Ingersoll Rand Comments
Smart Grid RFI: Addressing Policy and Logistical Challenges

Definition and Scope

The deployment of technology to make the nation's electric grid a more interactive, efficient and responsive system is already underway. At the early stages of any major technological shift, stakeholders often use the same term-of-art to mean different things which can lead to miscommunication. To minimize confusion as we identify policy challenges and recommendations, this RFI uses the broad definition of Smart Grid laid out in Title XIII of the Energy Independence and Security Act of 2007 (EISA). Title XIII mentions that the smart grid uses communications, control, and information technology to optimize grid operations, integrate distributed resources including renewable resources, increase energy efficiency, deploy demand response, support electric vehicles, and integrate automated, interactive interoperable consumer devices. We encourage commenters to reference the full text of EISA section 1301.

We invite comment however on whether this is the best way to define the smart grid. What significant policy challenges are likely to remain unaddressed if we employ Title XIII's definition? If the definition is overly broad, what policy risks emerge as a result?

We also invite comments on the geographic scope of standardization and interconnection of smart grid technologies. Should smart grid technologies be connected or use the same communications standard across a utility, state, or region? How does this vary between transmission, distribution, and customer-level standards? 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?

Interactions With and Implications for Consumers

Typical consumers currently get limited feedback about their daily energy consumption patterns and associated costs. They also have limited understanding of variations in the cost of providing power over the course of the day and from day to day. Many smart grid technologies aim to narrow the typical consumers' knowledge gap by empowering consumers with greater knowledge of and ability to control their consumption and expenditures. This vision transforms many consumers' relationship with the grid, which prompts us to ask the following questions.

- For consumers, what are the most important applications of the smart grid? What are the implications, costs and benefits of these applications? What new services enabled by the smart grid would customers see as beneficial? 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?

  Much of the focus on customer demand for smart grid technologies relates to the possibility of reduced energy bills as a primary source of attraction. However, much of the research into consumer behavior around energy use demonstrates that an approach which focuses only on cost savings may ignore other powerful motivators. If smart grid technologies can incorporate other features which enhance quality of life, such as additional ability to control/monitor one's home, it would likely broaden the appeal of such technologies.
- How well do customers understand and respond to pricing options, direct load control or other opportunities to save by changing when they use power? What evidence is available about their response? To what extent have specific consumer education programs been effective? What tools (e.g. education, incentives, and automation) increase impacts on power consumption behavior?

What are reasonable expectations about how these programs could reshape consumer power usage?

- To what extent might existing consumer incentives, knowledge and decision-making patterns create barriers to the adoption or effective use of smart grid technologies? For instance, are there behavioral barriers to the adoption and effective use of information feedback systems, demand response, energy management and home automation technologies? What are the best ways to address these barriers? Are steps necessary to make participation easier and more convenient, increase benefits to consumers, reduce risks, or otherwise better serve customers? 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? How do these factors relate to other factors like consumer education, marketing and monthly savings opportunities?

    Recent research by OPOWER has provided reason to believe facilitating demand response among customers would be well complemented by additional measures designed to encourage behavioral changes relating to energy use through leveraging both basic behavioral mechanisms as well as civic participation motivators. The only alternative to adequately considering behavioral change among energy users is a level of centralized energy control which would likely prove unpalatable to the general public and thus policy makers as well.

- 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?

    Discussion of "choices" implies that most consumer decisions relating to energy use are conscious and premeditated as opposed to largely unconscious and the result of habit. Expecting increased information and education to overcome a lifetime of habit may well result in failing to modify behavior in the desired manner. To avoid this, energy use information must be transformed in the minds of consumers. It must have the three necessary components of true transparency: salience, relevance and accessibility. Only in this way can it rise to the level of prominence necessary to modify longstanding behavior patterns.

- What steps are underway to identify the best combinations for different segments of the residential and commercial market?
- Are education or communications campaigns necessary to inform customers prior to deploying smart grid applications? If so, what would these campaigns look like and who should deploy them? Which related education or public relations campaigns might be attractive models?
- 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? What are the important lessons from efforts to persuade people to recycle or engage in other environmentally friendly activity? What are the implications of these insights for determining which tasks are best automated and which should be subject to consumer control? When is it appropriate to use social norm based tools?
- 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?

    As the deployment of smart grid technologies has yet to occur with force much analysis has yet to be done about which technologies, techniques and policies will be most effective at reducing consumer energy use. The FERC NAPDR must allow for sufficient flexibility to allow best practices to be identified and then serve as a vehicle for more widespread dissemination throughout the federal-state policy making community.

