   The federal government can best assist by providing information resources and information sharing opportunities, including workshops, hearings, and seminars. State regulators remain responsible for local implementation decisions.

3. 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)?

   Demand response should be allowed equal footing to other capacity sources. Dynamic pricing load reductions should be treated as a reduction in the load forecast.

4. 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?

5. Will other smart grid programs have important impacts on wholesale markets? Can policies improve these interactions?

6. 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?

   For the most part, utilities do not have the right incentives, because they make more money when selling more energy. Also, because consumers will capture the majority of smart grid benefits, either immediately or ultimately, policymakers have an obligation to consider what incentives to utility shareholders are consistent with achieving those benefits.

7. 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?

   With the market opened up via the OpenADE and HAN interfaces, third parties will have many opportunities to provide products and services. The keys are the interfaces and providing consumers with price incentives in the form of dynamic pricing. In this regard, Peak Time Rebates have been shown to be effective in reducing peak demand and are favored by consumer groups.

8. 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?

   No changes in the standards or standard-setting process are needed. What's needed is going live with the OpenADE and HAN interfaces.

9. How should the interaction between third-party firms and regulated utilities be structured to maximize benefits to consumers and society?

   The responsibilities of regulated utilities should be clearly specified by regulators and include protection of consumer privacy and data. Once consumers have authorized a third party to access data, the utility should be protected from any liability once the third party receives the data. Instead, state or federal privacy laws of general (or specific) application should take effect. California's energy data privacy law is an example.

10. How should customer-facing equipment such as programmable communicating thermostats, feedback systems, energy management systems and home area networks be made available and financed?

    Such customer-facing equipment should be made available as it has been for many years: in multiple ways. Consider smart thermostats. Consumers buy their own, receive rebates from utilities for qualifying purchases, or receive fully-subsidized devices as part of load control programs. The specifics of the program should determine availability and financing, with no preconceived solution. State commissions and other utility regulators have many good options available to them already.

11. Are there consumers behavior or incentive barriers to the market achieving efficient technology adoption levels without policy intervention?

    There is no consumer behavior barrier; consumers have consistently shown that they respond to more energy information and to price signals. On the incentive side, consumers have virtually – the exception is calls for civic action – no incentive to shift load away from peak hours without a dynamic pricing incentive. Policymakers set rates, so policymakers must intervene and provide such an incentive (as noted above, Peak Time Rebates are a good way to start).

12. 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?

    Only for devices operating at the interface between the consumer world and the utility world.

    Within the consumer world, such testing should be left to the market; UL certification is an excellent example of a market-driven service. More apt is Wi-Fi compatibility, which manufacturers ensure through voluntary efforts. The Wi-Fi alliance performs certification, but not every device goes through such certification, nor is there any legal or regulatory requirement for such certification.

Within the utility world, utilities perform their own testing and certification. Without a compelling need, the existing system should remain unchanged.

At the interface between utilities and consumers – the meter HAN radio talking to the consumer-owned device with a HAN radio – national certification makes sense. This is because the connection between devices has critical security elements, plus the connection fundamentally affects the utility's operations (because the utility's device is involved).

13. <u>If there is a need for additional certification, what would need to be 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?</u>

    Yes; see answer to immediately preceding question.

VI. Long Term Issues: Managing a Grid With High Penetration of New Technologies

1. <u>What are the most promising ways to integrate large amounts of electric vehicles, photovoltaic cells, wind turbines, or inflexible nuclear plants?</u>

   Through a combination of proper price signals (via dynamic pricing) and automated controls (these may, but not need, be HAN enabled). Our nation uses price signals to manage most other resources, because it works better than regulatory command and control. For intermittent resources, the price signals and automated control will stimulate the availability of storage and responsive loads to minimize the cost of those resources, including reducing the current requirement for having a standby backup power plant equal in capacity to the wind or solar resource.

