STATEMENT OF
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U.S. DEPARTMENT OF ENERGY

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

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Mr. Chairman and Members of the Committee, thank you for this opportunity to testify before you on the Department's progress in advancing smart grid projects and activities under Title XIII of the Energy Independence and Security Act of 2007 and the American Recovery and Reinvestment Act of 2009 (Recovery Act). Creating a smart grid is critical to meeting future demand growth while maintaining a reliable electric system.

A smart grid uses information technology to improve the reliability, availability and efficiency of the electric system: from large generation through the delivery system to electricity consumers and eventually to individual end-uses or appliances. The information networks that are transforming our economy in other areas are also being applied to grid applications for dynamic optimization of electric systems operations, maintenance, and planning.

There are several guiding principles to the Department's smart grid efforts. First is the need to establish quantitative metrics for guiding the implementation of smart grid activities. Efforts to develop smart grid metrics have been underway for some time. For example, in June 2008, the Office of Electricity Delivery and Energy Reliability (OE) sponsored a "Smart Grid Implementation Workshop" which brought together stakeholders from across the country to discuss smart grid definitions, metrics, and analysis and the data and methodologies that will be needed for the effective application of those metrics. The Department envisions these metrics may become key indicators for understanding progress towards implementing a smart grid.

*Potential Smart Grid Metrics:*

- **Dynamic Pricing**: fraction of customers and total load served by Real Time Pricing (RTP), Critical Peak Pricing (CPP), and Time of Use (TOU) tariffs
- **Real-time System Operations Data Sharing**: Total Supervisory Control and Data Acquisition (SCADA) points shared and fraction of phasor measurement points shared.

- **Distributed-Resource Interconnection Policy**: percentage of utilities with standard distributed-resource interconnection policies and commonality of such policies across utilities.
- **Policy/Regulatory Progress**: weighted-average percentage of smart grid investment recovered through rates (respondents' input weighted based on total customer share).
- **Load Participation Based on Grid Conditions**: fraction of load served by interruptible tariffs, direct load control, and consumer load control with incentives.
- **Load Served by Microgrids**: the percentage total grid summer capacity.
- **Grid-Connected Distributed Generation (renewable and non-renewable) and Storage**: percentage of distributed generation and storage.
- **Electric Vehicles (EVs) and Plug-InHybrid Electric Vehicles (PHEVs)**: percentage shares of on-road. For example, light-duty vehicles comprising of EVs and PHEVs.
- **Grid-Responsive Non-Generating Demand-Side Equipment**: total load served by smart, grid-responsive equipment**.**
- **Transmission &Distribution (T&D) System Reliability**: utilizing the Institute of Electrical and Electronics Engineers, Inc (IEEE) indices that measure distribution system reliability.
- **T&D Automation**: percentage of substations using automation.
- **Advanced Meters**: percentage of total demand served by advanced metered customers.
- **Advanced System Measurement**: percentage of substations possessing advanced measurement technology.
- **Capacity Factors**: yearly average and peak-generation capacity factor**.**
- **Generation and T&D Efficiencies**: percentage of energy consumed to generate electricity that is not lost.
- **Dynamic Line Ratings**: percentage miles of transmission circuits being operated under dynamic line ratings.
- **Power Quality**: percentage of customer complaints related to power quality issues, excluding outages.
- **Cyber Security**: percent of total generation capacity under companies in compliance with the North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection standards.
- **Open Architecture/Standards**: Interoperability Maturity Level – the weighted average maturity level of interoperability realized among electricity system stakeholders
- **Venture Capital**: total annual venture-capital funding of smart grid startups located in the U.S.

A second guiding principle is transparency. It is the Department's intent to use every means at its disposal to keep the public informed of and involved in the progress of the smart grid developments. There are several avenues for effective communication to occur. These include, for example:

