ENERGY EFFICIENCY

ADDENDUM TO THE IEEE-USA POSITION STATEMENT ON
NATIONAL ENERGY POLICY RECOMMENDATIONS

Adopted by the IEEE-USA
Board of Directors, 19 November 2010

Energy efficiency is one of the principal building blocks of the IEEE-USA National Energy Policy Recommendations, released in February of 2010. IEEE-USA views the pursuit of energy efficiency in all sectors of the economy as an essential part of a policy portfolio aimed to achieve energy security and economic growth while reducing greenhouse gas emissions. To accelerate adopting policies and practices that will promote and hasten implementing energy efficiency in the United States, IEEE-USA urges federal, state and local governments, along with quasi-governmental and private sector organizations, to aggressively pursue the energy efficiency initiatives outlined in these Recommendations, further elaborated on below.

Throughout this document, *efficiency* means *to perform a task using less energy*, in contrast to *conservation -- reducing energy use by no longer performing a task or not delivering a service.* Further, *demand response -- changing behavior so as to move energy consumption to different time periods*, is not the focus of this paper. However, because demand response and energy efficiency are closely intertwined, some of the measures discussed below include a demand response component.

Opportunities for significantly increased efficiency exist throughout the energy chain – in the production of usable energy, its distribution and its eventual use in buildings, industry and transportation systems. In general, most end-users will only adopt technologies they deem to be cost-effective. An exception may be energy efficiency expenditures made pursuant to implementing public policies. Major improvement in energy efficiency can be made by applying currently available cost-effective technologies and processes. As the demand for energy continues to grow, developing new, energy-efficient technologies will play an important role in a multi-faceted approach to meeting our energy requirements, while reducing the amount of new production capacity needed and its associated transmission.

Consider the 2009 report, *Real Prospects for Energy Efficiency in the United States*[1], a result of the work of the Panel on Energy Efficiency Technology convened by the National Academy of Sciences, National Academy of Engineering, and National Research Council. According to the Panel, it is possible to achieve energy usage reductions of nine percent and 14percent in 2020 and 2030, respectively, by using existing and developing technologies, instead of the projected 12-19 percent increases in energy usage.

Panel members assert: *"it is possible to achieve significant energy savings and still maintain lifestyles."* As one example, investing in deploying energy efficiency technologies in residential and commercial buildings alone can save about 25 percent of the average retail cost of electricity. A study by the Electric Power Research Institute (EPRI) and the Natural Resources Defense Council (NRDC) estimates that energy efficiency programs in residential, commercial and industrial sectors have a realistic potential of reducing electricity use by five percent in 2030[2], compared to a U.S. Energy Information Administration - Annual Energy Outlook 2008 reference case. Focusing on transportation estimates, the EPRI/NRDC study[3] showed reductions in greenhouse gas emissions, and petroleum fuel consumption (by 2.0 million barrels per day in 2030, and 3.7 million barrels per day in 2050) through electrification of the light- and medium-duty vehicle fleet.

IEEE-USA urges federal, state, and local governments, along with quasi-governmental and private sector organizations, to work toward improving energy efficiency. Specifically, IEEE-USA makes the following recommendations:

Recommendation: Promoting education and user awareness of energy efficiency opportunities

Although it is debatable whether or not U.S. consumers as a whole make rational or optimal energy use and efficiency decisions, progress can be made in improving consumer behavior. The end user must be made aware of cost and consequences before they can take action. While education about the economic value of energy efficiency can influence individual decisions, the larger environmental consequences of the impacts can also provide a motivation for action beyond strictly economic value. To these ends, the government, utility companies, and other public/private organizations must sponsor programs that will improve consumer knowledge and encourage capital investment in energy-efficient technologies.

For example, consumers must be educated about Energy Star, which rates over 60 energy-efficiency categories, including lighting, appliances, televisions, computers, heating and cooling equipment, and even new homes. The Energy Star program is estimated to have saved about 175 TWh of electricity in 2006, according to the National

---

[1] National Academy of Sciences, *Real Prospects for Energy Efficiency in the United States*. 2010, p.3
[2] Electric Power Research Institute, *Assessment of Achievable Potential from Energy Efficiency and Demand Response in the U.S.: Executive Summary (2010-2030),* January 2009, p.8
[3] Electric Power Research Institute, *Environmental Assessment of Plug-In Hybrid Electric Vehicles,* July 2007, p. 5-10

Academy of Engineering study[4]. In addition, commercial consumers must be educated about energy efficient practices, such as how Leadership in Energy and Environmental Design (LEED)-certified office space can lead to, among other things, considerable savings in utility bills and maintenance expenses. Currently, a number of federal tax credits are available to energy efficient product users, and the 2009 Stimulus legislation has enhanced these benefits. Information regarding financial and environmental benefits of increased energy efficiency must be disseminated to consumers to motivate energy use decisions. Many opportunities exist to increase process efficiency while improving productivity and product quality.

