Modernizing America's Electric Grid

Solutions for
Transmission, Storage,
Distribution & Resilience

For consideration during the
2014 Quadrennial Energy Review

National Electrical
Manufacturers Association

The Association of Electrical Equipment
and Medical Imaging Manufacturers
www.nema.org

National Electrical Manufacturers Association

July 10, 2014

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Mr. Secretary, Director Holdren and Mr. Utech:

As you conduct the first phase of the President's Quadrennial Energy Review, I am pleased to transmit for your consideration, on behalf of the more than 400 member companies of the National Electrical Manufacturers Association (NEMA), the following recommendations on ***Modernizing America's Electric Grid: Solutions for Transmission, Storage, Distribution and Resilience***.

These recommendations are the product of deliberations by some of the nation's leading electrical manufacturers and innovators. We hope you will consider these recommendations as the beginning of a productive government-industry dialogue on policies to facilitate the modernization of America's electric grid – with **technologies that make the grid more reliable, resilient, secure, and efficient, while boosting U.S. competitiveness, enhancing energy security and reducing emissions.**

NEMA is the association of electrical equipment and medical imaging manufacturers, founded in 1926 and headquartered in Arlington, Virginia. NEMA's 400-plus member companies manufacture a diverse set of products including power transmission and distribution equipment, lighting systems, industrial automation and building control systems, intelligent transportation and smart grid products, and battery and energy storage technologies. Worldwide annual sales of NEMA-scope products exceed $100 billion.

Respectfully,

Evan R. Gaddis
President and CEO

Executive Summary

Introduction: The Challenges We Face in Modernizing America's Electric Grid

America faces several important challenges in modernizing our electric grid. The first is achieving a **reliable, resilient and efficient electric** delivery system with the ability to withstand outages, maintain high quality electric service, recover from extreme weather events, and save energy. The U.S. currently wastes more energy than it consumes, but our innovative electroindustry has the technologies to make vast improvements in energy efficiency**.** Section I of this report lays out the electroindustry technologies and recommended policy solutions to meet these challenges.

A second increasingly important challenge is our ability as a nation to withstand cyber-attacks and physical attacks on the electric grid. Section II of this report explains the technologies and recommended policies necessary to fully **secure America's electric grid**.

A third important challenge is **financing electric grid modernization** at a time of limited infrastructure budgets and state utility rate structures that incentivize consumption rather than efficiency. Section III of this report lays out tax incentives, rate structure reforms and other financing solutions.

I. Solutions to Improve Grid Reliability, Resilience and Efficiency

1. Incentivize the construction of microgrids and energy storage systems.

- A microgrid is a localized grouping of electricity generation, energy storage, and electrical loads. Storing electricity when demand is low and supplying it when consumers most need it improves the efficiency of the grid, increases reliability, and reduces the need for additional generation.
- A microgrid's multiple generation sources (solar, wind, gas, CHP[1] etc.), and ability to isolate itself from the larger network during an outage on the central grid, ensures highly resilient and reliable power. Microgrids enable basic life services to continue in the event of a prolonged outage.
- In combination with energy storage, microgrids can provide ancillary services to the broader electric grid -- such as voltage and frequency regulation. Microgrids also reduce dependence on long distance transmission lines, reducing transmission energy losses.
- Microgrids and energy storage can be incentivized through removing regulatory obstacles; R&D spending; grants and loan guarantees; agency procurement; and encouraging private financing.

[1] "A microgrid could incorporate many technologies, including low- or zero-emissions distributed generation and combined heat and power (CHP) systems, automated demand-response and load management, and distributed energy storage." Tom Stanton, *Are Smart Grids in Your Future*, National Regulatory Research Institute October 2012.

2. Amend eligibility requirements for federal flood insurance to require water-resistant components, wiring, cabling, and elevated substations in federally-designated flood plains.

- Water-resistant electrical components, including wiring and cabling, can help to ensure the continued operation and availability of critical infrastructure assets involved in a flood event, including power and water utilities, manufacturing facilities, transit systems, traffic control systems, and roadway lighting.

3. Amend the Stafford Act to allow disaster assistance to be used to replace damaged equipment with more resilient technologies, including on-site back-up power.

- On-site backup power provides a reliable and cost-effective way to mitigate the risks to lives, property and businesses from power outages. Onsite backup systems use local generation at the facility site to provide power when grid power is not available. For many facilities, such as hospitals, emergency call centers, first responders, and gas stations, standby generation is critical. For example, Florida requires some gas stations to have on-site generators to run the pumps in the event motorists need to fuel up for an evacuation.

