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EMPOWERING CONSUMERS AND PROMOTING INNOVATION THROUGH THE SMART GRID

HEARING

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

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EMPOWERING CONSUMERS AND PROMOTING INNOVATION THROUGH THE SMART GRID

THURSDAY, SEPTEMBER 8, 2011

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:11 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Benjamin Quayle [Chairman of the Subcommittee] presiding.

RALPH M. HALL, TEXAS
CHAIRMAN

EDDIE BERNICE JOHNSON, TEXAS
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U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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Subcommittee on Technology and Innovation

Empowering Consumers and Promoting Innovation through the Smart Grid

Thursday, September 8, 2011

10:00 a.m.-12:00 p.m.

2318 Rayburn House Office Building

Witnesses

Dr. George Arnold

National Coordinator for Smart Grid Interoperability, National Institute of Standards and Technology

The Honorable Donna Nelson

Chairman, Public Utility Commission of Texas

Mr. John Caskey

Assistant Vice President, Industry Operations, National Electrical Manufacturers Association

Mr. Rik Drummond

Chief Executive Officer and Chief Scientist, The Drummond Group

HEARING CHARTER

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION U.S. HOUSE OF REPRESENTATIVES

Empowering Consumers and Promoting Innovation through the Smart Grid

THURSDAY, SEPTEMBER 8, 2011
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose

On Thursday, September 8, 2011 the Subcommittee on Technology and Innovation of the Committee on Science, Space, and Technology will hold a hearing to examine the status of efforts to develop open standards for smart grid technologies and drive innovation within smart grid development. This hearing will provide the Subcommittee with an update on current standards development accomplishments, as well as the actions needed to empower and protect consumer interests while promoting innovation through the growth of the smart grid.

2. Witnesses

- **Dr. George Arnold**, National Coordinator for Smart Grid Interoperability, National Institute of Standards and Technology
- **The Honorable Donna Nelson**, Chairman, Public Utility Commission of Texas
- **Mr. John Caskey**, Assistant Vice President Industry Operations, National Electrical Manufacturers Association
- **Mr. Rik Drummond**, Chief Executive Officer and Chief Scientist, The Drummond Group, Inc.

3. Brief Overview

The hearing will examine efforts led by the National Institute of Standards and Technology (NIST) to coordinate the development of a common framework and standards necessary to ensure a secure and interoperable nationwide smart grid. The smart grid is a planned nationwide network that uses information technology to deliver electricity efficiently, reliably, and securely. The smart grid is designed to improve the transmission of electricity from power plants to consumers, provide grid operators with information about conditions of the electricity system, integrate new technologies into the grid, and allow consumers to receive more information about electricity prices and availability from the electricity system. This represents a leap from a one-way, analog system of disconnected power suppliers to a two-way, digital, interoperable national network. As envisioned, the smart grid is a more efficient way to distribute and diversify power sources, creating capabilities to make the grid more efficient by reducing demand peaks and increasing capacity utilization while providing consumers with innovative tools to reduce energy usage, potentially saving them money.

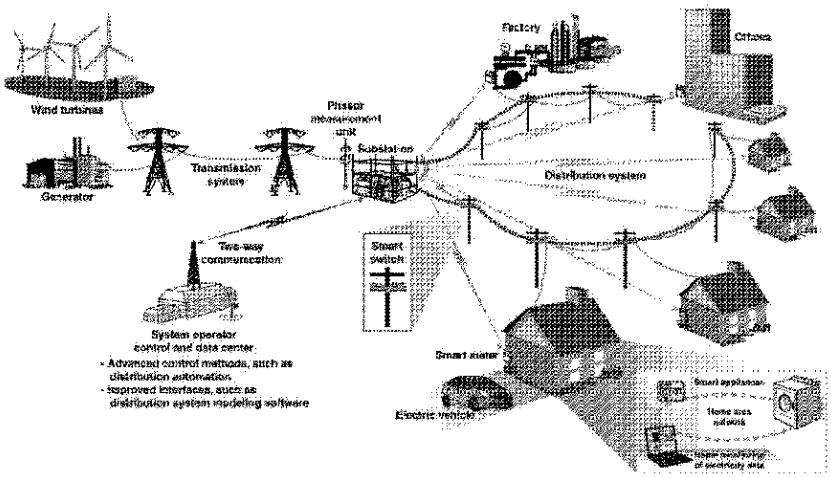

Figure 1. Common Smart Grid Components. Image is excerpted from a U.S. Government Accountability Office report, *Electricity Grid Modernization: Progress Being Made on Cybersecurity Guidelines, but Key Challenges Remain to be Addressed*. GAO-11-117, January 12, 2011. www.gao.gov/products/GAO-11-117.

4. Background

The electric grid has changed little since the end of the nineteenth century. Since President Roosevelt directed the Rural Electric Administration to electrify the continent, electricity and information has flowed in one direction; from generator to end user. Electricity has to be used the moment it is generated, and because the capacity for the generation of power matches the consumption of power, the electricity supply system must be sized to generate enough electricity to meet the maximum anticipated demand. A modern smart grid is designed to change this completely. The smart grid is envisioned to operate with a two-way flow of electricity and information capable of monitoring everything from power plants to customer's individual appliances. This will provide utility operators and consumers the data necessary to better manage energy usage, allowing for better control of costs and lower electric bills.

The Energy Independence and Security Act of 2007 (EISA) (P.L. 110-140) set requirements for a "reliable and secure electricity infrastructure." Under EISA, 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." NIST supports one of the key roles in the growth of the smart grid—bringing together manufacturers, consumers, energy providers, and regulators to develop "interoperable standards." In other words, NIST is responsible for making sure the many pieces of the smart grid are able to work together.

The American Recovery and Reinvestment Act (ARRA) invested approximately $4.5 billion, matched by $5.5 billion in private funding, to modernize energy infrastructure in America. The ARRA included funding for NIST to conduct its work on interoperability standards for the smart grid. Interoperability, the ability of diverse systems and their components to work together, is vitally important to the performance of the smart grid at every level. It enables integration, effective cooperation, and two-way communication among the many interconnected elements of the electric power grid.

Because the smart grid will touch so many aspects of life in the twenty-first century, the development of standards involves a wide range of national and international stakeholders, from both the private and public sectors. Stakeholders include appliance and consumer electronics providers; municipal electric utility companies; standards development organizations; and state and local regulators. NIST has identified 22 stakeholder groups-each of whom has representation in the standards development process. NIST's work will cover the entire electricity system including generation, transmission, distribution, and end-user equipment and devices.

Standards Development

NIST's work on the smart grid has been enabled by funding from both the ARRA and NIST's annual appropriations. ARRA funds totaled $17 million to bring together stakeholders to develop a framework for the smart grid and coordinate the development of standards, including $12 million provided by the Department of Energy and an additional $5 million from ARRA funds appropriated directly to NIST. To support the NIST Smart Grid program, Congress appropriated a total of $2.3 million in fiscal year (FY) 2009, $5 million in FY10, and $8.3 million in FY11. The President's budget request for FY12 includes a $22.8 million initiative entitled "Interoperability Standards for Emerging Technologies," which would include an additional $9.1 million to support NIST's Smart Grid program.

NIST has been driving the creation of a smart grid architectural framework, and interoperability standards in a three-phased plan. Phase one (complete) engaged stakeholders to identify applicable standards and requirements, gaps in currently available standards, and priorities for additional standardization activities. Phase two (ongoing) established a public/private partnership called the Smart Grid Interoperability Panel (SGIP) to continue development of interoperability standards and drive longer-term progress. Phase three (ongoing) is the development of a testing and certification framework for smart grid standards.

In January 2010, the NIST-led process published the *Release 1.0 Framework and Roadmap for Smart Grid Interoperability* [1], which provided an initial foundation for an interoperable and secure smart grid. The framework included a high-level conceptual reference model, the identification of 75 existing families of standards applicable to the ongoing development of the smart grid, and 16 high-priority action plans to fill gaps in the standards portfolio (three have been added to the original 16 listed in the Release 1.0 NIST framework). NIST is updating the framework based on work carried out since Release 1.0, and expects to publish Release 2.0 by the end of 2011.

The Smart Grid Interoperability Panel (SGIP)

The SGIP is a private/public partnership that engages stakeholders from the entire smart grid community in a participatory public process to identify applicable standards, gaps in currently available standards, and priorities for new standardization activities for the evolving smart grid. Membership in the SGIP has grown to over 680 organizations, including private companies, universities, research institutes, industry associations, standards setting organizations, laboratories, and Federal, state, and local government agencies. Almost 1800 individuals participate in the committees and working groups, and an elected 27-member governing board representing 22 different stakeholder groups oversees the SGIP.

The SGIP is executing 19 priority action plans to fill standards gaps, and is also continuing work on the Catalog of Standards [2], which contains descriptive information about standards deemed relevant to the smart grid through the SGIP consensus process. The first six entries have been approved by the SGIP membership and have been entered into the catalogue. Each standard considered for inclusion in the catalogue goes through a cybersecurity review by the SGIP Cybersecurity Working Group, to identify potential vulnerabilities and necessary mitigation actions.

The SGIP is also working on the development of a testing and certification framework for the smart grid. The SGIP Testing and Certification Committee published the *Interoperability Process Reference Manual, Release 1* [3], which provided the structure and processes for testing and certification programs relevant to the smart grid.

To guide future planning for NIST's work on the smart grid, NIST also established a Smart Grid Federal Advisory Committee. The Committee's input to NIST helps guide long-term SGIP activities and also assists in directing research and standards activities at NIST. The Committee provides input to NIST on smart grid standards, priorities and gaps, and on the overall direction, status, and health of smart grid implementation by the smart grid industry. The Committee's first report, focused on the long-term direction of NIST's smart grid work is expected near the end of this year.

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[1] NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0. January 2010. http://www.nist.gov/public—affairs/releases/upload/FERC-letter-10-6-2010.pdf

[2] Available at: http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCatalogOfStandards.

[3] Interoperability Process Reference Manual, Release 1.0. November 2010. http://collaborate.nist.gov/twiki-

Regulation

EISA directs the Federal Energy Regulatory Commission (FERC) to institute a rulemaking to adopt such standards and protocols as may be necessary to insure smart grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets" at any time after NIST's work has led to "sufficient consensus" in the Commission's judgment. In the past, few interoperability standards have been adopted in regulation for national infrastructures. The vast majority of standards in these industries are used on a voluntary basis.

Based on work conducted by the SGIP, NIST notified FERC in October 2010 that it had identified five families of existing voluntary consensus standards as ready for consideration by regulators. FERC hosted a Technical Conference to invite public discussion of whether sufficient consensus was found to institute a rulemaking proceeding. On July 20, 2011 FERC issued an Order in which it found there was insufficient consensus to institute a rulemaking proceeding at that time to adopt the initial five families of standards.

"The Commission finds there is insufficient consensus for the five families of standards under consideration. For this reason, the Commission will not institute a rulemaking proceeding at this time with respect to these standards. The Commission encourages stakeholders to actively participate in the NIST interoperability framework process to work on the development of interoperability standards and to refer to that process for guidance on smart grid standards."

The five families of existing voluntary consensus standards were "foundational" standards covering common information models and protocols for utility energy management systems, substations, distribution systems, and intercontrol center communications. The five standards were among the most mature standards identified in the NIST Framework, and the "insufficient consensus" conclusion of FERC calls into question whether voluntary standards for smart grid may be sufficient without a mandatory rulemaking process.

5. Issues for Examination

Enabling Cost-Effective Smart Grid Investments

The development and adoption of standards for the smart grid has been an unprecedented, complex undertaking, enabling electric utilities to deploy and use technology advancements in an accelerated manner. There has been significant investment in the smart grid, with many smart grid related technologies, such as smart meters, deployed with ARRA funds despite the fact that many standards have not been set. Given the scale of possible future investment and the need to retrofit existing technologies, interoperability is imperative. The Subcommittee has requested that witnesses address the need to ensure investments in the smart grid are cost-effective to keep electricity affordable. This includes discussing how the interoperability standards being developed through the NIST framework process ensure present investments in new technologies generate future value through interoperability and upgradability.

Unlocking the Potential of Innovation in the Electricity Sector

Transforming the electricity grid to a modern smart grid can help spur the creation and deployment of new products and services in the electric sector, boosting economic growth and job creation. Building an updated transmission infrastructure including modern information and communications technologies provides a foundation for innovation. Witnesses have been asked to address how the development of open, interoperable standards can help create the markets for smart grid technologies essential to America's ability to lead and create jobs. International coordination on smart grid standards will reduce trade barriers in smart grid technologies, helping drive international trade and investment. Witnesses have also been asked to discuss the importance of working to cooperate with other nations on smart grid interoperability standards, which is critical to increasing market opportunities for American industry.

Empowering Consumers

Providing consumers information about energy use and consumption helps them to better understand how they are using electricity, allowing for better management of that use. The Subcommittee has asked witnesses to address how encouraging the development of a portfolio of smart grid technologies and programs, including innovative third-party applications, can help consumers save energy and encourage the

development of a market for smart grid technologies. It is important to provide consumers with information and to allow innovation to flourish, but it is also important to protect that data to ensure consumer privacy. Consumers need to be adequately informed about the benefits, costs, and risks associated with smart grid systems.

Securing the Grid

The Subcommittee has requested that witnesses address the complex cybersecurity challenge that smart grid technologies pose. With advanced metering infrastructure, smart appliances, and third-party service providers, there are a great number of entry points through which to stage cyber attacks. By exploiting loopholes in cybersecurity, attackers could breach the privacy of customer power usage data and could potentially overload systems or cause false readings. It is especially important to ensure that the evolution of standards and guidelines keep pace with the evolving cyber threat in order to protect the grid from cyber attacks, improve recoverability, and ensure the Nation's security and economic prosperity.

Chairman QUAYLE. The Subcommittee on Technology and Innovation will come to order.

Good morning, and welcome to today's hearing, entitled "Empowering Consumers and Promoting Innovation through the Smart Grid." I want to thank all of you for coming. Mr. Sarbanes from Maryland is stuck in traffic due to our weather, and I thank you for braving the weather this morning. In front of you are packets containing the written testimony, biographies and Truth in Testimony disclosures for today's witnesses. I will now recognize myself for five minutes for an opening statement.

Today's hearing will evaluate the progress that has been made on the development and implementation of a nationwide smart grid. The blackout that darkened the Northeast in the summer of 2003 opened our eyes to the vulnerability and age of our electrical system. One of the planned improvements is to modernize our electrical grid to create a system that can communicate information and relay electricity in two directions: both to and from the consumer. The smart grid has the potential to improve the reliability of electric power delivery, and promote economic growth through the development of new technologies. Given the scale and complexity of our electric grid, this transition will require systems that can seamlessly communicate.

In 2007, the Energy and Independence Security Act directed the National Institute of Standards and Technology to coordinate the development of a common framework, including protocols and model standards for the implementation of smart grid technologies. NIST plays a key role—bringing together manufacturers, consumers, energy providers and regulators to develop interoperable standards to ensure that the smart grid's many pieces are able to work together.

As a non-regulatory agency, NIST has a long history of collaborating with industry to develop voluntary standards. However, the Energy Independence and Security Act empowers the Federal Energy Regulatory Commission to initiate a rulemaking process to adopt standards where it believes a sufficient consensus has been achieved. I am concerned with the prospect of mandating standards and the effect such mandates could potentially have on innovation. There may be parts of the smart grid where formal regulation is unnecessary and a consensus standard is sufficient to ensure interoperability. I generally believe that we should avoid imposing regulations on industry and innovators, when a collaborative product is possible through NIST's non-regulatory process.

The Committee on Science, Space, and Technology has held a series of hearings assessing the transformation of our electric delivery system to a smart grid. Today's hearing will further detail the progress that has been made by examining the status of efforts to develop the open standards that are necessary to support cost-effective deployment of smart grid technologies.

We should not underestimate the value of standards. Open, consensus-based standards help facilitate the development of new innovative technologies by promoting plug-and-play operability for smart grid devices in both the national and international markets. I am especially interested in how a smarter grid could enable small companies to develop new products based on a transparent stand-

ards platform that is available to all innovators. With the many renewable energy companies in my home state of Arizona, I am also interested in how the updated grid could allow small generators and intermittent renewable energy sources to play a larger role in our electrical system.

I would like to thank all of our witnesses for their participation today.

[The prepared statement of Mr. Quayle follows:]

PREPARED STATEMENT OF THE SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION
CHAIRMAN BEN QUAYLE

Good Morning. I would like to welcome everyone to today's hearing, evaluating the progress that has been made on the development and implementation of a nationwide smart grid.

The blackout that darkened the Northeast in the summer of 2003 opened our eyes to the vulnerability and age of our electrical system. One of the planned improvements is to modernize our electrical grid to create a system that can communicate information and relay electricity in two directions—both to and from the consumer. The smart grid has the potential to improve the reliability of electric power delivery, and promote economic growth through the development of new technologies. Given the scale and complexity of our electric grid, this transition will require systems that can seamlessly communicate.

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I would like to thank all of our witnesses for their participation. I would also like to welcome and thank the gentleman from Maryland, Mr. Sarbanes, for his role in the hearing today. I now recognize him for five minutes for an opening statement.

Chairman QUAYLE. I would also like to welcome and thank the gentleman from Maryland, Mr. Sarbanes, for his role in the hearing today, and I now recognize him for five minutes for an opening statement.

Mr. SARBANES. Thank you very much, Mr. Chairman. I appreciate you calling this hearing. This is a critical hearing. We are

looking forward to hearing from our witnesses today with respect to the progress that is being made in this standard setting.

Putting in place a smart grid for the country is a huge priority, and of course, if you look at the Energy Independence and Security Act, that was one of its premier objectives back in 2007. There was a real boost to your efforts, of course, with the American Recovery and Reinvestment Act in terms of dollars being put behind this effort. The effort is well underway.

I have only come to this Committee recently but I understand there was a hearing about a year ago that examined the progress that was being made, and I take it that there is really three phases that this effort represents. The first phase was setting up this framework and roadmap for the smart grid interoperability. The second phase is to get this panel working, and I know we will hear about that today, and then the third phase is really to go out and test this and certify it and make sure that it is really working. There is a lot of tentacles involved in this. You are pulling in a lot of different input from many, many different sources, of course: the private sector, prior public standards efforts that have been in place and so forth.

So we are looking forward to this update and we want to know what we can do to help facilitate the progress that you are making both in terms of tools that you have and the resources that are available to you.

We all want a grid that is more reliable and resilient, that is more efficient and cost-effective, and you can read into that last phrase "not wasteful," and one that is secure. That is obviously a key concern these days as well.

Now, we can look at this through various lenses. I mean, we just went through this tremendous weather event here on the East Coast with the hurricane. In Maryland, we had hundreds and hundreds of thousands of people that were without power for days on end. The systems we have for reporting outages and attending to them are in some ways antiquated when you compare it against the smart grid vision that we have, and when we get to that kind of place, you are going to be able to identify where these outages have occurred, respond to them more quickly, figure out how to bypass transformers and other parts of the grid that may be down so that you can keep power in place for as many of the customers, whether they be businesses or individuals, as possible. So that is certainly one lens to look at this smart grid enterprise through.

Another I bring, which is, I guess, somewhat parochial but my district pretty much surrounds the NSA organization in Baltimore, which is located at Fort Meade, and there have been concerns over the last few years by leaders at NSA about whether just the power source is going to be there to sustain their operations over time. So that goes to the question of whether you have a reliable source of power for these critical assets that exist out there, and so we are obviously very interested in the reliability, in the efficiency of these operations and the security, which I think is something that you will get to in our discussion.

