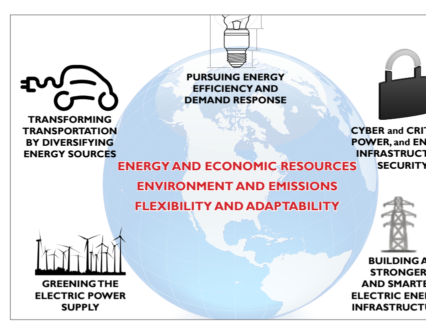
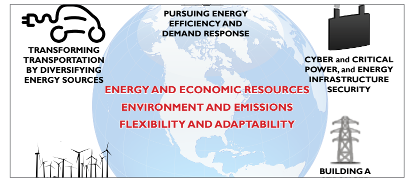
IEEE★USA

POLICY POSITION STATEMENT

2013 NATIONAL ENERGY POLICY RECOMMENDATIONS





Inside

This statement, as approved by the IEEE-USA Board of Directors in October 2012, was developed by the IEEE-USA Energy Policy Committee and represents the considered judgement of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of more than 205,000 engineering, computing and technology professionals who are U.S. members of IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of the IEEE or its other organizational units.

Introduction

ENERGY underlies three converging challenges facing the United States today: economic prosperity, security, and the environment. Electricity continues to be a key enabler in addressing these challenges, but it has come under substantial pressures to respond to environmental concerns, deal with uncertainties in both local and global energy supplies, and accommodate the rapid evolution of new generation sources and technology options available to its users. The major challenge is to develop solutions which take into account limited energy supplies as well as availability of financial resources.

To ensure that we can reliably and securely meet our growing energy needs, we must:

- use energy and economic resources more efficiently;
- expand energy sources for our transportation systems;
- transition our energy systems and our economy to one that can better manage our environment and emissions; and
- build flexibility and adaptability into all elements of our energy infrastructure.

Established and new technologies must be applied at unprecedented scale, and on an accelerated schedule. Bold actions and substantial investments will be required together with the development of a clear national energy policy framework. This statement outlines the key actions and investments that IEEE-USA recommends to both public and private entities to reach these critical objectives.

PURSUING ENERGY EFFICIENCY AND DEMAND RESPONSE

Energy efficiency[1] and demand response are essential elements in any comprehensive national energy policy because often the energy that does not need to be produced is the cleanest, safest and the least expensive option for users. These options demand more attention at all levels of the economy because they are crucial driver of the cost of providing energy services in a sustainable way. Further, demand response is an important complement to renewable resources as it provides options to compensate for some of the variability of wind and solar.

All sectors of the economy are substantial consumers of energy and most of them have some flexible energy uses suitable for demand response. Federal, state and local governments must improve energy efficiency and create demand response options in the public sector and must become leaders in promoting these measures in the private sector among households, businesses, and industries. Much of this effort is already taking place. While the electric utility industry has significant market incentives to continuously improve energy efficiency of the power system, efforts to increase efficiency and demand response capabilities across all components of the economy need to continue.

1 We define energy efficiency as the ability to provide the same or better product or service using less energy.

IEEE-USA urges federal, state and local governments, along with quasi-governmental and private sector organizations, to work toward improving energy efficiency and pursuing demand response opportunities:

- Promoting users' education and awareness of energy efficiency and energy management opportunities and incentives;
- Developing and implementing methods and standards for sustainable products and buildings, consistent with life cycle analysis and customer comfort and productivity needs;
- Equipping customers and energy managers with systems, data, and methods needed by power electronics, adaptive controls, and computational intelligence used for energy management.
- Developing, commercializing, and using efficient electric technologies in transportation systems;
- Supporting R&D on new industrial processes that can improve productivity, product quality, and energy use;
- Developing efficient system designs, technologies, and processes to further reduce energy losses and improve performance of electric power generation, transmission, and distribution.

TRANSFORMING TRANSPORTATION BY DIVERSIFYING ENERGY SOURCES

Today, more than 96 percent of the energy used in transportation comes from oil. The transportation sector consumes about two-thirds of all petroleum used in the United States. Oil will continue to be a major fuel for decades, but our ability to substantially reduce its use for transportation will be essential to reducing the national security risks inherent in dependence on a single energy source.

A radical transformation of the transportation sector is needed, not only to reduce our dependency on oil, but also to increase the security of our transportation system and to reduce emissions in the transportation sector, particularly in large cities. Because transportation emissions are widely dispersed, it is unlikely that these could ever be captured and stored. Hence the principal option is substitution of alternate energy sources for oil.