2. <u>What approaches make sense to address the possibility that large numbers of other consumer devices that might simultaneously increase power consumption as soon as power prices drop?</u>

   Except in the extreme case, power always costs something, so energy users – both homes and businesses – always have a financial incentive not to turn something on. Moreover, the whole purpose of dynamic prices is to reflect relative abundance or scarcity. If large numbers of "other" consumer devices increased power consumption at lower prices, the prices would go up in response to the higher demand. Markets are very effective at balancing supply and demand, provided price signals are allowed to reach market participants.

3. <u>For instance, what is known about the viability of and tradeoffs between frequently updated prices and direct load control as approaches to help keep the system balanced?</u>

   Hourly pricing and automated control of air conditioning has been shown to be effective in residential programs in both Illinois and District of Columbia in reducing system peak demands.

4. <u>How do factors like the speed of optimization algorithms, demand for reliability and the availability of grid friendly appliances affect those trade-offs?</u>

Availability of automated appliances will grow over time and provide an increasingly valuable resource in matching supply and demand, especially needed for taking best advantage of intermittent renewable resources.

5. What are these strategies' implications for competition among demand response, storage and fast reacting generation?

   The implications are not relevant. The key is allowing effective – and fair – competition between demand response, storage, and fast-reacting generation. The market – in this case State Commissions, RTOs, and utilities – will decide on the appropriate mix in each of their own specific regions.

6. What research is needed to identify and develop effective strategies to manage a grid that is evolving to, for example, have an increasing number of devices that can respond to grid conditions and to be increasingly reliant on variable renewable resources?

   One area of additional research, in the form of demonstration programs, is in using existing energy storage and automation to offset variation in generation by renewable resources. There is substantial storage capacity in the form of existing building envelopes and building mass that can be pre-cooled or pre-heated over a period of time that can be extended to account for some renewable resource variability. Substantial storage capacity in refrigeration exists as well, though the control technology is a bigger problem (buildings can be retrofit with automated sensors and thermostats; refrigeration, especially at the household level, cannot be easily adjusted).

   Demonstration projects, building on existing work being done at Lawrence Berkeley National Laboratory, should explore the potential in this area.

7. What policies, if any, are necessary to ensure that technologies that can increase the efficiency of ancillary services provision can enter the market and compete on a level playing field?

   FERC should adopt wholesale market policies allowing demand response to compete effectively and fairly in wholesale power markets for ancillary services.

8. What policies, if any, are necessary to ensure that distributed generation and storage of thermal and electrical energy can compete with other supply and demand resources on a level playing field?

   These policies are appropriately handled at the state level, though federal agencies can provide expertise in analyzing options for specific projects and initiatives.

9. What barriers exist to the deployment of grid infrastructure to enable electric vehicles? What policies are needed to address them?

   To date, EV charging tariffs do not meet all of the essential goals:

   - to allow EV owners to save money by charging at low off-peak rates,

- to provide an economic incentive to avoid charging during high-cost peak hours, and
- to provide an economic incentive to minimize rapid charging, because it creates very high demand that ultimately could threaten distribution transformers.

Hourly pricing – opt-in – offers the best solution to the first two goals. However, hourly pricing is determined in the generation and transmission markets. Therefore, there is no price signal from the distribution grid to avoid rapid charging unless necessary. Time-of-use pricing provides a good, continuing incentive as well, but also without the distribution incentive.

The classic solution is a monthly demand charge, but this provides no continuing incentive once the first high demand peak is reached during the month. As one solution, this could be modified into a daily demand charge to make the incentive continuing.

Another possibility would be to impose a demand charge when a threshold is exceeded. However, because there is great variation in individual home peak demands, such a threshold would have to be individually tailored relative to something like total monthly usage. This is complex and difficult.

Another would be to impose a surcharge any time rapid charging is used. This could be determined by monitoring the charger or using an algorithm to determine when rapid charging is used.

An additional rate design that should be evaluated is Peak Time Option.

