

**STATEMENT OF
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U.S. DEPARTMENT OF ENERGY
BEFORE THE
UNITED STATES HOUSE OF REPRESENTATIVES
HOUSE APPROPRIATIONS SUBCOMMITTEE ON
ENERGY AND WATER DEVELOPMENT
MARCH 30, 2011**

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear before you today to discuss the President's Fiscal Year (FY) 2012 budget request for the Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE).

President Obama has described his vision of how to win the future: out-innovate, out-educate and out-build the rest of the world. We at the Department of Energy are poised to help meet that vision, guided by the President's innovation agenda that includes three clean energy goals: increase investment in clean energy; generate 80 percent of electricity from clean energy sources by 2035; and put 1 million electric vehicles on the road by 2015. A modernized electric grid, in particular, is critical to enabling the successful achievement of these goals and the race to "win the future." Therefore, the \$238 million investment in 2012 for OE supports the President's vision and OE's role in competing in a worldwide technological race. Today, availability and access to affordable electricity is something that most Americans take for granted. We depend on, and expect, the reliable, affordable, efficient and secure delivery of electricity while at home, at work, at school and wherever our activities lead us. But the electric power grid was not designed for the highly technical, modern lifestyle of today: a world where iPhones and iPads are a common commodity and where the plug-in electric vehicle is not just a concept but a growing reality. America's existing electricity delivery system, based on technology developed in the early 1900's, is beginning to struggle to meet the growing complexities and demands of the 21st century.

It is the mission of this Office to lead national efforts to modernize the electricity delivery system, enhance the security and reliability of America's energy infrastructure and facilitate recovery from disruptions to energy supply. A modern grid is crucial to meet the Nation's growing need for energy, sustain the economic recovery, ensure a cleaner environment, and enhance national security. If we fail to develop and deploy the next generation of electric transmission and distribution technologies and to implement new policies and challenge conventional approaches, we risk falling behind the global push towards greater efficiency and increased adoption of cleaner energy, in an increasingly competitive world.

The FY 2012 request of \$238 million will set us on the right path to mitigate this risk and succeed. The increased investment will emphasize the integration of renewable energy sources, focus on long-term system planning, expand analytical capabilities, and promote aggressive approaches to next-generation grid technologies. Specifically, the request includes \$193 million for research and development (R&D) to develop technologies in several crucial areas –

transmission and distribution systems, energy storage, and cyber security – so that the next generation of grid technologies can meet the Nation’s needs and achieve deployment and commercialization. The R&D program request also includes funds for the creation of a new Smart Grid Technology and Systems Hub where a multi-disciplinary group of experts can work together to enhance smart grid technologies and systems. OE’s request provides \$8 million to provide technical assistance to states and regions, and to support electricity policy analysis that facilitates development of electricity infrastructure to meet our Nation’s future energy challenges. The request also includes \$6 million to improve the reliability and resiliency of critical energy infrastructure and to facilitate recovery from disruptions to the energy supply.

By the end of FY 2010, OE successfully obligated the \$4.5 billion from the American Recovery and Reinvestment Act of 2009 for grid modernization. We will continue to oversee the execution of these funds, with particular emphasis on maximizing value for the taxpayer. These Recovery Act projects and their intended accomplishments influenced the development of the FY 2012 request.

HIGHLIGHTS OF THE FY 2012 REQUEST

OE’s FY 2012 budget requests \$238 million, a 38 percent increase over the FY 2010 appropriation, to accelerate the transformation of the electric power grid. For example, within the \$238 million request, \$20 million will support cutting-edge clean energy research and development (R&D) through a new Smart Grid Technologies and Systems Energy Innovation Hub, and \$57 million will build on the momentum we’ve gained from Recovery-funded work to develop and commercialize grid-scale energy storage that will increase penetration of variable renewable generation into the grid and improve reliability. Also featured in our FY 2012 budget are expanded research efforts in advanced modeling of the grid at \$20 million, which will provide a more comprehensive, in-depth systems understanding of the grid at both the transmission and distribution level.