IEEE-USA proposes a two-pronged effort: (1) to electrify transportation, focusing on plug-in electric and hybrid technologies — and in parallel, (2) pursue replacing conventional fuels with alternative liquid fuels and expanding the use of natural gas for heavy-duty vehicles. Domestically produced electricity and alternative liquid fuels would give the United States the ability to maintain its economy and transportation system regardless of what happens in the rest of the world.

Conventional hybrid vehicles have already demonstrated their ability to substantially increase fuel economy. The plug-in capabilities will add an option to substitute electricity for some or all of the oil used in the vehicles.

1. Electrifying Transportation: Plug-In and Hybrid Electric Vehicles

The electric infrastructure already in place is sufficient to permit on the order of 75 percent reduction in the dependence on liquid fuels through greater penetration of plug-in electric vehicles (PEV), which includes all electric and plug-in hybrid electric vehicles. In addition, very little oil is used to produce electricity in the US and the fuels used (nuclear, coal, gas and renewables) are primarily domestic. Therefore, electrification of vehicles would produce a direct and immediate substitute for oil along with commensurate benefits for national security and the environment. Electric motors are inherently more efficient than internal combustion engines; motors do not consume energy while vehicles are stopped in traffic and motors, when paired with batteries, provide the opportunity to recover energy from braking. Current hybrid electric vehicle (HEV) technology, e.g., Ford Focus, Toyota Prius, and Honda Insight, demonstrates the potential of this approach.

Electrifying the transportation sector will increase transportation energy efficiency and reduce greenhouse gas and other emissions, even with the current generation fuel mix. Increased use of natural gas for generation is making the environmental advantage even more prominent. In addition, electrification opens up a clear pathway to zero emissions in the transportation sector.

While the technical feasibility of PEVs is evidenced by the growing number of manufacturers, the market is still in its infancy. The current sales volume and maturity of plug-in vehicles are comparable to those of Prius in 2000, when it entered the U.S. market. Stable, predictable incentives, similar to those provided to conventional hybrids are needed to expand this market and enhance economies of scale. These market development measures should be combined with further technology refinement to improve cost competitiveness with conventional internal combustion technology.

IEEE-USA recommends that federal, state, and local governments, along with quasi-governmental and private sector organizations, develop and pursue a strategy to electrify transportation, including mass transit, passenger and commercial vehicles, buses, and short- and long-distance rail by:

- Increasing transportation efficiency and promoting the rapid deployment of PEVs and HEVs through measures such as (1) raising CAFE standards to those of other developed economies, (2) offering incentives such as tax rebates, commuter lane driving opportunities and special parking privileges for consumers who purchase PEVs and HEVs, and (3) accelerating the development of HEV and PEV technology for military applications;
- Promoting the development and deployment of battery charging infrastructure;
- Accelerating and diversifying R&D aimed at improving battery technology including: (1) increasing energy storage density, (2) decreasing cost; (3) increasing life, (4) assuring safety,

(5) implementing rapid battery recharge or change-out strategies, and (6) identifying secondary markets for used batteries;

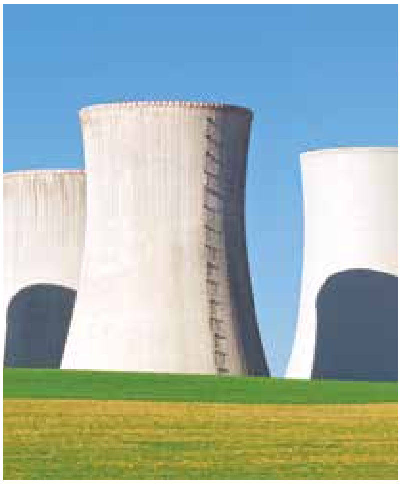
- Promoting research on the integration of PEVs on the electric grid and the development and implementation of industry consensus standards to realize their full potential benefits;
- Identify the true costs and benefits of electricity and other alternatives to oil for transportation; and
- Accelerating and diversifying R&D aimed at substantially reducing weight, volume, and cost of power electronics (PE) for PEVs. This includes: (1) highly efficient PE interfaces, (2) wide band-gap material research, (3) advanced packaging, and (4) enhanced reliability.

