House Select Committee on
Energy Independence and Global Warming

Hearing on "Get Smart on the Smart Grid: How Technology Can Revolutionize Efficiency and Renewable Solutions"

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Written Testimony of
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Good morning Mr. Chairman and members of the Committee, I am Bob Gilligan, Vice President, Transmission and Distribution at GE Energy Infrastructure. Thank you for the invitation to testify today on the Smart Grid, and the tremendous opportunities it presents for our nation.

As the hearing's title suggests, technology can revolutionize efficiency and renewable solutions, and, in the process, the electrical power grid that remains little changed since its inception. While the grid is a marvel in engineering design and may, indeed, be one of mankind's greatest achievements, it has yet to be transformed into a modern grid, a sustainable grid, a truly smart grid that takes advantage of proven, cleaner, cost effective technologies that are available or in development today. GE believes that the Smart Grid is an essential component to addressing the energy demand, security and environmental challenges we face. We applaud the Obama Administration and Congress for embracing the Smart Grid in the recently signed American Recovery and Reinvestment Act of 2009.

Today, we will share our vision for the Smart Grid, provide information about how our technology solutions enable the Smart Grid, and introduce our perspective on the policies and activities necessary to make the Smart Grid a welcome reality.

GE Energy

GE Energy Infrastructure is one of the world's leading suppliers of power generation and energy delivery technologies with businesses focused on fossil power, gasification, nuclear, renewable energy – including wind, solar and biomass, oil and gas, water, as well as transmission and distribution. We have more than 100 years of industry experience, and our team of 65,000 employees operates in more than 140 countries.

GE Transmission and Distribution (T&D)

GE T&D provides technology solutions that enable grid management and optimization for electric utilities worldwide. These solutions encompass hardware, software and services supporting the entire electricity delivery value chain, from power transformers at the generation switchyard to smart meters at the customer premises. They help utilities boost their productivity and reliability, while at the same time reducing their environmental footprint, and they empower consumers to monitor and control their electricity usage.

GE has been in transmission and distribution almost as long as it has been in energy - some 80 years, and our business consists of four divisions focused on power delivery, automation, smart metering and asset management. We have a strong North American presence, with headquarters in Atlanta, GA, and facilities in Melbourne and Bradenton, FL, Shreveport, LA, Somersworth, NH, Denver, CO, along with Mexico, Canada and the United Kingdom.

The breadth and scope of our portfolio differentiates us from others in the industry. We provide network, sensor and control, and monitoring and diagnostic equipment, smart meters, and a suite of asset management and grid management applications, in addition to project management expertise and a Smart Grid solutions focus. We strive to help utilities safely and efficiently design, automate, operate and manage their critical transmission and distribution assets.

The business has experienced significant growth over the past few years, and we expect this trend to continue as electric utilities prepare their networks for increasing population and energy demand, while addressing security and environmental concerns with an aging infrastructure and workforce.

The Transmission and Distribution Industry in the US

The customer base we serve is both large and diverse. There are over 3,100 investor owned utilities, municipals, cooperatives and federal and state agencies that deliver electric power across 50 states, 3 interconnections and 8 reliability entity regions. They keep the lights on and the systems running for over 142 million residential, commercial, industrial and governmental customer premises. (EIA)

The network itself is vast and intricate, and accounts for some 40% of industry asset value. There are over 160,000 miles of high voltage transmission lines, millions of miles of distribution lines and over 60,000 transmission and distribution substations. (DOE OE, IEEE, Newton-Evans)

The enormity and complexity of this network, coupled with its social, economic, regulatory and political operating environments, directly impact the understanding, acceptance and ultimate promotion of the Smart Grid.

It may be helpful to reflect on the following that further influence the dialogue on Smart Grid …

- Annual electricity use in the typical home and average retail price per kilowatt hour continue to trend up year over year (EIA)
- Our nation's transformer fleet is aging, and the load on each transformer is continuing to rise; when frequency and severity of loss are taken into consideration, electric utilities face the highest risk (Hartford Steam Boiler)
- Transmission and distribution losses amount to almost 6% of net generation (EIA)
- There has been a 3% per year increase in outage duration and a 4% per year increase in outage frequency over the past five years (DOE)

- Power outages and power quality disruptions cost U.S. businesses $100+ billion per year (EPRI)
- There has been a well documented decline in U.S. energy R&D spending and the underinvestment by both the public and private sector has become a focus of policy debate (Harvard)
- By 2030, given the points noted above and the fact that electricity consumption is expected to increase at least 30 percent (EIA), almost $1 trillion of investment is projected to be needed … $298 billion in transmission, $582 billion in distribution and $85 billion in advanced metering infrastructure and demand response (EEI/Brattle Group)

