The Reform Institute, June 30, 2008

The Smart Alternative: Securing and Strengthening Our Nation's Vulnerable Electric Grid

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With an increasing focus on developing and utilizing alternative energy sources to ensure a secure and reliable energy supply, the need is becoming abundantly clear for a modernized energy infrastructure capable of facilitating such innovation and enhancing America's resilience. The essence of resilience is the ability of our Nation to identify, prepare for, respond rapidly to, and recover from any possible catastrophic event. The practical adoption and implementation of a next-generation electrical- power grid – Smart Grid – will reduce the consequences of the electrical grid being targeted by terrorists or adversely affected by a natural disaster while improving energy efficiency and reliability.

EXECUTIVE SUMMARY

The U.S. electrical power grid – installed more than a half century ago – has provided energy successfully to our homes and businesses for many decades and is a critical component of our national defense and infrastructure. It affects nearly every aspect of our daily lives. But the grid quickly is reaching the end of its design cycle and in its current state soon will no longer serve the rising energy demand of consumers or our national resilience. Simply put, the evidence is clear that modernization of the existing grid – currently comprised of a patchwork of energy-inefficient fixes mending an overburdened system – not only is inevitable, but vital to our national security and ability to recover quickly in the event of a catastrophe.

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"Critical national security and Homeland defense missions are at an unacceptably high risk of extended outage from failure of the [electrical] grid."

– Defense Science Board Task Force Report, 2/08

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Hampered by rising demand, a lack of investment in transmission facilities, and federal policies that deter increasing domestic energy supply, the existing grid has been taxed to the limit and lacks the capacity to meet the Nation's growing energy demand.

The existing grid does not possess the capability to mitigate the occurrences of blackouts and their adverse consequences, provide incentives to consumers to reduce consumption, or improve environmental impacts through the utilization of more renewable resources. These inadequacies place in peril our national, economic, and environmental security and are unsuited to meet the long-term demands of the digital age. The task of hardening our critical infrastructures – including our military installations – against a catastrophic event must begin with efforts to bring resilience and security to the electrical grid, which connects them all.

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The DOD's national strategic and command authorities rely on 99 percent of their energy supply from "outside the fence."

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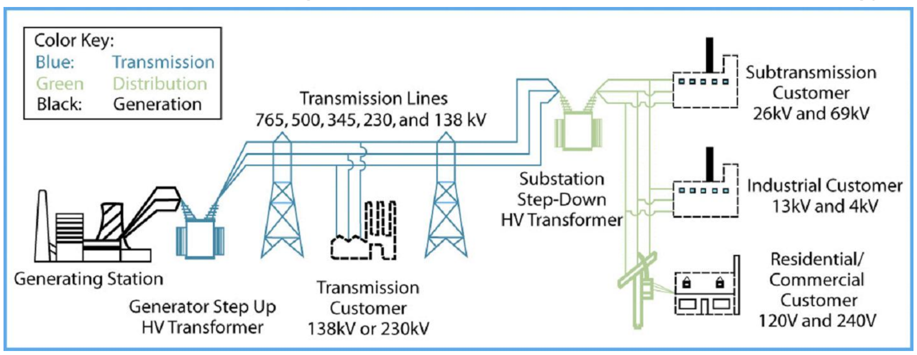
The next generation of electrical grid – widely known as "Smart Grid" – is an integration of advanced, two-way communications systems and sensors into the electrical transmission and distribution network enabling utilities to optimize grid performance in real-time, provide incentives to consumers for reducing energy consumption through demand response, and integrate renewable energy resources into grid operations. This smart system allows utilities to understand demand and regulate supply, and most importantly for the purposes of resilience, either reallocate electricity during times of crisis or peak demand or prevent outages through proactive diagnosis of the grid and its individual elements.

The Smart Grid offers the next generation of power delivery and furthers the ability of the grid to continue to provide power in the immediate wake of a catastrophic event. But the Smart Grid's benefits span far beyond resilience as a modernized grid would have a dramatic positive impact on the environment by lowering consumption and increasing the utilization of renewable energy sources, and provide incentives and control for consumers and businesses to make decisions regarding their individual energy consumption.

We must move quickly as a nation to secure our critical infrastructure and ensure that it can support vital emergency response, military, economic, and social activities during a crisis. Congress has recognized that the vulnerabilities of the current electrical grid threaten our national resilience and, therefore, necessitate change.