Industrial personnel involved in selecting equipment and systems must be educated in recognizing those that are truly energy efficient and appropriate for their operating procedures and methods. Better understanding, coordination and selection of systems will contribute to better plant energy efficiencies. Currently, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), Industrial Technologies Program works in collaboration with U.S. industry through public-private partnerships to among other things, (i) enhance energy efficiency and productivity, (ii) support advances in innovation, and (iii) bring affordable energy technologies to the marketplace. Similarly, in the buildings sectors, one of the most important needs is efficient lighting design education, so we must call on our dearth of lighting professionals with such skills. Increased education in efficiency methods will also lead to better maintenance decisions by building owners and operators, who can, in turn, make wiser decisions about maintaining energy consuming systems. Better maintained motors and lighting systems can keep their intended efficiencies. Poorly maintained systems can lose efficiencies over time, due to parasitic energy mechanisms (i.e., excessive heat production).

Recommendation: Promoting capital investment in energy-efficient technologies and processes for residential, commercial, transportation and industrial sectors

Energy efficiency is increased through a combination of technological innovation, knowledgeable design, installation expertise and predictable economic incentives. However, the widespread adoption of energy efficient technologies requires a net positive economic return for the owner over the expected (economic) life of the investment. The economic attractiveness of efficiency-related capital investments in the residential, commercial and industrial areas varies widely depending upon the relative cost of the technology, operating conditions, installation costs, government regulations, and the long-term cost of energy. In some instances, the payback period is less than a year; in others, it could be decades.

Opportunities for improving energy efficiency through improved design, process improvement and redirected investment are available in all sectors. Areas that provide attractive returns on capital investment include:

[4] National Academy of Sciences, *America's Energy Future: Technology and Transformation: Summary Edition*, 2009, p.88

- Implementing Whole Building Design in new residential construction
- Requiring that all residential and commercial construction meet LEED design criteria
- Specifying high efficiency motor drivers in industrial processes

For example, the capital investment required to construct all new buildings in the United States to high energy efficiency standards yields an attractive return. The National Academy of Sciences[5] estimates that by investing $440 billion between 2010 and 2030 to implement energy efficiency improvements in all new construction, an aggregate of $170 billion in annual energy cost savings would be achieved in 2030 and future years. That investment would represent a very attractive 2 ½-year simple payback period.

Recommendations are provided by sector below.

(a) Residential Sector -- Many of the existing buildings in our nation were constructed when energy was less expensive, and building technology was not as advanced. Inadequate insulation, leaky building envelopes, obsolete lighting systems and inefficient HVAC systems are common.

Currently, the most financially attractive approach is to design all new construction using an integrated building design concept system (Whole Building Design), a concept optimized for the local environment. Using LEED specifications at the time a residential building is constructed results in an energy efficient, low-impact design. Such buildings could be constructed for a 30-40 percent decrease in energy usage, relative to current practice, by:

- Improving heating, ventilating, and air conditioning systems (HVAC) by using the latest technologies, including variable speed air-conditioning/refrigeration and, in some cases, geothermal heat pumps
- Improving water heating systems by installing solar-thermal and heat pump technologies
- Increasing the use of energy efficient appliances and other equipment by rigorously implementing Energy STAR Program specifications
- Adopting intelligent thermostats and energy management systems
- Installing high efficiency lighting (fluorescent and LED lighting) systems

Adoption of these measures would be accelerated by enacting predictable, long-term incentives for energy efficiency and technological R&D similar to the *American Recovery and Reinvestment Act of 2009*. Retrofit of the existing building stock should be the top priority for such incentives. For example, the American Physical Society Energy Future Fact Sheet[6] states that energy consumption of existing residential buildings can be reduced 15% to 35% when they undergo full energy-upgrade renovations such as more efficient insulation, windows and lighting; elimination of infiltration and duct leakage; upgraded furnaces, boilers, and air conditioners; new

[5] National Academy of Sciences, *America's Energy Future: Technology and Transformation: Summary Edition, 2009*, p.83.
[6] http://www.aps.org/energyefficiencyreport/pressroom/factsheet.cfm

power supplies that waste less electricity in stand-by or low-power modes; and energy-efficient appliances.