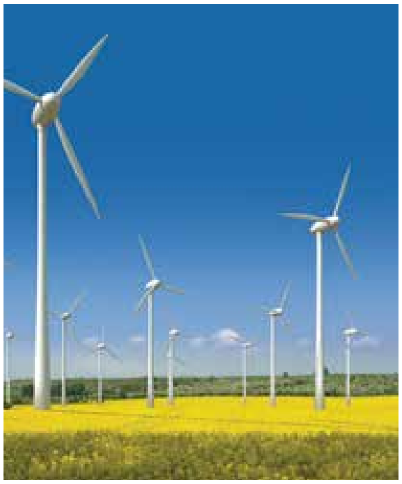
2. Developing and Using Alternative Transportation Fuels

The fastest and most efficient way to reduce dependence on petroleum is to combine a strategy of rapid electrification together with a rapid development of alternative liquid fuels to satisfy the continuing requirement for liquid fuels. Some alternative liquid fuels generate CO_2 emissions as great as conventional petroleum but others offer an opportunity to substantially reduce net CO_2.

To help meet our transportation fuel demand from secure, domestic sources as soon as possible and at reasonable cost, IEEE-USA recommends:

- Passing legislation to mandate fuel flexibility in vehicles;
- Pursuing R&D to convert sustainable biomass to transportation fuels, which can be blended and distributed with gasoline;
- Promoting fuel flexibility in the fuel distribution system and advanced control technologies to maximize efficiency and minimize emissions across the spectrum of fuels;
- In all government procurement of light-duty vehicles, give preference to vehicles that offer three-way fuel flexibility to use at least gasoline, ethanol, and M60 methanol blends;
- Promote the use of biofuels that offer a higher energy return on energy invested (EROI); and
- Support comprehensive legislation which would enhance the greater use of natural gas in heavy-duty vehicles, so long as such legislation provides equal or greater stimulus to electrification and alternative vehicles.





GREENING THE ELECTRIC POWER SUPPLY

Electricity generation is dominated by fossil fuels. In 2011, about 67 percent of electricity was generated from coal and natural gas, with most of the rest provided by nuclear and renewable (approximately 19 percent and 13 percent, respectively). Historically, the shift from burning fuels at the point of use to producing electricity at central power plants has increased the efficiency of electricity production and greatly reduced the emissions at the point where electricity is used, enabled less costly control of emissions at the point of generation, and reduced the total environmental impact of energy use. The U.S. needs to reduce the environmental footprint of the electric power supply in order to continue the longstanding effort to reduce criteria emission pollution and toxic emissions, and to contribute to global reduction in release of greenhouse gases.

Technologies ready for deployment include geothermal, wind, solar thermal and solar photovoltaic, direct combustion of biomass, and nuclear. Nuclear is well established, but no new plants have been placed into service in the United States in many years. However, some suspended projects have been restarted, and, as shown by commitments in Georgia and South Carolina, some of the industry is commercially ready to proceed with federal leadership, as well as public and private support. Nevertheless, the high initial cost of technology presents a serious barrier to new plant construction.

A shift from coal to gas generation is accelerating, with almost 10 percent of coal capacity scheduled for retirement over the next few years. Conversions from coal to gas should be expected as well. Compared to coal technologies, efficient gas generation reduces GHG emissions by about 50 percent. Nevertheless, coal is still one of the most abundant domestic resources and its continued use would be greatly bolstered by retrofitable carbon capture options, along with technologies for reuse and sequestration of CO_2. Unfortunately, carbon capture is yet to be demonstrated on a commercial scale and it is not expected to make a significant contribution to GHG reduction in the foreseeable future.

To a large extent, the pace of progress toward electricity produced from renewable sources will be influenced by public policy. This is because most of these technologies are still more expensive than, and would increase the price of, electricity compared to fossil generation. National policy should support renewable development even though it is more expensive than natural gas at current low natural gas prices. Any policies designed to influence the market prices, such as a production tax credit for wind generation, must be stable and predictable to inform investments in these green generation options. For the investment community the best case scenario would be a stable and predictable price offer for all renewable energy resources stimulating private investment and jobs.

1. Expanding the Use of Renewable Electric Generation

Renewable electric generating technologies, particularly those that emit minimal greenhouse gases, must be deployed to the extent that they are technologically and economically practical, and have an acceptable impact on the environment and aesthetics. Such technologies include electricity generated from wind, sunlight, waves, tides and underground heat (geothermal). Since most renewables are not dispatchable, integrating large amounts into the bulk power system requires flexible resources capable of "firming" the production pattern from variable renewable technologies.

