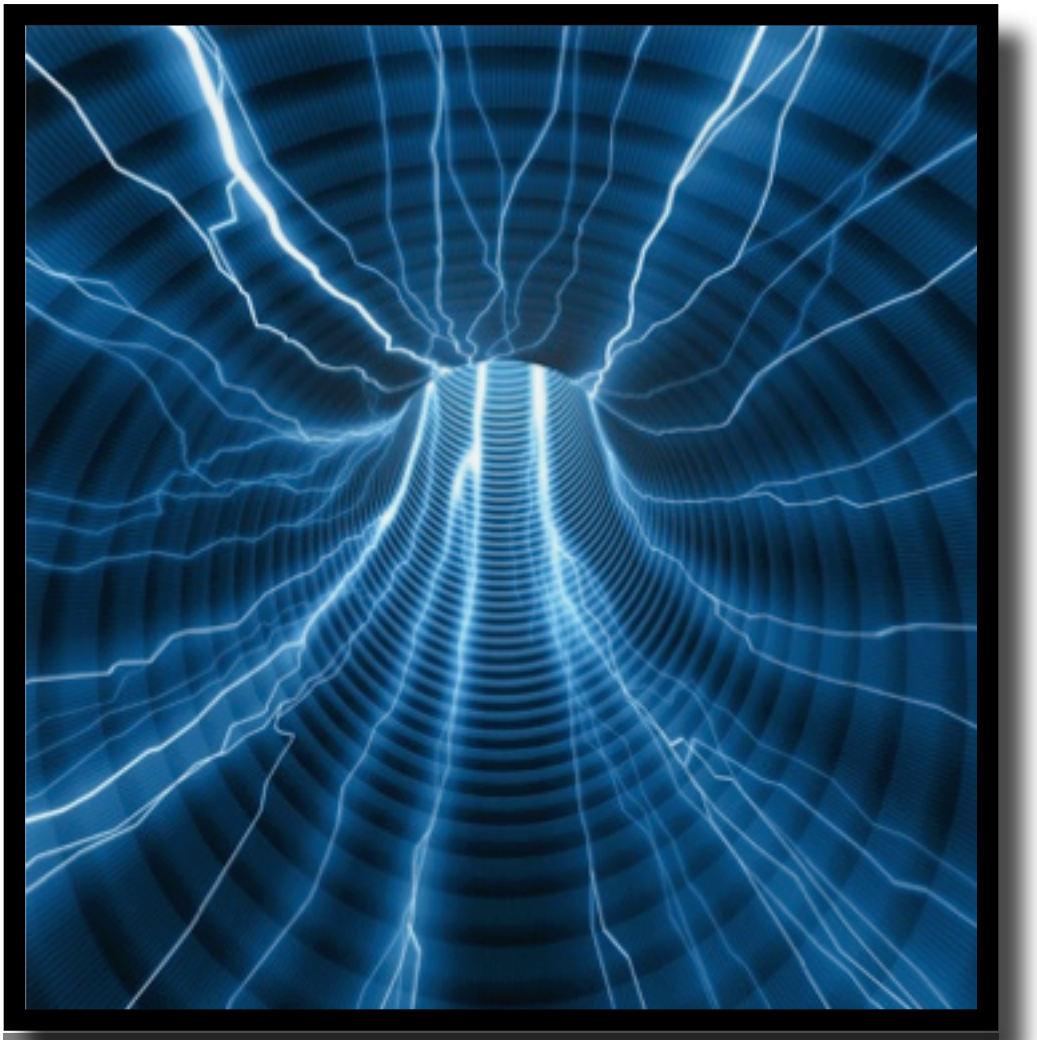
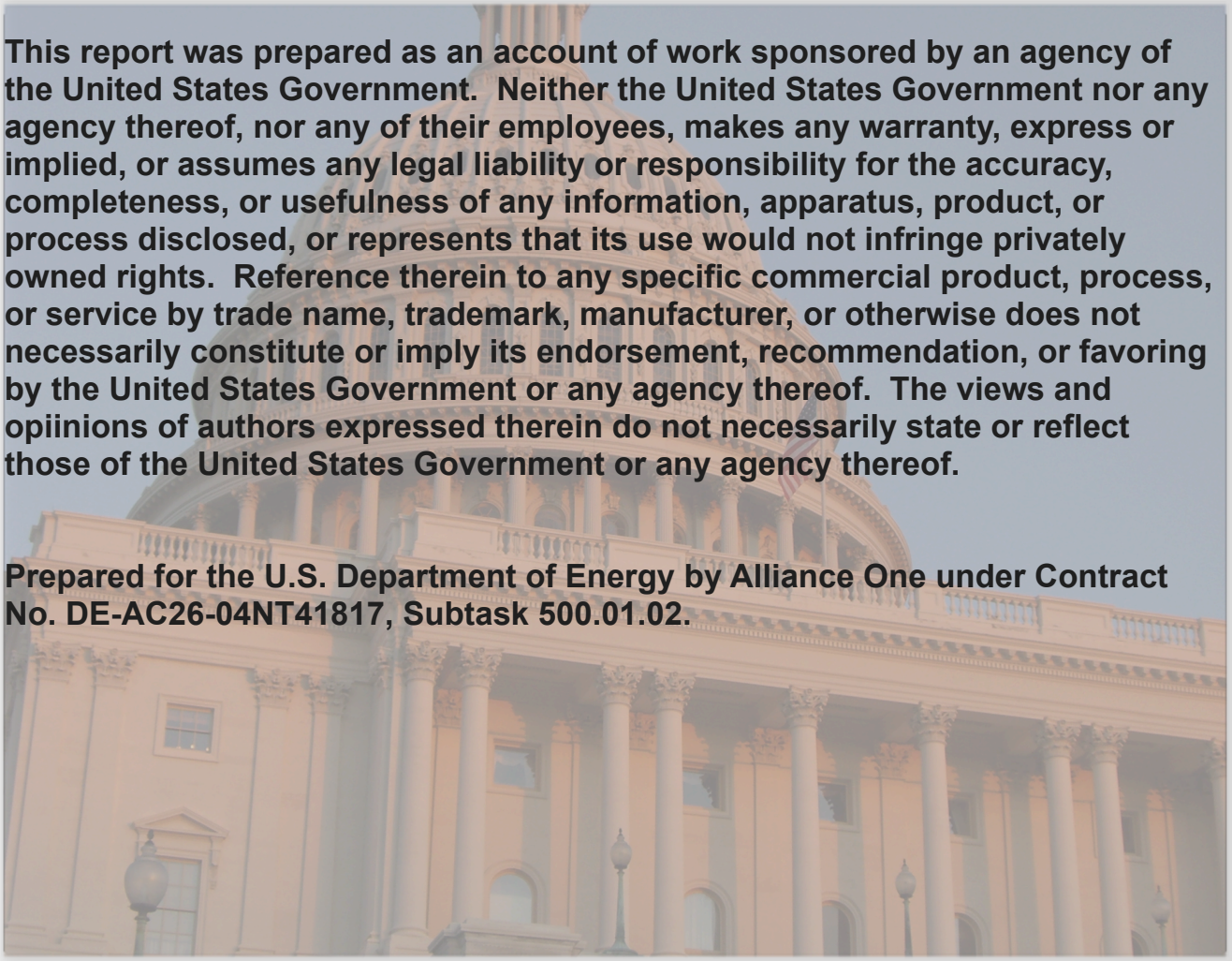
THE SMART GRID STAKEHOLDER ROUNDTABLE GROUP PERSPECTIVES