- Bi-annual reports to Congress, as required by the Energy Independence and Security Act of 2007 (EISA) Section 1302, on the status of smart grid implementation nationwide. The first such report is undergoing the concurrence process and should be available shortly.
- The Smart Grid Subcommittee of the Electricity Advisory Committee, as required by EISA Section 1303, which has produced a report, "Smart Grid: Enabler of the New Energy Economy," with recommendation for how OE proceeds with its smart grid activities. This report can be downloaded from our website (http://oe.energy.gov/DocumentsandMedia/final-smart-grid-report.pdf).
- The Federal Smart Grid Task Force, as required by EISA Section 1303, has met every month since March 2008 to coordinate Federal activities, and includes involvement from Federal Energy Regulatory Commission (FERC), National Institute of Standards and Technology (NIST), Environmental Protection Agency, Department of Homeland Security, United States Department of Agriculture, and the Department of Defense.
- The offering of "Smart Grid E Forums" to provide information on key topics of interest through web-based seminars in collaboration with utilities, state regulators, consumer groups, equipment manufacturers, and national laboratories and universities from across the country. Last week OE sponsored its 4th such E Forum which provided information on the potential role for the smart grid to enable clean energy development and covered topics such as wind integration and electric and hybrid electric vehicles.
- The establishment of a Smart Grid Clearinghouse to serve as a central repository for smart grid project information, applications, requirements, performance, costs and benefits, standards, etc.

It is the Department's intent to build on these activities and work closely with key stakeholders so that the Nation is working in a consistent direction and not at cross purposes. There is neither the time nor the resources to spend dealing with problems that could be addressed through effective stakeholder engagement and Federal coordination.

For example, the Department is contributing to the efforts of the National Association of Regulatory Utility Commissioners (NARUC)-FERC Smart Grid Collaborative by supporting the development of a web-based information clearinghouse to share what is known about smart grid projects and foster better information exchange. The Department is also working with the Smart Grid Stakeholders Roundtable and EPA to assist public and private sector group to develop a common understand of smart grid challenges and opportunities.

*Interoperability Standards*: The Department recognizes that one of the major barriers to commercial success is the lack of industry-based standards for governing how the many different devices involved in smart grid, and their ability to communicate with each other in an efficient and secure manner, can become more interoperable than they are today.

The Department has learned hard lessons over the years about the amount of time and effort it takes to get standards of this type developed, implemented, and accepted. For example, after more than 10 years of development, there are still activities underway for full implementation of uniform and consistent grid interconnection standards for distributed energy resources. The Department understands that there are standards development organizations such as the Institute of Electrical and Electronics Engineers, International Electrotechnical Commission, American National Standards Institute, International Organization for Standardization, and the International Telecommunications Union who need to be involved in the process and that these organizations rely primarily on volunteers and contributions from their members to work on the standards development effort.

The Department is committed to moving the standards through the development process and getting them to the point for adjudication by federal and state regulatory agencies as rapidly as possible by implementing EISA Section 1305. The Department is working closely with NIST which has primary responsibility to coordinate development of a framework for interoperability standards, as called for in EISA Section 1305. The Department has provided technical and financial assistance to NIST to support their efforts.

*Cyber Security:* The cornerstone of a smart grid is the ability of multiple agents, i.e. devices, to interact with one another via a communications network. The interaction of multiple devices, and the benefit that this brings to the electric power system, is what differentiates the smart grid from the existing system. If not properly protected, the smart grid could be vulnerable including:

- *Breach of Availability*. Smart grid technology will include an immense communications network to manage the distribution infrastructure. One of the key reliability promises of the smart grid is enhanced management of the grid under emergency conditions. However, without proper planning, a natural- or man-made event could disable the communications infrastructure, rendering the smart grid ineffective at coping with the emergency situation.

- *Breach of Integrity*. A basic service for the smart grid is the ability to measure the use of electricity and transmit that information to the utility for billing purposes. A cyber intruder could compromise the data and send false information to the utility and either lower or increase the billing, depending upon the motivation.

- *Breach of Confidentiality*. If a perpetrator is able to access and view data being transmitted between the utility and smart meters at customer

premises, they could potentially use that information for unauthorized or illicit purposes.

Over the last eight months, DOE has been working collaboratively with the Utilities Communications Architecture Users Group (utilities, vendors, et al) to develop cyber security requirements (including vulnerability testing through the DOE Smart Grid Test Bed) for advanced metering infrastructure (AMI), a key application for the smart grid. This work will help accelerate the development of cyber security requirements for other smart grid technologies. Additionally, the Department is currently developing the EISA Section 1309 - Study of the Security Attributes of a Smart Grid System for delivery to Congress by the end of the fiscal year.