IEEE-USA recommendations:

- Congress should focus more aggressively on funding for R&D activities aimed at reducing the cost of energy delivered by a broad range of renewable electric power technologies.
- Congress and the states should promote the use of renewable energy because of its security of supply, distributed and modular nature, and reduced greenhouse gas emissions. Some states, such as California, have achieved high penetration of renewable electric generation using portfolio standards. This and other mechanisms should be considered by all states and Congress.
- Financial incentives for renewables should assure that these technologies don't get displaced in the long-run by the short-term availability of inexpensive gas.
- US DOE and FERC should continue to support adaptation of regional planning practices and operating procedures to support integration of renewable power production for public benefit

2. Revitalizing Nuclear Power Generation

Nuclear power plants are among the power generation sources that emit negligible greenhouse gases. They have the ability to provide continuous base-load generation, regardless of the time of day or weather conditions. The 104 existing nuclear plants in the United States are cost competitive with both conventional fossil fuels and renewable sources and, through license renewal, could operate for many decades. Nuclear power is, and must remain, an important part of a balanced portfolio of energy sources.

IEEE-USA recommends:

- US DOE should propose, and Congress should enact, a comprehensive spent nuclear fuel management program that would close the fuel cycle and develop a disposal facility as mandated by the Nuclear Waste Policy Act of 1982
- Congress should enact incentives to encourage deployment of advanced nuclear fuel reprocessing technologies to reduce proliferation concerns, and to reduce the volume and lifetime of wastes
- Congress should appropriate funds to support fundamental R&D in industry, academia and government to continue exercising world leadership in nuclear fission and fusion science
- DOE and NRC should actively support provisions of the Energy Policy Act of 2005 pertaining to the construction of new power plants and the Next Generation Nuclear Plant (NGNP); and support development and licensing of small modular reactors, including their potential to re-power some existing fossil-fueled generating plants
- DOE should allocate funds to demonstrate applications of nuclear process heat/ cogeneration in chemical and petroleum industries, such as enhanced oil recovery, coal-to-liquid and production of hydrogen, and NRC should devise safety regulations for the commercial deployment of these nuclear process heat technologies
- NRC should continue to promote vigilant observance of safety practices, and, when required, mandatory upgrade of facilities as lessons are learned from operating experience — such as the accident at Fukushima — and from ongoing evaluations

3. Reducing Carbon Emissions from Fossil Power Plants

Coal is our nation's most plentiful, and one of its lowest-cost, domestic fossil fuel resources. It provides more than 20 percent of U.S. primary energy supplies and 45 percent of total electrical energy. Coal, however, is also one of the major sources of carbon dioxide (CO_2) and emissions such as sulfur oxides (SOx) and mercury. Only the use of petroleum in transportation is a comparable source of CO_2 within the United States. As a result of regulations requiring mitigation of the environmental impacts of coal combustion the construction of new coal power plants has greatly diminished in recent years and many older, less efficient ones are expected to be shut down. Most of them are being replaced by gas-fired power plants, which also emit CO_2, albeit at lower levels.

The capture, transport and storage (or sequestration) of carbon or its combustion products is a daunting challenge — because of the enormity of the necessary infrastructure, the loss in efficiency and plant output, and the cost. Yet, because coal is our nation's most extensive energy resource, the effort is essential, if we are to address the long-term challenge of mitigating greenhouse gas emissions.

IEEE-USA recommends:

- Congress and US DOE should maintain long-term R&D efforts to develop and test retrofitable pre- or post-combustion carbon capture and storage or reuse technologies that would make coal a viable energy resource in a future carbon-emission-constrained world.
- Congress and US DOE should continue public R&D in conjunction with private R&D to develop and demonstrate other clean fuel generation technologies, including biomass fuel production and utilization, and projects for carbon capture and storage from other fossil-fuels.

BUILDING A STRONGER AND SMARTER ELECTRIC ENERGY INFRASTRUCTURE

The National Academy of Engineering classified electrification as the number one engineering achievement of the 20th century. Today, the U.S. electric grid is a network of approximately 10,000 power plants, 170,000 miles of high-voltage (>230 kV) transmission lines, over six million miles of lower-voltage distribution lines, and more than 15,000 substations. The transmission system is an interstate grid whose primary purpose is to connect generating plants with electrical load centers like cities and with high demand commercial and industrial facilities. In turn, the local distribution system provides for service to residential, commercial, and small business customers.