FOR UTILITIES AND OTHERS IMPLEMENTING SMART GRIDS



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Introduction

State and federal governments continue to explore and encourage smart grid development through legislative, regulatory and financial incentives. As this occurs, many stakeholders, including consumers, environmental interest groups and state and local officials, are raising questions about the impacts of these investments, the benefits and the costs.

Utilities and other project developers involved in smart grid implementation can answer stakeholders' questions by providing clear, concise and specific information about their overall smart grid vision including: expected costs, technology choices, consumer and environmental benefits.

Key Findings

This document is designed to capture key questions posed by stakeholders concerning implementation of smart grids. These perspectives were compiled during a series of discussions among members of the Smart Grid Stakeholder Roundtable Group (*see listing at the end of this document*).

Key findings include:

- ***Stakeholders currently have more questions than clear direction about deployment of smart grid technologies.***
- ***More information on smart grid demonstrations and deployments is needed, particularly from the perspectives of utility regulators, consumers and those with expertise about the environmental impacts or benefits.***
- ***Several key players, including consumers and utilities, will play a leading role in the development of smart grid.***
- ***Some commercial customers and others are pursuing smart grid options outside the traditional utility rate structure, particularly in deregulated states.***
- ***Technology investment is important, but thorough evaluations and possibly the adoption of additional policies are needed to ensure that the potential environmental and consumer benefits from smart grid investments exceed the costs.***
- ***Pioneers of smart grid deployments need to learn from each other and help to inform further technology and policy development.***

Who Are We?

The Smart Grid Stakeholder Roundtable Group is comprised of stakeholders interested in ensuring that diverse interests are considered as utilities, states, the federal government and even customers undertake upgrades to the transmission and distribution grid through the adoption of smart grid technologies. The Roundtable represents a range of stakeholders including state agencies, consumer groups, environmental groups, commercial and industrial consumers, utilities and public utility commissions. Through a series of meetings, we have identified issues that are worth exploring to assist stakeholders, policy-makers and utilities as they explore adopting smart grid technologies.

Why Develop This Document?

The all encompassing and crosscutting nature of the Smart Grid renders it a complex issue and the ever-evolving definitions further complicate the dialogue.

Furthermore, smart grids often have intangible benefits such as increased reliability and service quality, which may make it more difficult for state legislative, regulatory and consumer bodies to appreciate the entire cost/benefit picture.

For instance, smart grid technology has the potential to ***augment*** the environmental goals of utilities, policymakers and consumers. However, stakeholders recognize that the certainty and magnitude of those benefits must be weighed against other proven clean energy options, which might in fact exceed those expected solely from smart grid technologies.

Nevertheless, utilities and others are moving forward to address both state and federal government interest in improving the operation of the grid. Therefore, it is important that utilities supply stakeholders with a concise picture of how these investments will present advantages for their customers.

Recently, the importance of stakeholder perspectives was underscored by a document produced by The Smart Grid Collaborative.[1] The document was provided to the Department of Energy (DOE) for consideration as it evaluates smart grid funding applications. The Smart Grid Collaborative is a joint effort of the National Association of Regulatory Utility Commissioners (NARUC) and the Federal Energy Regulatory Commission (FERC). NARUC President Frederick Butler of New Jersey and co-chair of the Collaborative commented in releasing the document: "The criteria we are proposing reflects the consensus among state and federal regulators that any smart grid stimulus funding must be used for projects that enhance the safe, reliable, affordable, intelligent and interactive operation of the interstate transmission and local distribution systems."

[1] http://www.ferc.gov/industries/electric/indus-act/smart-grid/FERC-NARUC-collaborative.pdf

What This Document Intends to Provide:

The Smart Grid Stakeholder Roundtable Group developed this document to provide ***general guiding principles*** for utilities and other smart grid project developers as they begin to plan and implement upgrades to their metering infrastructures, transmission and distribution networks. The Group is interested in having utilities and others recognize that by offering specific details to stakeholders about "smartening the grid" they can provide:

- ✓ ***A clearer picture of all of the costs, the environmental and efficiency benefits***
- ✓ ***A transparent explanation of the technology choices***
- ✓ ***An assessment of the anticipated life time of chosen technologies, as well as a response to questions concerning potential obsolescence and how the utility anticipates addressing the issue***
- ✓ ***And supporting documentation describing any consumer research available indicating levels of consumer interest and/or readiness to participate in consumer dependent demand side management programs***

The goal in creating this document is to help utilities and other smart grid project developers better communicate how and why they think smart grid technologies will benefit consumers and the environment, as well as the overall electric system in general.

The group also wants underscore the importance of consumer education and emphasize that utilities will be more effective in their rollout of smart grid technologies if they:

1. ***Provide an unambiguous vision, or understanding, of what system upgrades will look like over the next several years***
2. ***Assign a consumer value derived from those investments***
3. ***And, explain the advantages (and potential disadvantages) to consumers and the environment***

Background

What Is A Smart Grid? Smart grid is a term with varied meanings to different audiences. The multitude of workshops and programs that involve smart grid deployment makes it increasingly difficult for consumers or businesses to identify what "it" is or understand the potential benefits or concerns.

For most, a smart grid represents:

- ***A technology vision to optimize electricity delivery operations in the transmission and distribution systems***
- ***An opportunity to expand the use of information technology, including two-way communication between the utility and the customer***
- ***Greater ability to increase efficiency and reliability, as well as facilitate the integration and dispatch of renewable technologies into the broader grid network.***

The DOE has identified key goals and objectives for upgrading the grid. These goals include:

- ➡ Increased reliability
- ➡ Increased security
- ➡ Greater economic efficiency
- ➡ Greater energy efficiency
- ➡ Improvements to the environment
- ➡ Increased safety
- ➡ Utilizing a vision; not randomly implementing technologies

Communicate Supporting Statistics to Stakeholders

While DOE has created this overarching view of how the electricity delivery system will be transformed, equally important is for utilities and other smart grid project developers to communicate their vision along with supporting statistics to stakeholders.