4. Allow use of Community Development Block Grant (CDBG) funds for restoration of privately-owned electric utility infrastructure.

- In prior cases of exceptional damage to the electric grid (e.g. 9/11, Hurricane Katrina), funds were made available through the CDBG program to repair or rebuild privately-owned utility infrastructure; however, in the case of SuperStorm Sandy HUD limited assistance to utilities that met the definition of "small business." However, if a state or local government deems it important to avoid added cost burdens on low- and moderate-income electricity customers, the CDBG program should be available as a means to reduce the economic impact.

5. The federal government (FCC and NTIA) should allocate a common set of frequencies for communication with intelligent electrical devices, enabling faster restoration of power, more efficient use of capacity, and improving grid security by regulating products operating within the frequency band.

- Wireless communications solutions offer the most effective communications medium to support continued Smart Grid evolution in both urban and rural settings. However, current frequencies available to support communications are limited.

6. The Federal Energy Regulatory Commission (FERC) should have backstop siting authority for interstate transmission lines, similar to authority they have for natural gas pipelines, including lead authority in coordinating environmental and other reviews.

- This proposal would retain states' primary authority to set transmission routes within their borders, yet remove their *de facto* veto of interstate projects through inaction or permit denials.

7. Facilitate installation of smart technologies that reduce transmission congestion by updating FERC Order 1000 on cost allocation.

- Order 1000 allows transmission providers to join a region and gives regions flexibility in planning and cost allocation methods. However, application of Order 1000 for new technologies is restricted by high dollar thresholds. While the bias towards larger projects may have been appropriate when there was constantly increasing load growth, some areas of the grid now require more targeted and granular improvements, such as dynamic line ratings, FACTS[2] devices, and energy storage systems. While installation of these technologies can result in extremely high cost-benefit ratios, they can be very low-cost and do not meet the current threshold requirements. A reduction of these thresholds would help transmission owners propose and build transmission upgrades that utilize these new technologies in their most beneficial applications.

8. NIST, in collaboration with industry, should develop better reliability metrics in order to facilitate transmission investments and improve reliability.

- New metrics for assessing grid reliability will help transmission planners clearly compare alternatives, including options that incorporate new and innovative technologies. New metrics should seek to include an important piece of data that has been missing from rate discussions: how much do power interruptions and fluctuations in power quality cost U.S. electricity consumers.

II. Solutions to Improve Grid Security

9. Cybersecurity: Promote industry-led consensus standards to protect the grid from cyber-attack and expand liability protection to incentivize innovations and the development of technologies to protect the electric grid from increasingly sophisticated cyber threats.

- NEMA recommends that government cybersecurity policies rely to the greatest extent possible on consensus-based industry standards. The field of cybersecurity is constantly changing and our nation's response must be similarly agile as we manage our response to new risks. The private sector's leadership in standards development will ensure our nation is up to the challenge. NIST (National Institute of Standards and Technology) collaborated extensively with industry in developing a voluntary risk-based cybersecurity framework based on existing industry standards and best practices.

- Many of the technologies needed to defend our nation's critical electric infrastructure are rapidly developing through active research and development, as well as more robust industry standards. However, barriers remain to further development and deployment of cybersecurity technologies. One barrier is the vulnerability of manufacturers and vendors to liability in the event of a successful cyber-attack. We recommend that the SAFETY Act's liability protections be expanded to cover critical infrastructure industrial control systems, associated software, and other related cybersecurity technologies.[3] Such protections are

[2] A flexible alternating current transmission system (FACTS) is a system composed of static equipment used for the AC transmission of electrical energy.
[3] See 32 Yale Law & Policy Rev. 239.

essential to incentivize innovations and the robust development of technologies designed to protect the electric grid from increasingly sophisticated cyber threats.

10. Physical Security: the federal government should work with industry to establish standards for physical hardening of transformers and substations and require deployment of advanced sensing equipment at critical junctures in the electric grid.

- In the wake of the recent assault on the PG&E[4] Metcalf substation in California, the federal government should work with industry to establish standards for physical hardening of transformers and substations. In addition, current guidelines should be updated to include the deployment of advanced sensing equipment at critical junctures in the electric grid to prevent intentional damage to assets and avoid major outages. Proactive substation design, including compact gas-insulated substations, will allow critical facilities to be fully enclosed and secured for greater protection.