Establishing the Smart Grid Technology and Systems Hub: The President has called for new investments in American innovation to help ensure that our economy is competitive. Consistent with this commitment to innovation, the Department’s FY 2012 request proposes to double the number of Energy Innovation Hubs, which reflect a research approach that brings America’s scientists and engineers together with non-technical experts (such as economists and policy analysts) to tackle the toughest problems in clean energy. One of the new hubs, the Smart Grid Technology and Systems Hub, will focus on high-level challenges to the transformation and modernization of the electricity infrastructure that makes up the electric grid. OE’s FY 2012 request includes \$20 million to establish this hub, which will invest in research, development, and demonstration of novel technologies and concepts to address these challenges with a systems-level approach, supplementing and connecting the on-going transformations in the electric industry. The flexibilities and capabilities introduced by these new technologies and concepts will facilitate the adoption and use of wind, solar, electric vehicles, storage, smart meters, and other advanced components.

The Hub will pursue integrated technology research on critical needs for advanced electric grid operation, moving the electric system from a static command and control system to a dynamic,

self correcting system. It will include development of advanced components and systems to increase utilization, flow control, and resiliency with condition monitoring, diagnostics, and reconfiguration for system evolution. It will explore new policy, markets, and designs for a modernized grid with layered controls and mechanisms to optimize transmission, distributed generation, micro-grids, storage, and demand management.

Building on other Hub concepts, the Smart Grid Technology and Systems Hub will call on a diverse, multi-disciplinary group to focus on the electric grid's unique challenges, addressing all aspects of the electric system by covering applied science, engineering, economic, policy and other issues that hinder grid modernization. Having a concerted effort with expertise from diverse backgrounds will foster an environment for creative and innovative solutions for the grid of today and tomorrow, ensuring economic strength and energy security. The Hub also represents an investment in human capital, building the capabilities, expertise and skills to foster the leaders for the power systems of tomorrow.

Increasing Investment in Grid-Scale Energy Storage R&D: Energy storage is an increasingly important solution to many of the challenges facing the grid, from integration of renewables to improved reliability, efficiency, and power quality. OE's FY 2012 request of \$57 million for the Energy Storage program is an increase of \$43 from FY 2010, a quadrupling of our investment over two years. The request represents investment in a diversified portfolio of storage technologies that includes large Compressed Air Energy Storage (CAES) and medium-to-small batteries and flywheels. These grid-scale technologies operate on various timescales and power levels, making the power system more robust and efficient. Large grid-scale, megawatt-level energy storage systems, or multiple, smaller distributed storage systems, have the potential to significantly reduce congestion in the transmission system and manage peak loads, increasing the overall reliability of the grid. Storage technologies also facilitate the integration of variable and intermittent renewable energy resources by storing electrical energy so that it can be available whenever it's needed.

The FY 2012 request supports advanced storage materials research, targeting key attributes of storage materials that affect lifetime, storage density, and cost; applied R&D on devices and systems, developing and testing advanced prototypes; and field validation of first-of-a-kind systems in life-like simulations and utility environments. It also supports analysis of storage systems, including the development of tools for utility and user planning for application of energy storage. Activities include field testing and modeling in collaboration with renewable energy developers and utilities to identify the most effective use of energy storage to integrate a high penetration of renewables like solar and wind. The request also supports a new suite of grid-scale energy storage demonstrations, maintaining the momentum and interest generated by the Recovery Act demonstrations. OE, with its focus on applied research for the electric grid, works collaboratively on energy storage research with the Offices of Science, Energy Efficiency and Renewable Energy, and the Advanced Research Projects Agency - Energy.

Building Advanced Modeling Grid Research capability: The FY 2012 request provides \$20 million for Advanced Modeling Grid Research, an initiative that will enable the Department to interpret and analyze newly-available, real-time data from the electrical system to anticipate system challenges and to identify technical, operating, and policy solutions that might mitigate

them. This research, done in partnership with universities and industry, focuses on applying scientific insights to new electrical system data for improvements in grid planning and operations. We anticipate that this research will improve grid reliability through analysis of real-time system dynamics, allowing system operators to anticipate irregularities in grid operations, rather than having to react after an event has occurred. In FY 2012, this effort will be expanded to capture the interrelationships of multiple systems, such as the communications layer, controls and the physical electrical system, and the interactions and seams between models.