Most of the systems currently in place were built by and for the regulated monopoly utility industry and are not fully prepared to handle the increasingly larger and faster changes in markets and technologies on both the supply and consumer-side. It is essential to assume that these changes will continue and the infrastructure must become more flexible and adaptable to deal with them. IEEE-USA's long-term vision is to tie generation, transmission, distribution, and use into a coherent network with ubiquitous data, information, and knowledge to enable best decisions by and for each stakeholder. The recommendations below represent some of the critical near-term steps towards this vision.

Much of the current federal effort is focused on transmission. Yet, it is essential that market design and grid expansion programs for both the transmission and distribution systems work together to maintain adequate levels of grid reliability and to provide customers with the services they demand. At the minimum, the system must support the addition of both conventional and renewable generators along with demand response and enable implementation of technologies like electric vehicles and solar on the distribution system. IEEE-USA makes the following recommendations to help ensure that the nation maintains a strong and secure electric delivery system.

1. Transforming the Network into a Smart Grid

Adding and utilizing existing intelligence — sensors, communications, monitors, optimal controls and computers — to our electric grid can substantially improve its efficiency and reliability through increased situational awareness, reduced outage propagation, and improved response to disturbances and disruptions. This so-called "Smart Grid" can also enable transparent pricing of electricity that will allow consumers to manage their energy costs and facilitate distributed generation and redundancy, opening the door to wider use of variable renewable generation sources and supporting expanded use of electric vehicles.

The federal government recognized this potential by implementing the Energy Independence and Security Act (EISA) of 2007. Title XIII of the Act mandates a Smart Grid that is focused on modernizing and improving the information and control infrastructure of the electric power system. Among the areas being addressed in the Smart Grid are: transmission, distribution, home-to-grid, industry-to-grid, building-to-grid, vehicle-to-grid, integration of renewable and distributed energy resources (such as wind and solar), and demand response.

IEEE-USA recommends:

- Continued federal government support for the Smart Grid Interoperability Panel (SGIP) as the principal coordinator of Smart Grid standards under EISA 2007, to the extent needed to ensure the viability and continued operation of this evolving private-public partnership;
- Working with IEEE's Standards Association, other Standards Developing Organizations (SDOs), and the stakeholder community to improve the timely development of Smart Grid standards and promote their widespread deployment;
- Development of an institutional infrastructure for testing and certification of products claimed to be compliant with Smart Grid standards, and of means for rapidly resolving technical issues and ambiguities either prior to or immediately following adoption by SDOs;
- Both public and private entities should provide R&D funding to address issues arising in SGIP activities and access to and use of Smart Grid functionality to benefit consumers;
- Working with state regulators, the Federal Energy Regulatory Commission, the National Association of Regulatory Utility Commissioners, and their joint Smart Grid Collaborative to resolve issues of customer involvement, especially for standards having benefits focused on national security, energy independence or difficult-to-quantify issues;

- Expand situational awareness thru use of new measurement technology;
- Support the advancement and the deployment of broadband and other communication technologies that help maximize Smart Grid benefits; and
- Review Federal policies on standards as those policies interact with international policies providing special recognition to particular SDOs for purposes of treaties and international trade and affect the Smart Grid.

2. Expanding the Transmission System

Much of the renewable energy and natural gas potential in the United States is located in areas that are remote from population centers, lack high demand for energy, and are not well connected to our national infrastructure for transmission of bulk electrical power. The recent expansion of natural gas production in the US has also affected development of the grid. To achieve public policy objectives, sufficient transmission capacity must link new natural gas generating plants, on-shore or off-shore wind farms, solar plants and other renewables to customers if those resources are to serve the energy needs of homes and businesses, and have the potential to replace significant portions of the oil used today in vehicle transportation.

New transmission will play a critical role in the transformation of the electric grid to enable public policy objectives, accommodate the retirement of older generation resources, increase transfer capability to obtain greater market efficiency for the benefit of consumers, and continue to meet evolving national, regional and local reliability standards.

To optimize the use of these natural gas sites and renewable energy resources the necessary electrical infrastructure must be installed, requiring both significant financial investments and cooperation at all levels on politically challenging items such as the siting of facilities and the routing of new transmission lines.