Congress has only begun to explore, in the last two major energy bills, the potential of the next generation of power delivery through the modernization of the U.S. electric grid. But complex jurisdictional hurdles and a litany of regulatory and private-stakeholder interests still create challenges for realizing the full deployment of the Smart Grid.

Increasing the resilience of the electrical grid will require the data, technological intelligence and capacity to manage electrical congestion, avoid overburdening the system, and avert electrical outages even as the population requires greater quantities of quality electricity. Keeping the power on is the first step to hardening the Nation's energy-dependent critical infrastructure. The electrical grid must be able to successfully manage a disaster and rapidly return to a state of near normalcy in order to maintain the integrity of all dependent infrastructures.



Electricity Generation and Delivery Process

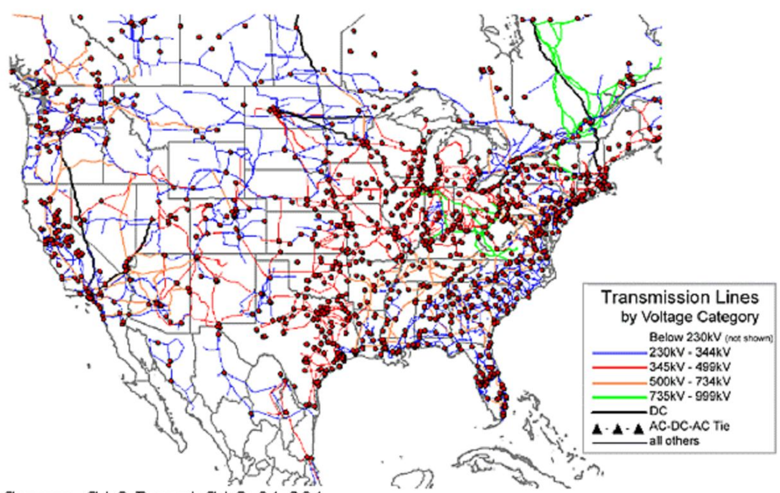
BACKGROUND

The U.S. electrical transmission and distribution system – installed many decades ago – provides electricity to every aspect of American society. This system is the largest machine in the world responsible for delivering energy from massive generation sources that derive power from coal, nuclear fission, oil, natural gas, hydro, geothermal, solar, and wind sources. Electric power originates at these generation stations, travels along massive high-voltage power lines to sub-generation transmission stations, and is ultimately distributed to the energy consumer – or end-user. The electrical grid has served its purpose well, but it quickly is reaching the end of its design cycle as it is an inefficient push system that offers little incentive to either the utility provider or consumer to monitor and conserve energy consumption.

The electrical power system in the United States entails over 16,924 electric generating units with more than 1,075 Gigawatts of generating capacity[1] involving more than 300,000 miles of transmission lines [2] and 500,000 miles of distribution lines.[3] But the deficiencies of this current electrical grid are inherent in its design. Electrical energy is ordinarily consumed immediately subsequent to its generation as it historically has been difficult and inefficient to store for prolonged periods. Having an unequal supply and demand of generated energy creates the potential of overburdening and causing extensive damage to the system. To counter-act this deficiency, the electrical grid is designed to disconnect at first sign of an electrical imbalance. When the generator disconnects it results in an electrical outage – or blackout.

Despite being designed to mitigate damage caused to the system and its users, electric delivery interruptions and the ensuing periods before power restoration threaten our national security as our defense capabilities are disabled, our economy is weakened, and the lives of Americans who depend on energy for basic needs – including heating and cooling, as well as emergency services – are placed in peril.

The electrical grid as we know it was installed at a time when the current massive consumer demand could not have been foreseen. The dramatic increase in the number of new and larger homes, rising urbanization, and the widespread adoption of digital technology and other energy-thirsty devices has overloaded our electrical delivery system and driven up costs as utilities search for new sources of energy to meet demand. The electric grid is further burdened by public policies inhibiting the increase in domestic energy production.



Source: GAO Report GAO-04-204

The most significant corollary to our increased dependence on the electrical grid is the increased consequences of power fluctuations. Power fluctuations, which were once merely an inconvenience, now are a major grid vulnerability that threatens our Nation's security and cost tens of billions of dollars in lost commerce each year. Should the electrical grid become a deliberate target of a terrorist attack, a casualty of a natural disaster, or simply malfunction, an overloading of the system would create a ripple effect that could bring our economy to a standstill, jeopardize our national security and possibly cost lives.