So, the time for significant change is now. Fortunately, over the past few years, we have found common ground in the Smart Grid concept as a way to move the industry forward and into the future. GE T&D is working across the entire General Electric Company, as well as with our utility customers and other technology providers. We are also actively engaged with the Department of Energy Electricity Advisory Council, the GridWise Alliance, the Smart Energy Alliance, IEEE Smart Grid Coordinating Committee, EPRI Intelligrid and Open AMI, among others, to continue advancing the conversation. Furthermore, GE's Global Research Center has been actively collaborating with the Department of Energy Office of Electricity on several Smart Grid technologies that will demonstrate capability early. Today, we add perhaps the most critical audience to the mix and gratefully acknowledge the Congress' interest and increasingly active involvement.

The Smart Grid … at GE

The Smart Grid is a framework for solutions. It is both revolutionary and evolutionary in nature, because it can significantly change and improve the way we operate the electrical system today, while providing for ongoing enhancements in the future.

The Smart Grid is defined differently by and provides different benefits to the various audiences it serves.

It is both a bigger, stronger network – like our interstate highway system, and it is a digitized, smarter network – like the Internet.

It represents technology solutions that optimize the value chain, allowing us to squeeze more performance out of the infrastructure we have and to better plan for the infrastructure we will be adding.

It requires collaboration among a growing number of interested and invested parties, in order to achieve significant, systems level change.

At GE, our perspective is that the Smart Grid is the integration of electrical and communication infrastructures, and the incorporation of process automation and information technologies with our existing electrical network. Smart Grid is essentially modernizing the 20th century grid for 21st century society.

Of utmost importance are the tangible, quantifiable and meaningful results:

- Optimizing renewable energy integration and enabling broader penetration
- Empowering consumers to manage their energy usage and save money without compromising their lifestyle
- Delivering increases in energy efficiencies and decreases in carbon emissions
- Improving the utility's power reliability, operational performance and overall productivity

Smart Grid empowers smarter energy choices, as real or near real time data, information and insight are transferred directly to utility operators and consumers.

The American Recovery and Reinvestment Act, and the direction being provided by various federal and state regulatory agencies, give the industry a tremendous opportunity to noticeably begin transforming our grid into a more automated, interactive and intuitive power delivery system.

GE Smart Grid Solutions

The following examples should help you better understand how our utility customers use GE's Smart Grid solutions in their daily operations.

- Advanced planning and visualization systems - enhance grid modeling and management
- Sophisticated control systems - facilitate centralized management of the distribution system, with modular advanced applications for continued enhanced services
- Voltage control using regulators, capacitor banks, and advanced control solutions - improve grid operation by reducing losses
- Automatic fault detection, isolation and restoration - improve grid operation and enhance reliability
- Online monitoring and protection, including predictive maintenance - improve asset reliability and extend operation
- Smart meters with two-way communication - offer power quality monitoring, remote connect/disconnect, and real time price communication

As utilities begin to cope with the effects of higher penetrations of renewable energy resources in their network, Smart Grid technologies will help with their integration and management.

- Better coordination of central generation, with the new addition of controllable loads, to compensate for renewable energy variability
- Better coordination and control of the distributed resources themselves, such as utility access to advanced grid integration functions in the power converters for wind and solar energy resources

And, we envision the following examples of consumer usage of GE solutions as we build out the smart home of the future:

- A "Home Energy Manager," available both via in-home display and via Internet-enabled devices, that empowers consumers to monitor, control and optimize their electricity consumption
- Smart appliances with 2-way utility communications, capable of shedding significant load at peak times, while keeping the consumer in control of their operation
- Other variable load control devices, such as programmable communicating thermostats and pool pump controls
- Distributed energy generation systems, such as solar photovoltaic, supported by net metering programs
- A smart charging interface for plug-in hybrid electric vehicles

As proof of concept and commitment, GE is developing a suite of Demand Responsive appliances that interact with a smarter grid. A demonstration project is currently underway between GE and Louisville Gas and Electric Company (LG&E), a subsidiary of E.ON U.S. A full suite of smart consumer appliances, including washers, dryers, ranges, refrigerators, dishwashers and microwave ovens, are installed and active in consumer homes in Louisville, Kentucky. These units are receiving time of use pricing, and critical peak signals from LG&E's smart meters. In response to these signals, the units reduce their power draw, they delay the start of cycles, and they shift temperatures all in a consumer friendly fashion. These changes in appliance behavior serve to not only reduce the peak load on LG&E's network, but also reduce consumer energy costs by performing optional tasks during periods of lower billing rates.