An explanation of the other elements in the FY 2012 budget request is provided below.

RESEARCH AND DEVELOPMENT

OE supports the applied research, development, and demonstration of technologies that modernize the electric power grid, increasing its reliability, flexibility, efficiency and functionality. The Research and Development (R&D) program is OE's largest, accounting for more than 80 percent of our total FY 2012 budget request. A clean energy future depends on the growth and maturity of renewable energy technologies like wind and solar, but the variable and intermittent nature of these resources present a challenge for a grid designed for a fixed, constant energy supply. Through collaboration with private industry, academia and public entities, our R&D activities promote both competitive energy markets and a clean energy future through the development of an adaptable, "smart" electric transmission and distribution system.

The FY 2012 request of \$193 million for the R&D program emphasizes innovative tools and technologies that will enable increased integration of renewable resources, and in doing so help secure national energy independence. In addition to those previously discussed, the request includes funding for: Transmission Reliability and Renewables Integration, Smart Grid Research and Development, Power Electronics, and Cyber Security for Energy Delivery Systems.

The *Transmission Reliability and Renewables Integration* activity, funded at \$20.8 million within the Clean Energy Transmission and Reliability subprogram, focuses on developing advanced transmission-level sensors, tools, and capabilities, and ensuring that transmission-level renewable resources can be effectively integrated into the grid. More sophisticated transmission technologies and power system information are essential as the demand for higher quality electricity and the integration of renewable resources grows. The work focuses on providing real-time data to improve electric transmission and distribution planning and operations, and includes support for renewable integration models and regional reliability studies.

The *Smart Grid Research and Development* activity focuses on developing the next generation technologies that integrate two-way communications and digital technology into electricity distribution systems, while encouraging consumer involvement. By providing consumers with information about their usage, and the ability to participate and communicate with the power system, we will realize the full potential of energy conservation and demand response. The activity, funded at \$35 million, includes projects studying the development of microgrids, a grouping of local generation that can disconnect and function independently from the grid when conditions dictate, thereby enhancing energy security; analysis of high penetrations of renewable

resources at the distribution level; the integration of the charging and discharging of plug-in electric vehicles into the grid; and a consumer communications program together with outreach to State regulatory bodies on Smart Grid.

The *Power Electronics* activity, within the Smart Grid Research and Development subprogram, focuses on the development of utility-scale devices that provide faster switching capabilities, flexible power conversion and better flow control, resulting in improved grid performance and efficiency. Funded at \$10 million in FY 2012, the activity emphasizes the development of Gallium Nitride on Silicon (GaN-on-Si) based devices in the near term, as they show significant promise in high voltage applications. We are focusing on increasing the operating voltage of these devices, optimizing the manufacturing process and validating their performance, with the goal of demonstrating commercial viability and encouraging adoption by the marketplace.

The *Cyber Security for Energy Delivery Systems* subprogram, funded at \$30 million in the FY 2012 request, pursues the research and development of next-generation resilient communications and control systems that enable power systems to survive intentional cyber assaults without loss of critical function. Unlike conventional information technology systems which can break the cyber systems that control electric grid power flow, power systems are specifically designed to control real-time physical processes that deliver continuous power so their cyber security measures must be tailored to the unique requirements of these systems, such as response times of much less than a second. They must offer multiple levels of access for users, which may change depending on operating mode, have components that are by necessity physically located outside in populated areas and often spread across long distances, but must be available for operation at all times. Through research and development of next-generation technologies, system vulnerability research, and stakeholder training, the subprogram addresses the unique cybersecurity requirements and operational needs of the electric grid to ensure continuous, reliable electric power.