Blackouts and power quality issues are not the only reason for concern. The inefficiencies of the energy sector also burden the economy. Of all energy consumed to produce electricity, only 30 percent reaches consumers in the form of electricity,[4] transmission and distribution losses are valued at more than $25 billion a year.[5] Adding more generators only increases these inefficiencies. Further exacerbating the problem is the physical limitations of the current grid. The aged grid has become so problematic in its limitations that it is incapable of employing new and renewable energy generation sources (e.g., solar, wind, hydro) at a capacity that justifies building new generation plants powered by such clean domestic energy. In some areas the energy produced outweighs the transmission capacity by 65 percent.[6] There is a vast need to increase not only the efficiency, consistency, and capacity of our electric infrastructure, but also its security.

Unfortunately, there exists little economic incentive for utility companies to address inefficiencies of the current grid. Intuitively, making the electrical grid more efficient would mean delivering the same amount of usable electricity to the consumer but requiring less costly initial energy input to do so; that equates to selling the same output at a lower price. Left without incentive, utilities to date have preferred to retain the same inefficient generation, transmission, and distribution system to maintain profit margins.

The increase in demand for electricity and other sources of power is vastly outpacing the increase in power supply. The challenges and opportunities of the new century dictate that we not rely on an outmoded electrical grid system that is nearing the end of its design cycle. Growing the grid in the usual incremental manner through a patchwork of improvements provides only temporary relief to the burdens facing the grid and merely aggravates its vulnerabilities. For these reasons and more, the current electrical grid cannot continue to serve our national strategic objectives, the demands of American consumers, or the need to improve our environment and mitigate global climate change. It is static in its design, inefficient, and limiting to a nation that seeks to expand its use of renewable energy resources. The existing grid is a liability to our Nation's security and resilience.

MODERNIZATION - THE SMART GRID

As the modernization of the domestic electrical grid is paramount to the resilience of the Nation, the centerpiece of this effort should be the deployment and utilization of a "futureproof" electrical system upgraded with advanced communications, sensors and diagnostic software commonly referred to as the "Smart Grid."

What is the Smart Grid?

The Smart Grid, in essence, is an amalgam of communications and electrical capabilities that allow utilities to understand, optimize, and regulate demand, supply, costs, and reliability. This advanced technology allows electricity providers to interact with the power delivery system and determine where electricity is being used and from where it can be drawn during times of crisis or peak demand. The monitoring capability of the Smart Grid serves to improve grid resilience by empowering the utilities to re-route electricity to areas that have lost or are on the precipice of losing power. More importantly, the real-time diagnostic capability of a Smart Grid enables utilities to predict and prevent outages and power disturbances before they occur.

The communications overlay of the electrical system that comprises the Smart Grid can be described more technically as a "standard web services interface for new and existing utility applications, the ability to use any IP wide-area network for the data communications backhaul, and an open meter interface for connecting to in-home devices such as thermostats, water and gas meters, or any energy aware home area network."[7]

The Electric Power Research Institute (EPRI) envisions the Smart Grid as a power system that can incorporate millions of sensors all connected through an advanced communication and data acquisition system. A system that will provide real-time analysis by a distributed computing system that enables predictive rather than reactive responses to blink-of-the-eye disruptions and is designed to support a changing generation mix in a carbon constrained world. It would allow for a more effective and efficient participation by consumers in managing their use of electricity.[8]

Current Grid Deficiencies

In order to fully understand the benefits of this advanced Smart-Grid capability, it is constructive to comparatively analyze the existing electrical grid. Unlike the Smart Grid, the functional deficiencies of the current electrical grid include, but are not limited to, the following:

- It is an inefficient push system that requires utilities to flood the system with electricity – much more than is needed – to ensure reliability and meet demand.
- It is based on a consumption- and revenue-based business model that offers no incentive for utilities to conserve energy.
- It is woefully inadequate as its "static" design does not allow utilities adequately to monitor data pertaining to electricity consumption or outages, and thus respond and recover in the wake of a catastrophic event.
- It places in peril the ability of our military and homeland security forces to fulfill their missions to defend Americans.
- It veils the true costs of electricity until month's end and, in turn, has a limited ability to provide end-users with the control to understand and regulate their individual electricity consumption.
- It requires maintenance costs from remote and automated disconnects/reconnects and trips to the field.
- It causes a lapse of a significantly higher number of minutes without

power incurred by end-users during outages during the restoration process.
- It lacks the communications overlay that would enable the expansion of existing cyber-security capabilities.
- It has a more significant carbon footprint due to higher peak demands, higher supply and consumption, a lack of incentive to conserve, and inability to utilize fully the potential of renewable and alternative sources of energy.