So we know that there is a lot left to do. I do want to commend NIST. From my understanding of the progress you've already

made, there is a lot of different balls in the air here and of course everyone wants to get this in place as quickly as we can.

So I appreciate the testimony that you will present here today. We are looking forward to it.

Thank you, Mr. Chairman, for calling the hearing, and I will yield back my time.

[The prepared statement of Mr. Sarbanes follows:]

PREPARED STATEMENT OF REPRESENTATIVE JOHN P. SARBANES

Good morning. I want to thank our witnesses for being here with us today for this important status update on the smart grid standards effort. And Chairman Quayle, thank you for holding this hearing.

As many of you may know, the subcommittee held a similar hearing just over a year ago. At that point in time, the smart grid standards development process was still in its relative infancy. NIST had recently published the *Framework and Roadmap for Smart Grid Interoperability - Release 1.0*, and the Smart Grid Interoperability Panel (or SGIP) was just getting its feet off the ground.

Since this smart grid effort is as fast-paced as it is vast, I believe it is appropriate and prudent for us to check in on how this NIST-led effort has unfolded over the last year and learn more about where we are and where we are headed.

I think we would all agree that our electricity grid is in desperate need of modernization. There is no doubt that the United States would be better served by an electric grid that is more reliable and resilient, more efficient and cost effective, and more secure. And our nation will be closer to energy independence if our grid can accommodate the addition of more renewable energy resources and provide information that helps us reduce energy use and minimize energy waste. A smart grid has the potential to deliver all of this for us at a fraction of the price that is already projected to be spent on grid modernization and expansion.

A smart grid will incorporate two-way communication capabilities into the electric grid, facilitating a constant flow of information between electricity suppliers and consumers. This will enable better alignment between electricity supply and demand, improving our ability to prevent power blackouts and brownouts which cost the U.S. economy $80 billion per year.

It will provide grid operators with immediate and detailed information on the power disruptions that do occur so that power can be restored more quickly and efficiently. It can also reduce the cost of electricity by providing consumers access to real-time information on the current market price of electricity, offering people the choice to use energy when it is cheaper.

The scale and complexity of developing a smart grid is astounding. And the investments—both public and private—that will be needed to make it a reality are significant. That is why we need to make sure that we do this right and that all of the various pieces will work together. We can help ensure that the investments that are made today will continue to pay off long into the future if everyone involved in this important endeavor is playing by the same rule book. And that's where standards come in.

I think we will all be impressed by the work that has already taken place and is currently under way on the standards that are needed to help us realize a true smart grid.

And I think we will be equally impressed by the work that remains to be done to make the smart grid goal a reality.

Certainly, the task with which NIST has been charged is a daunting one. By all accounts, the progress that has been made in such a short period of time is staggering, and NIST's effort to keep the train moving with everyone on board has been a remarkable accomplishment.

It's essential that we continue to build on this momentum and keep our eye on the ball. For this reason, I look forward to hearing from our witnesses whether there is anything more that we here in Congress can or should do to ensure that progress continues and that those participating in this process have the tools that they need to see this effort through.

Thank you, again, for being here today. I look forward to your testimony.

Chairman QUAYLE. Thank you, Mr. Sarbanes.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time I would like to introduce our witnesses, and then we will proceed to hear from each of them in order.

Our first witness is Dr. George Arnold, the National Coordinator for Smart Grid Interoperability at NIST. Next, we will hear from the Hon. Donna Nelson, Chairman of the Texas Public Utility Commission. Our third witness is Mr. John Caskey, Assistant Vice President of Industry Operations at the National Electrical Manufacturers Association. Our final witness is Mr. Rik Drummond, CEO and Chief Scientist at The Drummond Group.

Thanks again to our witnesses for being here this morning. As our witnesses should know, spoken testimony is limited to five minutes each. After all witnesses have spoken, Members of the Committee will have five minutes each to ask questions.

The Chair now recognizes our first witness, Dr. Arnold.

STATEMENT OF DR. GEORGE ARNOLD,
NATIONAL COORDINATOR FOR SMART GRID INTEROPERABILITY,
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Dr. ARNOLD. Chairman Quayle, Ranking Member Sarbanes and Members of the Subcommittee, I would like to thank you for the opportunity to discuss NIST's progress in accelerating the development of standards for the smart grid, which as you noted, is central to the Nation's efforts to promote innovations that increase the reliability, efficiency and security of the electric delivery system and provide benefits to consumers.

The basic structure of today's grid has changed little over its 100-year history. The U.S. grid is operated by over 3,200 utilities using equipment and systems from hundreds of suppliers with little past emphasis on standardization, resulting in many proprietary systems that do not interoperate. The successful transformation of this aging infrastructure will have important economic and consumer benefits.

As you have noted, under the Energy Independence and Security Act of 2007, Congress assigned NIST the primary responsibility to coordinate the development of standards for the smart grid. NIST is providing strong national and international leadership in carrying out this assignment.

In April 2009, NIST announced a three-phase plan to carry out its responsibilities. The initial phase resulted in the January 2010 publication of the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1. This document described a reference model for the smart grid, identified 75 initial standards and specified 16 high-priority action plans to fill gaps. Another significant milestone was the September 2010 publication of the NIST Guidelines for Smart Grid Cybersecurity, Release 1, which provides foundational guidance for the cybersecurity of the grid.

The second phase of the NIST effort established the Smart Grid Interoperability Panel, or SGIP. The panel's membership has grown to over 680 private and public sector organizations with almost 1,800 individuals participating in its committees and working

groups. The SGIP also provides a forum for international collaboration, benefiting U.S. exports of smart grid products. The SGIP has achieved many significant accomplishments since its formation, which are described in my written testimony. The SGIP is making progress in developing a smart grid testing and certification framework, the third phase of NIST's effort, which is chaired by my colleague, Mr. Drummond. To date, five private sector organizations have announced testing and certification programs following the SGIP's guidelines. NIST is in the process of updating the smart grid framework, and we anticipate publication of Release 2.0 by the end of 2011.

NIST's smart grid work has been enabled by funding from both the Recovery Act and NIST's annual appropriations. A significant portion of NIST's smart grid budget has been used to fund the administration and operation of the SGIP. In the longer term, our vision is that the SGIP will mature into an independent organization funded primarily by the private sector to evolve the standards framework after NIST's coordination role is complete. However, it will take several years for the SGIP to develop a business model and private sector funding sources that are self-sustaining.

To guide the longer-term planning for NIST's work, NIST has established a Smart Grid Federal Advisory Committee whose first report is expected in November 2011.

Throughout this process, NIST had worked closely with the Department of Energy and federal and state regulators. EISA directs FERC to institute a rulemaking to adopt standards as necessary after NIST's work has led to sufficient consensus. However, voluntary use of consensus standards rather than regulation may be sufficient in most cases to ensure the interoperability of the smart grid.

In other national infrastructure such as the telecommunications system and the Internet, few, if any, interoperability standards have been mandated through regulation. In 2011, a FERC decision found that there was insufficient consensus to institute a rulemaking proceeding and expressed support for the NIST process and referred stakeholders to the NIST process for guidance on smart grid standards.

Our standards efforts play an important role in promoting innovation that will benefit consumers. The standards help avoid stranded utility investments by facilitating interoperability and upgradeability. The standards promote vendor competition and economies of scale that will result in lower costs for consumers. The standards help enable the development of innovative third-party applications and smart appliances to help consumers save energy and reduce peak usage and overall usage. Finally, through this work, NIST is leading the development of rigorous open standards and guidelines for cybersecurity and data privacy through public-private cooperation.

NIST is proud to have been given an important role in this initiative, and I thank you for the opportunity to testify today. I would be happy to answer any questions you may have.

[The prepared statement of Mr. Arnold follows:]

PREPARED STATEMENT OF DR. GEORGE ARNOLD, NATIONAL COORDINATOR FOR SMART GRID INTEROPERABILITY, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Introduction

Chairman Quayle and Members of the Subcommittee, I am George Arnold, the National Coordinator for Smart Grid Interoperability at the Department of Commerce's National Institute of Standards and Technology (NIST).

Thank you for the opportunity to appear before you today to discuss NIST's progress in accelerating the development of standards needed to realize a secure and interoperable nationwide Smart Grid. I last testified about our progress and plans before the Subcommittee on Technology and Innovation on July 1, 2010.[1] Today, I would like to update you on our accomplishments, where we are going, and some of the key actions needed to ensure protection of consumer interests, including cost and privacy, while driving innovation within Smart Grid development.

The Smart Grid, which will modernize the United States electric power delivery system, is central to the Nation's efforts to increase the reliability, efficiency and security of the electric delivery system and also to help build the infrastructure that will facilitate clean energy sources to American homes and businesses. The Smart Grid utilizes advanced information and communications technologies to enable a two-way flow of electricity and information. This marriage of energy and information technologies will create capabilities to make the grid more efficient by reducing demand peaks and increasing capacity utilization and providing consumers with tools to reduce energy usage and potentially save money. It can also increase reliability, enable more widespread use of distributed and renewable energy sources, and facilitate electrification of vehicles.

The Smart Grid is an important contributor to the Administration's overall goal of fostering innovation and creating jobs in a clean energy economy through policies that catalyze private sector investments to modernize the nation's electrical infrastructure. NIST's mission—to advance innovation and U.S. industrial competitiveness—fits well with this goal, and we are committed to helping make that vision a reality. As former Commerce Secretary Gary Locke noted, "If we get this right, if government and business can team up effectively, we have an almost unprecedented opportunity to change how we use electricity, reduce greenhouse gas emissions, and create new jobs in an emerging industry."[2]

Modernizing and digitizing the nation's electrical power grid—the largest interconnected machine on Earth—is an enormous challenge and a tremendous opportunity. Several years ago, the National Academy of Engineering described electric power and the electric grid as the greatest engineering achievement of the 20th century, and the largest industrial investment in the history of humankind.[3] The basic structure of the present grid has changed little over its hundred-year history. The U.S. grid, which is operated by over 3200 electric utilities using equipment and systems from hundreds of suppliers, has historically not had much emphasis on interoperability or standardization, and thus has incorporated many proprietary interfaces and technologies that result in the equivalents of stand-alone silos.

The successful transformation of this infrastructure into an interoperable system would support the Administration's vision of a highly reliable electrical grid that uses a diverse suite of energy resources, including distributed and renewable resources, energy efficiency, and supports electric vehicles. This 21st century grid would be a significant engineering achievement with important economic and environmental impacts.

NIST's Standards Role: A Framework for Interoperability

A nationwide, interoperable and secure Smart Grid would optimally be harmonized with international standards. Under the Energy Independence and Security Act of 2007 (EISA), Congress assigned the NIST the "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 . . . " [EISA, Section 1305]. That Act further specifies that the interoperability framework should be "flexible, uniform, and technology neutral." Congress instructed that the framework should accommodate "traditional, centralized genera-

[1] Testimony of George Arnold before the House Committee on Science and Technology Subcommittee on Technology and Innovation United States House of Representatives, July 1, 2010, available at *http://gop.science.house.gov/Media/hearings/ets10/july1/Arnold.pdf*

[2] Commerce Secretary remarks at Jobs and Competitiveness Round Table, Durham, NC, June 13, 2011, available at http://www.commerce.gov/news/secretary-speeches/2011/06/13/remarks-jobs-and-competitiveness-round-table-durham-north-carolin

[3] Nat'l Acad. Eng., Greatest Engineering Achievements of the 20th Century (2003), available at http://www.greatachievements.org.

tion and transmission resources" while also facilitating incorporation of new, innovative technologies, such as distributed and renewable energy resources and energy storage.

NIST is providing national and international leadership to drive the creation of interoperability standards needed to help make the Smart Grid a reality. We are engaging industry, government, and consumer stakeholders in an open and public process. We have published a first Release of a standards framework for the Smart Grid,[4] are nearing the completion of a second Release, and, together with the private sector, have made significant progress in creating an ongoing public/private partnership that will provide a process for the continuing development and maintenance of Smart Grid standards needed to support the electric grid for decades to come.

Our work to establish protocols and standards for the Smart Grid has been carried out with a great sense of urgency. Deployment of various Smart Grid elements, including smart sensors on distribution lines and smart meters in homes, and of distributed sources of renewable energy is already under way, and has been accelerated as a result of Department of Energy (DOE) Smart Grid Investment Grants and Smart Grid Demonstration Projects and other programs supporting renewable energy generation. Without standards, there is the potential for technologies developed or implemented with sizable public and private investments to become obsolete prematurely or to be implemented without measures necessary to ensure security.

While we are driving this program with a strong sense of urgency, we must also keep in mind that the foundation we lay with these standards likely will establish the basic architecture of the grid for decades. Any fundamental mistakes made at this stage may be difficult and costly to correct later. We especially cannot afford to make incorrect architectural choices or adopt weak standards that would compromise the security, reliability or stability of the grid. We need to work both quickly and carefully.

I would like to provide a brief overview of our efforts and accomplishments to date.

In April 2009, NIST announced a three-phase plan to carry out its EISA responsibilities. In May 2009, the Secretaries of Commerce and Energy convened a meeting of nearly 70 top executives from the power, information technology, and other industries, and asked those executives whether their organizations would commit to support the process established by NIST.

The NIST process had three phases:

- *Phase 1,* which took place from April 2009 to January 2010, engaged stakeholders in a participatory public process to identify applicable standards and requirements, gaps in the currently available standards, and priorities for additional standardization activities.
- *Phase 2,* which began in November 2009 and is ongoing, established a public/private partnership called the Smart Grid Interoperability Panel (SGIP) to continue development of interoperability standards and drive longer-term progress.
- *Phase 3,* which is also ongoing, is developing a testing and certification framework for Smart Grid standards.[5]

The NIST plan has received broad support and active participation from industry. In a letter, the U.S. Chamber of Commerce commended NIST for its "willingness to reach out to the private sector on these issues." The Chamber described the NIST-led process as "transparent and inclusive."[6]

In January of 2010, the NIST-led process reached a major milestone with the publication of the Release 1.0 Framework and Roadmap for Smart Grid Interoperability (NIST Special Publication 1108).[7] This document provides an initial foundation for an interoperable and secure Smart Grid and has been widely cited by the Smart Grid stakeholder community, both domestically and internationally. The Release 1.0

[4] NIST Special Publication 1108, "NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0," January 2010, available at http://www.nist.gov/public_affairs/releases/upload/smartgrid_interoperability_final.pdf.

[5] Opening Remarks of George Arnold, Smart Grid Interoperability Standards Technical Conference, held on 1/31/11 at FERC Headquarters available at: http://elibrary.ferc.gov/idmws/File_list.asp?document_id=13888084

[6] U.S. Chamber of Commerce's Response to Notice requesting public comments on the second draft of NISTIR 7628, the Smart Grid Cyber Security Strategy and Requirements (75 Federal Register pages 18819-18823 at http://edocket.access.gpo.gov/2010/pdf/2010-8415.pdf, Docket Number: 100202060-0143-01). Comments available at: http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/NISTIR7628Draft2CommentsReceived

[7] Supra, note 3.

Framework described a high-level conceptual reference model for the Smart Grid, identified 75 existing families of standards that are applicable to the ongoing development of the Smart Grid, and specified 16 high-priority action plans to fill gaps in the standards portfolio with new or revised standards.

Another significant milestone in the development of the NIST framework was the publication of NIST Interagency Report (IR) 7628, "Guidelines for Smart Grid Cyber Security," in September 2010.[8] This three-volume document, which has also been widely cited by industry and regulators, provides the foundational requirements and guidance for efforts to ensure cybersecurity in the Smart Grid.

The Smart Grid Interoperability Panel (SGIP), established by NIST in November 2009, is a public/private partnership. The SGIP provides a mechanism for NIST to "solicit input and cooperation from private entities and other stakeholders," as directed by EISA. In the long term, NIST envisions that the SGIP will mature into a permanent, stand-alone organization that will support the continuing evolution of the Smart Grid standards framework after NIST's EISA-directed coordination role has been completed.

During its first two years of operation, the SGIP has focused its efforts on establishing processes and procedures for its work; overseeing and expediting the completion of the Priority Action Plans established in the NIST Release 1.0 Framework; creating additional action plans as needed; developing the cybersecurity guidelines for the Smart Grid including a methodology for reviewing the cybersecurity aspects of standards; and developing a testing and certification framework.

Membership in the SGIP has grown to over 680 organizations, including private companies, universities, research institutes, industry associations, standards setting organizations, testing laboratories, and government agencies at the Federal, state and local levels. Almost 1800 individuals participate in the committees, working groups, and priority action plan teams working under the panel, representing these hundreds of organizations. An elected 27-member governing board, representing 22 different stakeholder groups, including electric utilities, electric equipment manufacturers, building automation providers, information and communications technology companies, state regulators, and venture capital firms, oversees the SGIP.

While the vast majority of participants in the SGIP are from the private sector, members of NIST's technical staff and management also play a role as technical contributors and leaders in the various boards and committees of the SGIP, working alongside their private sector counterparts. The NIST participants bring to the SGIP technical expertise in standards and measurement science in the areas of power engineering, information technology, industrial control systems, building energy management, communications, and cybersecurity.

The international partnerships that NIST has built with the governments of other countries have resulted in global recognition of SGIP's role. The SGIP provides a forum for international collaboration on smart grid standards development. The number of international participants in the SGIP has increased significantly over the last year and these efforts are designed to reduce barriers to trade in smart grid technologies and services around the world. International coordination on smart grid standards will help drive international trade and investment in this fast growing sector and U.S. exporters of smart grid products will benefit as a result. The SGIP has achieved many significant accomplishments since its formation. I would like to highlight a few.

The SGIP has been executing 19 priority action plans to fill standards gaps (three were added to the original 16 identified in the Release 1.0 NIST framework). These action plans have resulted in a number of key standards deliverables, which include:

- A Smart Meter Upgradeability Standard, published by National Electrical Manufacturers Association, that will ensure that many of the large number of meters to be installed over the next several years can be upgraded to accommodate anticipated updates to metering standards.
- Internet Engineering Task Force Request for Comments (RFC) 6272, which specifies the various Internet protocols to be used in the Smart Grid.
- Publication of NIST IR 7761, which provides guidelines for utilities and their suppliers to assess wireless communications standards for use in various Smart Grid applications.
- A customer energy usage information data standard, published by the North American Energy Standards Board (NAESB), that enables entrepreneurs to develop third party applications to help customers to monitor their energy usage and save money.

[8] Available at http://csrc.nist.gov/publications/PubsNISTIRs.html#NIST-IR-7628.

- The selection of three standards published by Society for Automotive Engineers (SAE) International to support electric vehicle charging.
- Publication of an "SEP 1.x to 2.0 Transition and Coexistence" guideline, which will ensure that millions of meters that have already been deployed using early versions of the Zigbee Smart Energy Profile (SEP) will be able to interoperate with future IP-based home area networks. This is especially important to states like Texas that have pioneered in the early deployment of smart meter technology.

Another key early deliverable from the SGIP is the Catalog of Standards,[9] containing descriptive information about standards deemed relevant to the Smart Grid through the SGIP's consensus process. This catalog will provide key input to future releases of the NIST framework.

A critical element of the SGIP's process is a cybersecurity review of each standard considered for inclusion in the catalog. The SGIP Cybersecurity Working Group, which is chaired by a NIST staff member, reviews each candidate standard against the requirements in NIST IR 7628 to identify potential vulnerabilities and necessary mitigation actions.