IEEE-USA recommends:

- Reforming the state-by-state approval process for routing and siting to ensure that delays in transmission construction do not also delay progress in expanding the use of renewable energy and achieving national clean air goals;
- DOE should continue support for the development of regional plans that include both federal and state public policy goals, such as the Eastern Interconnection Planning Collaborative and MISO's Multi-Value Projects;
- ISOs/RTOs and industry should support goals for integrated interregional, regional and local transmission system planning (FERC Order 1000) to increase system efficiency, achieve public policy objectives and continue to meet evolving reliability standards.

3. Accommodating New Types of Generation and New Uses of Electricity

New types of generation and new uses of electricity are creating both challenges and opportunities. Examples of new generation types include wind and solar, both of which vary in output and predictability. While most wind installations are grid-scale generation sources, many solar, and a few wind, sources are also in place in distribution grids, presenting additional challenges, which are discussed below. An example of a technology that serves both as an electricity use (load) and as an electricity source is energy storage, affording the opportunity to compensate for varying grid conditions by providing or absorbing energy to help correct system voltage or frequency. Placing an energy storage device in the distribution grid to serve as both a load and as a distributed energy resource (DER) also offers new integration challenges and opportunities for increased reliability: The electric vehicle, for example, presents challenges in minimizing the grid impact of its charging and also in the opportunity for its use as a DER.

Another technology that has received renewed interest is direct current (DC), especially in localized grids called “microgrids.” For example, solar photovoltaic produces DC, batteries store DC, and loads such as computer equipment and variable speed motors operate on DC. The grid operates mainly on alternating current (AC), and conversions need to take place between AC and DC to interconnect DC generation or loads to the AC grid. Efficiency considerations suggest minimizing the number of such individual conversions, leading to exploration of new concepts for managing electricity at locations involving these generation sources, storage methods, and loads.

As mentioned above, the new loads and many of the new generation sources, such as solar, will often be connected to the distribution grid that has been traditionally designed to unidirectionally distribute the output of the bulk electric system. Accommodating these new loads and generation sources will require both bridging the gap between the transmission and distribution grids and crossing the chasm between federal regulation of the transmission grid and individual state regulation of the distribution grid. The importance of meeting these challenges is heightened because the economic feasibility of many of the new technologies is dependent on their serving both the transmission and distribution grids simultaneously.

Over recent decades, the transmission grid has been stressed by an increase in electric demand and changes in the location and characteristics of generating plants, such as the recent shift to natural gas generation. The introduction of new sources of renewable wind and solar power must also be managed because of the variability in output inherent in their operation. Further, the increasingly complex and competitive regional power markets can add stress to the grid. These conditions can create grid congestion, reliability risks and higher transmission losses, all of which can result in higher rates for electricity. Reinforcing the grid and deploying advanced technologies will help address some of these concerns and increase physical and cyber security of the grid. A strong transmission grid provides the flexibility and robustness required to maintain reliability for future conditions that may be difficult to predict.

Increasing reliance on natural gas – even for baseload supply – exposes much of the electricity supply to potential interruptions in gas supply. Adequate natural gas storage and other measures will be needed to mitigate against these potential risk. Further, the markets for wholesale electricity are very different from those for natural gas. They differ both geographically and in scheduling approaches. It will be important to provide for a better coordination of these markets to eliminate potential challenges as electricity generation will have to compete with other consumers for natural gas.

The importance of the distribution system to achieve national energy policy objectives must not be overlooked. Distribution systems are operated by local utilities under state regulation (or for some municipals and cooperatives, state authority to self-regulate), but as new types of technologies are employed their operation becomes more closely linked with that of the inter-regional transmission grid and wholesale electric trading markets. Operation of technologies such as demand response (DR), distributed energy resources (DER) as well as electric vehicles are inextricably linked to operation of both the local distribution system and the regional transmission grid. Design, operation and regulation of the distribution system must accommodate the evolution of technology.

Unlike many energy resources, electric power is generated and consumed instantly, unless it is stored by converting electricity to other forms of energy that can be converted back to electricity when needed. Many believe that large-scale energy storage must be developed and deployed if intermittent sources of electric power, such wind and solar, are to reach their full potential. Until less expensive storage becomes available, there are other cost effective solutions to dealing with the variable nature of renewable energy sources, such as improved forecasting and spinning reserve. When it becomes available, energy storage could serve some or all of these functions and reduce fossil plant usage.

