Smart Grid: Will It Get Renewables to Market and Promote Energy Efficiency?

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The "smart grid" is a broad term designed to summarily describe the capabilities of an advanced electricity transmission and distribution grid. Anticipated smart grid features include improvements in reliability, two-way communication capabilities for electricity pricing, demand and remote diagnosis and control of components of the transmission and distribution system, and integration of renewable energy. Although all of the specific contours of the smart grid have yet to emerge, the reality of a more intelligent grid is on the horizon.

Smart grid proponents cite several reasons in support of its development. Smart grid technologies have been estimated to have the potential to reduce power disturbance costs to the U.S. economy by $49 billion per year and to eliminate the need for approximately $46 billion in infrastructure investments over the next 20 years.[1] New storage capabilities, initially achieved in large part through charging all-electric vehicles in off-peak hours, will increase utilization of renewable energy by mitigating variable output. Consumers will benefit through greater ability to control costs and conserve energy by obtaining detailed, contemporaneous usage data to inform their consumption choices. Similarly, utilities will benefit through improved ability to control and utilize load. Finally, proponents argue, the smart grid is not a question of preference; it is a necessity. For each of the past 28 years, peak demand for electricity has outpaced transmission growth by almost 25 percent. The electricity delivery system is overburdened and without improvements, will not keep up with the nation's needs.[2]

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Whose Projects Are Qualifying for DOE Smart Grid Grants?

In the Energy Independence and Security Act of 2007 (EISA 2007),[4] Congress expressed its support of the development of a smart grid. EISA 2007 established a grant program to be administered by the Department of Energy, and directed the Federal Energy Regulatory Commission to adopt standards and protocols related to smart grid functionality and interoperability. In the American Recovery and Reinvestment Act of 2009,[5] Congress dangled the carrot for which smart grid proponents had been waiting by funding the Smart Grid Demonstration Program (SGDP) and Smart Grid Investment Grant (SGIG) program originally established by EISA 2007. The SGDP projects are intended to benefit either regional demonstrations of advanced technologies for use in planning and operations of the electric power system or grid-scale energy storage demonstrations. An example of the winner of a SGDP is FortZED in Ft. Collins, Colorado.[6] FortZED encompasses more than 7,000 customers and is aiming to be the world's largest active zero-energy district.

The purpose of the SGIG program is to facilitate the development of a variety of smart grid technologies, tools, and techniques necessary to accelerate the modernization of the nation's electric transmission and distribution system. On October 27, 2009, President Obama announced $3.4 billion in SGIG awards. One hundred applicants in 49 states will benefit from the awards. The largest portion of funding ($3 billion) will support digitized grid components such as smart meters that facilitate two-way communication and give consumers information and control over their energy consumption. For example, Baltimore Gas and Electric Co. in Maryland received $200 million to deploy smart meters to all its 1.1 million customers. Other funded projects include the installation of over 200,000 smart transformers designed to alert utilities before they fail, sensors that allow operators greater visibility of the grid to prevent blackouts and to better incorporate renewable energy sources, and automated substations that enhance response time to power outages.[7]

FERC also recently adopted a Smart Grid Policy, in which it identified six areas to which the National Institute of Standards and Technology should give the highest priority in the smart grid interoperability standards development process, and adopted an Interim Rate Policy designed to encourage early investment in smart grid technologies.[8] The priority areas for interoperability standards development are: cyber security and physical security for equipment that can provide access to grid operations, development of a common information

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framework, wide-area situational awareness, demand response, electric storage, and electric transportation.

FERC's Interim Rate Policy provides incentive rate treatments for smart grid investments made prior to FERC's adoption of final interoperability standards. These include allowing single-issue rate treatment, permitting recovery of stranded costs of legacy systems being replaced by new smart grid equipment, and contemplating the possibility of allowing accelerated depreciation for smart grid investments. The rate treatment also covers recovery of stranded costs of smart grid investments that are never fully deployed due to circumstances beyond the investor's control, including such factors as the adoption of final interoperability standards that the equipment invested in cannot be upgraded to meet.

The effect a fully implemented smart grid could have on how we produce, deliver, and use electric energy has been compared to the dramatic effect the Internet has had on the ways in which we communicate. Not surprisingly, the challenges to realizing all of the benefits of a smart grid are substantial, and there are varying viewpoints on the pros and cons of various aspects of the smart grid. One fundamental element of a smart grid is to facilitate the increased use of generating capacity to meet load, which will require improved communication between bulk generation and transmission systems and between distribution systems and load. This will require a coordinated strategy among FERC, which has authority over the bulk transmission system, and state regulators that have authority over distribution systems. To date, the smart grid has been developing in large part on a piecemeal, state-by-state basis, in many cases through technologies deployed to implement load management and real-time pricing. While greater federal oversight and involvement over interoperability standards by FERC is needed to fully achieve the benefits of a smart grid, finding the appropriate line to draw between matters that are related to retail sales, and therefore under state jurisdiction, and matters that are related to wholesale sales subject to FERC jurisdiction will be increasingly difficult.

A major concern with transitioning to a smart grid is cyber security. Another fundamental goal of the smart grid is to reduce the existing physical vulnerabilities of the grid through better two-way communications and better systems to monitor and control grid operations. This may cause new cyber vulnerabilities to emerge. Creating cyber-security systems that are impervious to outside interference, and at the same time that facilitate widespread interoperability and communication among millions of access points on generation, transmission, and distributions systems and on industrial, commercial, and residential loads is an enormous challenge.

Fully implementing a smart grid will require billions of dollars of capital investment over many years. Much of the necessary technology has only been imagined, and much is only in the early stages of development. Federal and state legislators and regulators will be faced with difficult questions of allocating costs of developing the smart grid between shareholders and consumers, and transmission owners and generators. For example, in response to FERC's proposed Interim Rate Policy, commenters argued forcefully both for and against permitting any recovery of smart grid costs before final standards are adopted. In defense of its decision to allow rate recovery, FERC cited the need for early deployment so that new technologies could be tested in the real world of utility operations. In FERC's view, rate incentives are necessary to encourage such investments.

Finally, we are all going to need to get a lot smarter about how we use electric energy. That will require access to better information and to education on how benefit from new technologies. As with the transformation from a paper-filled to a paperless world made possible by the advancement of computing and the Internet, a complete transformation to a smart grid where consumer appliances are smart enough to communicate with the grid, and consumers are smart enough to take full advantage of that functionality, will happen at an evolutionary pace.

Given that our economy relies heavily on the availability of an abundance of reasonably priced electric energy, maximizing the use of generation, transmission, and distribution capacity, increasing the availability of renewable energy, improving power quality, and reducing outages will undoubtedly yield tremendous benefits. Everyone from inventors and producers of smart grid technologies, to those involved with power generation, transmission, and distribution, to the general consuming populace, will be affected. Exactly how we as a nation go about achieving the full smart grid vision has yet to be decided and will be the subject of legislation and regulatory proceedings for many years to come.