Phase 3 of the NIST plan is the development of a testing and certification framework for the Smart Grid. In December 2010, the SGIP Testing and Certification Committee, which is co-chaired by a NIST staff member, published the "Interoperability Process Reference Manual, Release 1,"[10] providing an important foundation for this phase of the plan. This document specifies the structure and processes for testing and certification programs relevant to the Smart Grid. To date, five private sector organizations have announced testing and certification programs conforming to this guide. The most recent such program, established by a consortium of four industry alliances to test and certify using the Smart Energy Profile 2.0 protocol, will certify interoperability of consumer appliances with the Smart Grid to reduce or delay energy usage when the grid is overloaded.

NIST is in the process of updating the Smart Grid framework based on work carried out since Release 1.0 was published in January 2010. NIST has posted a draft of Release 2.0[11] and invited public comments, and we anticipate publication of Release 2.0 by the end of 2011.

NIST's work on the Smart Grid has been enabled by funding from both the American Recovery and Reinvestment Act of 2009[12] (Recovery Act) and NIST's annual appropriations. The Recovery Act funds totaled $17 million, including $12 million provided by DOE and an additional $5 million from Recovery Act funds appropriated directly to NIST. More than half of NIST's work through the end of FY11 was supported by the Recovery Act funds, which will have been completely expended by the end of this fiscal year.

To support the NIST Smart Grid program, Congress has appropriated a total of $2.3 million in FY09, $5 million in FY10, and $8.3 million in FY11. The FY12 President's Budget sustains NIST's Smart Grid efforts by providing funding to accelerate development of needed standards through priority action plans, establish the testing and certification framework, and ensure smart grid cybersecurity standards and guidelines stay ahead of evolving threats.

A significant portion of NIST's Smart Grid budget has been used to fund private sector contractors that support the administration and operation of the SGIP. In the long term, our vision is for the SGIP to mature into an independent organization, funded primarily by the private sector that will continue to support the evolution of the Smart Grid standards framework after NIST's EISA coordination role is complete. However, it will take several years for the SGIP to develop a business model and private sector funding sources that are self-sustaining.

To guide future planning for NIST's work on the Smart Grid, NIST established a Smart Grid Federal Advisory Committee in September 2010. The first report of this committee is expected in November of 2011, and it will provide important input to guide the longer-term direction for NIST's Smart Grid work.

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[9] Available at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCoSStandardsInformationLibrary

[10] SGIP Interoperability Process Reference Manual, Version 1.0, available at: http://collaborate.nist.gov/twiki-sggrid/pub/SmartGrid/SGTCCIPRM/SGTCC_IPRM_Version_1.0_Updated.pdf.

[11] Available at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/IKBFramework.

[12] Pub. L. No. 111-5, available at http://www.gpo.gov/fdsys/pkg/PLAW-111publ5/pdf/PLAW-111publ5.pdf.

Engagement with Regulators

EISA directs FERC to "institute a rulemaking to adopt such standards and protocols as may be necessary to insure smart-grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets" at any time after NIST's work has led to "sufficient consensus" in the Commission's judgment.

The development and adoption of standards for the Smart Grid is an unprecedented, complex undertaking. In the past, few, if any, interoperability standards have been adopted in regulation for national infrastructures such as the electric grid, the telecommunications system, or the Internet. The vast majority of standards in these and many other industries are used on a purely voluntary basis, without government regulatory action. Similarly, voluntary consensus interoperability standards may be sufficient in many cases to insure the functionality and interoperability of the Smart Grid in interstate power transmission and regional/wholesale electricity markets, without government regulation.

In the first exercise of its type under EISA, NIST notified FERC in October 2010 that it had identified five families of existing voluntary consensus standards as ready for consideration by regulators.[13] To invite public discussion of whether there were sufficient consensus to institute a rulemaking proceeding, FERC hosted a Technical Conference on January 31, 2011, followed by a supplemental notice on February 16, 2011 soliciting written comments from interested parties.[14]

On July 20, 2011, FERC issued an Order,[15] in which it found that there was insufficient consensus to institute a rulemaking proceeding at that time to adopt the initial five families of standards. At the same time, FERC's Order expressed support for the NIST process:

> "We believe that the best vehicle for developing smart grid interoperability standards is the NIST interoperability framework process, including the work of the SGIP and its committees and working groups ... The Commission recognizes and appreciates the comprehensiveness of the smart grid interoperability framework process developed by NIST ... Therefore, we encourage utilities, smart grid product manufacturers, regulators, and other smart grid stakeholders to actively participate in the NIST interoperability framework process to work on the development of interoperability standards and to refer to that process for guidance on smart grid standards."[16]

NIST believes that FERC's action is consistent with NIST's public comments to the Commission that it can send appropriate signals to the marketplace by recommending use of the NIST Framework.[17]

FERC's decision is also consistent with the Administration's "Policy Framework for a 21st Century Grid,"[18] released on June 13, 2011, which recommended to FERC that in order "to enable the development and implementation of smart grid standards, merely embracing the standards as best practices in the field—rather than as mandatory ones—is sufficient ... " FERC's support of the NIST Interoperability Framework could encourage utility companies looking for smart grid solutions to rely on the framework for guidance, but leave it to individual utilities to decide how to best comply.

NIST believes that FERC's decision did not close the door to the possibility of future rulemaking if it is determined that adoption of certain standards is necessary to ensure their deployment to ensure interoperability.

Testimonies, comments and reply comments received from the FERC technical conference were valuable sources of input to NIST and the SGIP. Based on our evaluation of this input, several steps are being taken to improve NIST and SGIP proc-

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[13] NIST letter to FERC Chairman Jon Wellinghoff, October 6, 2010, available at: http://www.nist.gov/public_affairs/releases/upload/FERC-letter-10-6-2010.pdf

[14] Federal Energy Regulatory Commission (FERC) Notice of Technical Conference re Smart Grid Interoperability Standards under RM11-2. December 21, 2010, available at: http://elibrary.ferc.gov/idmws/File_list.asp?document_id=13875396

[15] 136 FERC 61,039, Order, "Smart Grid Interoperability Standards," Docket No. RM11-2-000, issued July 19, 2011, available at: http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20110719-3029.

[16] Id.

[17] Comments of US National Institute of Standards and Technology in response to the Commission's Supplemental Notice Requesting comments under RM11-2, April 7, 2011, available at: http://elibrary.ferc.gov/idmws/File_list.asp?document_id=13909438

[18] White House. "A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future." June 13, 2011, available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc-smart-grid-june2011.pdf

esses. For example, SGIP has initiated a task group to consider how to add reviews of reliability and implementation issues within the SGIP.

Ensuring Protection of Consumer Interests

Let me conclude with a discussion of critical actions being taken to ensure protection of consumer interests, highlighted in the Administration's "Policy Framework for a 21st Century Grid."

Regulators and utilities need to ensure that their investments in a Smart Grid are cost-effective to keep electricity affordable. The standards being developed through the NIST program play a critical role in this respect. They will help ensure that present investments in new technologies will generate future value for ratepayers by facilitating interoperability and upgradeability. These standards will also reduce market fragmentation and help create economies of scale, providing consumers greater choice and lower costs. They will help promote healthy vendor competition that will result in lower costs for utilities and, ultimately, for consumers.

Policymakers should ensure that residential and small business consumers have access to a portfolio of easy-to-use Smart Grid programs, technologies, and policies that empower them to manage their energy use effectively. The standards being developed through the NIST program will help enable timely consumer access to data that can help them control their energy usage. The standards will encourage the development of innovative third-party applications to help consumers save energy and encourage development of a market for smart appliances that can reduce energy usage during peak demand periods. The standards will also offer policymakers a solid framework for protecting consumer data privacy.

Finally, the Federal government must continue to facilitate the development of rigorous, open standards and guidelines for cybersecurity through public-private cooperation. Cooperation between stakeholders can help identify and address the diversity of cyber risks the electric power sector faces. The Federal government will work with the private sector to provide the appropriate level of support for the continuing evolution of those standards and guidelines, to keep pace with the evolving threat. The three-volume report, NIST IR 7628, Guidelines for Smart Grid Cyber Security,[19] presents a framework that organizations should use to develop effective cybersecurity strategies tailored to their particular combinations of Smart Grid-related characteristics, risks, and vulnerabilities. Volume 2 of NIST IR 7628 is devoted to privacy guidelines for Smart Grid data, and NAESB is in the process of developing a business practice standard for data privacy consistent with the NIST guidelines. Organizations in the diverse community of Smart Grid stakeholders—from utilities to providers of energy management services to manufacturers of electric vehicles and charging stations—can use the methods and supporting information presented in the report as guidance for assessing and mitigating risks. This approach recognizes that as the Smart Grid comes online, the electric grid will rapidly change from a relatively closed system to a complex, highly interconnected environment. Each organization's cyber security requirements should evolve as technology advances and as threats to grid security inevitably multiply and diversify.

Conclusion

The Smart Grid, with the unique investment opportunity afforded by the Recovery Act, represents a great opportunity to renew and modernize one of the Nation's most important infrastructures. NIST is proud to have been given an important role in this initiative, and is committed to achieving the Administration's vision of a cleaner, more reliable, more efficient and effective electricity grid that creates jobs and helps reduces our dependence on oil.

Thank you for the opportunity to testify today on NIST's work on Smart Grid interoperability. I would be happy to answer any questions you may have.

Chairman QUAYLE. Thank you, Dr. Arnold.

The Chair now recognizes Chairman Donna Nelson to present her testimony.

STATEMENT OF THE HONORABLE DONNA NELSON, CHAIRMAN, PUBLIC UTILITY COMMISSION OF TEXAS

Chairman NELSON. Thank you, Chairman Quayle. Good morning, and good morning to Ranking Member Sarbanes and Members of the Subcommittee. I am Donna Nelson, Chairman of the Public

[19] Supra, n. 7.

Utility Commission of Texas. Thank you for the opportunity to appear before you today to discuss the progress that we have made in Texas in implementing a smart grid. I would like to highlight several things that I think have made our program in Texas successful.

To tell the story of the smart grid in Texas is to tell the story of the success of the competitive electric market in Texas. The ERCOT region of Texas—and ERCOT stands for Electric Reliability Council of Texas—is located entirely within the state of Texas, and that makes Texas different than any other state in the continental United States in that it represents 85 percent of the electric load in the state. The ERCOT region has a successful competitive market. We have competitive generation, we have competitive retail providers, which we call REPs, but the TDUs, transmission and distribution utilities, the ones that own the wires and poles, are still regulated by the commission, and the competitive market has served us well in Texas. It spurred a lot of investment and it ultimately spurred the installment of smart meters.

In the mid-2000s, though, natural gas prices were rising; Texas is a natural gas on the margin state, and our state was growing and so policy leaders in Texas have a view that they really want everything to be able to provide electricity. We need all resources. And one of those resources is of course the demand response that you can get from the smart grid technology.

Against this backdrop, the state legislature wanted Texas to have that tool so they passed legislation encouraging the implementation of advanced meters and directed us, the PUC, to establish a cost-recovery mechanism for utilities. We did that. We adopted a rule, and it covered customer and REP access to data, minimum standards for advanced meter system deployment, cost-recovery and utility deployment plans. The four major utilities in ERCOT, that would be CenterPoint, Oncor, AEP and Texas New Mexico Power, have received approval from the commission for deployment of smart meters in their service territories. They have, todate deployed 4 million smart meters and are scheduled to deploy a total of 7 million by the end of 2013.

I would like to touch on a few key components that we believe have allowed for fast deployment. First, the state legislature encouraged deployment but did not mandate it. Second, the legislature explicitly provides that customers own their own smart meter data and are in control of authorizing access to an entity other than their retail provider. Third, the Texas PUC has overseen an implementation initiative in order to make the smart grid a reality. The initiative is comprised of a stakeholder collaborative with representatives from utilities, vendors, REPs and consumers. And finally, REP strongly supported the rollout of the smart grid technology because in a highly competitive retail market, they wanted to have a competitive advantage over other companies.

State commissions maintain jurisdiction over the distribution grid and have the ultimate responsibility for adoption and enforcement of rules relating to utilities and retail markets. It is important that the processes at NIST and at the FERC continue to recognize the role of state commissions. We believe that the creation of open national standards can create a level playing field across

industry, sectors and the markets. In the long term, standards should ensure interoperability of devices across utility service territories and across the country. I want to stress that a balance must be struck between existing standards that enable deployment and allow for benefits to reach consumers today while working to refine and create future standards to address the smart grid of tomorrow.

Let me close by stating that regardless of whether a state has restructured its electric industry as Texas has done, there are many benefits to be realized from the smart grid. Many customers want more information about their electricity bills. Currently, two of our largest utilities are conducting pilots and they are finding that customers are responding very well to the smart grid and are reducing their electric usage. And standards are constantly evolving because technology does not wait. Policy at the federal and state level should continue to recognize the need for customer choice and control and provide guidelines for the smart grid, not mandates.

Thank you so much for the opportunity to testify today and share the Texas experience.

[The prepared statement of Ms. Nelson follows:]

PREPARED STATEMENT OF THE HONORABLE DONNA NELSON, CHAIRMAN, PUBLIC UTILITY COMMISSION OF TEXAS

Introduction

Chairman Quayle and Members of the Subcommittee, I am Donna Nelson, Chairman of the Public Utility Commission of Texas (Texas PUC). Thank you for the opportunity to appear before you today to discuss the progress we have made in Texas regarding the adoption and implementation of a smart grid. I would like to highlight several things that I believe have made Texas a leader in deploying smart grid technology and in delivering the benefits of that technology to consumers.

To tell the story of the Smart Grid in Texas is to tell the story of the competitive electricity market in ERCOT. The Electric Reliability Council of Texas (ERCOT) region is located entirely within the state of Texas and includes approximately 75% of the state's geographic area, 85% of the electric load, and 22 million consumers. The Texas legislature restructured the electric industry in the ERCOT region in 1999. As a result of that restructuring, Retail Electric Providers (REPs) provide electric service to consumers at prices that are not regulated by the Texas PUC, while the Texas PUC continues to regulate the rates of transmission and distribution utilities (TDUs) pursuant to traditional rate of return regulation.

The competitive model has served Texas well. Today, prices in the competitive areas are lower for consumers than they were in 2001 before the competitive market opened. Consumers can shop from a myriad of product including prepaid service, time of use pricing, fixed and variable pricing, and renewable energy. The Texas PUC oversees a website at PowerToChoose.com that allows consumers to shop for electric service from among hundreds of product offerings. The competitive ERCOT market has also spurred the investment of $36.5 billion in new generation, and Texas leads the nation in installed wind generation capacity.

Smart Grid Initiatives

State legislation has encouraged the implementation of advanced metering by directing the Texas PUC to establish a cost recovery mechanism for utilities that deploy smart meters and related networks. The Texas PUC adopted a rule in May 2007 related to smart meter deployment.[1] The rule addressed customer and REP access to data, minimum standards for advanced metering systems (AMS) deployed, cost recovery, and utility deployment plans. Four utilities in ERCOT (CenterPoint Energy, Oncor Electric Delivery, American Electric Power-Texas and Texas New Mexico Power) have received approval for the deployment of smart meters in their service territories. Those utilities have presently deployed approximately four mil-

[1] 1 See PUC SUBST. R. §25.130, available online at: *http://www.puc.state.tx.us/rules/subrules/electric/25.130/25.130ei.cfm*

lion advanced meters and are scheduled to deploy a total of approximately seven million by the end of 2013. The Texas PUC has approved over $2 billion dollars in Smart Grid investment in the ERCOT region.

CenterPoint Energy was awarded a $200 million stimulus grant from the DOE. CenterPoint Energy will use $150 million of this grant to the accelerate the deployment of 2.2 million smart meters that were originally scheduled for completion in 2014 and are now scheduled to be completed by mid-2012. CenterPoint Energy is using the remaining $50 million to fund an Intelligent Grid initiative, which will automate 15% of CenterPoint Energy's service territory with advanced distribution management capabilities. This will include a "self-healing" system that will automatically identify outages, isolate faulted sections, re-route power, and improve overall reliability performance. This has also enabled CenterPoint Energy to provide proactive alerts to customers via email, text message, and phone for issues such as outages and storm preparation. CenterPoint Energy has created or retained 550 jobs as a result of the DOE grant.

By the end of 2013, Texas will have nearly seven million smart meters installed within the ERCOT region. In its smart meter rulemaking, the Texas PUC mandated a robust set of functionality—and did not mandate technology. These meters are home area network (HAN) enabled, record and transmit data in 15-minute increments, and are required to adhere to open standards. Energy management devices that are connected to the meter and the utility system are also being provided to customers on a voluntary basis.

The installation of smart meters and the associated systems are a core component of the smart grid. Meters with a robust set of functionality are the building block to achieving significant improvements in customer service and lower costs. To fully realize the benefits of this technology, providers and their customers need access to information that shows how much electricity the customers use and when they use it. In approving utility deployment plans, the Texas PUC authorized the development of a web site that makes smart meter information available to customers, REPs, and other energy service providers. This web site, SmartMeterTexas.com, enables customers with a smart meter installed in any of the four utility territories to go to one location and view their electricity usage on a 15-minute basis. This website is also compliant with the American Disabilities Act.

One of the major challenges with implementing the smart grid is that the realization of benefits does not occur overnight. The smart grid, comprised of a "system of systems," takes years. In Texas, we recognized that realization of the benefits will require revisions to the existing framework—including market processes, utility and REP systems, retail and wholesale systems at the ERCOT ISO, and Texas PUC rules.

I would like to touch on a few key components that we believe have allowed for faster adoption and realization of benefits of this technology. First, a progressive state policy led by the legislature has encouraged deployment, not mandated it. Second, the statute explicitly states that customers own their smart meter data and are in control of authorizing access to an entity other than their REP. This has ensured that customers have access to their smart meter information allowing them to have more choice and control. Customers can also access their data on a real-time basis with a device installed inside their home. Third, the Texas PUC has overseen an implementation initiative in order to make the smart grid a reality. The initiative is comprised of a stakeholder collaborative with representatives from utilities, vendors, REPs and consumers. This stakeholder process has addressed issues relating to customer privacy, changes in wholesale and retail markets, customer protection rules, access to data, changes to utility systems, the development of the SmartMeterTexas.com web site, and the requirements for the home area network. The work resulting from this process has allowed REPs and other energy service providers to take advantage of the new functionality from the utility systems—thereby developing products for customers at a faster pace. And, finally, REPs strongly supported the roll out of smart grid technology, because, in a highly competitive retail market, they wanted to have a competitive advantage over other REPs.

Retail products with features including usage comparisons, smart phone apps, online web tools and analysis, and other innovative services all are leveraging the ongoing smart grid investment. Further supporting the development of new choices for consumers includes an initiative by Reliant Energy. Reliant Energy received a $20 million stimulus grant from the DOE. More than 250,000 customers are benefitting from at least one Smart Energy product or service, such as those listed above, that Reliant offers. Reliant will enroll 500,000 consumers on Smart Energy Products and Services by March of 2013.

National Standards Effort

The Smart Grid is an emergent technological ecosystem that offers many possibilities to many different stakeholders. Participation in developing standards is paramount to: defining interoperable requirements connecting the different software components and technologies comprising the Smart Grid; ensuring reliability, safety, security and privacy are adequately addressed; assisting in optimizing value and avoiding limiting Smart Grid potential; assisting in defining reasonable and necessary component performance characteristics comprising the Smart Grid; assisting in defining common ground for interaction between new groups of stakeholders participating in the Smart Grid; and providing the opportunity for educating participants in developing and supplying components for building and/or operating the Smart Grid.