(b) Commercial Sector -- Energy efficiency improvements in commercial buildings can be financially attractive. For example, the sustainable (LEED Existing Building criteria) retrofit of the Empire State Building in New York is expected to cost $13.2 million[7]. However, at the completion of the project, energy savings are estimated to be $4.4 million per year, for a three-year payback. Designing new commercial buildings specifically for energy efficiency can generate even higher returns over the life of the structure.

Because lighting is such a large component of commercial energy consumption, the installation of high efficiency "intelligent" lighting systems can have paybacks of less than two years. These systems utilize daylight-responsive controls, occupancy sensors and advanced lighting designs to use energy only as needed. Improving lighting efficiency also has the secondary effect of reducing the size and cost of air conditioning and electrical distribution systems. The broad range of technologies allows a skilled lighting designxer to improve efficiency while improving the quality of ambient and task lighting.

(c) Industrial Sector -- In 2008, the industrial sector consumed 26 percent of the total electrical energy used in the United States. Motor driven equipment represents the majority of this usage. Motors account for about 17 percent of the total electrical energy usage in the United States.

Improving motor efficiency can be the single most cost-effective energy efficiency capital expenditure available to manufacturers.[8] According to the Center on Globalization[9], the replacement of obsolete electric motors with new high-efficiency or premium efficiency motors can generate payback periods on capital investment ranging from as short as seven months to four years, depending upon operating conditions, electric power rates, installation costs and utility rebates.

The *Energy Policy Act of 1992* required minimum efficiency standards for all industrial motors. However, current motor efficiency (NEMA Premium) ratings can exceed the efficiency requirements of the Act. Revision of the *Energy Policy Act* should be considered to raise efficiency standards to the current state of the art, and to provide incentives for users to replace obsolete drives.

Capital investments in energy system monitoring, electrical power distribution optimization, variable frequency drives, waste heat recovery (combined heat and power), and combined cycle power generation all represent potential energy efficiency improvements. However, each investment must be examined in detail to determine if there is an attractive rate of return for the user.

---

[7] New York Observer, April 20, 2010

[8] See, for example, Zabardast, A.; Mokhtari, H., "Effect of high-efficient electric motors on efficiency improvement and electric energy saving," Third International Conference on Electric Utility Deregulation, Restructuring and Power Technologies, 2008. DRPT 2008 pp.533-538; http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4523464&isnumber=4523365

[9] Center on Globalization, *U.S. Adoption of High-Efficiency Motors and Drives: Lessons Learned.* 25 February, 2010, p.6

(d) Transportation Sector -- The National Academy of Engineering report[10] *America's Energy Future: Technology and Transformation* indicates that, per capita, energy use in the United States in 2006 was 335 million BTU per person, the highest in the developing world -- and nearly twice as high as second place Japan (179 million BTU). The principal source of the difference in per capita energy consumption between the United States and other developed countries is in transportation energy use. Much of this difference is attributable to higher usage of private automobiles to meet basic transportation needs, as a consequence of the lower density land use patterns in the U.S. However, there are opportunities to reduce our transportation energy use through a combination of policy and technology changes.

Transportation management policies are already practiced abroad and many of them could be adapted to US conditions. These include

- City center automobile restrictions
- City cars
- Car sharing
- Fuel taxes to increase cost of automobile use
- Congestion pricing
- Land use and urban design strategies

Engineering solutions include improvements in vehicle design through new materials, controls, as well as new transportation technologies. Electrification of transportation, one of the major energy efficiency options, is addressed in other recommendations below.

Further, because of its critical importance to national security, future electricity use patterns, control systems, and energy efficiency improvements, the transportation sector will be discussed at length in a separate EPC background paper.