Each of these deficiencies cut adversely against our Nation's resilience in that the current grid lacks the ability to sufficiently protect itself and related critical infrastructure, reduce our dependence on foreign sources of energy, conserve energy, capitalize on alternative sources of energy, improve our environment, and lower end-user costs. Thus, modernization that would improve efficiency and reliability would have a stabilizing effect on the economy, national security, and the energy-dependent critical infrastructure.

Smart Grid Benefits

By contrast to the deficiencies of the existing grid system, the Smart Grid is a dynamic and more resilient electrical and communications delivery system that utilizes energy that the existing system wastes through inefficiencies. The Smart Grid creates incentives for conservation, fortifies the reliability of our homeland and military security forces, improves the carbon footprint of the grid, reduces systemic maintenance, prevents outages and mitigates restoration in the wake of those outages that do occur, and improves reliability of supply.

RESILIENCE AND NATIONAL SECURITY

The electrical transmission and distribution system is vital to our national security and global economy. Improvements to the electrical grid have successive benefits to the Nation's security as an effort to exploit the vulnerabilities of this electrical grid would have a catastrophic impact. Economic turmoil would lie in the wake of cascading blackouts, and total power loss would render our critical infrastructure and essential services nearly useless. The energy resilience of the Smart Grid means that hospitals, first responders, fire stations, police departments, and homeland security and military forces always possess the requisite power to fulfill their missions of protecting and caring for Americans. Businesses would also be able to continue operations in the event of a crisis, moderating the adverse consequences of a catastrophic event on the economy.

Notable anecdotal evidence of the fragility and vulnerability of the U.S. electrical grid system can be found with the power outage five years ago in the Northeastern United States and parts of Canada. On August 14, 2003, a combination of high heat and demand caused a sagging high-voltage power line near Cleveland, Ohio to come in contact with trees that had not been trimmed by the local utility. The U.S.-Canada Power System Outage Task Force later concluded that this contact caused the first of a series of cascading power failures resulting in a loss of electrical power to approximately 50 million people located in a 9,300-square-mile area throughout the region. A simple contact of a high-voltage power line caused more than 265 power plants and 500 generating units to shut down, including 22 nuclear plants. Full power was not restored from these sources for a period of nearly two weeks.[9]

The consequences of the summer of 2003 power failure were significant, as delivery systems for oil and water were shut down, rail and air travel was disrupted, homeland security and communications capabilities were unavailable, and lives were placed in peril as residential homes and businesses were without air conditioning. And, of course, the negative impact on productivity caused a drag on the economy.

While some may argue that the grid functioned as designed in 2003 in that it sensed a problem and disconnected to avoid greater damage, most would agree that this incident served as a warning to the U.S. that it must move to modernize its methods of energy delivery and make the system more resilient. This outage was mild in that it did not cause damage to transmission or distribution infrastructure, which allowed for the system to be restored in a fairly short period of time. However, a natural disaster, or a physical or cyber attack certainly would cause more damage and result in prolonged outages.

The employment of Smart Grid technologies would minimize the consequences of an attack or catastrophic event by providing energy providers with an enhanced ability to identify the location of the failure and quickly re-route electricity to locations where demand is most critical. This advanced capability would serve to shorten power restoration times, which is the essence of resilience. By mitigating the consequences of an attack affecting the electrical grid, the Smart Grid would serve as a deterrent for such attacks, thereby strengthening and insulating our energy dependent critical infrastructure.

The U.S. Department of Defense (DOD) is the single largest user of energy in the United States – consuming more than 3.8 billion kilowatt-hours (kWh) of electricity each year. That total represents nearly one percent of the total electricity consumption of the Nation, and 75 percent of the Federal Government's consumption. The DOD's principal concerns are not the availability of energy to ensure the reliability of its missions, but rather the fragility of the existing electrical grid and its susceptibility to extended outages. The DOD's national strategic and command authorities rely on 99 percent of their energy supply from "outside the fence."[10]

In its February 2008 report, the Defense Science Board Task Force Report found that "critical national security and Homeland defense missions are at an unacceptably high risk of extended outage from failure of the grid." The report indicates that the grid is not designed to withstand a coordinated multi-pronged attack, and insurgents in Iraq and Afghanistan commonly and effectively have coordinated attacks on the power grid as part of their tactics.[11]

The deployment of Smart-Grid technologies would provide the necessary reliability to DOD to fulfill its critical missions, as well as reduce the agency's energy consumption and costs. All of these benefits serve to make our Nation more secure and resilient.