The creation of open, national standards can create a level playing field across industry sectors and the market. In the long term, standards should ensure interoperability of devices across utility service territories and across the country. This national set of standards should recognize and encourage an ecosystem of existing and evolving standards. A balance must be struck between existing standards that enable deployment and allow for benefits to reach consumers today, while working to refine and create future standards to address the Smart Grid of tomorrow. This process should result in the creation of a national set of standards that can provide direction for utilities, industry and market participants.

State commissions maintain jurisdiction over the distribution grid and have the ultimate responsibility for adoption and enforcement of rules relating to utilities and the retail markets, including the functions and operations of electronic equipment that is a part of the distribution network or metering infrastructure. It is important that the processes at NIST and at the FERC continue to recognize the important role of state commissions. The Smart Grid Interoperability Panel (SGIP) has provided an excellent forum for those presenting different views to meet and develop common standards and recommendations sufficiently broad to define Smart Grid.

The development of standards is the subject of much discussion at all levels of government. Standards are not static but are constantly evolving. Once a standard is adopted, there are revisions to improve the standard based on real world applications. While some have advocated for a federal package of mandatory standards for adoption, we do not believe that the federal government should take action to mandate standards. If we settled on standards when the internet was first created—the internet likely would not have evolved to where it is today.

Conclusion

Many residential energy customers are technically savvy. Use of the internet, smart phones and smart technology is increasing. As a result, an interest in products such as pay-as-you-go, time of use rates, and access to information is growing. Policy makers must recognize that it is vital that consumers have the ability to understand their energy usage and costs. While the traditional utility model provides this information thirty days after the fact, the smart grid, if implemented properly, will make this information available to consumers on the next day or the same day, depending on the technology.

Regardless of whether a state has restructured its electricity industry, there are many benefits to be realized from the Smart Grid. Customers require more information about their energy bills. Experience continues to show that customers will take advantage of this information. Policy at the federal and state level should continue to recognize the need for customer choice and control, and provide guidelines for the smart grid, not mandates.

Thank you for the opportunity to testify today and share the Texas experience.

Chairman QUAYLE. Thank you, Chairman Nelson.

The Chair now recognizes Mr. Caskey for five minutes to present his testimony.

STATEMENT OF MR. JOHN CASKEY, ASSISTANT VICE PRESIDENT, INDUSTRY OPERATIONS, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

Mr. CASKEY. Good morning, Chairman Quayle and Members of the Subcommittee. My name is John Caskey, and I am the Assistant Vice President of Operations and the Director of the Power Equipment Division at the National Electrical Manufacturers Asso-

ciation, NEMA. Thank you for providing me the opportunity to testify today. My testimony today is informed by more than 30 years of experience in the energy field. As the Director of the Power Equipment Division at NEMA, I work directly with the manufacturers that produce products that make up the electric grid and the evolving smart grid. In addition, I am the Vice Chair of the Governing Board of the Smart Grid Interoperability Panel, SGIP, and the Chair of the SGIP Vision/Mission/Roadmap Task Team. On the SGIP Governing Board, I represent the standards development organizations and the specifying organizations.

NEMA is the trade association for the electrical and medical imaging manufacturing industry. Founded in 1926 and headquartered in Rosslyn, Virginia, our member companies manufacture products used in the generation, transmission and distribution, control and end use of electricity that exceeds $120 billion in worldwide sales.

One of NEMA's primary missions—of particular relevance to today's hearing—is that we are a standards development organization, or SDO, accredited by the American National Standards Institute.

NEMA member companies are technology leaders and have been researching, developing, and deploying Smart Grid technologies for many years. In most cases, the technology needed to support smart grid are already available and have been deployed on a limited basis across the country. However, what has been missing is a complete set of standards and associated testing and certification requirements that ensure interoperability of the different components of the grid. This is our greatest challenge.

The Energy Independence and Security Act of 2007, in which this Committee played a critical role, blazed new trails in the development of smart grid. Title XIII of EISA charged the National Institute of Standards and Technology with the lead role in coordinating the development of a framework and model standards to ensure interoperability in the smart grid. NEMA is one of the non-government agencies named in EISA to work with NIST on the implementation of the interoperability framework of standards for smart grid.

One example of NEMA's role as an SDO is the development of the NEMA smart meter upgradeability standard. This standard was developed and approved through an ANSI-accredited process within 90 days of NIST's request for NEMA's help. This standard was accomplished through the cooperation and work of five major meter manufacturers, several utilities, the Department of Energy, and NIST. NIST's formation and funding of the SGIP public-private partnerships has been crucial for bringing all the smart grid stakeholders together to develop needed standards.

NEMA believes that the Federal Government should continue to serve as a partner with industry in the effort to establish smart grid standards. These standards are ultimately what will empower the consumer and drive cybersecurity, improved reliability and cost minimization. In addition, promoting these U.S. smart grid standards internationally is one way to strengthen the export market for U.S.-manufactured products. NEMA has taken the lead with the assistance from the Department of Commerce to promote the U.S. smart grid roadmap in Mexico and Canada. In addition to a U.S.

trade and development agency program, NEMA is promoting the U.S. smart grid roadmap in China. As these countries and others adopt their smart grid architecture and standards, it opens the market for American manufacturers and creates the opportunity for more American jobs.

Three additional thoughts I would like to leave with you today. Number one, the next major step for the SGIP is to create a roadmap that will lead the organization forward for the next three years. The NIST framework has led us this far by identifying the most immediate standards work that needed to be completed over the first two years of the SGIP. Now the SGIP leadership needs to focus on providing direction for the next phase of smart grid development.

Item two is, there continues to be confusion about the definition of consensus and the possibility for mandatory smart grid standards. Many people, including myself, define consensus as a product or policy that everyone can live with. Others feel that a consensus requires a super majority such as 75 percent. Still others feel that passing a simple majority of 51 percent signifies consensus. NEMA believes that the SGIP should work with FERC and NIST to resolve this issue before any standards are made mandatory by any federal agency.

The third point is that smart grid standards are radically more complex than most existing standards. Smart grid standards require an evolution from simple physical standards such as defining the physical attributes of an everyday 120-volt electric appliance plug to very complicated communication and protocol standards that may offer hundreds of variations in the application of those standards. This issue radically changes the meaning of compliance and our understanding of the concepts of interoperability and plug-and-play. This may be the first time that commissions and consumers will be exposed to the realization that you can have two products that meet the same standard that do not talk to one another and do not provide the same functionality.

I am happy to address these issues in more detail and answer any questions you may have. Thank you, Mr. Chairman, for inviting me here to testify today.

[The prepared statement of Mr. Caskey follows:]

PREPARED STATEMENT OF JOHN CASKEY, ASSISTANT VICE PRESIDENT, INDUSTRY OPERATIONS, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

Good morning, Chairman Quayle and Members of the Subcommittee. My name is John Caskey and I am Assistant Vice President of Operations and Director of the Power Equipment Division at the National Electrical Manufacturers Association (NEMA). I want to thank you for providing me the opportunity to testify today.

My testimony today is informed by over 30 years of experience in the energy field. As the Director of the Power Equipment Division at NEMA, I work directly with the manufacturers that make products that comprise the electric grid and the evolving smart grid. I have had the opportunity to work with National Institute of Standards and Technology (NIST) and most of the other stakeholders in the Smart Grid community since the signing of the Energy Independence and Security Act of 2007 (EISA).

I serve as the Vice-Chair of the Governing Board of the Smart Grid Interoperability Panel (SGIP), Chair of the SGIP Vision/Mission/Roadmap Task Team, and a member of the SGIP Business and Operating Procedure Working Group.

NEMA is the trade association of choice for the electrical and medical imaging manufacturing industry. Founded in 1926 and headquartered in Rosslyn, Virginia,

our member companies manufacture products used in the generation, transmission and distribution, control, and end use of electricity that exceed $120 billion in worldwide sales. These products are used in utility, medical imaging, industrial, commercial, institutional, and residential applications. In addition to our headquarters in Rosslyn, Virginia, NEMA also has offices in Beijing and Mexico City.

One of NEMA's primary missions—of particular relevance to today's hearing—is that we are a Standards Development Organization, or SDO, accredited by the American National Standards Institute (ANSI). A NEMA standard defines a product, process, or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which the products are designed.

NEMA believes that standards play a vital part in the design, production, and distribution of products and systems destined for both national and international commerce. Sound technical standards benefit the user, as well as the manufacturer, by improving safety, bringing about economies in manufacturing processes, eliminating misunderstandings between manufacturer and purchaser, and assisting the purchaser in selecting and obtaining the proper product for his particular need.

NEMA member companies are technology leaders and had been researching, developing, and deploying Smart Grid technologies for many years, well before the term Smart Grid was even coined. However, as technological advances accelerated across the power equipment and telecommunications industries, the need to establish a set of interoperability standards for the Smart Grid became increasingly important.

The Energy Independence and Security Act of 2007 (EISA), in which this Committee played a critical role, has blazed new trails in the development of the Smart Grid. Title XIII of EISA charged the National Institute of Standards and Technology (NIST) with the lead role in with coordinating the development of a framework and model standards to ensure interoperability in the Smart Grid. NEMA is one of the non-government organizations named in EISA to work with NIST on the implementation of the "Interoperability Framework" of standards for Smart Grid.

From the perspective of an organization with more than 85 years of experience with standards development, NEMA applauds the work done thus far by the National Institute of Standards and Technology, the Smart Grid Interoperability Panel (SGIP), and the National Coordinator for Smart Grid Interoperability.

The benefits we will see as a result of the development of a Smart Grid are extraordinary. Layering on communications and other technologies to improve the intelligence of the electrical delivery system will increase grid reliability, improve power quality, reduce the frequency and duration of outages, promote economic growth through development of new technologies and an improved electric infrastructure, bolster efficiency by giving grid operators and utilities greater situational awareness, and—as the name of today's hearing indicates—empower the ratepayer to become an active participant in the electricity delivery system.

Legal Authority

As you know, the House Science, Space, and Technology Committee was instrumental in creating the foundational legislation that has put our nation on a course to develop a Smart Grid.

EISA Section 1305 states:

> *"The Director of the National Institute of Standards and Technology shall have primary responsibility to coordinate the development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems. Such protocols and standards shall further align policy, business, and technology approaches in a manner that would enable all electric resources, including demand-side resources, to contribute to an efficient, reliable electricity network. In developing such protocols and standards—*
>
> (1) *the Director shall seek input and cooperation from the Commission, the Office of Electricity Delivery and Energy Reliability and its Smart Grid Task Force, the Smart Grid Advisory Committee, other relevant Federal and State agencies; and*
>
> (2) *the Director shall also solicit input and cooperation from private entities interested in such protocols and standards, including but not limited to the Gridwise Architecture Council, the International Electrical and Electronics Engineers, the National Electric Reliability Organization recognized by the*

Federal Energy Regulatory Commission, and National Electrical Manufacturers Association.

Standards and the Role of the Federal Government

Before I go on to describe the work that has been done as a result of EISA, I would like to address a few more basic questions. What are standards, why do we need them, and why is it important that the federal government be involved?

The interoperable, or smart, electrical grid consists of many different products, woven into a complex "system of systems" that must seamlessly provide sufficient and cost-effective electrical energy to power our homes, offices, schools, and businesses.

The scale, complexity, and interconnectedness of the electrical grid require that everyone and everything involved in developing and managing it are "playing from the same sheet of music." The Smart Grid is managed and coordinated by modern communications and control software which, in order to work optimally together, must share a common language and common understanding of the operational details of the many interconnected elements of the power grid. Reliable and effective interoperability requires a foundation of standards.

Now, why is it beneficial to have the federal government involved? While only a handful of areas in the U.S. were electrified in 1900, by the time we reached the 21st Century, electricity had become the cornerstone of the American way of life. Without electricity today, we could not pump our water, feed our citizens, charge our electronic devices, operate our military, or provide almost any of the vast variety of vital government services. The electric grid is clearly the most critical piece of our national infrastructure.

In the U.S., standards are typically developed by the private sector with varying degrees of participation by the government. EISA has opened the door to a more active government role providing an "umbrella" under which the private sector defines standards for Smart Grid products and systems.

A successful Smart Grid implementation mandates interoperability between utility operators which will transcend current jurisdictional boundaries. For as long as utility companies have been regulated entities, tensions have existed between state and federal regulators. Now, as Smart Grid applications like demand response can reach from the meter of a homeowner in one state to the hydroelectric dam operator in another, there are a number of new challenges which will rise to the federal level. One issue that is already gaining attention at the federal level is cyber security of the Smart Grid as utilities wrestle with the prospect of securing their operations across state boundaries and varied utility commission service areas.

Implementation of the Energy Independence and Security Act of 2007 (EISA)

NIST's leadership in the development of a Smart Grid has been exemplary and NEMA has been extremely pleased with the way in which the provisions in EISA have been carried out.

Once NIST received its initial funding, the agency spent time evaluating the Smart Grid environment and inventorying available Smart Grid-related standards as directed by EISA. NIST then established the Smart Grid Interoperability Panel (SGIP) in November 2009. According to its charter, the mission of the SGIP is to "provide an open process for stakeholders to participate in providing input and cooperating with NIST in the ongoing coordination, acceleration and harmonization of standards development for the Smart Grid."

The SGIP serves as an unparalleled forum where private industry can gather to discuss the future of the Smart Grid.

Participation of so many stakeholders across the Smart Grid spectrum in the SGIP is a testament to its importance. The SGIP comprises 22 stakeholder categories representing the breadth of the electrical industry and includes over 600 organizations and more than 1,800 individual participants. Current membership in the SGIP includes a variety of international interests from several countries across the globe, but most importantly from our trading partners in Canada and Mexico, both of whom sell electricity to U.S. utilities. In addition, the SGIP has a governing board structure elected from the stakeholders plus three at-large members. The SGIP is organized through a charter and bylaws to cover operating policy and provides membership opportunities for domestic and international interests. Indeed, the SGIP has also functioned as a conduit to its international peers for Smart Grid activity across the globe.

NEMA has been fully engaged in the progression of the SGIP. Representatives from NEMA-member companies as well as NEMA staff have served in numerous elected positions of the SGIP. NEMA's objective for the future of Smart Grid is to continue to provide quality leadership and make sure that the human capital re-

quired to run the SGIP is well supported by both NEMA staff and member companies.

While the first few months of the SGIP were devoted to getting the organization up and running, its members are now addressing critical issues around cyber security, smart metering, home area networks, in-home communication standards, etc. By identifying a consolidated list of technology gaps, referred to as "Priority Actions Plans" or PAPs, some of the most pressing needs have already been address through new standards developed by the SDOs participating in the SGIP. This will continue to be an ongoing process with a lot of this work completed in the remaining months of 2011 and into 2012.

It was, and continues to be, NEMA's belief that the federal government can serve as a partner with industry in the effort to establish Smart Grid standards. As the convener of the SGIP, NIST-funded resources have provided a valuable administrative role, allowing free public access to the proceedings and enabling the industry to focus their resources on the work of identifying and developing standards. Relative to the subtleties of the NIST-SGIP relationship, it is important to note that these are NOT government contractors simply executing NIST's vision for the Smart Grid. Instead, NIST's funding provides a democratic forum in which the industry's vision for the grid can be developed and mature on its own with the NIST staff getting a front-row seat to the process and immediate access to the results.

At the same time, the NIST Framework and Roadmap for the Development of Smart Grid Interoperability Standards (NIST Special Publication 1108, dated January 2010) provides a playbook that any interested party can use to get involved with Smart Grid. Over the last two years, as part of a program with the U.S. Department of Commerce the NEMA staff has had an opportunity to meet with several trade delegations from other countries about their Smart Grid efforts.

NEMA encouraged the formation of the International Electrotechnical Commission (IEC) Strategy Group on Smart Grid in 2008, which brought Smart Grid experts together from 14 different nations to develop a framework for international smart grid protocols and model standards to achieve interoperability of Smart Grid devices and systems. A roadmap has now been released based on existing international standards that can be used consistently for today's utility projects in many parts of the world. The NIST effort is coordinating with IEC to encourage adoption of global standards that reflect U.S. practices wherever it makes sense.

Smart Grid standards are a particular challenge. They will require an evolution from simple physical standards, such as defining the key features of an everyday 120-volt plug, to very complicated communication and protocol standards that may offer hundreds or possibly thousands of future features. Further complicating this effort is that any given utility may choose to implement a different subset of those features. This issue radically changes the meaning of "compliance" and our understanding of the concepts of "interoperability" and "plug and play."

Meter Upgradeability Standard

With all the general discussion thus far, it may be beneficial to highlight a specific example of the type of standards accomplished under NIST and the SGIP.

One of the critical issues facing electric utilities and regulators is the need to guarantee that technologies or solutions that are selected and installed by utility companies today will be interoperable and in compliance with future national standards-in other words, "future-proof." In order to preserve their investments, utilities want to be sure that the systems they select will allow for evolution and growth as Smart Grid standards evolve.

One of the first and largest Smart Grid investments being made by many utilities is deployment of advanced metering infrastructure (AMI), with smart meters being the main component, as the primary connection between the consumer and the utility which will allow for greater participation in energy management by the ratepayer.

As a result, NIST identified the need for a meter upgradeability standard as a high priority requiring immediate attention. The objective was to define requirements for smart meter firmware upgradeability in the context of an AMI system for industry stakeholders, such as regulators, utilities, and vendors.

As noted earlier, EISA requested that NEMA support NIST in the Smart Grid effort. Even before the SGIP was created, NIST called on NEMA to develop a standard to address meter upgradeability. The NEMA SG AMI-1 smart meter upgradeability standard was developed and approved through an ANSI-accredited development process within 90 days of when NEMA's assistance was requested. This could not have been accomplished without the cooperation and work of the five major U.S. meter manufacturers, the utilities, the DOE and NIST. The success of

NEMA SG AMI-1 demonstrates that standards development can be far more responsive than has historically been the case where it has often taken many years.

Promoting Exports through Standardization

The efforts made by NEMA in Smart Grid are also aimed at strengthening the export market for U.S. manufactured products. As referenced earlier in my testimony, NEMA has taken the lead, with assistance from the Department of Commerce, to promote the U.S. Smart Grid roadmap in Mexico and Canada. NEMA is also working through the U.S. Trade and Development Agency on a Smart Grid roadmap with China. As these countries adopt the U.S. Smart Grid architecture and standards, it opens the market for U.S.-manufactured products and technologies.

Consensus One issue that recently surfaced within the SGIP, NIST, and FERC relates to the definition of consensus. And this definition has implications on whether and how any given standard derived through the NIST process is made mandatory by regulators, as authorized in EISA. NEMA has been vocal about our contention that any standard coming out of an accredited standards development organization should satisfy the "sufficient consensus" clause in EISA. The procedures that NEMA must follow in order to maintain our ANSI accreditation ensure that consensus is built into every standard we publish.

Consensus is defined in many different ways. Many people, including myself, define consensus as a product or policy that "everyone can live with." Others feel that consensus is just a super majority, such as 75%. Still others may define consensus as unanimity.

EISA states:

> *At any time after the Institute's work has led to sufficient consensus in the Commission's judgment, the Commission shall institute a rulemaking proceeding to adopt such standards and protocols as may be necessary to insure smart-grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets.*

As stated above, in the fall of 2010, NIST sent the first five families of standards to FERC for its consideration, as directed by EISA. While the five families of standards, which dealt largely with cybersecurity, that were sent to FERC were not sanctioned by SGIP, they had been considered by NIST with significant input from stakeholders. In January 2011, FERC held a technical conference to receive feedback on these standards.