As an evaluation is developed of system upgrades, the costs, benefits and potential risks must be clearly defined. For instance, stakeholders will likely want to know what technologies are utilized in these upgrades, if they are interoperable, the potential associated energy savings, etc.

What are You Pursuing and Why?

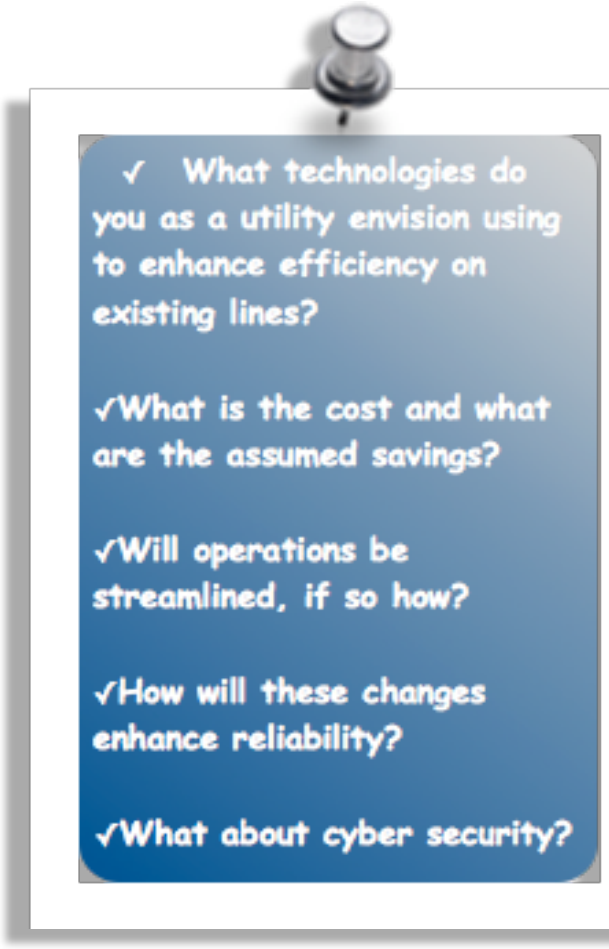
Utilities or developers might explore the use of two-way communication devices; advanced sensors; technology that can improve the efficiency and reliability of power delivery; and technologies that help coordinate power production from large numbers of small power producers such as rooftop solar panels or small wind turbines. Project developers might be considering upgrades that supply more specific instantaneous information, which helps reduce demand from commercial buildings.

The reliance on useful statistics and data will aide in the communication as stakeholders want to know what consumers can expect from the implementation of these technologies. For instance, DOE notes that if the transmission grid were just 5% more energy efficient, the energy savings would equate to

removing 53 million cars off the road – and with that comes the associated benefit of eliminating related environmental emissions.[2]

That kind of practical information should be translated into local benefits. Utilities excited about both the potential to transform the way they deliver electricity to homes, and the development of new business models to serve consumers, must also recognize the importance of fully explaining the costs, and the benefits associated with smart grid investments.

Defining and Communicating a Vision/Purpose



The Stakeholder Roundtable Group encourages utilities implementing a smart grid to develop a broader "vision" or long-range plan for the future of their electric transmission and distribution system. This is important even if they currently plan to pursue only a portion of those upgrades.

The vision should be driven by isolating key policy and operational goals, such as enabling scalable demand-side resources; reliably integrating variable generation resources; improving reliable delivery and increasing information availability about the grid to support both outage reduction times and better energy-use decision-making by consumers.

And, because smart grid changes may address virtually all segments of the electricity system, it is essential for utilities to work across traditional business divisions to ensure all aspects of their vision and the related smart grid solutions are defined properly.

Targeting Consumer Education

Customers are bombarded with information. It is critical for utilities to clearly and concisely describe their near and longer term smart grid vision so stakeholders can fairly evaluate smart grid upgrades. Without a succinct view, more questions than answers may arise.

Stakeholders want to understand how consumers can benefit from smart grid, which customer classes utilities have targeted (residential, commercial or industrial), how they will provide environmental and/or efficiency savings, how much of those identified benefits rely on consumers altering their behavior, and what electric rate program[3] or broader energy policy changes will be necessary.

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[2] Smart Grid, An Introduction. DOE www.oe.energy.gov/1165.htm

[3] See Regulatory Assistance Project's July 2009 issues letter: "Smart Grid or Smart Policies: Which comes First?" www.raponline.org/showpdf.asp?PDF_URL=Pubs/Issuesletter%5FJuly09%2Epdf>

Accountability and verification of the costs that utilities propose be recovered through rates, are essential components of any effective stakeholder communication program.

The What, Where and Why Behind a Utility's Smart Grid Choices

While some utilities are relying heavily on "smart meters" and enabling new services to residential customers, many stakeholders are interested in exploring investments in the transmission and distribution grid. Stakeholders would like to see a weighing of all potential investments that includes a benefits vs. costs profile and a full evaluation of what is best to pursue given the ultimate increase in electric rates needed to achieve these upgrades.

Stakeholders are also seeking some assurances that ***investments made are both the least-cost and tied to the technology upgrades.*** Complicating cost/benefit analysis is the fact that many smart grid technologies are enablers of other benefits, such as end-use energy efficiency and integrating larger penetrations of renewable energy into the grid. Consumers are interested in knowing if less expensive methods that achieve the same results are available.

Reliability, safety, and cyber security also play roles in the delivery of electricity, and it is essential to communicate how technology can enhance or complicate those components of the electric system.

Costs are Important, and They Are Increasing...

Costs in the utility sector are increasing. Upgrades of power plants to comply with environmental regulations, the potential for mandatory greenhouse gas reductions, costs associated with the addition of new power generators, or the increased use of renewable generation all can add to the customer bill. Even non-smart grid related upgrades to the transmission and distribution network would further impose upward cost pressure.

Quantifying all of the benefits resulting from smart grid upgrades is essential, but not necessarily simple. Smart grid technologies may provide benefits that go beyond the definition of generic transmission system improvements, such as supporting end-use energy efficiency and enabling larger penetrations of variable renewable energy into the grid.

Some of these advantages are more tangible. For instance, some smart grid transmission and distribution technologies are designed to reduce outage time, improve efficiency of electricity delivery and to reduce the vulnerability to cyber attacks.