With respect to GE's promotion of energy efficiency, we would like to highlight our continuing partnership with Energy Star™ and our highly successful Ecomagination business initiative. With approximately 80 certified products across all sectors of the economy, Ecomagination addresses customer demand for more energy efficient products and services. And, it reflects GE's commitment to invest in innovative solutions to environmental challenges, while generating profitable growth for the company and its investors.

GE T&D has two Ecomagination certified products.

- The highly efficient transformer (amorphous): If all 1.1 million distribution transformers that are installed each year in the U.S. and Mexico were to use GE's amorphous metal core technology, rather than high efficiency silicon steel, the annual energy savings would be approximately 750 million kWh, which could avoid more than 465,000 tons of CO2 emissions – equivalent to the impact of removing nearly 90,000 cars from U.S. roads for one year.
- Grid efficiency software (coordinated volt-VAR control): If installed on 10% of the distribution feeders in the U.S., GE's voltage control technology is designed to reduce electricity consumption by approximately 9.3 billion kWh per year, avoiding annual CO2 emissions equivalent to those of 1.1 million cars on U.S. roads.

GE T&D also offers capacitor banks and series compensation that reduce grid congestion and improve efficiency.

GE Activity in Research, Development and Demonstration

GE is investing significant internal resources into developing the technologies for the Smart Grid that our utility customers want and need. We are a most active and visible provider of Smart Grid solutions, due to the strength of our existing portfolio and this focus on continued research, development and demonstration.

GE smart meters with Internet-based protocols have been deployed at American Electric Power, Oklahoma Gas & Electric and Pacific Gas & Electric, among others. We have a comprehensive Smart Grid pilot with American Electric Power that is in the final phases of completion. This initiative includes smart meters with time of use rates and near real-time information being shared with consumers, as well as outage and distribution management systems to improve reliability and efficiency. This initiative also provides monitoring and diagnostics of critical transformer assets. Furthermore, there will be R&D projects to achieve energy efficiencies from the distribution grid. We have recently joined Austin Energy's "Pecan Street Project" to make the City of Austin and its partners a local clean energy laboratory and hub for the emerging cleantech sector.

GE has also been collaborating with the Department of Energy Office of Electricity Delivery and Energy Reliability, as well as with the Office of Energy Efficiency and Renewable Energy. A great example of this collaboration is in the area of integration of both centralized and distributed renewables, with key programs addressing the challenges of high penetration wind energy and solar energy currently underway. These programs are designed to culminate with real-world demonstrations that prove the value of this advanced technology. Our Power Conversion Systems team, based in the GE Global Research Center, our Energy Applications and Systems Engineering team, our Renewables team and our T&D Smart Grid team work closely together to turn theory into reality for wind, solar, geothermal, plug-in hybrid electric vehicle and battery integration.

To highlight one initiative, we are actively working with the Maui Electric Company and the Department of Energy to solve the challenge of integrating very high penetrations of renewable energy. Over the past decade, Maui has seen huge growth in its energy needs. Although the island is rich in renewable energy resources, including wind and solar energy, until recently these sources have serviced only a small portion of the island's electric power, meaning that energy has primarily come from imported oil. Maui Electric Company is committed to reduce its dependence on imported fossil fuel and replace it with local, clean, renewable energy resources.

That is why GE supplied 20 1.5 MW wind turbines to the Kaheawa Wind Farm on Maui. The energy they generate can power 11,000 homes, reduce greenhouse gas emissions by 160 million pounds and save 163,000 barrels of oil … every single year.

When you compare 30 MW of wind energy from this one farm to the peak island load of 200 MW, Maui very quickly leaps to the forefront of the definition of high penetration, wherever you look around the globe. This year, Maui will get approximately 10% of its energy from wind and there are plans for even more wind energy on Maui. Due to this high penetration and the daily variability of wind production, Maui is an excellent example of a system that can benefit from the features of Smart Grid technology. GE is working closely with the Maui Electric Company and the Department of Energy to develop Smart Grid technologies that can help compensate for this variability, and may eventually help Hawaii reach its goal of having 70% of its energy from clean sources.

We hope this gives you more insight on how we are currently working with our utility customers to address our collective Smart Grid future. The value we provide comes through our history and brand, longevity in the market, continued financial strength, recognized domain expertise and relevant portfolio. Our consultative approach, our quality products, projects and processes and our ability to rapidly deploy at scale are what make us a Smart Grid leader.