11. Authorize the Department of Energy to require strategic siting of: spare transformers, long lead-time components, and regional pools of equipment reserves.

- Increase coordination and transparency between utilities, regulators and equipment manufacturers to ensure there are sufficient numbers and types of spare transformers and other vital equipment reserves available near critical electrical infrastructure to allow for rapid response to a wide range of security breaches. Develop standards and guidelines for reserves of critical long lead-time substation components, such as large transformers.

III. Financing Grid Modernization

12. Accelerated depreciation for Smart Grid technologies.

- We support corporate tax reform and a system that is predictable, efficient and has rates that are comparable to those of other advanced economies – achieving this by broadening the tax base and lowering tax rates. If Congress deems it appropriate to broaden the tax base and retain a limited number of simplified, high priority incentives, we propose enactment of three technology-neutral energy efficiency tax incentives:
  - 5-year accelerated depreciation for investment in Smart Grid technologies.
  - deductions to encourage installation of equipment and systems to maximize or improve energy efficiency in new and existing buildings; and
  - 5-year accelerated depreciation for investment in energy efficient industrial technologies.

[4] Pacific Gas and electric Company

- Greater energy efficiency is a national priority that will boost economic productivity and competitiveness, enhance U.S. energy security, mitigate outages and reduce emissions.

- Examples of Smart Grid technologies that would be eligible for accelerated depreciation are: advanced metering infrastructure (AMI) including smart meters; fault detection, isolation and restoration (FDIR) systems; wireless communications that enhance grid security; demand-response technologies that reduce demand for electricity; high voltage DC (Direct Current) transmission lines to connect remote renewable energy sources to population centers; grid-connected storage; new technologies for easily transported spare transformers; buried transmission cables; modular, standardized Extra High Voltage (EHV) rapid recovery transformers; voltage/VAR management technologies capable of reducing overall distribution line losses; and improvements that enhance the ability of the electric grid to withstand cyber or physical threats.

13. Offer federal incentive grants to states to adopt performance-based regulatory models that reward modernization and efficiency rather than increased consumption.

- The American Society of Civil Engineers estimates there is a *transmission and distribution infrastructure investment gap of approximately $11 billion per year, which will result in an aggregate gap of more than $730 billion by 2040.*[5] Unfortunately, utilities are hindered by antiquated business models and regulatory structures that do not properly incentivize transmission and distribution infrastructure investments. Modernized utility business models and regulatory structures are needed to encourage the investments needed to make the U.S. electric grid more reliable, more efficient, and cleaner.

14. Establish a national infrastructure bank (NIB) to incentivize modernization of the electric grid and other U.S. infrastructure.

- A transition to performance-based or outcome-based regulatory models is a longer-term solution to financing grid modernization. In order to incentivize grid modernization investment in the short-term, we recommend Congress consider establishing a national infrastructure bank (NIB)[6] to leverage private sector investment in modernizing the electric grid and close gaps between the rate of return the private sector requires and the revenues that current rate structures can generate. There is ample precedent for federal support of grid modernization. For example, the Rural Electrification Administration administers a $5 billion loan program that finances the operation of generating plants, electric transmission and distribution lines or systems.

[5] American Society of Civil Engineers. "Failure to Act: The Economic Impact of Current Investment Trends in Electricity Infrastructure," 2011, accessed June 10, 2014, http://www.asce.org/uploadedFiles/Infrastructure/Failure_to_Act/SCE41%20report_Final-lores.pdf.

[6] Based on a proposal by William A. Galston and Korin Davis at the nonpartisan Brookings Institution; paper released December 13, 2012: http://www.brookings.edu/research/papers/2012/12/13-infrastructure-bank-galston-davis

Questions about the recommendations presented in this white paper can be directed to the following NEMA staff at (703) 841-3200 or by emailing QER@NEMA.org.

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About NEMA

NEMA is the association of electrical equipment and medical imaging manufacturers, founded in 1926 and headquartered in Arlington, Virginia. NEMA's 400-plus member companies manufacture a diverse set of products including power transmission and distribution equipment, lighting systems, industrial automation and building control systems, intelligent transportation and smart grid products, and battery and energy storage technologies. Worldwide annual sales of NEMA-scope products exceed $100 billion. **www.nema.org**

INTRODUCTION: THE CHALLENGES WE FACE

The U.S. electric grid is called the biggest and most complex machine in the world. While it daily delivers gigawatts of electricity, it does so via a basic design with origins in the 19th century, attempting to serve 21st century needs. Modernizing America's grid faces several key challenges: achieving reliability and resilience while improving efficiency; securing the grid from cyber- and physical attacks; and financing grid modernization at a time of limited infrastructure investments.