In addition, due to the integrated nature of the transmission grid, not all benefits may be recognized directly by local consumers. ***Accordingly, the Stakeholder Roundtable recommends that utilities should detail the incremental benefits from smart grid improvements that can be directly linked to efficiency improvements, environmental gains, etc.***

From the utility perspective, it is important to recognize that consumer backlash could result if customers perceive or realize that they are saddled with increased costs without:

- ★ Any noticeable improvements in reliability and/or safety
- ★ A clear understanding of how much participation is required of them,
- ★ Receiving information about verified environmental benefits the utility has linked to smart grid technologies.

What is the utility of the future and how will it affect consumer costs, improve the utility's environmental footprint and provide for increased potential savings? These are all questions stakeholders want answered prior to proceeding down the smart grid path.

Smart Grid and Its Link to The Environment

While much of the smart grid discussion revolves around the digital technology being deployed in smart meters and transmission and distribution system upgrades, it is also important to recognize the environmental benefits or potential disadvantages affiliated with the smart grid.

Environmental benefits include:

- Reduced integration costs for variable renewable technologies and plug-in electric vehicles
- Greater use of clean distributed generation options by all consumers (such as solar rooftops)
- Enhanced load control capabilities that can provide sustainable energy efficiency savings for utilities and therefore help to avoid new generation
- Reduction in energy losses across the transmission and distribution grids

Although the smart grid does not ***ensure*** the realization of these environmental benefits, it could play a role in ***enabling*** them if deployed in conjunction with complementary policies. Consequently, stakeholders will want to know if these technologies are the only way to achieve the desired environmental benefits.

Environmental Concerns:

While peak load shaving is an important tool for utilities, it does not always result in total emission reductions. Load shifting can in fact mean less reliance on peaking generators that are not coal fired, to

a greater reliance on base load fossil plants. Therefore, the utility should examine the total system benefits or the potential of increased coal use if peak load shifting is the reason behind supporting smart grid installation.

And to the extent that smart grid technologies enable clean distributed generation, complimentary policies may be needed to incent the adoption of those clean generation options. Such incentives can help to avoid triggering the use of backup diesel generation by larger customers on high peak demand days -- a major contributor to smog.

Smart Grid's Relationship to a Utility's Overall Environmental Goals

Utilities that envision using smart grid technologies to enhance environmental programs should present the smart grid in the context of a broader strategy for achieving overall environmental benefits. A utility's holistic approach to meeting emission reduction goals may rely on load control, increased deployment of various renewables, and other measures. Those issues should be fully presented in a smart grid communications program.

A Vision of the *Entire* Grid

The Stakeholder Roundtable Group recommends that plans to upgrade the electric system should first include an examination of the whole system, reviewing transmission and distribution systems as well as meter programs. ***A total system approach will help identify the low-cost and high-benefit opportunities and in some cases, a portfolio of solutions across the grid may result in the lowest cost opportunities.*** This information will assist stakeholders in understanding the total "smart grid" picture.

Transmission

In addressing the "Big Picture", Stakeholders should understand what upgrades are planned to the transmission system and why.

There are many aspects of a smart grid communication plan that will help all stakeholders -- from consumers to policymakers -- better appreciate how utility upgrades will improve the environment, the economy of delivered power, and reliability. Moreover, as we move forward, many will be asking if security of the grid is also enhanced.

Utilities should consider the following issues in developing a communication plan describing their smart grid goals. Issues listed below are specific to the transmission system:

What Technologies Are You Using and Why?

The vast array of conferences, information forums and web sites, help to inform the public and stakeholders about smart grid. Yet, it is vital for utilities to communicate their own vision, identifying the technologies selected, why that technology was chosen and how the technology will be used to improve operations. It is also crucial that the technologies chosen be compatible with other utility systems with which they are interconnected. These technologies can include but are not limited to:

- **Phasor Measurement Units (PMUs) and Wide Area Measurement systems (WAMs):** PMUs are high-speed sensors that can be used to monitor power quality and in some cases respond automatically to changes in voltage. WAMs are a network of phasor measurement units that process information in real-time, thus facilitating transmission system operations on a regional and national scale.
- **Advanced Controls:** Advanced controls, such as automated fault detection and diagnosis systems, intelligent distributed control systems and voltage stability monitoring and control software, offer automated approaches to improving grid operations.
- **Energy Storage Devices:** Storage technologies such as advanced batteries, pumped hydro and others will allow electricity to be stored and dispatched during times of peak demand or to provide steady power from intermittent renewable technologies such as solar and wind.
- **Distributed Generation Controls:** Sensors at the substation may detect problems in circuits downstream from the substation, allowing utility operators to more easily enable customer-owned distributed generation.

Stakeholders will want to know:

- Is the utility considering the future ***potential of energy storage*** and will that make any of the current technologies obsolete?
- Will controls that are used to benefit distributed generators be paid for by those beneficiaries?
- Will the technologies permit net metering with customer-sited generation?
- How many ***existing and anticipated future distributed generators*** does the utility believe will benefit from these controls and has an adequate cost/benefit analysis been developed taking into consideration any environmental effects?
- Will utilities be working with the National Institute for Standards and Technology (***NIST), which is coordinating a stakeholder-based consensus building process on interoperability standards,*** intended to maximize the benefits of smart grid deployment?
- Are there opportunities to improve grid operation using ***existing hardware*** coupled with new software; and are advanced control technologies the most cost effective solution?
- Should ***all consumers pay*** for these upgrades and how will regulated rates reflect the costs?
- How will ***utilities monitor*** the information they are now receiving from these upgrades and how will that be translated into action to improve grid operations?

- Will this technology be ***integrated into the existing Supervisory Control and Data Acquisition Systems*** (SCADA), which currently assimilates information from the transmission and distribution system and helps to monitor outages, etc.?
- Will the ***usefulness*** of the technology be limited if neighboring systems do not upgrade their networks?
- What ***operational procedures*** will be implemented both with the utility and with Independent System Operators to ensure that the information provided by the technologies is used to achieve the maximum benefits at the lowest cost?
- How is ***ratepayer money being spent*** and what accountability measures are included in the plan?
- What measures are being undertaken to ***avoid sticker-shock and rate-shock*** (for instance, gradually increasing rates to recover the cost)? Further, if there are rate-deferrals, are those amounts going to be recovered using the long-term cost of debt as opposed to a higher interest rate?