It is NEMA's view that most if not all of the Smart Grid community felt that these five families of standards were a very good starting point. During FERC's Technical Conference, the question of whether these standards represented the consensus of the industry was responded to with skepticism by witnesses.

I believe some clarification is in order. Some may interpret the testimony presented at the Technical Conference as evidence that NIST had not fulfilled its responsibilities vis-á-vis consensus under EISA. Nothing could be further from the truth. No panelist said that the five families of standards under consideration should not be part of the Smart Grid. Further, no panelist suggested that the five families of standards did not achieve certain Smart Grid functionality. Instead, it is my view that the mere fact that it was FERC—a regulatory agency—asking the question about whether or not these standards represented consensus raised witnesses' concerns that FERC was leaning toward mandating these standards in some form.

Now, let me be clear. NEMA does not believe inclusion of a standard in the NIST Catalog of Standards should make that standard mandatory. And at least in this case, FERC agreed; in July 2011, FERC concluded it would not take action on the first five families of standards. But, NEMA does believe a standard in the Catalog is something that FERC, as well as state utility commissions, can point to as a repository of good ideas for grid operators looking for Smart Grid solutions. Indeed, the SGIP Governing Board believes the Catalog of Standards is a source, but not necessarily the sole source, for Smart Grid implementers.

What's Next?

The next area of focus for NIST and the SGIP is to establish a Roadmap for standards activities for 2012-2014. Now that the work on the first set of critical standards is under control, we need to develop a roadmap for the next three years. This has proven to be much more difficult than expected because technologies, regulations, consumer participation really occur in stages. We need to develop an organized plan to create standards to support that staged evolution.

For example, electric vehicles represent a new and unique set of challenges to grid operators. For the first time in our electricity history, utility companies have to deal with a mobile component to the nation's electricity load. The same EV that charges

in a homeowner garage overnight, could, in all likelihood, appear as a load element in an office garage or retail parking lot in a completely different part of the grid at some point later in the day. Additionally, during peak demand periods or emergencies that same vehicle could be used to return power to the grid. This kind of variability, introduced at the fringes of the grid (the utility to consumer connection) may require new standards and regulations to be seamlessly integrated with existing grid operations.

NIST's greatest role in this respect is as a resource for regulators. Given their mission and history in metrology, NIST is uniquely situated and qualified to define metrics that work for regulators and utilities and enable them to tie incentives for Smart Grid to well-defined parameters. If our objective is to promote the adoption of Smart Grid, we first have to admit that in a regulatory setting it would be virtually impossible to define the concept of "smartness;" other metrics clearly need to be defined. NEMA also encourages NIST to continue to refine its guidance in the Interagency Report on Cybersecurity. Further, NIST can work with utilities to create implementable cybersecurity plans. And NIST can work with regulators to define functional cybersecurity regulation.

Summary

Standards development for the Smart Grid is a unique and massive effort. NEMA supports the continued collaboration between the Federal government and industry to address the many standards challenges that lie ahead, including the evolution from straightforward physical standards to those requiring communications protocols and information technology.

NEMA believes NIST has responded appropriately and impressively to its responsibilities under the Energy Independence and Security Act of 2007. It has become the key facilitator for the development of Smart Grid standards.

NIST and the SGIP should continue to serve as a credible source of model standards for industry as well as the federal and state governments.

While consensus can be defined in numerous ways, NEMA believes regulatory agencies must exercise extreme caution in making the leap from a consensus standard to mandatory application of such standard.

The efforts to establish Smart Grid standards, both domestically and internationally, will create certainty, interoperability, upgradeability, and as a result will drive adoption of Smart Grid technologies, generating economic growth and creating jobs.

NEMA looks forward to working with NIST and the SGIP to develop a roadmap that will guide our standards work over the next three years.

Chairman QUAYLE. Thank you, Mr. Caskey.

The Chair now recognizes our final witness, Mr. Drummond, for five minutes.

STATEMENT OF MR. RIK DRUMMOND, CHIEF EXECUTIVE OFFICER AND CHIEF SCIENTIST, THE DRUMMOND GROUP

Mr. DRUMMOND. Chairman Quayle, Congressman Sarbanes and other Committee Members, I am Rik Drummond, CEO of Drummond Group Inc., a GridWise Architecture Council member, a board member of SGIP and the chair of SGIP Testing and certification Committee. Drummond Group has been heavily involved in the smart grid since 2004 when I became the initial chair of the DOE-sponsored Smart Grid Architecture Council in 2005–2006. Smart Grid Architecture Council was the initial group that started socializing the need for general interoperability among software and hardware to solve the known and projected problems of the United States power grid. The interoperability requirement is in EISA 2007 legislation and is the basis for the Smart Grid Interoperability Panel's objectives.

The challenges the SGIP Testing and Certification Committee faces in working together to develop an interoperability framework for testing and certification are best elucidated by discussing the key components of the SGIP interoperability testing framework, which we call the interoperability Process Reference Manual, or

IPRM. The first version of this was released in January 2011, about nine months after the start of SGIP, and I'll go through the four sections very briefly here.

The first section is, how do we enhance testing lab processes for quality and repeatability. We chose to base these on the ISO international standards 17025, which talks about quality for test labs. Our challenge here is that I expect that this will probably increase testing costs by about 25 percent, and we are working that within the committee.

The second section defines requirements for certifying test lab results by trusted third parties. This section is again based on the ISO 65 guide. The challenge is that many product vendors and associations question the need for additional costs associated with paying for third parties to certify test lab results. These first two sections, by the way, parallel the efforts going on in Health and Human Services' testing and certification endeavor for implementing EHR meaningful use across Medicaid and Medicare.

Section three provides guidance for testing for cybersecurity mechanisms within a software product. Security testing of cybersecurity mechanisms and interoperability testing are normally at odds philosophically. Security attempts to restrict available functionality depending on the authorization while interoperability attempts to remove the restrictions so information flows between entities. Testing for both of these at the same time, where we can, will save cost and money.

The last section provides guidance on how to achieve interoperability in testing. Currently, many test labs do not verify interoperability. They only verify conformance of a product to a standard and assume that conformance includes interoperability. Frequently, conformance does not ensure interoperability. Interoperability must be verified during testing, and this has been a challenging point to get across. As you can see, our challenges are many but they are being solved through negotiation and collaboration.

A question you asked me, Chairman Quayle, in the invitation letter was, what can the Federal Government do to help facilitate interoperability in cybersecurity and the smart grid, and after much thought, I am going to suggest one thing here. The Federal Government could ensure that wide availability of conformant interoperable products are in the marketplace by requiring all products purchased by the Federal Government have been verified through testing and certification procedures much like that in the interoperability process reference manual. Since the Federal Government is about 25 percent of GDP, this would have a sizable impact on the smart grid and other industries.

In summary, the Smart Grid Interoperability Panel and Testing and Certification Committee is making significant progress in achieving the wide availability of high-quality conformant and interoperable products in the smart grid marketplace as specified in EISA 2007. The frameworks, the testing framework, the IPRM, and full implementation within the industry will take years to accomplish. That is as it should. As the power grid industry segment moves to better understanding of interoperability solutions, the interoperability testing framework and its purpose and benefits. Thank you.

[The prepared statement of Mr. Drummond follows:]

PREPARED STATEMENT OF RIK DRUMMOND, CHIEF EXECUTIVE OFFICER AND CHIEF SCIENTIST, THE DRUMMOND GROUP, INC.

Introduction

Chairman Quayle and Members of the Subcommittee, I am Rik Drummond, CEO of Drummond Group Inc, a testing and certification server provider. I am a board member of the NIST sponsored Smart Grid Interoperability Panel and the Chairperson of the Smart Grid Interoperability Panel's Testing and Certification Committee.

Thank you for the invitation and opportunity to appear before you today to discuss Drummond Group's involvement in Smart Grid testing and certification as well as the Smart Grid Interoperability Panel (SGIP) Testing and Certification Committee's (SGTCC) endeavors to solve Interoperability issues in Smart Grid products and services. I will focus on our accomplishments, our direction, and some of the key items needed to ensure protection of consumer privacy and the maintenance of cost/benefit for current services, while driving innovation within Smart Grid development.

1. Drummond Group Activities, Testing Challenges

A — Describe Drummond Group activities related to testing and certification of smart grid technologies and modernization of the electric grid.

Drummond Group has been heavily involved in the Smart Grid since 2004, when I became the initial Chair of the DoE sponsored *Smart Grid Architectural Council* in 2005-2006. *Smart Grid Architectural Council* was the initial group to start socializing the need for general Interoperability among software and hardware to solve the known and projected problems on the USA Power Grid as we moved to the Smart Grid.

In 2009 Drummond Group was selected as the Interoperability Specialist subcontractor to the *Center for Commercialization of Electric Technology* (CCET) on "Discovery Across Texas: Technology Solutions for Wind Integration in ERCOT DE-OE0000194."

Drummond Group continues to work with CCET on this endeavor. We are currently focused on the third party privacy issue for shared information for the purpose of enhancing the consumer experience in the Smart Grid. The focus is on third party providers that help the consumer manage their electrical power consumptions more effectively and efficiently while ensuring existing privacy rules and regulations are implemented.

I am on my second term as chairman of the NIST sponsored *Smart Grid Interoperability Panel Testing and Certification Committee* (SGTCC). I am also on my second term as a board member of the Smart Grid Interoperability Panel. Our focus this year in SGTCC is: 1) Speeding the off-the-shelf productization of standards based interoperable products in the market place, 2) increasing the consistency of interoperability testing and certification services across all products implementing the 100+ technical standards used to integrate the Smart Grid systems, and 3) decreasing the cost to service providers and consumers in implementing and integrating products within their portions of the Smart Grid network.

SGTCC released the initial voluntary interoperability policies and procedures in December 2010, nine months after the kick-off working meeting of the SGIP in March 2010. These voluntary, predominantly ISO9001 based policies and procedures are enshrined in the SGIP's "Interoperability Process Reference Manual" version 1 (IPRM). We are currently working on the release of version 2. This second version will increase clarity, fill in gaps identified by the six initial users of the Manual and streamline the implementation process by the testing and certification community. Version 2's anticipated released date is January 2012 for general use by the Smart Grid culture. While the focus of the IPRM is to enhance interoperability in products based on a single standard, there are interoperability issues the IPRM will not solve. It will not solve those issues of integrating multiple products, based on multiple standards in support of a service provider's workflow or technical or business process. An SGIP workgroup exists to solve these issues which are currently called internally, for lack of a better name, *End-2-End Testing Workgroup*.

End-2-End Testing normally takes place in the pre-production roll-out of Smart Grid infrastructure by the Transmission and Distribution Service Providers (TDSP). Many suppliers of electricity, Transmission and Distribution Service Providers, generally, repeat in a large degree, the end-2-end testing and integration verification that was previously accomplished at other service providers. Of course, there are dif-

ferences in the configuration of products between service providers, but SGTCC believes that commonalities far out weigh the differences. The focus of our *End-2-End Testing Work Group* is to facilitate the sharing of these test data results and techniques to speed the implementation of new technologies and services across the Smart Grid. The thinking is: since another Service Provider has already accomplished it, why not leverage their findings to facilitate integration in one's own network area?

B — What are the greatest technical challenges of testing and certifying Smart Grid technologies in the market with few standards in place to support interoperability?

Article by Drummond: "How the GridWise Interoperability Framework Can Save Time and Money"

Coming to Grips with a Definition

Smart Grid interoperability means different things to different people. Some view it as a low-level technical topic. Others view it as a standard with an obscure name. Both are components of interoperability, but there are many other aspects.

The GridWise Interoperability Framework aids the discussion of those many aspects by breaking the problem into bite-sized pieces. This article is the first in a series that will explore each aspect in more detail. The goal is to clarify interoperability and to determine what needs to be agreed upon so that systems can play together with the least amount of effort and cost.

Wikipedia's definition of interoperability is: "the ability of diverse systems and organizations to work together (inter-operate)." It further states that "the IEEE defines interoperability as: the ability of two or more systems or components to exchange information and to use the information that has been exchanged." It is interesting to note that Wikipedia says the term can be used technically or broadly in a way that takes into account "social, political, and organizational factors that impact system to system performance."

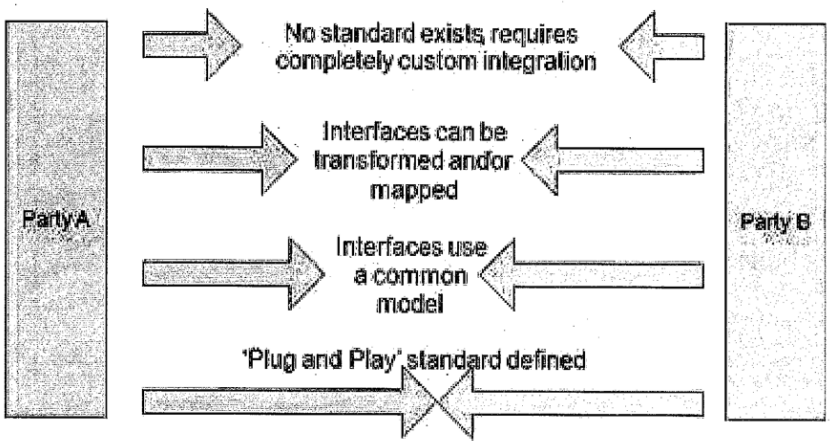
Anyone that has observed interoperability efforts in other industries can confirm that social, political and organizational factors have at least as much impact as purely technical issues! Past decades have witnessed interoperability conflicts over things such as Betamax vs. VHS, HD vs. Blu-Ray, systems-oriented architecture (SOA) and (just now beginning) iPhone vs. the Google mobile phone standard. For every battle that shows up in the headlines, there are dozens of others known only to insiders, but with similar consequences: delay, confusion, higher costs and higher risks for end users.

The Expanded GridWise Definition

The GridWise Interoperability Framework exists to minimize that kind of pain and delay. It adds to previous definitions of interoperability with the following characteristics:

- An exchange of meaningful, actionable information between two or more systems across organizational boundaries.
- A shared understanding of the exchanged information.
- An agreed expectation for the response to the information exchange.
- A requisite quality of service: reliability, fidelity, and security.

There are many paths to interoperability. They range from expensive, custom integration projects to plug-and-play architectures. Scott Neumann describes this variability as the "distance to integrate." (See drawing.)



As an illustration, the flash drive in your pocket is a plug-and-play device. It conforms to the USB specification as a specific type of USB device, which is recognized by the operating system to have specific properties and behavior. If the flash drive does not conform to these specifications (or if the correct device driver is not installed in the operating system) then plug-and-play becomes plug-and-pray or plug-and-slay (as in urge to kill).

The Four Levels of Interoperability

Plug-and-play (at the bottom of the drawing) is usually reserved for interfaces in wide-spread, commodity use. Product interchangeability is supported by rigorous specifications and strenuous testing. The high cost of achieving this level of integration requires a large market to apportion the costs.

The next level (second from bottom) involves systems that use a common information model but with differing technical transports, transaction sequences and data encoding. Integrating such systems requires time and effort—but at least they are talking the same language. System design, software development and testing at the information level are still needed, as they are for the underlying technical transports and data encoding. As the GridWise Interoperability Framework reminds us, interoperability means all layers must work together from technical to informational to organizational.

At the next level up, some interfaces use different information models and the data must be mapped or translated before it can be used. Think about currency and exchange rate. If you know the exchange rate between the US and France then it's easy to map dollars to francs.

If such translations are not available, then you are at the top-most level and it's time to pull out the checkbook. The old adage applies: "Anything is possible with software, given enough time and money." There is a thriving systems integration market for providing custom (and costly) interoperability solutions. Money can either be spent each time an end-user attempts to integrate or on a one-time interoperability/conformance test at the product level. It typically costs much less to do a one-time interoperability/ conformance test at the product level.

Now that we understand the definition of interoperability and the distance to integrate, we can start implementing specifics for the Smart Grid.

2. SGIP — Represents Testing and Certification Vendors

A — Describe the process of testing for conformance and Interop.

Article by Drummond: "Six Steps to Achieve Interoperable Networks, Systems, and Devices in the Smart Grid on any Standard"

Conformance is not Interoperability

The program must clearly convey the different meanings between conformance of an implementation to a standard, and interoperability between two or more implementations of the standard. Confusion regarding this aspect is currently a major hindrance to the success of conformance and interoperability programs. This misunderstanding of the differences between conformance and interoperability in the marketplace, testing, and at times, the program authors themselves, results in confusion as to what is meant by successfully passing the testing program. Conformance means that an implementation adheres to the dictates of the standard.

(I will not discuss profiling of standards at this time)

While one might think that all programs that completely adhere to a standard (conformant) would be interoperable, in practice they often are not. Interoperability means that implementations adhere to the dictates of the standard and intercommunicate appropriately with other implementations that adhere to that same standard. (I will forgo the discussion of gateway standards at this time.) Interoperability adds one more requirement over and above conformance.

The problem is that many testing programs test only for conformance and then unceremoniously presume and declare it interoperable. Stakeholders in the marketplace believe they are receiving interoperable implementations because they have been told so, but they are getting only conformant products. Conformant implementations may not be interoperable among themselves. This is especially the case in more complex software and hardware systems. This leads to the first aspect discussed above in which "certified" implementations now require debugging when they are installed by the end-user, thus damaging the credibility of the test program. And they slow ongoing Smart Grid implementation. Once the compromising of the testing program's credibility starts, it can take a few of years to correct the perception by the marketplace of end-users. This is why the test program must be thought of as a stakeholder in the process early on.

B — What is the importance of testing and certification in the implementation of standards of Smart Grid devices, systems, and processes?

Interoperability Verified not presumed

The program must verify, not just assume, interoperability among the various product implementations of a standard. There are many different types of standards. Some are device oriented. Some are business-to-business. Some are written from the ground-up, detailing all the software and firmware with dependencies on other standards to achieve their purpose. Other standards are focused on communication protocols, while others are focused on the semantic meaning of the data. Only testing the conformance of any of these standards may achieve different levels of 'near' or 'actual' interoperability. Depending on a number of factors, including the standard, the testing regime, the software/firmware under test, and others, conformance testing may produce interoperable implementations. Such a result is good in that no additional testing steps are required to achieve interoperability. However, there remains a problem. It is rarely known that a conformance test has produced interoperable product implementations unless verification is performed with an additional test step to prove that the implementations are indeed interoperable. There are only two points in the timeline as a standard evolves from formation to product implementation where implementations can be verified as actually interoperable:

1. The product implementations may verify interoperability in concert with conformance testing; or
2. When the end-user is attempting to deploy the product implementation in the field.

The first case represents the testing program and the stamp of approval of 'certified' by the program and demonstrates that products are both conformant and interoperable. In the second case, the conformant and presumed interoperable implementations are released to the marketplace where the end-user is expected to validate interoperability and correct any shortcomings in the testing program. It is well known from studies over the past 20 years that errors found in software products after field deployment may cost as much as 40 times the amount to correct than if those errors are found before the implementation is released to the marketplace. This additional cost does not include the original cost, frustrations and loss of good will by the end-users.

Not verifying that conformant implementations are interoperable when they are given a 'certified' grade in a conformance and interoperability testing program often cause the program to become irrelevant as we have seen in other industries. When this happens, interoperability often stalls for that standard in the industry—sometimes for years.