Hurdles to the Smart Grid

Whether one views the Smart Grid as the deployment of smart meters and advanced metering infrastructure that will facilitate time of use pricing signals and enable demand response … or the further automation and remote management of the distribution network … or transmission build-out with accompanying deployment of phasor measurement units and wide area monitoring and control systems, there are hurdles that must be overcome.

The following is a representative rather than exhaustive list of key challenges and areas of concern. Note that these closely resemble Chapter 3 of the Department of Energy Electricity Advisory Committee report entitled "Smart Grid: Enabler of the New Energy Economy."

- Lack of a comprehensive Smart Grid strategy and roadmap required for systems level change, compounded by the overall complexity of systems integration
- Substantial capital investment required up front, made even more difficult with the current crisis in the capital and credit markets
- Regulatory structures that consistently recognize and capture the full range of benefits of Smart Grid technology and provide assurance of appropriate cost recovery (particularly important given that the regulatory approval process varies by state, and may result in vastly different outcomes for a utility operating across state lines)
- Utility business model that minimizes risk and ties returns to electricity sales, which can slow down the adoption of technology, as well as energy efficiency and demand response initiatives
- Interoperability, and the need for faster, more comprehensive development of standards, in conjunction with faster, larger scale demonstrations
- Policies, applications, compliance, etc. with respect to physical and cyber security, data integrity and/or privacy
- Availability and overall capability of Smart Grid educational tools for policymakers, regulators and consumers to shift attitudes and behavior

Smart Grid Recommendations

The time is now for making headway with the Smart Grid, and the American Recovery and Reinvestment Act provides some much needed impetus for the industry.

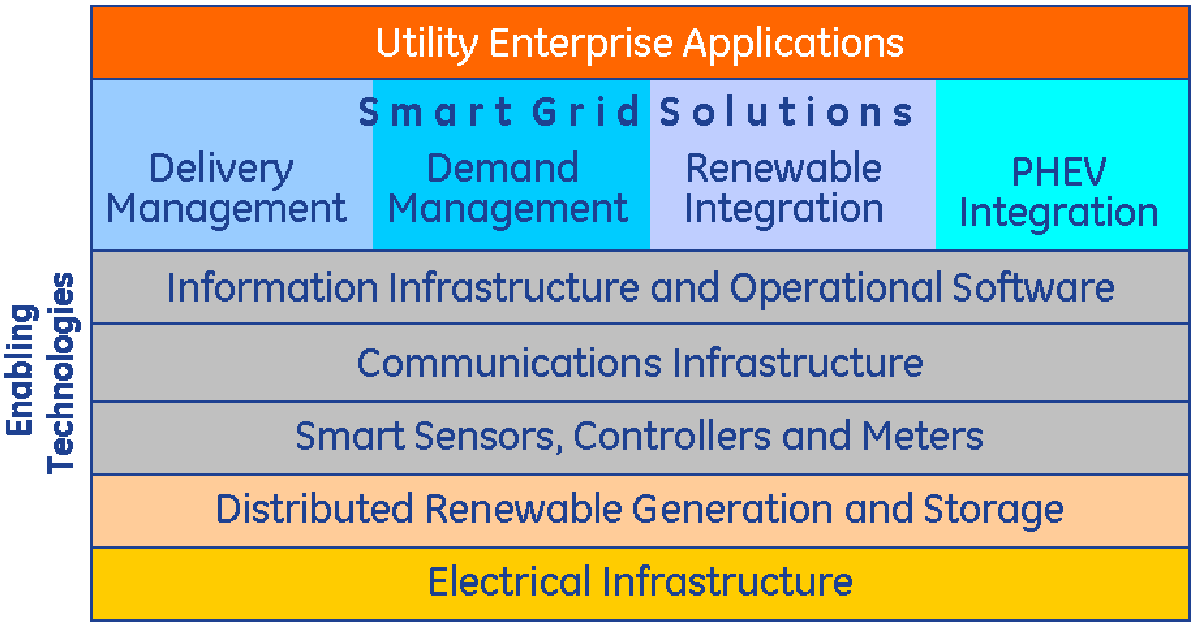
With respect to implementation, we believe it is in the long-term national interest to take a broad, all encompassing view of the Smart Grid to ensure that societal benefits will be fully realized as they pertain to our economy, environment and energy security … growth in GDP, creation of jobs, reduction in carbon emissions, expansion of renewable energy and distributed energy resources that minimize our dependence on imported oil. We believe the solutions approach as it proves in societal benefits will also instill confidence in the marketplace and drive continued investment in the future.

To achieve a more rapid deployment of Smart Grid technologies and related recognition of benefits, GE recommends funding solutions around delivery management, demand management, renewables integration and electric and plug-in hybrid electric vehicle integration.