In addition, Stakeholders will find it useful for utilities to explain how Smart Grid additions will affect:

Reliability

- ✓ Will outages be significantly lowered and if so, how?
- ✓ Will voltage variances be improved and what does that mean for customers?
- ✓ Will these changes make your transmission network more resilient where real- time information from sensors embedded in the system will anticipate, detect and respond to problems and thereby avoid or mitigate outages?
- ✓ Will power flow over the system be optimized, thereby minimizing operating costs?
- ✓ Will these changes help to offset grid congestion?

Cost/Benefits

- ✓ What are the anticipated savings and over what time period?
- ✓ Will these savings delay more costly generation options?
- ✓ Will these cost savings provide greater benefits than a new transmission line (when considering a cost/benefit analysis) or does the plan envision utilizing both new lines and upgrades?
- ✓ Will reliability upgrades correspond to lower prices for transmission and capacity costs?

Distribution System

What Technologies Are Under Consideration and Why?

Several technologies exist that may help a utility further enhance reliability at the distribution level. These include:

- **Integrated Volt/VAR Control (IVVC):** IVVC equipment allows utilities to reduce system voltage without jeopardizing reliability.
- **Intelligent substations:** Technology additions can also increase the "intelligence" of the substation by providing utilities more real-time information. This allows utilities to more closely match supply and demand, and increase decision time regarding grid conditions.
- **Fault detection, diagnosis and restoration:** By using a network of sensors, utilities can quickly identify faults in the distribution network and determine control strategies that could prevent additional faults and broader system outages.
- **Feeder upgrades:** With the addition of communication enabled smart re-closers and switches, both power system information and the ability to perform automated functions is increased, possibly reducing downtime and increasing the efficiency of delivered electricity. (Smaller utility systems may not be able to realize all of the above benefits.)
- **Transformers:** Power analyzers at the transformer level, which may interact with smart meters, provide additional data on consumption, outages, fault locations and restoration information.

Stakeholders will want to know:

- ***Are utilities following the FERC/NIST/DOE protocol process*** so that they are certain various communication devices can "talk" to one another?[4] If not, how are utilities ensuring interoperability?
- Has information been provided regarding ***how much these upgrades will cost*** and how flexible this will make the overall system?
- Is there a ***clear lifetime*** for the technologies and will they become obsolete within that timeframe? (Customers are concerned about obsolescence of newly purchased equipment and stranded costs.)

Reliability

- How will the technology actually increase reliability and reduce system outages, and how will this be communicated to consumers?
- How will the technology reduce or increase the potential for cyber security attacks?
- Has the technology chosen been proven or is this experimental? If it is experimental, what are the risks and who assumes the costs?

[4] **FERC Smart Grid Policy Statement**: *www.ferc.gov/whats-new/comm-meet/2009/031909/E-22.pdf*.

Costs/Benefits

- ✦ Has the utility created a broad plan that will allow for additions in technology deployment?
- ✦ Will consumer data be protected by the utility to prevent cyber security concerns?
- ✦ Will consumer data be easily accessed in a manner that meets market requirements (in order for consumers to take the necessary steps to reduce load, etc.)?
- ✦ Have the utilities properly documented all the benefits so they can be netted against the costs to reduce the overall price tag for customers?
- ✦ What steps has the utility taken to ensure the safety of the data and the systems, and do those costs outweigh the potential benefits?
- ✦ Will this technology impact interconnection costs and if so, has the utility fully demonstrated to consumers what those costs will entail, and that these technologies will not be utilized for anti-competitive purposes?
- ✦ What are the identifiable risks and who is responsible for mitigating each risk?

Residential Consumers

Many think of the smart grid primarily as a two-way communication device between consumers and the utility controller.

The advantages of this arrangement are twofold.

★ One, utilities are better able to control larger segments of residential load by cycling air conditioners and other major pieces of equipment off for short periods of time (with customer agreement) when peak demand is greatest.

★ Two, some programs are combined with rate structures that charge higher prices during times of high electric usage on the utility system (called peak pricing). In this case, consumers on an individual basis, can make their own choices to delay using large electric powered devices, such as washing machines or dryers, until a time when demand and the price for electricity is lower.

Stakeholder Questions on Rate Design & Demand Response

Some stakeholders are concerned that generic peak pricing programs will assist consumers with the greatest ability to make changes while leaving other consumers with simply higher rates.

Others point out that demand response (lowering the electric demand on the system through consumer incentives) can be facilitated through price signals, allowing for consumer response. Utilities can offer incentives to participate in utility-sponsored load control programs that do not put the entire customer class at risk of rate increases.

Some stakeholders and utilities view consumer oriented demand response as an essential component of moving toward increased energy efficiency. Yet other stakeholders point to studies suggesting that the potential for energy efficiency ***does not depend*** on smart grid technologies to achieve significant results. [5]

For larger consumers, access to instant energy use information and load control is an essential reason behind smart grid upgrades. Participation in ENERGY STAR programs such as Portfolio Manager helps large customers set investment priorities, identify under-performing buildings and verify efficiency improvements in order to receive EPA recognition for superior energy performance.[6] (*Additional information on commercial customers is found in the Commercial Section of this document*)

Do Consumers Want These Technologies?

Some stakeholders are concerned that ***residential consumers will not be interested in additional technologies*** that might provide them with more information to control their energy use, but also require their direct interaction. Yet, these technologies might be deployed despite these concerns.

Further, ***customers/stakeholders may be apprehensive to be an early adopter to such technologies,*** as smart grid capabilities continue to be tested and refined for greater reliability of performance and more effective user interface.

There is no clear answer as to how much even direct feedback on residential consumer bills is likely to change consumer use behavior. A study of residential energy bill reductions indicates that indirect

[5] For references to existing potential studies, see the National Action Plan for Energy Efficiency Vision for 2025 Appendix B (www.epa.gov/eeactionplan).

[6] Energy Star/Energy Portfolio Manager information can be found at: www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

feedback through enhanced billing detail resulted in a 0 to 10% reduction in energy consumption.[7] Another study found that further work is needed to understand the persistence of these savings. [8]

Working Together to Achieve the Desired Outcome

The Stakeholder Roundtable recommends that utilities, consumers, environmental groups and utility commissions work together to determine the best approach depending on the result they want to achieve in their specific service territory (load management, sustained energy efficiency improvements, etc.).

Utilities should also work with regulators and consumer and environmental groups to design the most appropriate pricing program, as price signals to consumers do not always guarantee success. Some distribution utilities are exploring programs that give utilities, instead of consumers, control of devices in order to maximize sustainable energy savings.

Creating a Win for Consumers

To create a positive opportunity for consumers, utilities should provide a portfolio of rate design options that enable all consumers to take advantage of the price signals. Further, customers should have the option to not participate without penalty.