Interaction with Large Commercial and Industrial Customers

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

Assessing and Allocating Costs and Benefits

Regulators pay a great deal of attention to the costs and benefits of new investments, appropriate allocation of risk and protection of vulnerable customer segments. The many unknowns associated with smart grid programs make these ubiquitous questions particularly challenging, which suggests a great need to share perspectives and lessons.

- How should the benefits of smart grid investments be quantified? What criteria and processes should regulators use when considering the value of smart grid applications?
- When will the benefits and costs of smart grid investments be typically realized for consumers? 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? 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? If these applications are described as benefits to sell the projects, should the costs also be factored into the cost-benefit analysis?
- 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?
- How do the costs and benefits of upgrading existing AMR technology compare with installing new AMI technology?
- 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?

    Direct load management carries with it the distinct possibility of increasing consumer discomfort resulting from inappropriate indoor environments. Any attempt to "sell" the public on the value of smart grid (another consideration at issue here) by any entity rests on the notion that far from a diminution of their quality of life smart grid will improve it. If discomfort results, this could well cause public sentiment to turn, threatening the continued growth and adoption of smart grid technologies and policies.
- How likely are significant cost overruns? What can regulators do to reduce the probability of significant cost overruns? How should cost overruns be addressed?
- 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?
- What are appropriate ways to track the progress of smart grid implementation efforts? What additional information about, for example, customer interactions should be collected from future

pilots and program implementations? How are State Commissions studying smart grid and smart meter applications in pilots? In conducting pilots, what best practical approaches are emerging to better ascertain the benefits and costs of realistic options while protecting participants?

- How should the costs of smart grid technologies be allocated? To what degree should State Commissions try to ensure that the beneficiaries of smart grid capital expenditures carry the cost burdens? Which stakeholder(s) should bear the risks if expected benefits do not materialize? How should smart grid investments be aligned so customers' expectations are met?
- When should ratepayers have the right to opt out of receiving and paying for smart grid technologies or programs like meters, in home displays, or critical peak rebates? When do system-wide benefits justify uniform adoption of technological upgrades? How does the answer depend on the nature of the offering? How should regulators address customer segments that might not use smart grid technologies?
- 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?

    It is critical that building/home owners retain ultimate authority to determine how energy use is managed. Only by allowing ultimate authority to rest with vulnerable populations can we be assured that they will be protected. Ultimate authority here means the ability to opt out of any program deemed not advantageous. While it is fair to rebut this point by stating that such a system may not result in savings of sufficient magnitude, this claim is predicated on the assumption that many will not want to participate. If the advantages of participation are abundant and clear, the hallmarks of a well constructed program, participation rates should not be a problem.
- What steps could ensure acceptable outcomes for vulnerable populations?

Utilities, Device Manufacturers and Energy Management Firms

Electricity policy involves the interaction of local distribution utilities, bulk power markets and competitive markets for electrical appliances and equipment. Retail electricity service is under state and local jurisdiction. Generally, bulk power markets are under FERC jurisdiction. Appliances comply with federal safety and efficiency rules. Smart grid technologies will change the interactions among these actors and should create new opportunities for federal-state collaboration to better serve citizens.

Greater collaboration seems essential. Some state regulatory agencies already oversee energy efficiency programs that help ratepayers acquire equipment like energy efficient appliances. Those appliances also are subject to federal regulatory oversight. As the smart grid evolves, these types of ties are likely to deepen. Moreover, EISA foresees a federal role in developing potentially mandatory standards for some smart grid equipment and voluntary standards for smart-grid enabled mass-produced electric appliances and equipment for homes and businesses. Many commentators suggest that utilities may lack appropriate incentives to invest in the most cost effective smart grid infrastructure and allow that infrastructure to be used to conserve energy, because most service providers generate revenue based on the number of kilowatt hours sold and pass through the capital costs of things like smart grid infrastructure. If this is accurate, then those disincentives are an impediment to achieving national and state goals and, therefore, merit state and federal policy makers' attention.

In issuing this RFI, DOE is mindful that the states oversee retail electric service and that state regulation differs state by state. Within states different types of service providers may be subject to different regulatory schemes depending, for example, on whether the service provider is investor owned, publicly owned or a cooperative. Recognizing the primary role of states in this area, we ask the following questions:

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

    The NIST process is proceeding well and the administration should continue to support it. The federal government should use its purchasing power to encourage implementation of the standards through specifying them as a requirement for equipment to be used on military bases, government buildings, etc. The legal framework surrounding implementation of smart grid policies around the country is fractured. While addressing this may be possible through modification of existing statutes, doing so would raise very thorny issues of federalism. This should be approached with caution, as such a longstanding issue of contention could serve to derail otherwise positive efforts. Thus, active attempts at voluntary coordination are that much more important. Leveraging the efforts of the private sector, a critical element of success, is most readily achieved by providing uniformity in the marketplace. Providing a forum for the sharing of best practices would be beneficial would be a positive step in that direction. This could be a role for the federal government.