Summary

Success of a conformance and interoperability program is about methodologies, market positioning and securing success for all the stakeholders. The program must be focused on supporting the implementations in the field for not only the product lifecycle, but also the lifecycle of the standard. The program must clearly identify what it is offering to the all the stakeholders as it identifies certified implementations. Are the products verified conformant or are the products verified conformant and interoperable? The program designers must anticipate its growth and demise as conformance and interoperability become institutionalized in the implementations over their lifetimes. All of these issues should be anticipated for a successful testing program irrespective of the standard. Not doing so may greatly reduce the introduction of conformant and interoperable implementations of the standard into the industry—stalling interoperability.

C — What challenges has the SGIP faced in working together to develop a framework to ensure interoperability of Smart Grid products?

The first versions of the IPRM went into place in January 2011 for SGIP members. The framework covered 4 broad area:

1. *Enhancing Testing Lab process quality and repeatability.* These processes are based on ISO 9001 requirements and are elucidated in the ISO 17025:2005 guide. Currently only a portion of the test labs used in the Smart Grid use these guides as the basis for their internal testing processes. Many others do not. Quality of the test results from labs is currently spotty. Interoperability is a 100% endeavor. Test Lab producing quality a 99% causes problems. Getting everyone in the Smart Grid to understand the need for consistent quality output for tested products has been problematic. The main inhibitor to solving this problem is the added cost for the implementation of ISO 17025 for product vendors to test products. I personally estimate a cost increase of 25 to 40% over pre ISO 17025 testing.
2. *Requirements for Certifying Test Lab results by a trusted third party.* These certification processes are currently being modified to fit ISO 9001. They will be elucidated in the forth coming ISO 17065 guide. Currently, the working guide is ISO 65. Currently, many product vendors question the need for the additional cost associated with paying for a third party to certify test lab results produce interoperable products.
3. *Guidance on testing of cyber security mechanisms within a software product.* Security testing of cyber security mechanisms and interoperability testing are normally at odds philosophically. Security attempts to restrict available functionality depending on authorization while interoperability attempts to remove restrictions so that information flows between entities appropriately. Conducting cyber security testing distinct from interoperability testing does and will cause problems. Tightening cyber security may make the product non-interoperable. And the converse, ensuring interoperability may inadvertently break cyber security mechanism. Conducting a single test of products, covering both cyber security mechanisms and interoperability requirement will allow these clashes to be resolved during the test. Thus a product or products will be released from the test lab that meets both the cyber security and the interoperability requirements at an anticipated lower cost.
4. *Guidance on how to achieve interoperability in testing.* Currently may test labs do not test for interoperability. They only test for conformance of a product to a standard and assume that conformance includes interoperability. A conformant product may not be completely interoperable with other conformant products. The introduction of conformant products in the market place which are only assumed to be interoperable moves the burden of getting products to intercommunicate to the persons installing the products in the field. They may have to fix non-interoperability problems that should have been fixed before the products were released to the market place. This greatly slows the introduction of new capabilities and products installed in the Smart Grid. Many test labs and service providers do not understand that conformance does not ensure interoperability within a set of products.

3. Federal Government Role

What do you believe are the most important actions for the Federal Government to take to ensure the protection of consumer interest, including cost and privacy while driving innovation within the smart grid development?

Since the United States is a federation of states, with attributed states rights, unlike just about any other country, what the Federal Government may do versus what would be helpful to do are not always the same. States differ in their regulations as to privacy of consumer data, security, allowable charges to the consumer and et cetera.

1. Ensure Cyber Security on the smart grid is a top down approach. Piece meal implementation across the Smart Grid will make the verification of security problematic for the USA power Grid.
2. Ensure the population in the USA understands the cost/benefits of the Smart Grid implementation. Increased Consumer cost for power is going to be problematic. Cost is going up significantly because of new EPA regulations on coal-fired plants and less significantly because of the implementations of smart grid technologies. I predict the consumers, especially those within one of the largest voting blocks, baby boomers on a fixed income, will react negatively to even minor cost increases caused by various regulations and technical enhancements to the power grid.
3. Ensure the implementation of the logic or verbatim use by the Federal Government of the Interoperability Process Reference Manual (IPRM v2) by including it within new versions of the FIPS. This would mean approximately 25% of the GDP would be required to increase software and hardware product quality, consistency, reproducibility and interoperability within the IT markets, thus partially, yet significantly, funding the efforts of Test Labs, Certification Bodies and product vendors to implement quality and consistency for Interoperability across all sectors of the economy including Smart Grid. Health and Human Services is implementing the Test Lab and Certification body quality requirements as part of the EHR Meaningful Use requirements for Medicaid and Medicare providers. While these currently do not focus on Interoperability as such they are implementing the quality framework to support Interoperable products within the market place. I would use the FIPS to prime the pump not new regulations on the private sector. The uncertain regulatory environment is slowing growth of the private sector.

Chairman QUAYLE. Thank you, Mr. Drummond, and I would like to thank all the witnesses for their testimony. I just want to remind Members that the Committee rules limit questioning to five minutes, and the Chair will at this point open the round of questions. I recognize myself for five minutes.

Mr. Caskey, the Energy Independence and Security Act of 2007 required that FERC initiate a formal rulemaking process to adopt interoperability standards when it was satisfied that a consensus was actually met. Do you believe that a formal rulemaking process is necessary or do you think that a consensus could be achieved without that formal rulemaking process?

Mr. CASKEY. I think that they are two different things. I think reaching a consensus on the standards that need to be applied for smart grid is one thing, and we are working towards that and I think we are meeting those requirements within the SGIP and the Governing Board of the SGIP. In terms of a rulemaking process, I personally do not think that it is necessary at this time and really doesn't benefit the development and the innovation going on in smart grid at this point. At some point in the future it may be more appropriate.

Chairman QUAYLE. So do you think that within the rulemaking process that those standards that could have been achieved, that there could be potentially harmful for innovation going forward? Is that——

Mr. CASKEY. I am sorry. Say that one more time.

Chairman QUAYLE. You said that possibly the rulemaking process could have a detrimental effect on innovation going forward. Is that what you're saying?

Mr. CASKEY. Yes. I don't think we are to the point yet of locking in any particular standards and making those standards mandatory. We are still growing those standards and modifying those standards, and at some point in the future having mandatory standards or rulemaking on those standards makes sense, but not right now from my perspective.

Chairman QUAYLE. Okay. Thank you.

Chairman Nelson, in your testimony you described all the progress that Texas has made, and you mentioned you had put forward about 4 million smart meters onto the marketplace. Texas is obviously a unique state in that it produces most of its own energy. Do you think that putting out these types of smart meters prior to the standards being set is putting the cart before the horse, or do you think it is a push to spur that process going forward?

Chairman NELSON. Well, I do recognize that it is a delicate balance. I think that if a state were to implement a smart grid program like Texas did and it were to do it in a way where you have open architecture and you made sure that whatever—however you implemented it would be in conformance with things moving forward, I think that you could do it, but it is difficult. It is difficult to do it without standards.

Chairman QUAYLE. Dr. Arnold, in January of 2011, the GAO noted that the federal—that FERC doesn't have the authority to enforce standards and recognized that a regulatory divide exists between federal, state and local entities on various aspects of smart grid interoperability and cybersecurity. The GAO further stated that such standards remain voluntary unless regulators use other authorities to enforce compliance. What really distinguishes the process of developing voluntary consensus standards from developing standards likely to be mandated and enforceable?

Dr. ARNOLD. Well, I think it is instructive to look at some other examples in other infrastructure such as the telecommunications network, and there, as I noted, the vast majority of standards are voluntary consensus standards which are used by industry because there is a benefit to industry in doing that. One example where it made sense to mandate a functionality or a standard was number portability, where to promote competition in the local exchange market, the FCC mandated the ability for consumers to take their telephone numbers when they switched carriers. There was no incentive for the service providers to implement that capability because it was costly, and why would they want to promote competition. So there was a case where in order to have that policy objective implemented, it made sense to mandate it. I think at this point, in my opinion, it is too early to tell whether there are such analogs in the smart grid but if there are, then it may make sense in selective cases like that.

Chairman QUAYLE. Thank you very much.

The Chair now recognizes Mr. Sarbanes for five minutes.

Mr. SARBANES. Thank you, Mr. Chairman. Thank you all for your testimony.

I am trying to get my head around the notion that there are parts of the grid that are already smart. I mean, we talk about a smart grid but Chairman Nelson, you sort of alluded to in your testimony the fact that there are parts of our national grid that you would view as being smart, and I don't know if anybody is in a position to quantify that somehow but maybe you could try and tell me. What percentage, knowing what you know and knowing what kind of aspirational standards you are working on, what percentage of the grid now is smart, or is that not a helpful way to at least get a baseline perspective on this? Anybody?

Chairman NELSON. I guess I would say it is very hard to quantify. In Texas, the way we started is, we started out with a rollout of the advance meters to the customers because we felt to have—if you are going to be spending money, you want to have customer acceptance and you want them to see the benefits. So we have that, and we are slowly making the rest of the grid smart and also that you can have things like self-healing distribution lines and transmission lines. So I would say at this point it is hard to quantify just because I don't know if you give the meters more of a percentage than the lines. It would just be difficult to quantify it.

Mr. SARBANES. Dr. Arnold, do you have a perspective on that?

Dr. ARNOLD. Well, there are so many different technologies that apply in an end-to-end system that I think the fact that we have 50 states that each can in their unique environments apply these technologies allows us to benefit from those experiences and roll them out nationally based on best practices. Certainly, the automation that is now being deployed in the transmission network with phasor measurement units, which will provide wide area visibility, will have tremendous benefits in reliability of the bulk power system, and that is well underway with Recovery Act funding. The application of smart meters in addition to the benefit in terms of energy savings that consumers can have through access to information also provides that visibility to the utilities for restoration after power outages. So I think it would be a mistake to try to deploy everything at once because these are new technologies that need to be proven in and the approach that we are taking of having nationally the ability to benefit from the different state deployments as well as the deployments in the bulk power system is a very good way forward.

Mr. SARBANES. One of the themes that we have heard already in your testimony and the questions that Chairman Quayle just asked is this notion of kind of a mandatory versus voluntary approach over time, and it sounds, Mr. Drummond, like you believe that the biggest nut to crack, the toughest problem is the interoperability issue, and we see that across the board. I mean the 9/11 Commission just came back, the chairmen, to talk about the remaining challenges of interoperability there, even though that was the number 1 priority years ago in the wake of that disaster to try to cure those problems. And maybe humans are innately inoperable, noninteroperable, if that is a word. But that would seem like an area where mandating some things would be called for, and I just would like to get your reaction to that.

Mr. DRUMMOND. Interoperability has a lot of meanings. The way we focused on it in SGIP testing and certification is, is that we see

it as a need to be market-driven. Businesses who buy products need to understand the cost-benefit tradeoffs from buying interoperably verified certified products versus buying those which have not been that way. An example, I have been doing this for a long time and I remember back eight or nine years ago in a different standard, we were doing interoperability testing and people who would those which had been certified would be able to install it within two or three days and make it work. Those who didn't might spend 6 months trying to get the product to work interoperably with someone else. So the key here is, is we need to put products in the marketplace that people can be assured are interoperable easily—that is why I keep saying the word "certified," by certified third parties—so the marketplace can see the cost-benefit and start putting those in place. We can make anything computer-wise interoperable. It is when you have hundreds of things happening over and over again, you do not want to keep repeating the same development cycle of integration. You want to make it much easier because it has done before because it has already been testified and certified.

I really think the market can drive this well, and the suggestion I had before was not so much going into regulations or anything else, it was thinking about if the Federal Government has so much buying clout out there and if you all saw it was beneficial to start buying certified interoperable products using testing, as we are recommending, that would push multiple industries, not just this one, into a more interoperable, more cost-efficient model than we have right now as we put things in place.

The last point is, if I buy interoperable products, I reduce my perceived risk as a manager and executive in a corporation if I know they are interoperable and I will move faster to implement new things in the network if that risk is reduced. When I still do not know my risk because I don't have certified products out there, I take much longer to move to the next phase of the network, the more intelligent network, because the risk is too high for me to move very quickly without doing a lot of due diligence. Does that answer your question?

Mr. SARBANES. Thank you very much.

Chairman QUAYLE. Thank you, Mr. Sarbanes.

The Chair now recognizes the gentlelady from Illinois, Mrs. Biggert, for five minutes.

Mrs. BIGGERT. Thank you, Mr. Chairman, and thank you for holding this hearing today, and I commend the witnesses for all the collaborative work that you are doing on this issue.

My question is related to the type of technology that the standards development process will eventually allow, and do you see room for variable types of smart grid technologies? The reason for this is that some of my constituents have raised privacy or health concerns with the smart grid devices, especially the wireless technologies, and this is from a community that has been working on this since 2005 and to develop the smart grid and the smart meters, and so this has come up from some of the constituents, and what happened here is actually that they did a survey and everyone agreed to have mandatory technology. So do you see that there is a mix of technologies being deployed that can address their con-

cerns and still meet the goals of an interoperable smart grid? Mainly it is the two issues. One is the health concerns and also privacy when they have the meters in their homes. I would like all of you to address this.

Dr. ARNOLD. Well, there are two aspects to that. In terms of privacy, this is a very important issue in the smart grid, and we are paying very strong attention to it. In fact, in our 700 page cybersecurity guidelines, we have a whole volume that is devoted to privacy issues and that volume includes an analysis of data privacy issues in the smart grid, a summary of applicable laws and regulations at the federal and state level, and provides guidance on how to apply business practices and technology to ensure data privacy. There are also some specific business practice standards consistent with those guidelines that are now under development by the North American Energy Standards Board, so this is an area that we are actively addressing.

On the health aspects of wireless communications, I would say that is a little bit outside of our jurisdiction because the FCC sets requirements on emission levels for wireless devices. To the best of my knowledge, the devices that are being used in smart grid applications, they have to comply with the FCC requirements, so——

Mrs. BIGGERT. Well, this community is having 15 gigawatts of energy, and it is a lot stronger than what they are doing right now as far as they put this into effect. They are worried about that, so maybe Chairman Nelson, could you address that since you are also putting these in?

Chairman NELSON. Well, let me just start out by talking about the privacy aspect. In Texas, our legislature made that determination by saying customers own their own data, and so in Texas now, the commission is in the process of fleshing that out because one of the things that we found most critical as you go forward in installing smart meters is that customers understand what is happening, and so we want to make sure that the process where third parties come in and contact them is a fair process.

In terms of the safety issue, I think there is a lot of evidence that the systems are safe. In terms of whether you can use—whether one system should be mandated, that is not the way that Texas went. We went with an option of letting the companies choose the technology, the transmission and distribution utilities.

Mrs. BIGGERT. Mr. Caskey?

Mr. CASKEY. Yes, a couple different points. One is dealing with technology, I think that the connection with the consumer is often at the meter, so often consumers are first concerned about that. I have read various studies by the Electric Power Research Institute and other organizations, and at least so far they have not found any evidence between any health concerns and the radio-type receivers and transmitters used in the smart grid and the smart meter deployment. Certainly, if there are issues associated with that or there are perceived issues associated with that, you can potentially take that out but then you lose some of the features and the benefits of those meters so the may not be very cost-effective once you take away that two-way communication aspect of those smart meters. Also in terms of technologies, there is a wide variety of technologies including at the generation of power that Dr. Arnold

had referenced and the transmission and distribution grid. There are lots of different technologies that make up the smart grid. There are literally hundreds of various technologies that will be applied to get the whole smart grid to work effectively together.

Mrs. BIGGERT. Thank you.

Mr. Drummond?

Mr. DRUMMOND. I am of the opinion generally that we in the architecture realm, which is what we are talking about now, the smart grid is an architecture or framework, need to put in place the philosophical principles behind it and what should work together, what shouldn't—that would be for privacy and technology—and let the lower levels, those who are dealing with the implementation and those sort of things, start making decisions in more detail, and if you do it in that manner, that means you can change over time easily as new standards happen. You can use slightly different standards for exactly the same reason in different areas because they would work best in those areas. So I think in answer to your initial question, there is a lot of variety out there you can go do. There is always this tradeoff about how much you mandate specific standard to go this which will actually reduce risk a whole lot, from my risk thing earlier, but it also squashes innovation. So you have this—you are kind of sitting on the head of a pin here trying to avoid both of those sort of things at once, and I think we are doing that well in SGIP right now, by the way.

Mrs. BIGGERT. Thank you very much.

Mr. Chairman, I yield back.

Chairman QUAYLE. Thank you, Mrs. Biggert.

The Chair now recognizes the gentleman from New Mexico, Mr. Lujan, for five minutes.

Mr. LUJAN. Thank you very much, Mr. Chairman.

Dr. Arnold, I want to talk a little bit about distributed generation and what that means to a nationwide interoperable grid. Distributed generation can reduce pollution. It can increase energy efficiency, promote the use of renewable generation and power homeowners and business owners. It has been suggested that when we have had blackouts or brownouts in some of the most urban metro areas of the country, that if there would have been a more elaborate distributed generation system, that we could have alleviated some of that load.

One of the principal barriers to the deployment of distributed generation is the process of connecting to the utility grid, the interconnection or the interoperability, if you will. We need common standards for interconnecting DG devices into the grid system. This year I have introduced a bill promoting net metering and establishing interconnection standards for net metering.

Like Chairman Nelson, I once chaired the New Mexico Public Regulation Commission, which is the equivalent of the public utility commissions around the country, and it was an honor to serve there. Everything that I learned there was that you needed to have those interconnection standards in order to push distributed generation and make it a reality so that one thing could talk to another, making it smart, I guess. Can you discuss efforts to develop common standards that support distributed generation that help empower consumers?

Dr. ARNOLD. Certainly. Well, first I can tell you that supporting distributed generation in the smart grid is one of the key requirements from the beginning in our effort, and we have a number of standards in our framework that provide technical capability for this including the metering standards, which have to support two-way measurement, and the electrical information connection standards. There is a standard known as IEEE 1547 that has been enhanced to support this, and I would also note that we have been successful in getting the IEC to adopt that as an international standard so that we are leading the global approach on this.

There is a lot more that needs to be done, though, because as the growth of these resources increases, the ability for utilities to know how much distributed generation is feeding into the grid and be able to forecast that becomes critical to maintain the reliability of the grid, and so to address the information management standards to support this, the SGIP is in the process of forming a new working group specifically looking at this whole suite of standards for distributed generation and storage, and I believe the official approval of this working group is going to take place this afternoon at the Governing Board meeting, so this has been a major area of focus and will continue to be.

Mr. LUJAN. That is encouraging, Dr. Arnold, that those conversations are taking place, again, working with an industry group, with IEEE, associated with seeing how you can establish some of these interconnection standards so that way there is more certainty out there. Many states have adopted net metering standards. It is one that I hope we can continue to see more states do and maybe some formal recognition by the government or encouraging them. I think that that is the way to go.

You know, truly as talk about minimum standards, I don't think that what is being suggested is pushing one technology or one software platform above another. When we talk about cloud computing now, something that just a few years ago no one imagined that would be part of a smart grid conversation, hardware and software. I think what is key is that we find a way where you can plug something in to something else and that they can talk to one another and that those software apparatus, whether we talk about Mac or we talk about PCs, Microsoft, Apple, it is amazing how software that is written today, how it doesn't matter what system you are on, you can work with one another. I think that is all that we are suggesting. And if there is a way to encourage what I am hearing today through the testimony that we can find a way to have interconnection standards, we can have a way to have interoperable standards associated with making these things talk to one another but then the gamut runs as it may and the market is going to develop the most efficient and effective tools to allow this to happen, to empower consumers, to make sure utilities know the certainty of what is happening with loads, to prevent power outages, and hopefully like in New Mexico we prevent natural gas outages as we saw in Texas with rolling blackouts recently, and it gives those tools more so that the commissions are working closely with the utility companies, the utility companies are working closely with the businesses, and we are saving money in the end. This is going to put more money in people's pockets. It is going to put more

money in small businesses' pockets and it is going to save money associated with the impact that dramatically happens in a community when we have these power outages.