Consumer education will be a key element in informing customers of the potential benefits and savings. This will help the utility ensure that that reduced costs from load shaping programs can be shared with all customers.

Protecting Consumers from Greater Ease of Disconnection

As smart grid technologies are deployed, it is essential for utilities to ensure their state policymakers that they will not use the technology to disconnect a larger number of customers simply because the technology facilitates that process.

At the same time, regulators should consider options for reducing disconnection and reconnection fees paid by customers if smart grid technologies reduce also result in a reduction of the utility's costs for those services. (Utilities will no longer be required to dispatch employees for those services.)

Regulations currently in place to provide customers with notice that their bills are in arrears and/or that they may face disconnection should not be modified with the adoption of smart grid. It is critical for utilities and regulators to recognize that smart meters do not replace the need for customers to have adequate notice to avoid termination of service.

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[7] Darby, Sarah. "The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing, and Direct Displays," Environmental Change Institute, University of Oxford, UK: April 2006

[8] EPRI Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.:http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405

Utilities can facilitate their own smart grid deployment programs by:

- ★ ***Addressing stakeholder concerns up front***
- ★ ***Address residential and commercial/industrial consumers separately as they will have varying needs***
- ★ ***Utilize consumer studies to help inform successful smart grid deployment.***

What Technologies Are You Using and Why?

Residential Consumers

- **Smart Meters:** **Advanced Metering Infrastructure (AMI)** capability is a large driver in what many see as the benefit of smart grid technologies. AMI can provide utilities with the ability to control not just one household's energy use, but neighborhood after neighborhood, creating new methods of achieving sustainable energy savings with little or no direct consumer participation. AMI may also provide more direct control over a consumer's electric bill. Aided by a significant increase in usage data, consumers may have the ability to determine when to operate certain large appliances at times of the day when electric rates are lower. In these circumstances, the technology would be coupled with an electricity rate structure that charges higher rates at times of the day when electric usage on the system is high and a lower rate when usage is lowest. (See earlier discussion on rate design.)

- **Smart Appliances**: Along with smart meters, some appliance manufacturers are developing smart appliances that will "talk" directly to the grid, and utility controllers will be able to cycle these appliances on and off with little or no consumer participation or loss of comfort. These appliances are a longer-term option for consumers. The onset of smarter grids will bring with it additional technology choices for consumer purchase. However, these would be consumer driven purchases and would not be considered in rate cases where stakeholders are involved.

What Stakeholders Will Want to Know: Utilities should consider answering the following questions when examining deployment of smart grid technologies at the residential consumer level:

- **Smart Meters Before Other Distribution Upgrades?** If distribution level enhancements such as smart meters are being considered prior to transmission or other distribution level upgrades, a rationale for this approach will help stakeholders understand what options the utility has considered and how this plan is best suited for its service territory.

- **Peak Load Reduction?** If these upgrades are intended to reduce peak load, how much load will be avoided over what period? Has the utility performed any customer research to fully understand the feasible consumer response rate? If this program is successfully deployed over the entire network, will that result in a shifting of peak loads vs. actual reductions? What is the anticipated environmental impact of these peak load reductions and how will they be

measured? (In some areas of the country, peak load shifting actually could result in higher carbon and other emissions if natural gas peaking facilities are shifted to base load coal plants.). Are these peak load savings being fully integrated into future generation and transmission upgrade and expansion decisions to reduce total system costs?

- **Rate Changes?** Are changes in regulated rates anticipated in order to make this deployment successful? If so:
  - When will those rate cases be filed?
  - What kind of analysis will be presented to ensure proper incentives are provided to customers though these rates?
  - How will these rate changes be explained to customers?

- **How Much Consumer Interaction Is Required?** If customer energy efficiency benefits are the goal, what type of enabling technologies will be required?
  - Will customers be required to purchase this technology or will the cost be rolled into the overall rates that all consumers pay?
  - How will that purchase be incented through rates and other programs to address the additional market barriers?
  - Will all customers have access to the enabling technology? For example, will Internet connections be required in homes to obtain information feedback?
  - Will costs be spread evenly across customers?
  - Has the utility examined all technologies in this category to ensure it is deploying the most advanced? (Stakeholders want to avoid the possibility of technologies becoming quickly obsolete and therefore create a stranded cost.)
  - Has the utility provided assurance that these technology choices are using interoperable standards to ensure communications function properly?
  - Has the utility conducted broad participation analysis for each customer class?

- **Cost Benefit Analysis:** Cost benefit analysis can be difficult when describing smart grid improvements. Utilities should know that key to this analysis are the following issues:
  - Are all areas of smart grid improvement given equal rating? These categories include reliability, consumer savings, environmental improvements and efficiency improvements.
  - What is the overall cost of this project and what are the anticipated benefits over the lifetime of the technology?
  - Before deployment of smart meters, have alternate technologies been considered that might provide larger benefits that are more direct?
  - What kind of benefit measurement protocols will be used and how will results be documented?

- **Environmental Impacts/Benefits:** Many smart grid additions are considered as tools to reduce a utility's overall environmental footprint and increase the efficiency of delivered electricity.

- Has the utility considered the broad environmental benefits as well as impacts from smart grid deployment? For instance, data storage associated with smart grid technology will undoubtedly increase. Data storage centers are huge energy users. Has the utility evaluated the broad spectrum of savings offset by the potential increases of electric use from its smart grid additions?

- **Customer Security:** With the advent of smart grid technologies also comes an increased amount of data accumulation and the potential for cyber security infiltrations. Stakeholders will want to know how the utility plans to store and utilize data, what kinds of increased security techniques will be added and the cost of all of these functions. Stakeholders want to be certain that the cost of this additional information does not outweigh the benefits of deploying a smart grid. And for customers to be secure in using the technologies, they will want assurances that cyber attacks will not increase.

- **Finding the Least Cost Method for Demonstrating Smart Grid Improvements:**
Some utilities are collaborating with smart grid equipment vendors to test technologies without adding costs to consumers. Some have developed a cost/share programs with vendors. It is important for stakeholders to determine if a utility has explored all possibilities to make smart grid programs as cost- effective as possible. If utilities are considering demonstration projects they should address the following questions:
    - What will constitute a success?
    - What portion of the larger service territory does this demonstration constitute?
    - Is this demonstration large enough to capture the broad mix of consumers that make up the larger service territory (residential – large and small homes, low-income and senior citizens, commercial, industrial)?
    - Who is bearing the cost of this demonstration and has the utility considered a cost-sharing program with potential vendors?
    - Will this technology be rolled out to the entire service territory if successful and if so, what is the time line?
    - How will this program be communicated to all customers?