Reliability, Resilience and Efficiency

The electric grid consists of three basic components, the same today as in the time of Edison and Westinghouse: (1) **generating stations** that produce electric power from a variety of sources (coal, natural gas, nuclear, hydro, wind, geothermal, and solar) which is then stepped-up via transformers to a higher-voltage that is more efficient for long-distance transmission; (2) **high-voltage transmission lines** that carry power long distances; and (3) **substations** (with transformers) that step-down high-voltage electricity for delivery to customers through distribution networks.

Reliability.—According to data from the U.S. Energy Information Administration, at the end of 2012 nearly 51% of all generating capacity was at least 30 years old. Key components include aging power equipment with high failure rates and obsolete system layouts that require additional substation sites and rights-of-way.

Major recent outages began with the failure of a single transmission line. Regardless of the cause—physical disruption, cyber event, or human error—a reliable grid must have multiple pathways through which power can be re-routed.

A modern and reliable transmission network is also critical to incorporation of renewable generation such as wind and solar into the electric grid, because those energy sources are often located far from demand centers.

In addition, the next few years represent a period of great uncertainty for the grid as coal-fired plants are decommissioned in the face of strict federal air quality rules. To a great extent, these will be replaced by an increasing number of distributed generation sources such as smaller, gas-fired turbines and consumer-owned renewable generation capable of depositing their excess power on the grid. These developments will impact both reliability and power quality, in addition to raising new safety concerns resulting from two-way power flows.

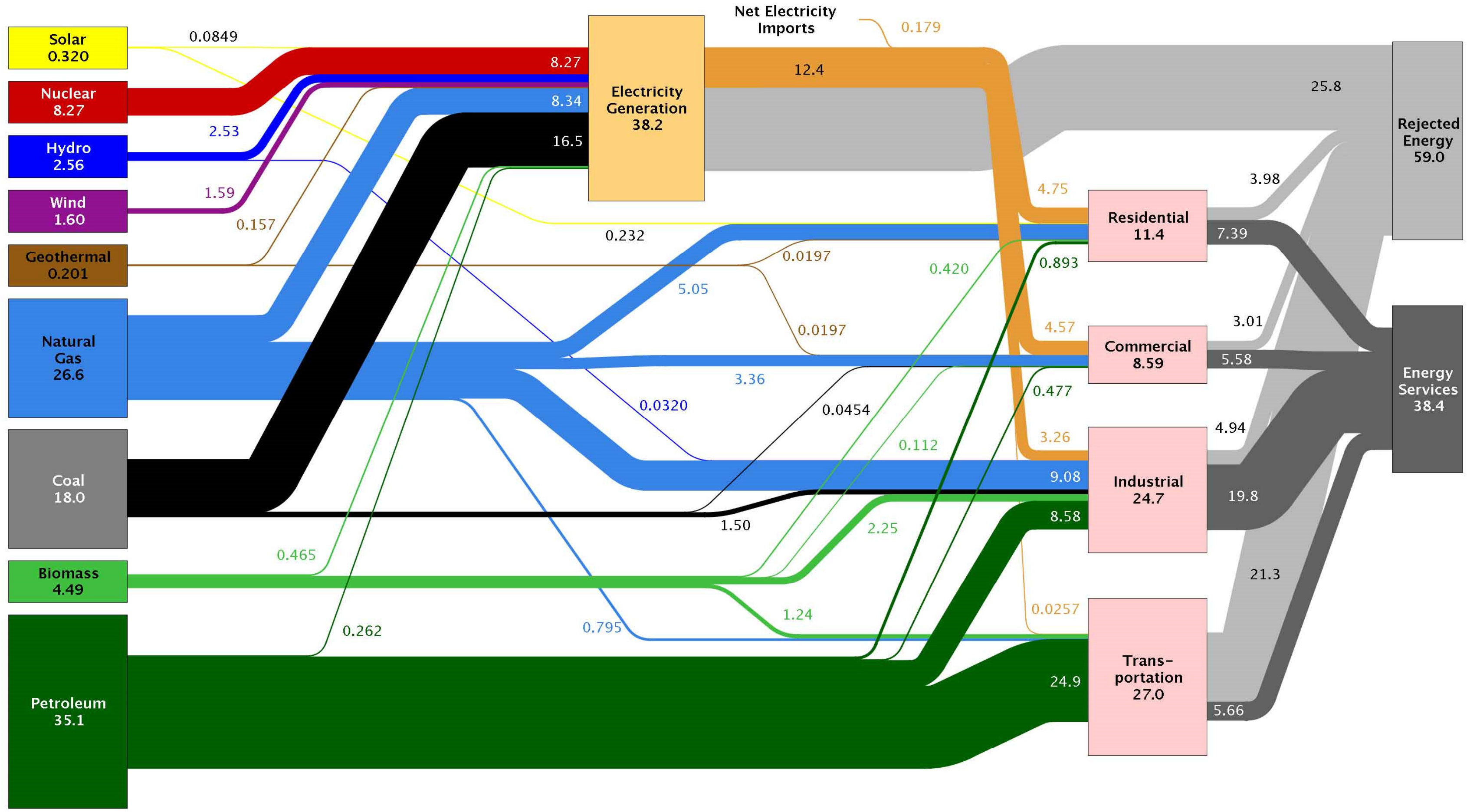
Unfortunately, today's complex web of local, state, and federal regulations – which we liken to the game "Chutes and Ladders" – make it difficult to gain approval for new transmission lines, even those that are absolutely essential to grid reliability or to the development of renewable energy. In fact, most proposed lines are never built because of the level of burden placed on the transmission operator.