An important subcomponent of our national security that can be addressed by a commitment to the implementation of the Smart Grid is cyber security. Committing to the Smart Grid enables the architecture of the grid to be designed with security in mind. The extensive amount of data that can be utilized by the Smart Grid in real time means that a comprehensive cyber security program can be integrated from its inception. The Smart Grid provides an enhanced bandwidth and computing power to enable more sophisticated grid protection software and encryption to thwart attacks on power infrastructure. In this manner the Smart Grid offers greater security for our critical infrastructure as it ensures that power is readily available while anticipating and avoiding threats to the integrity of the system.

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CONSUMER EMPOWERMENT

The Smart Grid provides enormous benefit to the energy consumer, besides those of national, economic, and environmental security. Some experts estimate that the existing inefficient electrical grid system costs consumers hundreds of billions of dollars per year in hidden costs and waste. In a global economy that provides consumers with endless product choices and prices, they are left guessing what type of energy they consume, and how much it costs when they consume it. The Smart Grid, in essence, grants consumers control of their personal energy footprints, allowing them to choose not only when they consume power, but what source of power they wish to consume. This is achieved through the demand response capabilities of the Smart Grid. Demand response ensures that supply and demand is balanced. Demand response allows consumers to place megawatts back on the grid at times of peak demand, and reduces the need for more generation plants, thereby reducing costs to consumers and eliminating waste.

During peak hours of the day, for example, a consumer will be able to see that the price of running a dishwasher or setting a thermostat at a certain temperature may be high during a period of peak demand and, therefore, may choose to use power during non-peak hours. Such a scenario improves the stability of the grid and reduces waste. When fully implemented, the Smart Grid will provide consumers with the ability to sell power from a plug-in vehicle, solar panels, or any type of stored energy back into the grid for general consumption, and choose what type of energy or mixture thereof they desire to purchase from the grid. The real time, two-way capacity of a Smart Grid offers consumers more flexibility and the freedom to tailor demand response options to their own needs – instead of turning air conditioners completely off multiple times a day, smart appliances can be turned down and managed through a ready "gateway" system that maximizes consumer control.

With the Smart Grid, consumers are able to "program demand-response meters from their homes to grant permission"[12] to utilities to adjust their power depending on systemic need. This empowers utilities to readjust and reroute supply depending on demand, and raise the temperature slightly in your house, or alter the way your appliances are performing to suit the interest of the supply source. While consumers would not *have* to submit their systems to this, they would have the option if they desire.

All of these consumer benefits when taken as a whole will yield the most important function of a consumer-friendly electrical grid system, which is a dramatically more reliable power delivery system susceptible to fewer power fluctuations and blackouts. As discussed throughout this paper, the occurrence and length of blackouts are threats to our Nation and to consumers who depend on reliable electricity for their everyday lives and well-being.

When demand overwhelms capacity due to a catastrophic event or simple overload, the system can be smart enough to alter its behavior and adjust accordingly. This is resilience. And consumers willing to alter their behavior can be rewarded through incentives.

IMPACT ON INDUSTRY

As U.S. industry in the digital age becomes more dependent on high-quality energy delivery, our economic security becomes more dependent on reliable energy. For this reason, we must promote energy continuity and reliability.

The full deployment of Smart-Grid technologies will mitigate dramatically the billions of dollars lost by American businesses each year as a result of the power fluctuations, congestions, and failures of the current electrical grid. Increasing energy efficiency and reliability will be crucial to improving the competitiveness of American businesses in a global economy.

The capacity optimization offered by the Smart Grid will improve energy delivery reliability, lower business costs, and reduce waste. While residential consumers suffer what typically amount to minor inconveniences resulting from power blackouts, the impact of power inconsistency on industry can be devastating. One 2005 power outage in southern California disrupted an estimated $75 billion dollars in economic activity.[13]

Businesses necessitate not only electrical resilience, but electrical continuity of the sort the current grid cannot provide. Massive power outages are occurring at an unprecedented frequency and industry is an unfortunate casualty. The Smart Grid's ability to optimize system reliability and resume electrical normalcy in short order, or avoid a disruption entirely, will provide the energy security that industry requires to sustain an energy dependent economy.