- **Communicating the Benefits :**
    - Will this project benefit all customer classes and has that been adequately detailed to these customers?
    - Have the cost/benefit scenarios for each customer class been evaluated?
    - How will potential cost savings measure up to other demonstration projects in other cities?
    - If the project uses smart meters, how do these meters differ from those in the 1980s and how soon will they be considered obsolete?
    - How often will the benefits be measured and verified during implementation? Will stakeholders have access to transparent, third-party evaluations of the project?

- What is the plan for educating consumers about AMI, various rate designs and how their household may benefit from smart grid?

- **Financing:** Stakeholders will also be interested if any federal dollars have been used in their program, and how the utility plans to leverage those dollars with vendor dollars.
  - For costs incurred by the utility, how will these costs be recovered?
  - If capitalized, what rate of return is expected?

Commercial/Industrial Customers

Commercial and Industrial customers have unique needs and can deliver a greater amount of energy savings. Reducing electricity use during peak and non-peak periods can actually provide direct benefits to the *entire* utility system. However, these customers have very specific requirements and it is important for utilities or other project developers to understand them in order to develop plans that successfully reduce overall system costs. Smaller utilities, on the other hand, may determine that they are best suited to focus smart grid activities on residential consumers where they can justify the cost/benefit expenditures.

What Technologies Are You Considering and Why?

- **Continuous Commissioning and Automated Diagnostics:** Commercial buildings account for approximately 40%[9] of overall energy use, yet it is difficult to encourage building owners to install equipment to reduce electric load because in most cases, it is the building customers that pay for energy usage. However, as green building certification and participation in programs such as EPA's Portfolio Manager increases and building codes are tightened, builders, architects, and building owners will seek methods to keep energy costs down.

[9] See EIA data: http://www.eia.doe.gov/emeu/aer/pdf/pages/sec2_6.pdf

- Smart grid technologies can help building managers reduce load through scaled automated diagnostics based on whole-building energy signals. [10] They can also assist building managers and owners in benchmarking their own building's performance against other buildings in terms of efficiency and energy costs per square foot. Smart grid implementation could also provide them with tools to verify costs, risks and benefits.
- Continuous commissioning from active monitoring assists the building owner and manager by providing a system to maintain end use equipment. When chillers, refrigeration equipment or energy management control systems are first installed, they are commissioned. This means each component is sized, specified and tested for a pattern of operation based on expected levels of occupancy, weather and other load determining factors.

- **Consumption Data** One significant step in helping building managers keep energy costs down is to provide *simple* access to consumption information. This information will help owners better manage energy use by ensuring that installed equipment such as chillers, refrigerators and energy management control systems are maintained and operating as designed.
  - Ensuring that the facility has access to its own consumption information allows for buildings to make certain equipment is properly commissioned to meet forecasted loads during operation, to allow for changes in operational requirements that occur over time, and to ensure installed technology is performing and not rendered obsolete through sub-optimal operational strategies. With consumption measuring devices and communication capabilities in place, building owners, managers and engineers can effectively monitor building performance of mechanical equipment and can alert proper personnel immediately if problems occur.

- **Access to Information** Many buildings have what can be described as "localized smart grids" with sophisticated building automation systems (BAS) that perform many routine and sophisticated functions. In some cases, all that is required from the utility to achieve optimal performance is building manager/owner access to their own consumption data. Newer BAS systems can be accessed remotely and programmed to respond to grid operations such as price or reliability signals. Utilities are encouraged to develop a full understanding of the commercial building consumer in order to meet and exceed the benefits derived from smart grid implementation.
  - Access to reliable and low-cost usage data remains the key to commercial building participation in the variety of programs available, particularly demand response programs. Commercial buildings with sophisticated BAS systems have almost unlimited ramping and start-stop flexibility, and have the potential to be dispatched efficiently in energy and ancillary service markets. Because reducing demand from large buildings can help reduce system peaks, and therefore the need for new generation, utilities should look to commercial buildings to assist with this challenge.

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[10] See PECI's Wiring the Smart Grid for Energy Savings: Integrating Buildings to Maximize Investment http://www.peci.org/About/smartgrid_whitepaper_final_071709.pdf

What Commercial/Industrial Stakeholders Will Want to Know

- **How Will Utilities Communicate and Transfer Information?** When designing metering and communications systems it is imperative for utilities to seek out commercial customers to understand lessons learned from their side of the meter and work with them to ensure optimal building operations are facilitated. Many commercial buildings can provide the utility with a bottom-up approach to efficiency.

- **What are the Anticipated Energy Savings?** The Electric Power Research Institute (EPRI) has estimated that with a market penetration of between 5% and 20% in large commercial buildings, smart grid devices could result in annual energy saving potential ranges of 2.2 to 8.8 billion kWh. This is equivalent to a .14 - .18% reduction in projected retail sales projected by the Energy Information Administration (EIA 2008 Annual Energy Outlook for the year 2030). Stakeholders will be interested in the specific anticipated energy savings for the projects utilities contemplate, and how they might compare to the anticipated energy savings from residential projects.

- **Financing Options?** Because the cost can be substantial for this sector, some commercial and industrial customers will be interested in working with the utility on financing arrangements to achieve the collective load reduction goals.

- **Customer Security?** With the advent of smart grid technologies also comes an increased amount of utility data accumulation and the potential for cyber security infiltrations into utility operations. While commercial buildings and tenants have had years of dealing with these issues in e-commerce and in developing secure open protocols for BAS system accessibility, many commercial buildings will want to know how the utility plans to measure, transfer, store and use consumer consumption information that will necessarily increase in terms of magnitude.

- **Non-Utility Options?** Consumers do not want to be limited to utility-only sponsored smart grid programs. It is important for utilities to understand the market efficiency of commercial buildings that exist, including service and performance contracting, energy service offerings and competitive supplier products and services.