Recommendation: Promulgating minimum efficiency standards for products and buildings consistent with life cycle analysis

Purchasers tend to focus more on initial costs rather than life cycle costs (i.e., initial costs, operations and maintenance costs, etc.). The fiscal risk of not considering life cycle costs is very high when considering that buildings can last 100 years or more. Developers often are more concerned with construction, equipment and appliance costs, rather than future energy bills. The builder has little incentive to optimize unseen items, such as insulation. Without standards, even the developer who wants to build efficient buildings may find it difficult to compete with other developers. Similarly, investment property owners often try to minimize their upfront costs, and may be unconcerned with energy bills that are paid by tenants. Due to limited competition for high-efficiency products, these products usually cost more.

[10] National Academy of Sciences, *America's Energy Future: Technology and Transformation: Summary Edition, 2009, p.20*

The National Academies' 2009 Report observes that from the beginning of the design process an integrated design should be used relating a building's heating, ventilation and air conditioning systems with those of the envelope systems and the lighting system and its controls. It is possible that with such a design concept new commercial buildings can reach a 50 percent savings in energy usage as compared to one that does not use an integrated energy design.[11] Such a design could be encouraged by better building energy performance standards.

Minimum efficiency standards have been the basis for some of the most successful policies used by states and the federal government to save energy in the United States. For example, refrigerator-freezers manufactured to meet standards after July 2001, typically consume about 30 percent less energy than the maximum energy usage permitted under the 1993 regulation[12].

The *American Clean Energy and Security (ACES) Act of 2009* incorporates energy savings from improved building codes and equipment standards. The American Council for an Energy Efficient Economy (ACEEE) estimates that if the codes and standards are followed, national energy consumption can be reduced by 4.6 percent and eight percent in 2020 and 2030 respectively[13].

Efficiency standards eliminate products with excessive energy operating costs and hasten development of innovations that bring improved performance. Standards complement consumer education and incentive-based programs in promoting energy savings. Minimum efficiency standards help to overcome the market barriers that often block cost-effective energy savings.

Life Cycle Analysis and assessment (LCAs) need to be taken into consideration when setting efficiency standards. LCAs enable the determination of the amount of energy, raw materials, waste generated, and disposal considerations in a product's entire lifetime. The Department of Energy, through its National Renewable Energy Laboratory and its partners, created the U.S. Life-Cycle Inventory (LCI) Database to help LCA experts answer questions about environmental impact. This data base[14] provides a cradle-to-grave accounting of the energy and material flows into and out of the environment that are associated with producing a material, component, or assembly. It's an online storeroom of data collected on commonly used materials, products and processes, and it is continually being updated and expanded to include more items.

---

[11] National Academy of Sciences, *Real Prospects for Energy Efficiency in the United States: Executive Summary*. 2010, p.8.

[12] Lawrence Berkeley Laboratory - ees.ead.lbl.gov/projects/past projects/refrigerators.

[13] Rachel Gold, Laura Furrey, et al., *Energy Efficiency in the Clean Energy and Security Act of 2009: Impacts of Current Provisions and Opportunities to Enhance the Legislation.* American Council for Clean Energy-Efficient Economy, Report E096, September 2009, p.5.

[14] www.nrel.gov/lci/database/default.asp

Recommendation: Developing, commercializing and using efficient electric technologies in transportation systems

The transportation sector runs almost entirely on petroleum and consumes an amount of oil closely equivalent to the entire amount imported by the United States. It is also the source for around 30 percent of all carbon emissions in the United States.

Continued development and engineering of more energy efficient devices and systems in the transportation sector needs to be carried out and includes:

- Electric, hybrid and, for longer-term, fuel cell vehicles
- Urban mass transit, regional light rail and mainline electrification
- Smart cars and highway systems
- Greenhouse gas mitigation in the shipping industry
- Fuel efficiency improvements in automobiles, trucks, aircraft and locomotives
- Truck-stop electrification to reduce truck idling losses
- Port electrification to reduce emissions and fuel use on ships

For example, the National Petroleum Council (NPC)[15] reports that existing and developing technologies have the potential to improve energy efficiency and to reduce petroleum consumption in light-duty vehicles, heavy-duty vehicles, air transport, marine shipping, and rail transport for these five transportation subsectors by 2030. The NPC report references Energy Information Administration (EIA) projections[16] of U.S. fuel demand for each of the subsectors. The following discussion summarizes the findings of the NPC study:

- <u>Light-Duty Vehicles</u> – Drive train, body improvements, and hybridization technologies have the potential to reduce fuel consumption by 50 percent in this subsector. Improvements beyond 50 percent will require breakthroughs in battery or fuel cell technologies. The extent to which these technologies translate into reduced fuel consumption depends on factors including customer preferences, vehicle and fuel costs, and vehicle attributes (acceleration, weight, and size).