IEEE-USA recommends:

- Resolving technical and jurisdictional issues associated with devices, such as battery storage and rooftop solar, that simultaneously serve both the distribution and transmission grids, and operate across institutional, regulatory, and information architectural boundaries;
- Collaboration among government, industry and users to improve forecasts of weather and other factors relevant to management of loads and renewable generation;
- More transparent, participatory and collaborative discussion among federal and state agencies, transmission and distribution asset owners, and RTOs/ISOs and their members and supporting research to improve understanding of mutual impacts, interactions and benefits that may be gained from these efforts;
- Increased federal research and development for emerging technologies that may impact the transmission and distribution grids, including new types of generation, new uses of electricity, and energy storage, with an additional focus on deployment and integration of such technologies to improve the reliability, efficiency, and management of the grids.

- U.S. DOE, FERC, and NERC should
  - continue working on better coordination of electricity and gas markets to mitigate potential new reliability issues due to increasing reliance on gas generation; and
  - update the wholesale market design to reflect in the design the speed at which a generator can increase or decrease the amount of generation needed to complement variable resources.
- NSF and/or other government agencies should aggressively support development of new curricula that add market economics to electrical engineering degrees.

CYBER and CRITICAL POWER, and ENERGY INFRASTRUCTURE SECURITY

The existing end-to-end energy and power-delivery system is vulnerable to natural disasters and intentional cyber-attacks. Virtually every crucial economic and social function depends on the secure, reliable operation of power and energy infrastructures. Energy, electric power, telecommunications, transportation, and financial infrastructures are becoming interconnected, thus posing new challenges for their secure, reliable, and efficient operation. All of these interdependent infrastructures are complex networks, geographically dispersed, non-linear, and interacting both among themselves and with their human owners, operators, and users.

Challenges to the security of the electric infrastructure include:

Physical security – The size and complexity of the North American electric power grid and its supply chain makes it impossible both financially and logistically to physically protect the entire end-to-end and interdependent infrastructure. There currently exists over 450,000 miles of 100kV or higher transmission lines, and many more thousands of miles of lower-voltage lines. As an increasing amount of electricity is generated from distributed renewable sources, the problem will be only be exacerbated.

Cyber security – Threats from cyberspace to our electrical grid are rapidly increasing and evolving. While there have been no publicly known major power disruptions due to cyber-attacks, public disclosures of vulnerabilities are making these systems more attractive as targets.

Due to the increasingly sophisticated nature and speed of some malicious code, intrusions, and denial-of-service attacks, human response may be inadequate. Furthermore, currently more than 90% of successful intrusions and cyber-attacks take advantage of known vulnerabilities and misconfigured operating systems, servers, and network devices. Technological advances targeting system awareness, cryptography, trust management and access controls are underway and continued attention is needed on these key technological solutions.

Cyber threats are dynamic, evolving quickly and often combined with lack of training and awareness: Cyber connectivity has increased the complexity of the control system and facilities it is intended to safely and reliably control. Thus, in order to defend electric infrastructure against the impacts of cyber-physical attacks, significant challenges must be overcome before extensive deployment and implementation of smart grid technologies can begin. Cyber security and interoperability are two of the key challenges of the smart grid transformation. As for security, it must be built-in as part of its design and NOT glued on as afterthought.

One important constraint on regulatory oversight of security protection is the split jurisdiction over the grid. The bulk electric system is under federal regulation but the distribution grid, metering, and other aspects of the grid are regulated by individual states. As a result the oversight of cyber security is split along with other regulatory functions.