Options for Putting Stakeholder Perspectives Into Practice

Stakeholders recognize that the dialogue on Smart Grid improvements also demands a significant amount of information flow from the utility/project developer. There are many approaches for states and utilities to pursue in order to put the ideas presented in this paper into practice. Examples include:

- **Collaboration with Stakeholders and Policymakers:** Several states have already facilitated stakeholder meetings by bringing interested parties together to discuss smart grid deployment. Stakeholders urge that utilities design workshops to include precise information, gather consumer input, detail the benefits to all stakeholder audiences and provide opportunities for all concerns to be expressed. ***In addition, for these meetings to be effective, goals and objectives should be summarized, measured and evaluated to ensure ideas have been adequately identified and put into practice. Finally, all stakeholders should have an equal voice in the process.***

- **Pursuing Operational Improvements:** A number of smart grid benefits rely on changes in customer energy use, integration of distributed generation and automation of the transmission and distribution networks. These changes will also require utility managers to develop and deploy new methodologies to ensure they are able to act on this ***new*** information. Therefore, utilities should be prepared to analyze and describe how they have fully considered the range of operational improvements that will be required to maximize system efficiency. ***This analysis should include a timeline and a list of expected results.***

- **Testing of Technologies And Practices Prior To Choosing One**: Utilities are already adopting varying approaches to technology testing. Some are exploring smart grid development by deploying several different technologies to determine the best features for their system. Others are collaborating with outside stakeholders to create a deployment plan that fits the needs of their consumers and their larger environmental goals. Still others are combining both approaches.

- **Contribute to And Leverage Ongoing Smart Grid Efforts:** Activities are under way to help expedite the effective advancement of the smart grid. Several key activities are:
  - ***NIST Smart Grid Interoperability Standards Project***: Under the Energy Independence and Security Act of 2007, the National Institute of Standards and Technology (NIST) has primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems. Interoperability is the ability of diverse systems and their components to work together. NIST recently developed a roadmap for achieving these standards
  - **DOE's Smart Grid Maturity Model:** The Smart Grid Maturity Model is a management tool that an organization can use to appraise, guide, and improve its smart grid transformation. Housed with Carnegie Mellon's Software Engineering Institute, the model primarily is focused on helping an organization improve its own "smartgridness," and it can also enable the industry by providing a common language and vision of the key elements of the smart grid transformation.
    For electric utilities, the Smart Grid Maturity Model provides a roadmap of activities, investments, and best practices for smart grid evolution along with guidance on related technological, regulatory, and organizational issues. [11]
  - ***DOE's Smart Grid Clearinghouse:*** This clearinghouse will provide information on the smart grid for utilities and consumers, including pilot programs and lessons learned.
  - ***NARUC/FERC Smart Grid Collaborative:*** NARUC and FERC launched this collaborative to help regulators understand what is being developed and how it will affect consumers. NARUC recently identified concerns of state policymakers. These include the cost of the smart grid, who will pay for it, who benefits, how ratemaking will be treated, and what the opportunity cost is compared to other utility investments.
  - ***Anticipating the Unintended Consequences:*** As utilities implement smart grid technologies, some larger customers may become more demanding in their

[11] For additional information see: www.sei.cmu.edu/smartgrid/tools/index.cfm

expectations for increased reliability and desire for real time information. Enhanced communication with these customers is essential in order to ensure that utilities are providing a broad picture of what to expect from system upgrades.

- ***Many other efforts are under way*** and a reference list (non-inclusive) is included at the end of this document.

- **Finally, making certain the I's are dotted and T's crossed:** Effective solutions to smart grid development should utilize all of the tools mentioned in this paper. Most importantly, utilities considering large scale technology deployment should ensure the following questions are answered:
  - ***Environmental Goals Matching Technology Deployment:*** Has the utility considered the broader environmental goals it must achieve when considering smart grid deployment and if so, has it prioritized technology deployment appropriately?
  - ***Getting the Largest Benefits for the Cost:*** Has the utility considered the costs and benefits to consumers? Has the utility chosen technologies that will provide the largest benefits for the cost incurred before considering technologies that might have higher costs with fewer benefits?
  - ***Information Access to Consumers***: Has the utility evaluated consumer needs and is it providing the kind of information those commercial/industrial consumers are seeking?
  - ***Developing the Plan, Reaching out To Stakeholders*****:** How has the utility reached out to stakeholders in developing a broad plan that meets the states/service territories/federal government and consumer goals in providing reliable electricity at the lowest possible cost?
  - ***Assessing the Plan:*** In the past, some utilities have reluctantly discussed avenues pursued that did not proceed as anticipated. Beginning and maintaining an active outreach and communication plan to all stakeholders will help to engage them in developments as they occur, and allow for continued acceptance with the audiences they are seeking to involve.

The Smart Grid Stakeholder Roundtable Group has provided these guiding principles in the hope that utilities will recognize the importance of developing a broad technology plan that includes and applies consumer input, and that identifies all the benefits and related costs of smart grid development. By working together, utilities, consumers, environmentalists and state and federal policymakers will help shape the industry for the challenges of the 21st century.

Disclaimer: *The Smart Grid Stakeholder Roundtable Group has provided input to this document, but as some are representatives of Public Service Commissions, or of associations, they are not necessarily able to endorse it as an official document of their state or organization. All Members have commented and agreed that this document serves a significant and useful purpose for helping both stakeholders and utilities pursue smart grid technologies in a logical and cost effective method.*

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Additional Resources for Utilities Implementing Smart Grids

Department of Energy Smart Grid Web Site: ***www.oe.energy.gov/smartgrid.htm***

Department of Energy Smart Grid Systems Report to Congress: July 09
www.oe.energy.gov/smartgrid.htm

Report to NIST on the Smart Grid Interoperability Standards Roadmap:
www.nist.gov/smartgrid/PAPCompilation-7-30-09.pdf

The Illinois Smart Grid Initiative: Coordinated by the Center for Neighborhood Technology with support from the Galvin Electricity Initiative: Report includes information regarding costs and benefits to electric consumers ***www.galvinpower.org/resources/listall.php?sct=14***

National Action Plan on Energy Efficiency: Vision For 2025: *particularly* Utility Best Practice Guidance for providing customers energy use and cost data; Sector Collaborative Customer Barriers to Efficiency ***www.epa.gov/eeactionplan***

Testimony of National Association of Regulatory Utility Commissioners: President Fredrick Butler of New Jersey before the Senate Energy and Natural Resources Committee, March, 3, 2009 ***www.naruc.org/policy.cfm?c=testimony***

The Smart Grid Frequently Asked Questions for State Commissioners: National Association of Regulatory Utility Commissioners
www.naruc.org/Search/results.cfm?cx=partner-pub-3891771558338672%3Ae0c2hyn7jdm&cof=FORID%3A10&ie=ISO-8859-1&q=smart+grid&sa=Search#1251

Federal Energy Regulatory Utility Commission Smart Grid Policy,
www.ferc.gov/whats-new/comm-meet/2009/071609/E-3.pdf

Regulatory Assistance Project's July 2009 issues letter: "Smart Grid or Smart Policies: Which Comes First? **www.raponline.org/showpdf.asp?PDF_URL=Pubs/Issuesletter%5FJuly09%2Epdf>**

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