PERMITTING, SITING, AND ANALYSIS

With a requested \$8 million in funding for fiscal year 2012, OE continues efforts to provide technical assistance to state and regional entities regarding their electricity-related policies. As utilities have increased their investment in next-generation energy technologies, we have experienced a marked increase in requests from state electricity officials for technical assistance on associated topics, including ratepayer-funded energy efficiency, smart grid and the related demand response, renewable energy, natural gas and clean coal. Electricity planners from both the public and private sectors are facing new challenges as the nation moves towards a clean energy future. Maintaining reliability and affordability while the generation portfolio evolves in numerous ways is a challenge. As the deployment of variable renewables grows, much of which is located in remote places far from where the electricity is needed, greater cohesive, regional thinking by state and local officials will be required. Accordingly, the FY 2012 request supports expanded collaboration with state and regional entities on interconnection transmission and electricity resource planning efforts, focusing on the operating and planning changes necessary to support an evolving electricity generation and delivery structure. The request also continues coordination of Federal authorizations for new transmission facility siting, issuance of permits for cross-border transmission lines, and authorization of electricity exports.

INFRASTRUCTURE SECURITY AND ENERGY RESTORATION

The FY 2012 budget request includes \$6.2 million to enhance the security and resiliency of the electricity grid, and facilitate recovery from disruptions in energy supply. The increasing complexity and interdependency of national energy infrastructure and expanding globalization of energy markets, in conjunction with the threat of both natural disasters and deliberate attacks, represent significant challenges for the energy industry. This office has built close relationships with the owners and operators of energy infrastructure as well as other government agencies, and has developed a thorough understanding of the tools and technologies needed to support energy infrastructure. This places OE in a unique position to help discover technical solutions to protect critical energy assets as well as facilitate their adoption by the energy sector.

We will improve our situational awareness capabilities through advancements in modeling tools for natural gas and petroleum sectors, power outage and restoration visualization and near real-time capabilities. We will work with energy sector stakeholders to encourage the open exchange of information on physical and cyber threats to critical infrastructure. We will maintain teams of fully trained emergency responders, prepared to facilitate recovery from energy supply disruptions. We will develop a strategic analytical framework for identifying and modeling foreign energy infrastructure that, if compromised, could negatively affect national energy security. And we will work with Federal, state and local officials to strengthen preventative measures through tabletop exercises, forums and workshops that increase understanding of critical infrastructure protection and security issues.

These activities represent OE's contribution to the security and resiliency of national energy infrastructure, and promote consistent, reliable and efficient energy nationwide.

PROGRAM DIRECTION

Our FY 2012 budget request includes \$31.2 million for Program Direction, which covers the cost of sustaining Federal staff and other services required to provide overall direction, management, and support for OE. The request supports 118 Full Time Equivalents (FTEs) in FY 2012, based in Headquarters and at the National Energy Technology Laboratory in West Virginia. This includes 12 additional technical staff with expertise in areas such as cyber security, power electronics, and smart grid technologies, as well as senior management personnel, needed to support OE's increasing workload and achieving its critical mission. The request supports an additional 26 FTEs that were funded through the Recovery Act in FY 2010. The grants and agreements awarded under the Recovery Act will continue for several years, and Federal staff provides critical technical project management and monitoring of ongoing Recovery Act grants and agreements.

CONCLUSION

Through our ongoing research and development and other efforts, we continue working to improve grid efficiency and reliability, improvements that can enable the Nation to move toward more affordable, accessible clean energy sources. Continued Federal investment in the research, development and deployment of new technologies, in combination with innovative policies and

investment in infrastructure, is crucial to improving performance of the Nation's grid and ensuring our energy independence, security and environmental well-being.

President Obama has defined an ambitious vision for our future, where most of our electricity comes from a wide range of clean energy sources, with electric vehicles that charge and discharge to the grid. We must modernize the electric grid to ensure it can support this future, reliably, securely and efficiently. As Energy Secretary Steven Chu has said, "The United States faces a choice today: will we lead in innovation and out-compete the rest of the world or will we fall behind? To lead the world in clean energy, we must act now. We can't afford not to."

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