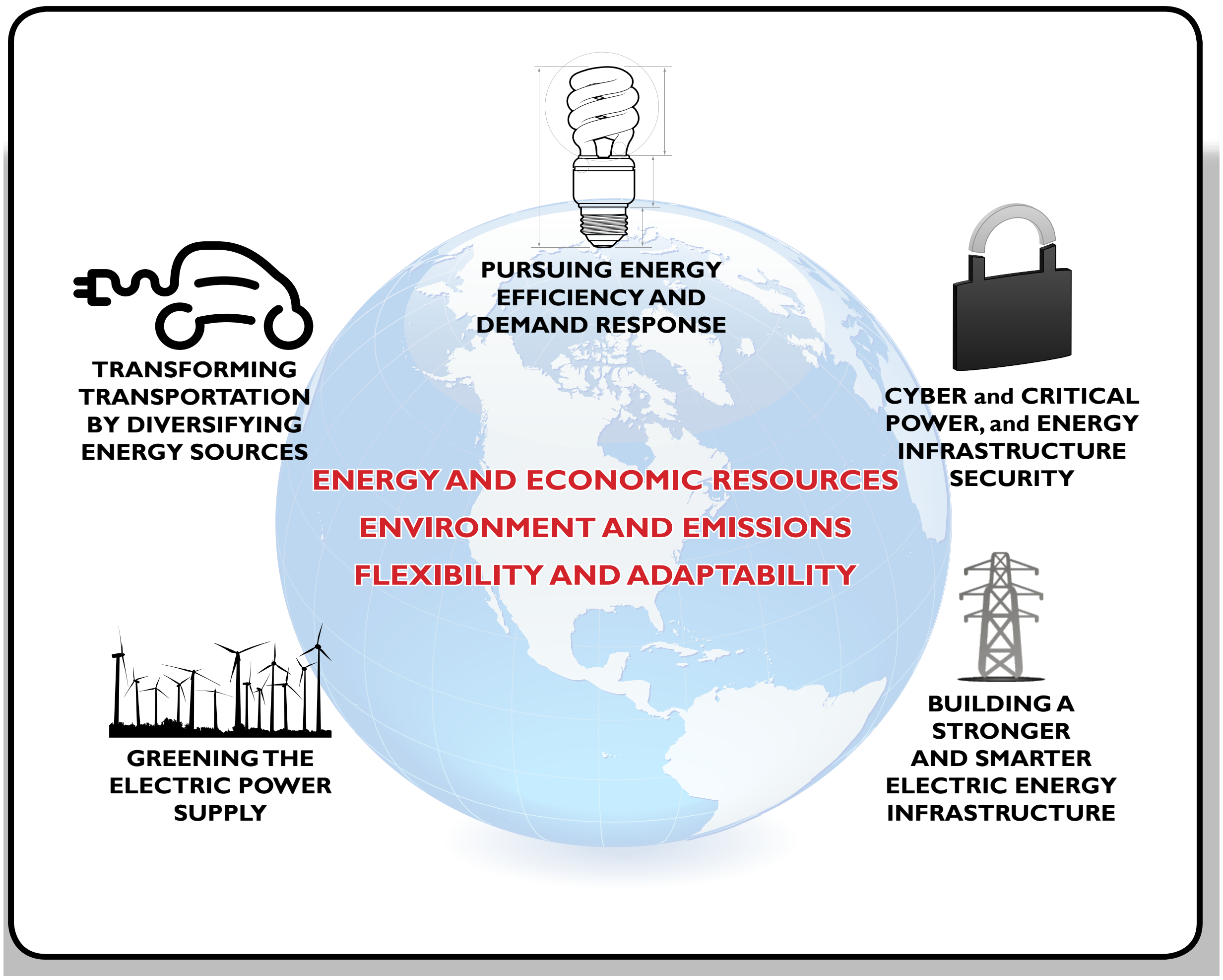
IEEE-USA recommends:

- Take necessary actions to facilitate, encourage, or mandate that secure sensing, "defense in depth," fast reconfiguration and self-healing be built into the infrastructure.
- Mandate security for the Advanced Metering Infrastructure, providing protection against Personal Profiling, guarantee consumer Data Privacy, Real-time Remote Surveillance, Identity Theft and Home Invasions, Activity Censorship, and Decisions Based on Inaccurate Data
- Wireless and the public Internet increase vulnerability and thus should be avoided
- Bridge the jurisdictional gap between Federal/NERC and the state commissions on cyber security.
- Electric generation, transmission, distribution, and consumption need to be safe, reliable, and economical in their own right. Asset owners should be required to practice due diligence in securing their infrastructure as a cost of doing business
- Develop coordinated hierarchical threat coordination centers – at local, regional, and national levels – that proactively assess precursors and counter cyber attacks
- Speed up the development and enforcement of cyber security standards, compliance requirements and their adoption. Facilitate and encourage design of security in from the start and include it in standards
- Increase investment in the grid and in R&D areas that assure the security of the cyber infrastructure (algorithms, protocols, chip-level and application-level security)
- Develop methods, such as self-organizing micro-grids, to facilitate grid segmentation that limits the effects of cyber and physical attacks.

THE NEED TO TAKE ACTION NOW

Urgent action is needed now because, with each passing year, U.S. options to respond to large local and global uncertainties will diminish. We cannot allow low prices to lull our country into complacency again. The need for a sustained energy strategy, policy, and regulatory structures is real and no longer just important, but urgent.

Now is the time to invest in new and established technologies to help our nation become better energy stewards, reduce environmental impacts, and secure energy supplies for the future. Electricity has a major role to play in reaching these objectives.



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