So I am encouraged by this hearing and I think there is a lot of promise here, and I think there is actually a lot of common ground between all of our colleagues here in the Congress with wanting to do the right here, so I appreciate it again, Mr. Chairman. Thank you very much for my time.

Chairman HALL. [Presiding] Thank you. The gentleman's time is expired. I will recognize myself for five minutes but I won't take five minutes because I know Chairman Quayle has already recognized all of you, and thanks you, but I would feel bad if I didn't thank the Texans out there. Rik Drummond, small business leader, thank you, and of course, I always save the best for last. Chairman Nelson, I really came down here to see if she is as attractive and intelligent as everybody always says she is, and we are glad to have each of you. Thank you for what you are doing. Don't judge our interest in you by the empty seats because everybody has two or three committees, and this goes into a permanent record and they will all have copies, and thank you very much.

I yield the balance of my time to Mr. Rohrabacher. For those who are present today, he is my favorite in the entire Committee that are Republicans. The Chair recognizes Mr. Rohrabacher.

Mr. ROHRABACHER. How do I follow that?

You know, I have been hearing about the smart grid and the grid, and we have to do something about the grid for so long. I mean, it just—over the years it just—and quite frankly, I am not an engineer and I don't understand all of the aspects of some of these things you have been talking about today. Some of them are a little bit above my pay grade. But there are some things that we do have to know here, and that is about the spending of government money and how it is being utilized to accomplish goals in the various departments and agencies.

When will the smart grid be available and be actually being utilized by the public? Whoever wants to answer that.

Mr. CASKEY. I will attempt to answer that. When you picture the entire smart grid working effectively and interoperating, We are literally talking about an evolution that is going to take 20 years or more. But we see parts of that today as you see various substations automated, you see the transmission grid automated, you see——

Mr. ROHRABACHER. Tell me, how far in the evolution have we come? Would you say we are year at 15, I mean, outside 15? Are we 15 years in or one year in? What are we in?

Mr. CASKEY. I think we discussed that a little bit earlier; is there a percentage on how smart the grid is today? I think the answer to that really depends on the individual utilities and those utilities know how much automation and how much smartness they have added to their localized grid, if you will, but in terms of a nation, I have not heard a figure thrown out there to say whether we are 20 percent smart today or 25 percent or what that is. So I don't know that.

Mr. ROHRABACHER. Smart as compared to what we were, let us say, 20 years ago, so—and the smart grid will save us energy, the

smart grid will ensure more security, et cetera, and how much will in the end the smart grid cost us to have in place as compared to what we were spending ten years ago?

Mr. CASKEY. I don't have the answer to that question.

Chairman NELSON. Let me just state in Texas what we have done is, the customers who get the advanced meters are the ones who pay for it, so it is not through a tax. It is a fee on their bill. And even with that fee, our rates are lower in Texas than they were in 2001.

I view smart grid ultimately as a cost-savings tool because, one, it gives customers the ability to reduce their usage and under the current technology, you get your electric bill 45 days and sometimes after you——

Mr. ROHRABACHER. I understand. When you succeed—I can't tell you how many times we have heard that when this program is in place, it is actually going to pay for itself so there is really no cost at all involved, and so absent that mindset, which I understand and it is not just smart grid that believes that stuff, but a lot of other people who come before us.

Let us then look, how much money—Dr. Arnold, the American Recovery and Reinvestment Act invested how much money in this effort and how much has been spent?

Dr. ARNOLD. The Recovery Act funds totaled $17 million and all of that will have been spent by the end of this fiscal year.

Mr. ROHRABACHER. Seventeen million?

Dr. ARNOLD. I am sorry — yes, $17 million in terms of the NIST work on the interoperability standards, so that is just the Recovery Act funds and that represents about half of the total funds. The rest was from the NIST normal STRS appropriations.

Mr. ROHRABACHER. So $17 million were spent in the last year, you're saying?

Dr. ARNOLD. Since about mid-2009.

Mr. ROHRABACHER. And that money was matched of course by the money that was already allocated for this project. Is that right?

Dr. ARNOLD. Well, approximately the same, a little bit less. I believe it is about $15 million will have been spent through the end of this fiscal year out of NIST's STRS normal funding.

Mr. ROHRABACHER. And once the recovery, the ARRA money is all gone, and it sounds like it is, the budget goes down back to what it was normally. Is that what is happening?

Dr. ARNOLD. Well, to sustain the effort at the current pace, we would have to increase the STRS component. If we continue with flat funding on the STRS, it is going to imply a significant reduction in the level of activity.

Mr. ROHRABACHER. And so when we were trying to figure out the total amount that NIST is spending, it is not 17, it is 35 million?

Dr. ARNOLD. Well, through the end of fiscal year 2011, it is about 17 plus 15—you can do the math—over that period.

Mr. ROHRABACHER. Okay. So that is $32 million. And that level, that $32 million level then will be cut back to what—basically in half. Is that correct? Is that what we are hearing?

Dr. ARNOLD. Well, the President's budget request for fiscal year 2012 included an increase in the STRS component to maintain a level of effort that is at a level that we need to sustain progress,

but if those funds are not available, there will be a significant reduction and probably a slowdown in our effort.

Mr. ROHRABACHER. Thank you, Mr. Chairman. I will wait to see if there is a second round to see if this money is being spent in the most efficient way. Thank you.

Chairman HALL. Your 10 minutes is expired.

Mr. ROHRABACHER. Thank you.

Chairman HALL. The gentleman always asks good questions, and we will come back to you if we—Mr. Lipinski, the gentleman from Maryland, is recognized for five minutes or whatever you really need. You are a good man to work with this on this Committee.

Mr. LIPINSKI. Thank you, Mr. Chairman. I am not from Maryland, but Illinois, it is close.

Chairman HALL. Your hometown is Maryland, Illinois, right?

Mr. LIPINSKI. You know, if you want that to be—if you want me to say that, yes, it is, as long as I get my five minutes of question time.

Dr. Arnold, I am pleased to see your section in your testimony about protecting consumer interest. Now, Mr. Rohrabacher had just said he is not an engineer. He started out his questions with that. Well, I am trained as an engineer, although I won't try to claim that I know everything about the smart grid, but what I do know, I am excited about the potential benefits. You know, we can have a more robust, resilient power system. We can diminish peak usage. We can give consumers more control. These are all great things that we can get from a smart grid.

But right now in my home state of Illinois, there is a tough legislative fight going on over who is going to pay for the new technology and who gets the benefit. AARP is strongly opposing the Illinois Infrastructure Modernization Act because of the potential for automatic rate increases. The Governor of Illinois, Governor Quinn, the Attorney General, Lisa Madigan, have also expressed concerns about this bill. Now, I share some of these concerns, and I think it is my job to make sure that the seniors in my district, you know, someone living on a fixed income is protected, and I worry that the push for a smart grid could just mean installing smart meters at consumer expense so utilities can then go ahead and lay off their meter readers. So as I said, I know the potential is there for great benefits.

What can you tell me, Dr. Arnold, about what elements of NIST standards will help consumers control their energy usage and save money and what can we do—and I don't know if—this probably isn't for NIST to make the determination on this but my concern is, how do we make sure that this information is going to be used by consumers to save money or how do we make that as likely as possible? We can't guarantee anything. We can't guarantee anyone does anything but we have to make that likely. But first, Dr. Arnold, what will help consumers control their energy usage and save money with the smart grid?

Dr. ARNOLD. So in terms of saving money and controlling usage, there are two elements of that. One is wasting less energy, so reducing your overall usage, and the other element is reducing your usage during peak periods when it is very expensive for the system to generate that energy. In terms of consumers wasting less en-

ergy, the fact that consumers have no knowledge today about how much they are consuming, is an issue, and with the smart grid, consumers will be able to,as they do in cases like in Texas, see how much they are using on a near-real-time basis.

Mr. LIPINSKI. That is one thing I was wondering. Will I—if I have a smart meter hooked up in my home, will I be able to hook that up to my computer and see in real time my usage or will I have to wait for the utility company to get me the information?

Dr. ARNOLD. The technical capability is there to transit that data to either the utility where you can get it on the Web or locally so it can be broadcast to a display within your home so you can see that in real time. I have such a meter, which enables me to do that in my home.

The other aspect in terms of reducing usage during peak periods, which benefits everyone because you need to provide less generation capacity and transmission capacity, my expectation is that technology will allow this to be done automatically where you will be able to push a green button on your appliance to tell it you want to run in eco mode, and it will automatically figure out the best time to run. Obviously a consumer will always be able to override that if they need to have something done at a certain time but the technology will be there to allow this to be automated so the consumer can set it and then forget it.

Mr. LIPINSKI. Very quickly, Chairman Nelson, how do you believe in Texas you were able to institute this and have the consumers save money with it? Were there specific provisions that you put into the law that helped this to occur?

Chairman NELSON. Yes, sir. The Texas legislature passed legislation in 2005 and 2007 encouraging the deployment of smart meters and they set up a system for how it would be paid for which as you indicated it was a controversial issue and continues to be but they addressed that.

Mr. LIPINSKI. But how do you get people to—if the Chairman will allow me, how do you—you can give people information. How do you maximize the likelihood that they will use this information to help save electricity and money?

Chairman NELSON. Well, there is a big customer education component of this where customers have to be aware of what they are doing, so we rolled it out. We are in the process right now of doing a test where CenterPoint and Oncor, our two biggest utilities in Houston and Dallas, are doing a pilot with 500 in-home devices and educating customers about it. We have retail providers in the Texas market, and that market is competitive and so they want to get customers and so they are trying to give a value-added thing and so they are working with customers to provide them information. Like some of them send out a once-a-week note to their customers by email and say this is how you are spending, this is what you have spent, if you continue using at the same level, your bill will be this, or some customers use every day but when we have a hot summer like we had this summer where in Austin our August temperature average was 105, in spite of the fact that we have got low rates, those bills are big and I think the larger the bill gets, the more the customer has an incentive to shave some of that off if they can.

Mr. LIPINSKI. I thank you very much, and I thank the Chairman for your indulgence here.

Chairman HALL. The gentleman's time has expired. The Ranking Member has indicated he has no objection to Mr. Rohrabacher asking one more question. The Chairman recognizes——

Mr. ROHRABACHER. Thank you very much, Mr. Chairman.

In talking about standards and, again, I plead guilty of not having the expertise of having the in-depth questions that you probably deserve, but let me just ask, when you have new standards, and that is what we are talking about with NIST, and it is a major part of this whole operation's success is the standards of what you are going to be required to have to have a smart grid, that means, of course, there is going to have to be new technologies. Now, I note that the Department of Energy where you are spending $35 million, they are spending $3.4 billion on smart grid technology development. Are you confident that we are going to be able to have the technology necessary, number one, to meet the standards, and will this equipment be available, do you believe, by American manufacturers rather than having us being dependent on overseas sources?

Dr. ARNOLD. So I would like to address that. The stakeholders in our process involve industry. They are really the biggest part of the process and they are at the table because they want the standards so that they can build the products and the utilities can use them. We have tried where we can, rather than reinventing the wheel, to pick up standards that have been used in other applications and modify them for the smart grid to allow these things to get deployed most quickly. In areas where there is entirely new functionality, you have to do something new, and we are always looking for the best way to do that. We have placed major emphasis on being in a leadership posture with respect to the international standards so rather than our picking standards that others are developing, we are developing them here, bringing them to the international standards organizations and we are having a great deal of success in getting the standards adopted internationally. I can tell you that in other parts of the world that are behind us in developing their frameworks for the smart grid, they recognize our leadership and are using the results of our standards work as the basis for their efforts. We are doing that specifically to maximize the export opportunities for U.S. suppliers.

Mr. ROHRABACHER. So you are confident that what you are doing is going to actually be a boon to American manufacturers and American technology corporations and not—is that something that you have in mind or is this something that you are just confident of?

Dr. ARNOLD. We have that very much in mind. I would point to the International Energy Agency, which estimates over the next 20 years, $10 trillion will be spent globally on modernization and build-out of electrical grids. The estimate as far as I can tell for the United States is about $2 trillion, so the market opportunity outside of the United States is much greater than it is in the United States and so we have very much in mind creating a standards framework that will allow U.S. manufacturers to not only build the U.S. grid but also export that technology to other parts of the world.

Mr. ROHRABACHER. Well, thank you very much.

Mr. Chairman, that does answer my question and I appreciate you giving me that last chance.

Chairman HALL. Thank you. The gentleman's time has expired.

I want to thank the witnesses for their very valuable testimony and the Members for their questions. The Members of the Subcommittee might have additional questions for the witnesses, and we will ask you to respond to these in writing. The record will remain open for two weeks for additional comments and statements from Members. The witnesses are now excused. We are adjourned.

[Whereupon, at 11:25 a.m., the Subcommittee was adjourned.]

Appendix I:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. George Arnold, National Coordinator for Smart Grid, National Institute of Standards and Technology

Questions submitted by Chairman Ben Quayle

Q1. What is the future smart grid standards development plan for both the National Institute of Standards and Technology (NIST) and the Smart Grid Interoperability Panel? How many additional standards need to be developed? Can NIST maintain the necessary pace for standards development to keep up with smart grid implementation into the future? How much funding is NIST requesting annually to continue these activities?

A1. NIST continues to execute its three-phase plan for leading and sustaining the accelerated pace of smart grid interoperability and security standards development. Phase I is completed (initial NIST roadmap and identification of standards) and Phase II (Smart Grid Interoperability Panel) and III (Smart Grid Testing and Certification Framework, developed as part of SGIP) are ongoing, including international outreach and coordination efforts. While much progress has been made to date (see www.nist.gov/smartgrid for NIST and SGIP programmatic highlights and accomplishments), significant work continues to be needed to develop new standards, evaluate and revise existing standards, coordinate and map different standards to each other within a common architectural and cybersecurity framework, and to help drive these standards into implementation supported by interoperability testing and certification support and incorporation of "lessons learned" back into the standards development process. This work is being undertaken through NIST and SGIP structured activities, including new and existing Priority Action Plans focused on requirements for standards development and Working Groups that are evaluating standards and framework elements, identifying new needs, and leading dialog with stakeholders including the regulatory community. While it is difficult to estimate the number of new and revised standards that will be needed to support the future smart grid with new functionalities, based on our experience to date, at a minimum it will be several times greater than the initial 75 standards identified by NIST in its Framework Release 1.0—that is, in the hundreds.

The pace of progress in coordinating development of smart grid standards has been accelerated in part due to ability to jump-start NIST's smart grid program using approximately $17 million of ARRA funding over the past two years; $12 million from the Department of Energy, and $5 million from the Department of Commerce. In addition, NIST spent $8.5 million of its annual STRS appropriation in FY11. The $17 million ARRA funding has been exhausted. NIST requested $17.6 million in the FY 2012 President's Budget to maintain the current accelerated pace for standards development.

Q2. NIST identified 75 existing standards, in January of 2010, as likely immediately applicable to an interoperable grid. NIST submitted five of these standards to the Federal Energy Regulatory Commission in October 2010. Why does this process take so long? When will NIST's responsibilities per the Energy Independence and Security Act of 2007 (EISA) be completed? Do you think EISA should be amended to possibly clarify that a formal rulemaking process is not always necessary?

A2. Of the 75 standards identified in the NIST Framework Release 1.0, 25 standards were identified for initial implementation and 50 standards were identified as needing further review. NIST and the SGIP have been developing additional guidelines and procedures for standards review and evaluation, including development of the NISTIR 7628 Guidelines for Smart Grid Cyber Security and establishment of SGIP Cyber Security Working Group (CSWG) and Smart Grid Architecture Committee (SGAC) review processes. With the availability of the NISTIR 7628 published in August 2010, the volunteer-based CSWG standards review team was able to use NISTIR 7628 requirements as the basis for its standards review process, including for its evaluation of the 5 standards identified in October 2010 as ready for consideration by regulators. This team has continued to make steady progress towards evaluating the 25 standards identified for initial implementation, plus many additional standards or requirements that have been developed or evaluated as part of Priority Action Plans. In parallel to the CSWG cyber security review process, NIST engaged in numerous collaborative discussions with FERC staff to revise standards review templates to help support regulatory interest and understanding of smart grid interoperability standards. This constructive dialog resulted in a more comprehensive re-

view process, and contributed to the increased timeline for the initial standards review. In addition, utilities and others have requested that additional standards reviews be established with respect to implementability and reliability issues, and work is underway to incorporate such reviews within the SGIP and its Catalog of Standards process.

NIST is actively engaged in leading the acceleration of the smart grid standardization process to meet its EISA responsibilities. In the long term, NIST envisions that the SGIP will mature into a permanent organization to evolve and maintain the Smart Grid standards framework and that NIST will reduce its active standards coordination role. However this will require that the SGIP develop a business model and funding sources that are self-sustaining. Continued NIST funding at the level requested in the President's Fiscal Year 2012 budget will allow NIST to complete and implement the NIST smart grid standards framework and develop a robust testing and certification infrastructure. With this foundation in place, NIST will then be in a position to continue to engage in the SGIP at a lower level while transitioning some of its resources and staff to address key smart grid measurement and research needs, also part of NIST's mission. NIST established a Smart Grid Federal Advisory Committee in late 2010 to provide advice and input to NIST on such issues, including input to help guide Smart Grid Interoperability Panel activities and also assist NIST with its smart grid research and standards activities. The Committee's initial report is expected to be completed in November 2011.

With respect to clarifying the role of formal rulemaking in EISA, the language "as may be necessary to insure smart-grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets" is already included in EISA under FERC's responsibilities, and may provide sufficient flexibility to FERC to address evolving needs without need for amendment.

Q3. A January 2011 Government Accountability Office (GAO) report assessing the progress of NIST smart grid cybersecurity guidelines identified remaining challenges regarding cybersecurity and physical threats to the smart grid. What steps are being taken to ensure that the standards upon which smart grid architecture is based do not lead to a greater cybersecurity risk on the national transmission grid?

A3. A multi-pronged approach is being taken to support enhanced cybersecurity for the Smart Grid. The NIST-led Cyber Security Working Group (CSWG) is providing foundational cybersecurity guidance, first through the issuance of NISTIR 7628, "Guidelines for Smart Grid Cyber Security" which was published in August 2010 and most recently in collaboration with DOE and NERC, NIST assisted in the development of the newly issued DOE Draft "Electricity Sector Cybersecurity Risk Management Process Guideline." This document is the result of a public-private collaboration to develop a foundational cybersecurity risk management guideline that provides a consistent, repeatable, and adaptable process for the electricity sector. Now the CSWG is developing an assessment guide that contains criteria for testing and examining the implementation of the NISTIR 7628 high level security requirements. The high level security requirements are also being augmented with specific security requirements for the advanced metering infrastructure. NIST, through the CSWG is facilitating security functionality in existing Smart Grid standards and for those standards under development. To date, over twenty-five standards or requirements have been assessed against the high level security requirements. The CSWG will be hosting a cyber-physical security workshop in April 2012 to review recent work and developments that have occurred in the cyber-physical areas across multiple industries. The goal of the workshop is to determine if there are security requirements that are unique to cyber-physical systems.