- 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)?

    Discussion of smart grid regulation may delay adoption as customers postpone purchasing smart-grid enabling equipment until regulations are issued. Providing incentives to use renewable energy sources will drive demand for load management technologies.

- How will programs that use pricing, rebates, or load control to reduce consumption during scarcity periods affect the operations, efficiency, and competiveness of wholesale power markets?
- Will other smart grid programs have important impacts on wholesale markets? Can policies improve these interactions?
- 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?
- What is the potential for third-party firms to provide smart grid enabled products and services for use on either or both the consumer and utility side of the meter? In particular, are changes needed to the current standards or standard-setting process, level of access to the market, and deployment of networks that allow add-on products to access information about grid conditions? How should the interaction between third-party firms and regulated utilities be structured to maximize benefits to consumers and society?

    There is a great potential for existing equipment makers to include smart grid enabling features in new product releases. Providing incentives, and directing federal purchases, will stimulate demand and reduce the cost to the consumer. The NIST standards process is working well and a significant change in that process would create uncertainty and delay.

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

Rebates and incentives will help drive adoption and stimulate consumer awareness and interest.

- Given the current marketplace and NIST Smart Grid Interoperability Panel efforts, is there a need for additional third-party testing and certification initiatives to assure that smart grid technologies comply with applicable standards? If there is a need for additional certification, what would need to 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?

  If Federal purchases specified a certification process and/or authority, then commercial purchases would be likely to utilize the same metrics (such as EnergyStar).
- Commenters should feel free to describe current and planned deployments of advanced distribution automation equipment, architectures, and consumer-facing programs in order to illustrate marketplace trends, successes, and challenges. And they should feel free to identify any major policy changes they feel would encourage appropriate deployment of these technologies.

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

Significant change in the technologies used to generate power and to keep supply and demand balanced is likely to occur over the foreseeable future. We invite comments on the steps that should be taken now to give the grid the flexibility it will need to deal with transitions that are likely in the next few decades. Commenters might address the following questions, some of which have more immediate implications.

- What are the most promising ways to integrate large amounts of electric vehicles, photovoltaic cells, wind turbines, or inflexible nuclear plants? 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? 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? How do factors like the speed of optimization algorithms, demand for reliability and the availability of grid friendly appliances affect those trade-offs? What are these strategies' implications for competition among demand response, storage and fast reacting generation? 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?
- 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?
- 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?
- What barriers exist to the deployment of grid infrastructure to enable electric vehicles? What policies are needed to address them?

Reliability and Cyber-Security

- We invite comment on the reliability opportunities and challenges that smart grid technologies create, including: What smart grid technologies are or will become available to help reduce the electric system's susceptibility to service disruptions?
- What policies are needed to facilitate the data sharing that will allow sensors (e.g., phasor measurement units) and grid automation to achieve their potential to make reliability and

performance improvements in the grid? Is there a need to revisit the legal and institutional approaches to generation and transmission system data collection and interchange?

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

Managing Transitions and Overall Questions

The following questions focus on managing incremental change during the gradual evolution of the grid that may transform the power sector over the next few decades.

- What are the best present-day strategies for transitioning from the status quo to an environment in which consumer-facing smart grid programs (e.g., alternative pricing structures and feedback) are common? What has been learned from different implementations? What lessons fall into the ``it would have been good to know that when we started'' category? What additional mechanisms, if any, would help share such lessons among key stakeholders quickly?
- 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? What are some strategies for integrating legacy equipment into a robust, modernized grid? What strategies are appropriate for investing in equipment today that will be more valuable if it can delay obsolescence by integrating gracefully with future generations of technology?
- How will smart grid technologies change the business model for electric service providers, if at all? What are the implications of these changes?
- What are the costs and benefits of delaying investment in metering and other smart grid infrastructure while the technology and our understanding of it is rapidly evolving? How does that affect the choice of an appropriate time to invest?
- What policy changes would ensure that the U.S. maintains global competiveness in smart grid technology and related businesses?
- What should be the priority areas for federally funded research that can support smart grid deployment?

    While one of the obstacles to full implementation of smart grid can be described as technological it is important not to conflate this with a need for technological improvements. Were many existing technologies incorporated into homes and buildings significant savings could be reaped and, just as importantly, lessons learned. Federal research spending would best be directed towards larger-scale pilots to capture learnings and best practices. This would also better enable the federal government to serve as the primary body for the dissemination of such practices around the country.

Finally, as noted at the outset, we invite commenters to address any other significant issues that they believe implicate the success or failure of the transition to smart grid technology.