- <u>Heavy-Duty Vehicles</u> – Engine efficiency, rolling resistance, and aerodynamic technology improvements have the potential to reduce new heavy duty vehicle fuel consumption by 15 to 20 percent. Operational improvements such as reduced idling and improved logistics can further reduce fuel consumption by 5 to 10 percent and advanced technology solutions, such as hybridization and fuel cells, offer fuel consumption reductions of an additional 25 percent.

- <u>Air Transport</u> – Engine efficiency, lightweight materials, and aerodynamic technology improvements together with operational improvements such as optimal trip routing and single engine taxiing have the potential to reduce air transportation fuel consumption by 25 percent.

---

[15] The National Petroleum Council, Topic Paper #28, Transportation Efficiency, July 18, 2007
[16] Energy Information Administration, Annual Energy Outlook, 2006

- Marine Shipping – Improvements in fuel combustion efficiency, hull and propeller maintenance and retrofit, new hull and propeller designs and operational improvements such as slow steaming and just in time delivery strategies have the potential to reduce marine shipping fuel consumption by 5 percent.

- Rail Transport – Incremental improvements in engine design, aerodynamics, and use of hybrids have the potential to reduce new locomotive fuel consumption by up to 30 percent.

Recommendation: Adopting intelligent transportation systems to reduce energy consumption

Intelligent energy management and control systems provide energy efficiency benefits in all sectors, including transportation. In fact, the fuel efficiency improvements during the recent past are largely due to computerized controls of fuel use.

Advanced hybrid vehicles have already demonstrated fuel savings. In the future, electric and hybrid power trains can be managed using routing knowledge to optimize recharging strategy. Enhanced management of acceleration and deceleration also holds promise for fuel savings. For example, in vehicle trials of this concept, conducted on Transport Research Lab's test track (United Kingdom)[17], participants achieved significant reductions in emissions, together with fuel savings of between five and 24 percent, depending on driving style. Using these results, the routes driven were scaled data for vehicle-kilometers driven on different road types in the United Kingdom. This analysis demonstrated a potential total UK fuel saving of 14 percent, equating to between 1.2 - 2.0 million barrels of oil per year. If a vehicle is already equipped with a phone and GPS, no additional hardware would be required to apply this technology. The intelligent system via wireless GPS technology also benefits the commercial trucking industry.

Recommendation: Developing system designs and technologies to further reduce energy losses in electric power generation, transmission and distribution

Opportunities for reducing energy loss through process improvements are also available to the electric utility sector. Areas of opportunity include:

- Power system data acquisition and control
- Generation control
- Load and energy management
- End-user distribution systems
- Cogeneration
- New technologies associated with transmission systems
- Measures designed to reduce peak demand, including demand response options, such as dynamic pricing.

[17]TRL Newsletter, April 2009, p.3
http://www.trl.co.uk/downloads/download_file.asp?file=../downloads/newsletters/TRL_News_April_2009.pdf

Even though the existing electric power delivery system (between the generator and the consumer) is very efficient (combined T&D losses in 2008 were about 7 percent [18]), advances in information technology and communications infrastructure (Smart Grid), as well as new electric power transmission technology, have the potential for enabling further efficiency improvements.

In fact, according to a report by the Electric Power Research Institute (EPRI)[19], Smart Grid technologies have the potential to reduce electricity use by more than four percent, saving $20 billion in customer costs by the year 2030.

A secure Smart Grid is one of the enabling technologies that will allow the efficient integration of local distributed generation into the existing power network. Distributed generation from renewable sources and eventually, plug-in electric vehicle batteries, can reduce the amount of power transmitted over long distances from remote generation sites. Additional reductions may be possible if energy storage technology is developed and used close to load centers. Distributed generation or off-peak use of the transmission system reduces the inherent power system transmission losses and, possibly, the need to burn fossil fuels.

In the power transmission system itself, improving existing technologies and applying new technologies, such as composite conductors, superconducting materials, high-voltage direct current (HVDC), and global network optimization will also help reduce systems losses.