Resilience.--America's largely above-ground, aging, and overstressed electric grid is vulnerable to extreme weather events. The National Climate Assessment, released in May of 2014, concluded that "certain types of extreme weather events…have become more frequent and/or intense." One need only recollect the devastation of SuperStorm Sandy in late 2012 to understand the nation's vulnerability.

Sandy's devastation, in addition to the tragic loss of life, homes, and businesses, left more than 8 million people in 16 states without power **--** with subways shut down, sewage plants crippled, and hospitals shutting their doors. **Much of this devastation did not have to happen. The solution is a resilient electric grid.**

Efficiency.—There is broad agreement that America needs to improve its energy efficiency. Greater efficiency reduces emissions, boosts productivity and competitiveness, and enhances energy independence. However, as reflected in the flow chart on the next page from the Lawrence Livermore National Laboratory (LLNL), Americans continue to waste more energy than we consume. In 2013, out of 97.4 quadrillion BTUs ("Quads") of energy used from the various sources, 59 quads were wasted ("rejected"); and out of 38.2 quads of *electricity* generated by the indicated various sources, 25.8 quads were wasted. Clearly, as efforts are made to improve the reliability and resilience of the grid, improving efficiency is a challenge of equal importance.

Estimated U.S. Energy Use in 2013: ~97.4 Quads



Source: LLNL 2014. Data is based on DOE/EIA-0035(2014-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Securing the Grid

Beginning with the White House's Policy Framework For The 21st Century Grid in June of 2011 and later Executive Order 13636 in February of 2013, a great deal of attention has been focused on the ability of the grid to withstand a cyber-attack.

The nature of the cyber threat to the grid is highly asymmetric. In some cases, there is evidence of nation-states who are targeting U.S. infrastructure for penetration and attack. In other cases, individuals with either mischievous or malicious intent are looking to exploit weaknesses in consumer and grid operator systems.

Recently, the cyber-threat to the grid has been joined by the threat of physical assault as in the widely publicized assault on a California substation using firearms.

The challenge going forward is to build security measures and backup systems into a modernized grid.

Financing Grid Modernization

These multiple challenges – aging of the grid, the complexities of siting new lines, increasing frequency of extreme weather events, cyber and physical threats, and the need to reduce emissions – require significant investments to increase the grid's reliability, resilience, security, efficiency and responsiveness to changing customer expectations and demands. However, the complexity of the utility regulatory structure in each of the 50 states makes financing improvements and modernization a daunting challenge.

While we have clear *national* needs for investments to make the grid more resilient and reliable, regulation of the grid is highly complex and Balkanized – controlled by the *50+ state public utility commissions and FERC*.