VII. Reliability and Cyber-Security

1. <u>What smart grid technologies are or will become available to help reduce the electric system's susceptibility to service disruptions?</u>

2. <u>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?</u>

3. <u>Is there a need to revisit the legal and institutional approaches to generation and transmission system data collection and interchange?</u>

4. <u>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?</u>
   These governments should ensure that all technology 1) within the utility’s control and 2) connected digitally with utility equipment meets security standards identified by NIST. Also see response to Question V.12 above.

5. How should the Federal and State entities coordinate with one another as well as with the private and nonprofit sector to fulfill this objective?

VIII. Managing Transitions and Overall Questions

1. 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?

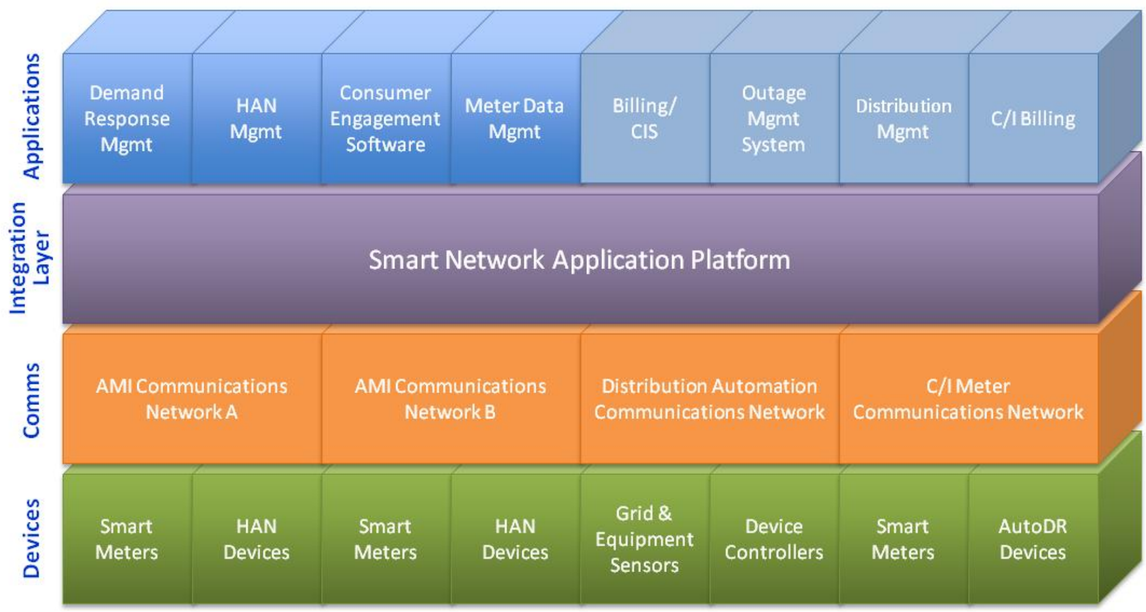
2. What has been learned from different implementations?

3. What lessons fall into the "it would have been good to know that when we started" category?

4. What additional mechanisms, if any, would help share such lessons among key stakeholders quickly? Webinars and conference presentations.

5. Recognizing that most equipment on the electric grid, including meters, can last a decade or more, what cyber security, compatibility and integration issues affect legacy equipment and merit attention?

6. What are some strategies for integrating legacy equipment into a robust, modernized grid? Flexible software that bridges the gap between the old and new equipment and accounts for the differences in functionality. The generic "smart network application platform" approach illustrated below accomplishes this goal.



7. 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?

The software platform approach illustrated above allows for integration of new applications, new communications equipment, and new smart grid device technologies.

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

   Utilities will have to manage the interface between meter HAN radios and consumer-owned HAN devices. This is a significant new responsibility – for which utilities must receive proper cost recovery – but not a fundamental change in the business. Utilities already have to oversee and certify the physical interface between the power grid and each home or building, which occurs largely, but not always, via the meter socket and related hardware.

9. 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?

10. How does that affect the choice of an appropriate time to invest?

11. What policy changes would ensure that the U.S. maintains global competiveness in smart grid technology and related businesses?

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