Recently developed power flow controllers, such as the UPFC (Unified Power Flow Controller), regulate the active and reactive power flows in transmission lines independently, so that active power flow is maximized, while reactive power flow is minimized, for an optimum flow along multiple transmission paths. Reduction in reactive power flow leads to freed up capacity of the line, increased flow of active power, reducing demand of reactive power from generators, and increased efficiencies of generators and step-up transformers. Maximizing the active power flow decreases congestion, and can delay the requirement for new transmission lines.

Network efficiency for transmitting a given amount of power is generally greater with the use of higher voltages for both transmission and distribution, because it can do so with less current. Losses are proportional to the square of the current. Appropriate expansion of the transmission network also provides additional parallel paths for power to flow. Every time a transmission line is added to the network, losses may be reduced. If the new line is at a higher voltage, losses are reduced further. The installation of capacitor banks at appropriate locations in the grid provides reactive power to increase voltages and reduce losses. Capacitor banks are low-cost additions, making it possible to utilize the capabilities of the transmission system more fully.

In sum, the synergistic combination of advanced information technology with improvements in power system equipment can enhance reliability, reduce the cost of power delivery to the consumer, and potentially reduce GHG emissions.

---

[18] http://www.eia.doe.gov/oiaf/aeo/assumption/electricity.html

[19] Electric Power Research Institute, *The Green Grid: Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid,* June 2008, p.1-3.

Recommendation: Promoting the use of high-speed communications networks and information technologies[20] to substantially improve controls, access to information and system efficiencies

Timely and secure access to information is key to efficient system operations – whether on the customer or utility side of the meter. Ultimately, ubiquitous communication will enable integration of all system elements, allowing customers to choose the quantity and quality of services they require, and providing the foundation for supplying these services in the most economical and efficient manner.

High-speed secure communication networks and information technology will enable the improvement of system efficiencies. System efficiencies garnered through the use of secure smart grid technologies can be borne from various sources, e.g., weather forecasts and data, and industrial, commercial, and residential energy supply and demand information. For example, data from smart metering along with secure two-way communication (i.e., from the meter to the consumer's premises; to controllers, processes and other devices; and from the consumer back to the utility), will provide consumers the potential to moderate electricity usage based on real-time energy cost and environmental impact data. Such data provides utilities with the ability to adjust energy output and detect problems within their systems.

Variable pricing (real-time pricing) provides real-time market-based energy prices, which, in conjunction with advanced control systems, will allow the consumer to optimize energy usage by seamlessly controlling power usage based upon the current price of energy and the criticality of the application. For example, electric vehicles could be programmed to recharge their batteries whenever energy costs are low, and resell stored battery energy back to the grid when rates are unusually high, or if the power system is experiencing unusually high stress. Likewise, industrial and commercial users could expand their current variable pricing contracts through the use of more sophisticated and efficient control strategies, including making use of energy storage.

Price-responsive energy management and control systems have been installed in a number of commercial establishments, ranging from the World Financial Center to convenience stores. The control systems often employ adaptive-predictive approaches to the management of HVAC and other processes (in effect, guessing the near-term future). With better access to utility/ISO information, customer control systems could be more effective by relying on the same weather, load, and system condition forecasts as the supplier. Note that some of this data (i.e., energy supply and demand information, etc.) is rendered relatively useless, if it is not distributed nearly instantaneously. Real-time data is required for energy providers to adjust output based on fluctuating demand, consumers to adjust their energy usage, energy providers to respond to outages, and other system failures, etc.

Two-way secure Smart Grid communications are expected to also improve the reliability of the grid. The Northeast Blackout of 2003, which affected 50 million people in eight states and in some Canadian provinces, is a prime example of the large scale power outage that could have been contained within a smaller geographic area, had the

[20] See also *Building a Stronger and Smarter Electrical Energy Infrastructure*, addendum to the IEEE-USA Position Statement on *National Energy Policy Recommendations*

advanced communications provided by Smart Grid technology been widely deployed together with intelligent applications.

Better access to information would enable greater efficiencies in the distribution system. For example, the ability to monitor and control voltage along the distribution drop could increase efficiency on the customer side. This effect would be particularly pronounced at the peak, when distribution losses are much higher than on the average.

With the passage of the *Energy Independence and Security Act of 2007* and the *American Recovery and Reinvestment Act of 2009*, $100 million per fiscal year from 2008 to 2012 and $11 billion, respectively, have been allocated for the creation of a Smart Grid. Continued legislative support and funding is necessary to derive the benefits of secure high-speed communication networks and information technologies.