Moreover, the current model of electric utility revenue – being tied to consumption (e.g. kilowatt hours sold) – is increasingly at odds with federal and state policies and regulations seeking increased energy efficiency and use of distributed generation (DG), and other distributed energy resources (DER). Solar, wind and other forms of "distributed energy," i.e., energy not generated from a central location, puts downward pressure on electric utility revenues.

In addition, the nation is just now fully emerging from a deep and prolonged recession and the public appetite for major public infrastructure investments is limited.

Reliability, resilience, efficiency, security, and financing: these are the challenges facing America's electric grid. Following are the solutions.

I. SOLUTIONS TO IMPROVE GRID RELIABILITY & RESILIENCE

1. Incentivize the construction of microgrids and energy storage systems.

***Description of Recommendation*:**

Microgrids, together with energy storage systems, greatly enhance grid resilience and reliability. Numerous steps can be taken to incentivize construction of microgrids and energy storage:

- Remove regulatory obstacles that inhibit investment in microgrids and energy storage.
- Enact the STORAGE 2013 Act investment tax credit legislation[7];
- Fully fund continuing construction of microgrids and energy storage at military installations and other government facilities;
- Fully fund the Department of Energy's energy storage R&D program and ARPA-E's AMPED (Advanced Management & Protection of Energy Storage Devices) and GRIDS[8] programs, and make the resources of the national laboratories available for R&D on microgrids and energy storage systems;
- Provide incentive grants and loan guarantees for "energy oases" to ensure basic services continue in high-risk population centers;
- Direct the Federal Energy Regulatory Commission (FERC) to provide comparable market access for energy storage; and
- Encourage the use of private financing for microgrids and energy storage through the use of energy savings performance contracts (ESPCs) where up-front capital costs are paid back over time through energy savings and excess production.

***Background*:**

Energy Storage.—The ability to store electricity generated at one point in time, to be used at another, is revolutionary. In a single day, one could interact with energy storage numerous times. The power used to brew your morning cup of coffee was sent to the grid smoothly and predictably through batteries at the wind farm; the flywheels at the data center secured your company's records during the thunderstorm; your electric vehicle's battery was programmed to charge overnight when power was cheap; while you were on vacation, your rooftop solar panels collected and stored power in your home's battery system keeping your electric bill to a minimum; and you maintained a cool home using your community's energy storage resources during the heat wave when your utility couldn't keep up.

The electricity generated from solar photovoltaic (PV) and wind turbines is subject to cloud cover and air movement. Energy storage systems smooth the peaks and troughs of the output

[7] Summary of the STORAGE 2013 Act

[8] The projects that comprise ARPA-E's GRIDS program, short for "Grid-Scale Rampable Intermittent Dispatchable Storage," are developing storage technologies that can store renewable energy for use at any location on the grid at an investment cost less than $100 per kilowatt hour. Flexible, large-scale storage would create a stronger and more robust electric grid by enabling renewables to contribute to reliable power generation.

from renewables leading to more consistent supply and greater grid efficiency.

Energy storage systems enable generation to be matched to demand. For example, surplus electricity generated during the afternoon by solar PV can be used in the evening when demand is typically the highest. Storing electricity when demand is low and supplying it when consumers most need it improves the efficiency of the grid, increases reliability, and reduces the need for additional generation. Energy storage will dramatically improve the reliability and market efficiency of the electrical system, from generation to consumption.

Microgrids.--A microgrid, sometimes referred to as an electrical island, is a localized grouping of electricity generation, energy storage, and electrical loads[9]. Where a microgrid exists, loads are typically also connected to a traditional centralized grid. When the microgrid senses an outage, it disconnects from the central grid and uses its own generation and storage capabilities to serve the local electrical load – achieving greater reliability and resilience.

In critical situations, microgrids can direct power to high priorities such as first responders, critical care facilities, and hospitals.

Microgrid generation resources can include natural gas, wind, solar panels, diesel or other energy sources. *A microgrid's multiple generation sources and ability to isolate itself from the larger network during an outage on the central grid ensures highly resilient and reliable power.*

The effectiveness of microgrids is further enhanced through energy storage. Storage systems not only provide backup power while the microgrid's generation sources are coming online, they can also be used to regulate the quality of the power and protect sensitive systems like hospital equipment that may be vulnerable to power surges during restoration efforts.