- Delivery management - involves improving grid efficiency through solutions that monitor power flow in real time, improving voltage control to optimize delivery efficiency and eliminate waste and over-supply … thus, reducing overall energy consumption and related emissions, while conserving finite resources and possibly lowering the overall cost of electricity
- Demand management - empowers consumers with energy choice and control … encouraging them to become smart consumers in smart homes, by giving them access to time of use rates and real time pricing signals that will help them to save 10% on power bills and cut their power use 15% during peak hours (DOE/PNL GridWise)
- Renewables integration - enables the seamless inclusion of cleaner, greener energy technologies into the grid from localized and distributed resources including rooftop solar and CHP … thereby reducing our nation's dependence on coal and foreign oil and promoting a sustainable energy future
- Electric and plug-in hybrid electric vehicle integration - brings another distributed resource to market, but one at scale - with supporting rates and billing mechanisms, that can help flatten the

load profile and reduce the need for additional peaking plants and transmission lines … potentially reducing the carbon footprint and fostering our energy security and independence

The figure below shows how enabling technologies such as smart devices, communications and information infrastructures and operational software are instrumental in the development and delivery of such Smart Grid solutions. As each utility customer begins the Smart Grid journey from a different place, based upon past actions and investments, present needs and future expectations, the solutions approach provides not only the necessary focus on societal and operational benefits, but also the flexibility for where and how to get started.



The development of new capabilities, the inclusion of related applications, services and project management with the enabling technologies and systems integration will be critical to actually fulfilling the grand promise of the Smart Grid. Thus, stimulus funding should be directed toward holistic Smart Grid solutions. For example, a logical approach might be funding city-scale Smart Grid solutions, where advanced metering infrastructure deployments have been independently funded and approved.

In addition, it seems while there is no difference in job creation in the short term, there is a significant one in the long term when choosing to focus on Smart Grid solutions over infrastructure alone. Findings from a recent KEMA study conducted for the GridWise Alliance indicate that disbursement of $16+ billion in smart grid incentives could result in the creation of up to 280,000 new jobs, with 150,000 being created in the first year alone. It is also expected that half of these jobs would continue beyond deployments as permanent, on-going high-value positions. Notably, many of these jobs will be with utility suppliers, as well as with utilities, the utility supply chain and new utility / energy service companies.

And with respect to carbon reduction, an EPRI study on 21st century transformation claimed that Smart Grid implementation could slash U.S. total carbon emissions output up to 25 percent.

So, it is the advanced, sophisticated solutions that include, but are not limited to, enabling technologies that will foster the Smart Grid in both the short and long term, differentiating our country and demonstrating leadership that may open up new markets for our solutions around the world.

Related Recommendations

In addition to much needed funding for Smart Grid initiatives, the American Recovery and Reinvestment Act included significant resources to spur wider broadband availability. This presents an important opportunity to leverage broadband/Smart Grid synergy.

The deployment of Smart Grid is dependent on a communications technology to connect the electrical infrastructure. The enablement of broadband to rural America, a priority initiative for this Administration, is also dependent on a communications technology that can be cost effectively deployed. GE has had insight into this synergy for some time, and we have worked with technology partners to develop next generation communication technologies that can support both Smart Grid and broadband. This emerging 4G technology, WiMAX, can be deployed with smart meters such that it provides consumers with information they need to make better energy usage decisions, as well

as the broadband connectivity that, to date, has not been available to them.

GE suggests that funding be made available for projects that demonstrate the combined benefits of Smart Grid and broadband via 4G technology, the most advanced communications technology in the marketplace. Leveraging the resources available for Smart Grid and broadband programs would speed the realization of benefits and reduce development and build out cost.

Concluding Remarks

This is an unprecedented time in the energy industry. And, with respect to Smart Grid, this is definitely the time to be innovative, agile and willing to make bold moves. We are energized by the focus and momentum now surrounding Smart Grid and the solutions that enable energy efficiency, consumer empowerment and the integration of more renewable energy … solutions that in turn provide economic, environmental and energy security benefits to our nation.

We thank you, in advance, for your careful consideration and thoughtfulness in how the stimulus will be awarded and spent. While there are many infrastructure investments in advanced metering infrastructure underway or in the process of being evaluated / approved, let us not miss this opportunity to accelerate deployment of additional applications and more comprehensive solutions that will provide those much "talked about" benefits and encourage much needed additional investment.

Once again, we commend Chairman Markey for his leadership on these issues, and we appreciate the Committee's time and look forward to its questions.