*Success Stories:* Wide Area Measurement Systems (WAMS) technology is based on obtaining high-resolution power system measurements (e.g., voltage) from sensors that are dispersed over wide areas of the grid. The data is synchronized with timing signals from Global Positioning System (GPS) satellites. The real-time information available from WAMS allows operators to detect and mitigate a disturbance before it can spread and enables greater utilization of the grid by operating it closer to its limits while maintaining reliability. When Hurricane Gustav came ashore in Louisiana in September 2008, an electrical island was formed in an area of Entergy's service territory. Entergy used the phasor measurement system to detect this island, and the phasor measurement units (PMU) in the island to balance generation and load for some 33 hours before surrounding power was restored.

The Department has also been actively involved in supporting early demonstration and testing of smart grid applications through National Laboratories and Power Marketing Administrations. For example, Pacific Northwest National Laboratory and the Bonneville Power Administration conducted a demonstration of "Smart" white appliances and dynamic pricing on the Olympic Peninsula and elsewhere in the Northwest. The results of that demonstration have been studied nationally and internationally. Building on this type of Department success is a priority in moving the smart grid along.

*End Goal***:** The Department envisions an electric system (generation, delivery and use) with the capability to 1) measure and understand system performance on a real-time (time and location) basis; 2) model and analyze policy and regulatory objectives and 3) improve resiliency (faster response times and ability to withstand cyber attacks without loss of critical services).

The Department's highest priorities are to implement the Recovery Plan and accelerate the development of interoperable, open standards. With respect to the Recovery Act, the Department is focused on releasing two notices of intent (NOIs) in order to implement the Smart Grid Investment Grant program and the Regional Demonstration Projects, followed by a subsequent release of formal solicitations for proposals. The NOIs will provide instructions regarding what types of projects qualify, who is eligible to be receive funding, and how proposals will be evaluated.

The Recovery Act requires issuance of NOIs for the Investment Program within 60 days of enactment and within 30 days for the Regional Demonstration Projects. The Department is currently on track to complete both NOIs prior to the respective deadlines.

This concludes my statement, Mr. Chairman. I look forward to answering any questions you and your colleagues may have.

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*Office of Electricity Delivery and Energy Reliability*

Patricia Hoffman was named Principal Deputy Assistant Secretary (PDAS) for the Office of Electricity Delivery and Energy Reliability at the United States Department of Energy in November 2007. The focus of her responsibility is to provide leadership on a national level to modernize the electric grid, enhance the security and reliability of the energy infrastructure and facilitate recovery from disruptions to the energy supply both domestically and internationally. This is critical to meeting the Nation's growing demand for reliable electricity by overcoming the challenges of our Nation's aging electricity transmission and distribution system and addressing the vulnerabilities in our energy supply chain.

Prior to her current position, she served in a dual capacity as Deputy Assistant Secretary (DAS) for Research and Development (R&D) and Chief Operating Officer within Office of Electricity Delivery and Energy Reliability. During her tenure as the DAS for R&D, she developed the long-term research strategy and improved the management portfolio of research programs for modernizing and improving the resiliency of the electric grid. This included developing and implementing sensors and operational tools for wide-area monitoring, energy storage research and demonstration and the development of advanced conductors to increase the capacity and flexibility of the grid. She also initiated a new research effort focused on integrating and distributing renewable energy through the electric grid, such as promoting plug-in hybrid electric vehicles and implementing smart grid technologies to maintain system reliability. As Chief Operating Officer, she managed the business operations for the Organization, including human resources, budget development, financial execution, and performance management.

Prior to joining the Office of Electricity Delivery and Energy Reliability, she was the Program Manager for the Federal Energy Management Program within the Office of Energy Efficiency and Renewable Energy at the United States Department of Energy. This program guides the Federal government to "lead by example" promoting energy efficiency, renewable energy and smart energy management. Complementing her building energy efficiency experience, she also was the Program Manager for the Distributed Energy Program which conducted research on advanced natural gas power generation and combined heat and power systems. Her accomplishments included the successful completion of the Advanced Turbine System program resulting in a high-efficiency industrial gas turbine power generation product.

Patricia Hoffman holds a Bachelor of Science and a Master of Science in Ceramic Science and Engineering from Penn State University.