Like with residential consumers of electricity, businesses will reap similar benefits from Smart-Grid demand response capabilities. But by consumer and corporate empowerment, as well as its environmental impact, the Smart Grid is creating new markets as private industry develops energy efficient and intelligent appliances, smart meters, new communications capabilities, and passenger vehicles. The Department of Energy predicts that Smart Grid deployment will open a $100 billion market in smart technologies.[14] These new market technologies will lower consumer and corporate electricity costs, and have a dramatic impact on the environment through efficiency and resource-utilization gains. The same study suggests that implementation of the Smart Grid should create $2 trillion per year additional GDP.[15] Thus, industry is not only made more competitive and secure by the adoption of the Smart Grid, but it is afforded new market opportunities**.**

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ENVIRONMENTAL BENEFITS

The environmental impact of Smart Grid deployment is multi-faceted, but often difficult to quantify – this despite studies projecting a 5:1 return on investment. But for the most part, the returns from Smart Grid technologies in the form of positive environmental benefits are often intangible and realized by a dispersed set of beneficiaries. Justification for Smart Grid adoption suffers from an inability of its advocates to make "rate-of-return" arguments on its behalf. But its environmental benefits cannot be denied.

According to the Modern Grid Initiative, every kilowatt-hour saved by the efficiencies of the Smart Grid will result in reduced expenditures on pollution controls at power plants.[16] One study by the Electric Power Research Institute suggests that implementation of the Smart Grid could reduce CO2 emissions by as much as 25 percent by the year 2020 through improved electrical efficiency.[17] As some experts argue, the cleanest form of energy is the energy that is saved.

A stable environment is critical to the resilience of any nation. By improving the efficiency of our energy delivery systems and diversifying fuel sources – primarily to cleaner fuels and technologies – we will improve the environment and enhance our energy sustainability, thereby mitigating the adverse consequences caused by a changing climate. The Smart Grid can be a critical component in improving both our climate and national resilience.

The Smart Grid's system optimization and demand response capabilities, as well as its conservation incentives serve to reduce energy consumption, thereby lowering the CO2 emissions caused by the generation of energy. Because of its ability to manage energy variability, particularly with wind power, the Smart Grid enables and encourages the development of alternative fuel sources and their integration on the grid. This added market for alternative and renewable energy suppliers also will serve to lower carbon emissions by replacing a percentage of the fossil fuels currently utilized. And by improving the utilization of the exiting grid assets through smarter energy management, the Smart Grid also reduces the need for new generating units built to meet increasingly higher peak demand.

The consumer benefits of Smart Grid appliances and vehicles also contribute significantly to the improvement of the Nation's environment. "Smart" appliances, including plug-in hybrid vehicles and energy efficient heating and cooling, have the added benefit of again lessening CO2 emissions and having a less detrimental impact on the global environment. These new technologies will communicate with the grid and be capable of powering down when sensing a stress on the system. This will reduce the occurrences of adverse grid events and conserve energy.

IMPEDIMENTS TO DEVELOPMENT

Despite its projected overwhelming return on investment, the deployment of the Smart Grid indubitably will not be realized without traversing significant regulatory and stakeholder challenges. Our Nation's electrical transmission and distribution system is regulated mostly on a state-by-state basis and involves the participation of a litany of stakeholders – state and federal regulators, utilities, consumers, investment entities, energy suppliers, and infrastructure providers. The implementation of the Smart Grid is a process that will take several years and not without a coordinated effort among these stakeholders.

Because transmission lines often cross state, and sometimes national borders, a comprehensive commitment to implementation of the Smart Grid is required to become a reality. While the Federal Government regulates interstate transmission, the bulk of transmission occurs intrastate and is regulated accordingly. Only through collaboration among all stakeholders can all the benefits of the Smart Grid be achieved.

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It is the policy of the United States to support the modernization of the nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure . . . .

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It is essential to the realization of the Smart Grid that state and federal regulators take a leadership role in its deployment. Because the design of the Smart Grid places energy consumers – both residential and industry – as the primary benefactors of lower costs and energy security, it is the utility companies that must be compelled to invest and participate. In addition, the Smart Grid – or any grid efficiency capability for that matter – is a double-edged sword for energy providers, as their business model dictates selling the maximum amount of energy possible without an incentive to conserve. Thus, regulators must devise a system of benefit sharing to provide incentive to all stakeholders.