While NIST has the federal responsibility for developing the standards framework, DOE is responsible for grid modernization. Through the Advanced Security Acceleration Project for the Smart Grid (ASAP-SG), DOE is partnering with several utilities to accelerate the development of Smart Grid cybersecurity requirements. These profiles provide asset owners, operators, and vendors with detailed requirements for the secure design, deployment and operation of resilient Smart Grid systems. Four security profiles have been completed—advanced metering infrastructure (AMI), third-party data access, distribution management systems and most recently, wide-area monitoring, protection, and control applications, (i.e., synchrophasors). The AMI security profile is being used by the CSWG and the Advanced Metering Infrastructure Security (AMI-SEC) Task Force within the Utility Communications Architecture International Users Group (UCAIug). In FY12, ASAP-SG plans to develop a profile for the home area network.

In another joint effort to improve smart grid security, DOE formed the National Electric Sector Cybersecurity Organization Resource (NESCOR). NESCOR is focus-

ing on the testing and development of secure technologies for the smart grid. NESCOR is currently working with the CSWG to develop guidelines that will address the security gaps and potential vulnerabilities of the SEP 1.x and provide recommendations on how the SEP 1.x profile should be implemented in deployments.

DOE has also partnered with the private sector to broadly enhance cybersecurity in the electric sector through the development of the 2011 *Roadmap To Achieve Energy Delivery Systems Cybersecurity*, an update of the 2006 Roadmap. Both industry-led Roadmaps were developed through a public-private collaboration of energy sector stakeholders. DOE facilitated the Roadmap development through the private-sector Energy Sector Cybersecurity Working Group (ESCSWG). The U.S. Energy Secretary Steven Chu, White House Cybersecurity Coordinator Howard A. Schmidt, and the North American Electric Reliability Corporation President and Chief Executive Officer Gerry Cauley all publicly recognized this public-private collaborative Roadmap effort focused on ensuring the security and reliability of energy delivery systems.

Questions Submitted by the Represenative John Sarbanes

Q1. Can you please clarify how much funding NIST has requested in the Fiscal Year 2012 budget for continuing its smart grid standards work? How does this requested funding level compare to the levels of funding NIST has provided to these smart grid standards efforts over the last several years?

A1. The President's budget request for Fiscal Year 2012 includes an initiative for Interoperability Standards for Emerging Technologies, which would provide an additional $9.1 million to support the NIST smart grid program, for a total of $17.6 million. NIST contributed $1.6 million from the STRS appropriation and $5 million from the NIST ARRA funding on smart grid in FY 2009 and another $5 million in FY 2010, which was the first direct appropriation for the smart grid program. In the FY 2011 spend plan, NIST's budget for smart grid was $8.5 million. The external component of NIST's smart grid program, including the contracted administration of the Smart Grid Interoperability Panel, was supported by ARRA funding totaling $17 million; $12 million provided through DOE and the $5 million from NIST's own ARRA appropriation as described above. Thus more than half of NIST's work through the end of Fiscal Year 2011 was supported by the ARRA funding, which have now been completely expended.

Responses by The Honorable Donna Nelson, Chairman, Public Utility Commission of Texas

Donna L. Nelson
Chairman

Rick Perry
Governor

Public Utility Commission of Texas

October 6, 2011

The Honorable Ben Quayle, Chairman
The Honorable Randy Neugebauer
Subcommittee on Technology and Innovation
Committee on Science, Space, and Technology
U.S. House of Representatives
2321 Rayburn House Office Building
Washington, DC 20515

Dear Sirs:

It was my pleasure to testify before you on September 8th at the hearing, *"Empowering Consumers and Promoting Innovation through the Smart Grid."* As stated in my testimony, we are committed to ensuring that consumers benefit from the investments made to modernize our electric grid. By leading the nation in smart grid development and deployment, Texas already experiences increases in reliability, customer choice and demand response.

Below are my responses to your questions.

1. **(a) From your perspective, in the absence of formalized standards, has the development of the smart grid stalled?**
   - *We do not believe that the development of the smart grid has stalled. The standards process has been successful in bringing parties from all organizations together to accelerate revisions to existing standards, identifying gaps, and moving the industry forward.*
   - *Standards exist today and have so for many years. Organizations have been providing standards for utilities and their vendors such as the American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE), and National Electrical Manufacturers Association (NEMA), among others. The value of the NIST effort is not the creation of new standards or the adoption of standards. Rather, the value is achieved because it recognizes that these different standards all have to interoperate.*

   (b) What is your view on whether existing technologies may need to be scrapped as standards development advances?
   - *A fundamental tenet of technology is that it does not stand still. Adoption of standards does not mean that it will stop evolving. The evolution of cellular phones to smart phones is a great example. The telecommunications industry did not jump from the rotary phone to the iPhone of today. We do not believe investment in the earlier technology was*

a waste. It allowed the industry to mature to where it is today. We believe the same can be said for the electric industry and components of the utility infrastructure that will support the modern grid.

- *Until technology (using a specific standard) is deployed, the problems cannot be vetted. Maturity of the standard does not come from formalized adoption, but from deployment and use of the standard.*

(c) How do we ensure that equipment purchased today works with the ongoing standards development process?

- *The utility will gain value from the existing assets deployed, and is responsible for developing a transition strategy as technology and standards evolve. In Texas, we have required the utilities to adhere to open standards as much as possible thus allowing the utility to be in a better position to make modifications to their systems - as technology advances.*
- *Therefore, the utility has to design their system infrastructure so that it can be upgraded over time – not completely scrapped.*
- *In addition to open standards, we believe that the users of the technology and equipment must be involved in the standards process. Utility involvement in the standards groups is essential.*
- *The utilities in ERCOT, due largely to the competitive market model, are held to a higher standard of interoperability. This is because there are multiple entities that engage and are dependent on the utility systems. For example, the file format for smart meter consumption data provided to the market is the same among four utilities, each with different vendors and systems. In contrast, the vertically integrated model is much slower in becoming interoperable because it does not interface with multiple parties as the utilities do in the competitive model.*

2. (a) What benefits have energy consumers in Texas received from the implementation of smart grid technologies?

- *With over four million smart meters installed, customers have achieved significant benefits. These benefits include easy and convenient access to their smart meter data, more choices in product offerings (such as prepaid service that depends on the smart meter), outage notifications and lower costs in market services. Services that required a truck roll with the older meters can now be performed remotely, so these charges are decreasing steadily over time commensurate with deployment.*
- *Customers in Texas with a smart meter can join a device to their smart meter if they choose. In no other place in the country is this allowed, except in select pilots. These devices can help the customer better manage their appliances, and can provide near real-time access to their usage data.*

(b) What do you see as the most important actions to ensure that the transformation of the American electric delivery system to a smart grid is a process that empowers and protects consumers?

- *We believe that the Texas statute provides a good model regarding customer data. The data is not shared with any other entity (besides the utility that reads the meter and the customer's provider that provides the service) without customer permission.*
- *The role of education for the consumer cannot be understated. The energy industry can look to other industries that have managed customer information for many years: banking, telecommunications, airlines, etc. A good example is the transition to digital cable. There was significant customer education touting the benefits of the conversion. The same is needed for modernizing the nation's electric grid.*

Responses by Mr. John Caskey, National Electrical Manufacturers Association

Questions submitted by Chairman Ben Quayle

Q1. You mention in your testimony that U.S. standards are typically developed by the private sector with varying degrees of participation by the government. The Energy Independence and Security Act of 2007 (EISA) opened the door to a more active government role, providing an "umbrella" under which the private sector defines standards for Smart Grid products and systems. From a standards developing organization perspective, how has this process, with the National Institute of Standards and Technology acting as a leader, versus its usual convener role, been managed? Do you feel that the National Electrical Manufacturers Association's participation on the Smart Grid Interoperability Panel has been sufficient?

A1. NIST (National Institute of Standards & Technology) is named in EISA "to coordinate the development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems." NIST has used this authority to form the Smart Grid Interoperability Panel (SGIP), a public-private partnership, to do the real work of standards development. NIST's leadership in establishing the policies and procedures of SGIP—designing it for inclusion of all stakeholders, funding the National Coordinator for Smart Grid Interoperability, and identifying initial priorities for the SGIP to consider—has been instrumental to the progress made thus far.

NIST's leadership in this area should not be construed to mean that NIST is "sitting at the head of the table," steering the standards development process. To its credit, through the establishment of the SGIP, NIST is promoting private sector-driven outcomes. Also, the *National Technology Transfer and Advancement Act of 1995* (NTTAA, PL 104-113) and its implementation via the Office of Management and Budget Circular A-119 requires standards that are endorsed or adopted by the U.S. Government to be developed by formally accredited standards developing organizations (SDOs) like NEMA, IEEE, and others. In that respect, the greatest function that NIST and the government can perform is to continue to provide forums and foster an environment where the various SDOs and stakeholder entities can come together and maintain progress toward the performance objectives for Smart Grid that were established in EISA.

NEMA staff and its member companies continue to have sufficient and appropriate levels of involvement across several of the stakeholder groups and the various priority action plans. NEMA staff has held a number of leadership positions within the SGIP and the manufacturers' perspectives around the table have been an integral part of the decision-making process.

Q2. In your testimony, you highlight the National Electrical Manufacturers Association's view that most, if not all of the Smart Grid community felt that the five families of standards considered during the Federal Energy Regulatory Commission's (FERC) Technical Conference were a very good starting point. However, you state that because it was a regulatory agency asking the question about whether or not these standards represented consensus, witnesses were concerned that FERC was leaning toward mandating these standards in some form. Based on your experience with the suite of standards submitted, what is the difference in the way that industry interfaces with the National Institute of Standards and Technology, versus how it interacts with FERC?

A2. NEMA maintains good relationships with both NIST and FERC. Congressionally-imposed mandates of the agencies themselves, however, create different dynamics between these two agencies and the private sector. The key difference is that NIST is not a regulatory agency while FERC is.

As a science-based organization with no regulatory mandate, NIST has earned the confidence of industry. NIST serves a partner with the private sector as the private sector drives the standards discussion. For all of its various definitions, "consensus," as discussed within the SGIP and the standards development community in general, means agreement on a standard that works for most everyone-and on a voluntary basis.

On the other hand, EISA gave FERC the authority to mandate consensus standards.

> "At any time after the Institute's work has led to sufficient consensus in the Commission's judgment, the Commission shall institute a rulemaking proceeding to adopt such standards and protocols as may be necessary to insure smart-grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets."

EISA gives FERC the ability to determine for itself what "sufficient consensus" means and if it has been achieved. And with its definition, it can move a voluntary industry standard into a government mandate. This authority is certainly one way in which the interface with the two agencies can differ.

Q3. What do you see as the most important actions to ensure that the transformation of the American electric delivery system to a Smart Grid is a process that empowers and protects consumers? Can the equipment needs of the Smart Grid be met by U.S. manufacturers? How will existing technologies and equipment fit in with the standards being developed for the Smart Grid? Do you envision any additional costs to the private sector or consumers in conforming with the standards?

A3. As far as standards are concerned, the most important action that can be taken to ensure the successful transformation of the electric grid into a Smart Grid is to allow industry to continue to drive standards development. That is, exercise great caution in the federal agencies before making a given standard mandatory. The standards development process is one that must be given the time and freedom to work its will, to ensure the standard leads to the best result for manufacturers, consumers, and every American who depends on a reliable source of electricity.

Policies that provide support for manufacturing innovation will promote the development of products that make the grid smarter. A smarter grid, with its two-way communication protocol designed to improve reliability, cost-effectiveness, energy efficiency, and consumer engagement and control, empowers consumers and gives them the information to make wise decisions about their electricity usage and take charge of their electric bill.

U.S. manufacturers are ready. In 2009, according to the Census, manufacturers in the United States shipped $6 billion of transformers and other power equipment, $10.6 billion of switchgear and switchboard equipment, $5.5 billion of storage batteries, and $10.1 billion of wire and cable, totaling more than $30 billion in equipment that is being used to modernize the electric utility grid.

Development of the Smart Grid is a gradual process which is already underway. It is not a wholesale swap of the old grid for the Smart Grid. The electric grid is a complex web of equipment and control systems that requires varying degrees of change for conversion into a Smart Grid.

Part of this answer also ties in to the previous question about the difference between the way the industry interacts with FERC and NIST. If, through the regulatory process some form of standard becomes mandatory, the utility interests would have no choice but to implement the requirements of that regulation. In certain instances, that may mean they have to replace devices on the grid in order to comply. In the end, the only true mechanism that utility companies have to replace equipment in the grid is the rate case which directly affects consumers of all stripes; residential, industrial, and commercial.

Many utilities have incorporated transmission and distribution equipment into their systems which conform to current standards. From smart meters to substation automation to gathering greater intelligence of the loads on power lines through phasor measurement units, utilities are deploying Smart Grid technologies today. They are doing so by layering on new technologies to existing equipment, upgrading to Smart Grid technologies as part of the natural cycling out of old equipment, or by proactively replacing functioning equipment with more modern technologies.

Through the SGIP, we are refining existing standards and helping utilities convert to new standards, bearing in mind the characteristics of the equipment already in the field. The Smart Meter Upgradeability standard is a prime example of the SGIP being responsive to the most critical needs of the industry. As many utilities have demanded smart meters, they also want the confidence of knowing that if they buy smart meters today, new smart meters standards will not result in stranded investments. Indeed, utilities are more likely to invest in those aspects of the Smart Grid for which the applicable standards are interoperable and upgradeable—the essential mission of the SGIP.

The cost-benefit picture for the Smart Grid is complex, but the benefits of the Smart Grid—increased reliability, more efficient operation, energy savings through greater intelligence and consumer control, and the reduced need for more generation capacity—significantly outweigh its costs by any measure.

For instance, as consumers replace older goods with newer ones, such as home area networks or appliances, they are acquiring new "smarter" features compliant with existing standards. In the case of smart meters, utilities provide a business case for the investment by analyzing return on investment. Two-way communication enables outage reporting, remote turn on and turn off, fewer truck rolls to visually inspect and monitor the grid, power quality monitoring, and the consumer's engage-

ment. In high-population areas, utilities will invest in automation of transmission and distribution systems due to benefits it gives ratepayers. The Smart Grid in general provides improved reliability and a positive economic impact through fewer and shorter outages.

Questions Submitted by the Represenative John Sarbanes

Q1. As a representative of a private sector standards development organization that has been very active and involved in the NIST process, you are very complimentary of how NIST has carried out its Smart Grid standards responsibilities. In your opinion, why has this been such a successful endeavor between NIST and standards development organizations? What lessons have been learned and what best practices have been gleaned through this effort that we ought to keep in mind should we decide to replicate this public-private model in the future in other areas?

A1. First, the quality of the organization in this case has led to many early successes. NIST, as an independent, objective, science-based agency, enjoys credibility with industry for its expertise and performance. As a result, industry is eager to participate in the NIST and SGIP activities.

Second, the people involved in this particular effort are of a high quality and have demonstrated the character and seriousness of purpose needed for this to be a successful partnership.

Third, the nature of the Smart Grid and the need for standards at this point in time make a partnership such as this timely, as evidenced by the participation of over 600 organizations and over 1,800 individuals.

We have learned what a successful approach to this sort of partnership looks like and now have some tangible results that can serve as a model for similar future efforts. NIST's decision to include a broad base of stakeholders has been essential to the SGIP's success. The work of NIST and the SGIP in establishing many of the procedures and policies before the partnership began, such as committee structure and ground rules, facilitated the process moving forward quickly. And once the bylaws and procedures were established, they have been enforced which has strengthened the relationship. Since that point, NIST's role has been one of facilitation and service—they are now the main interface between the SGIP and rest of the federal government. The greatest value they now bring is to help the SGIP set priorities that are consistent with those of other federal agencies and the Administration.

Responses by Mr. Rik Drummond, Chief Executive Officer and Chief Scientist, The Drummond Group, Inc.

Questions Submitted by Chairman Ben Quayle

Q1. From the perspective of a small business, how has the smart grid standards development process been managed?

A1. It is a totally volunteer effort with both small and large business participating equally. With respect to federal funding to small and large business participating in the FOA 36 projects the interface to the government is burdensome and has significant overhead. Larger organizations often have the internal legal and procedural expertise to fully understand all of the federal regulations and contractual issues. Small businesses often do not have the upfront moneys for initial investment in this expertise. Additionally, I expect from experience, the procedural overhead to interface the federal contracts adds 10-25% to the costs on some contracts.

Q2. With so many organizations participating, do you feel that the small business concerns have been sufficiently incorporated?

A2. I would say that most small businesses that do not specialize in interfacing to the federal government, will find incorporation into these contracts very burdensome and problematic. They will need to work through larger firms as subcontractors and will not bid directly to the federal government in many cases. Generally, doing business for significant amounts of moneys ($100,000s+) with the federal government is a real hassle. Most of the business experiences used to service clients in the private sector do not apply to servicing federal contracts.

Questions Submitted by Represenative Randy Neugebauer

Q1. In your testimony, you mention the consistency of interoperability testing and certification across all products implementing the 100+ technical standards used to integrate smart grid systems:

a. What certainty do we have that the existing technologies perform as claimed?

A1. The Smart Grid Interoperability Panel's Testing and Certification Committee, which I am the Chairperson, is implementing an "Interoperability Process Reference Manual." The manual specifies that for a smart grid standard to be "SGIP approved" it must have followed international Guidelines for standards-based product testing and certifying the test results. These two standards are named ISO/IEC 17025 and ISO/IEC 65 (forthcoming new version is ISO/IEC 17065.

These two Guidelines help ensure that products, as tested, "perform as claimed." At this time the buying market place does no know if products "perform as claimed."

As part of this effort Smart Grid Interoperability Panel's Testing and Certification Committee is working with Amerian National Standards Institute (ANSI) to accredit the testing labs and the certification authorities used to do all products in the SGIP related smart grid.

Q2. How can the failure of a product to be interoperable slow ongoing smart grid implementation?

A2. The smart grid standards support information flow in a secure manner. The user sees the information flow as the implementation of technical (managing devices) or business (bidding for electricity for tomorrow) processes necessary to execute the business' objectives. Two cases of products failing to interoperate:

Case 1: standards based products are purchased and assumed to be interoperate with other products based on that standard and they do not 'initially' work or they are implemented and show failures later, this breaks the business or technical process they support. Fixes take time and slow overall implementation within the Smart Grid.

Case 2: The buyer of the standard based product assumes, as is the case normally currently, they have to test the product with other products to ensure that it works "as advertised." This internal testing takes days, weeks, months, or years. This delays the implementation of the process in the business and among business and slows interoperability across parts of the smart grid.

Q3. What is the status of the work the National Institute of Standards and Technology is undertaking to further the testing and evaluation framework for smart grid technology to ensure that products sold perform as intended?

A3. See the first question for the answer. It is all focused on the output of the Testing and Certification Committee, the Architecture committee and the Cyber Security Work Group. These three together chose the appropriate standards, test and certify products based on those standards and ensure the implementations meet the cyber security requirements.

Q4. From your experience, is NIST adequately focused on supporting conformance and interoperability testing on the smart grid technologies that are being used already?

A4. Yes, the best they can. Unlike HHS' mandate, that gives them the power to ensure conformance and interoperability within EHR products (via moneys from Center of Medicaid and Medicare) NIST was not given this ability within the EISA 2007 act. Because of that implementers of interoperable smart grid products must fund the effort themselves.

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