Private industry has realized the market opportunities presented by an advanced electrical delivery system and has taken action. Currently there are efforts underway across the country to research and conduct test beds that, when taken as a whole, have the potential to become the Smart Grid.

Many of these efforts involve the utilization of "smart meters" on residential homes and businesses. Smart meters – a component of the Smart Grid – possess the advanced energy consumption monitoring capability of the Smart Grid, without the total integration of coordinated communications devices. Smart meters tied to low-bandwidth, high-latency systems that are addressable only a few times a day do not offer the same profound empowerment of the consumer as does the Smart Grid. While smart metering is certainly an improvement of the current electrical transmission and distribution system, it lacks the scope and far-reaching societal benefit potentially offered by adoption of the Smart Grid.

Congress, in the Energy Policy Act of 2005, took a significant first step toward modernization of the U.S. electrical grid by requiring that states consider implementing smart-metering technologies for residential and small commercial customers. However, in the wake of that Act the general ambiguity over which costs correlate to transmission, and hence federal regulation, and which costs are distribution related, and thus subject to state jurisdiction, left a regulatory uncertainty that served as a deterrent for Smart Grid investment.[18] Congress again addressed grid modernization in the Energy Independence and Security Act (EISA) of 2007 when it declared, "It is the policy of the United States to support the modernization of the [N]ation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure . . . ."

EISA is a significant public policy step forward for several reasons. First, the law is a pronouncement of national policy signaling to all stakeholders that a smart electrical grid is the direction in which the Nation is progressing. This Congressional action provides private industry with the confidence needed to invest in and work toward the realization of the Smart Grid and the optimization of its capabilities. Second, Congress also indicates in EISA that federal incentives would be provided in the form of federal funding for investment in the Smart Grid. Third, the law organized the responsibilities at the federal level by establishing several entities accountable to the Department of Energy. And, fourth, EISA encourages state regulators to consider requiring utilities to use Smart-Grid technologies.[19]

While EISA may have opened doors for the possibility of realizing a Smart Grid, utilities – which rely on maximizing their energy sales – and private industry are apprehensive about investing in expensive systems that may serve to affect their bottom line at the same time that the possibility of carbon emissions legislation looms at the federal and state levels. If passed, federal legislation mandating either a cap and trade system or a carbon tax could result in significant costs for industry. Thus, it is imperative that investment in the Smart Grid by utilities and private industry be rewarded by providing carbon credits for the resulting emissions reductions realized downstream – particularly to the extent that such investment is in enabling infrastructure for emissions-reducing technologies such as plug-in electric hybrid vehicles. It is unrealistic to believe that energy providers can absorb the losses associated with federal and state emissions mandates and simultaneously expect significant private investment in advanced electricity delivery technologies.

SUMMARY AND CONCLUSIONS

Our Nation is at a crossroads as our energy dependence and vulnerable critical infrastructure become significant liabilities to our security and resilience. The current electrical grid is outdated and inefficient and the demand for reliable electricity is increasing at a rate that overburdens the current electrical system. The consequences of the increasing number of power fluctuations and failures illustrate a microcosm of the chaos that looms over our economy and national defenses should a deliberate attack on the electrical grid or a natural disaster take place.

The Smart Grid is designed to optimize efficiency and stability. The adoption and implementation of the Smart Grid would address many current societal concerns through empowering consumers, securing our economy, hardening our national security, and lessening our impact on the environment. The scope of its benefits justifies a regulatory and private-sector commitment to the implementation of Smart Grid technologies. Whatever the means, the practical adoption and implementation of the Smart Grid should be a priority as we advance further into the digital age.

The domestic electric grid is so fundamentally plaited within all aspects of American life that any discussion of building a resilient nation must begin with securing and strengthening our vulnerable electric grid. The Smart Grid will enhance America's resilience by strengthening the ability of our energy infrastructure to withstand a catastrophic event without serious disruption to critical systems and activities, making the power grid a less attractive target for our enemies. Implementing a next-generation grid will also be instrumental to developing a secure and sustainable energy system. The Smart Grid demonstrates the importance of innovation, collaboration and leadership in homeland and energy security.

ENDNOTES

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[19] The Energy Independence and Security Act (EISA) of 2007(P.L. 110-140).

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