Microgrids offer additional advantages. Surplus power from microgrids can be sold to the central grid or stored for later use. In combination with energy storage and energy management systems, microgrids can also provide ancillary services to the broader electric grid -- such as voltage and frequency regulation. Microgrids also reduce dependence on long distance transmission lines, reducing transmission energy losses.

Also of increasing importance, microgrids can mitigate the effects of cyber-attacks by *segmenting* the grid.

Additional benefits of microgrids:

a. They are expandable and can be built in phases.
b. Microgrids generate revenue through payments for ancillary services such as load reduction and frequency regulation.
c. Because microgrids store energy for later use, they facilitate the use of renewable energy sources such as solar and wind.
d. Microgrids save money by increasing efficiency and decreasing the cost of labor and downtime in outages.
e. Microgrids increase power quality, which is important for research, high-tech manufacturing, and healthcare.

[9] Definition of "load": The part or component in a circuit that converts electricity into light, heat, or mechanical motion. Examples of loads are a light bulb, resistor, or motor.

f. Microgrids reduce losses due to long-distance transmission by shifting to on-site generation.
g. Microgrids protect against future unknown operational and financial risks.
h. Microgrids enable basic life services to continue in the event of a prolonged outage (pharmacies, banks, heating/cooling centers, supermarkets, phone charging centers).

Regulatory Uncertainty.—Despite the projected benefits, microgrids and energy storage suffer from underinvestment and under-adoption due in large part to *regulatory uncertainty about whether:*

- Microgrids and other forms of distributed energy must be regulated as "public utilities" (which would be undesirable for numerous reasons);
- Regulations for generation interconnection and net-metering are applicable;
- Regulations on ownership of distribution equipment are applicable;
- Microgrids will impact the current cost-of-service rate structures for utilities; and
- Microgrids above a certain capacity, that want to sell back to the macrogrid, become subject to FERC jurisdiction.

Additional Resources on Microgrids:

There are about 160 microgrid projects worldwide. Here is a good, but incomplete summary of notable microgrids in the US: http://galvinpower.org/resources/microgrid-hub/microgrid-projects. The aforementioned list does not include many university campuses, which are covered in this article: http://www.midwestenergynews.com/2014/02/07/with-reliability-a-concern-universities-looking-to-microgrids/

2. Amend eligibility requirements for federal flood insurance to require water-resistant components, wiring, cabling, and elevated substations in federally-designated flood plains.

Description of Recommendation:

Water-resistant electrical components, including wiring, cabling, and elevated substations can help to ensure the continued operation and availability of critical infrastructure assets involved in a flood event, including power and water utilities, manufacturing facilities, transit systems, traffic control systems, and roadway lighting. In areas the government has designated as prone to flooding, federal regulators should require owners of critical infrastructure to improve the resilience of those facilities to high-water conditions by installing electrical equipment that is specifically designed and manufactured to operate in such conditions, as well as requiring elevated substations where appropriate.

Background:

Most electrical equipment, including wires and cables, is vulnerable to damage when exposed to water and, in the case of flooding, to the sediments and contaminants present in flood waters. Such damage can lead to unsafe conditions; therefore, NEMA recommends the careful evaluation and, if necessary, replacement of water-damaged electrical equipment.[10]

Making up-front investments in the resilience of electrical equipment in critical facilities will pay off over time through obviation of the need to remove and replace the equipment after each high-water event.

To ensure continuity of operations of critical services and facilities in federally-designed flood-prone areas, the federal government – by law or regulation – should amend eligibility requirements for federal flood insurance to require water-resistant components, wiring and cabling for structures in federally-designated flood plains, as well as elevated substations where appropriate.

3. Amend the Stafford Act[11] to allow disaster assistance to be used to replace damaged equipment with more resilient technologies, including on-site backup power.

Description of Recommendation:

Congress should consistently allow FEMA Disaster Relief funds to replace damaged electrical equipment with more resilient technologies.

Background:

The Robert T. Stafford Emergency Relief and Disaster Assistance Act (P.L. 93-288, as amended) authorizes the President to make emergency and disaster declarations and provide federal disaster aid.

Declarations made pursuant to the Stafford Act trigger emergency funding to state, local, and tribal governments through the Federal Emergency Management Agency's (FEMA) Disaster Relief Fund (DRF). A portion of this emergency funding is sometimes used to rebuild damaged electrical equipment.

Recipients of disaster assistance should be permitted to "rebuild the smart way," maximizing the deployment of technologies to mitigate future power outages and ensure continued operation of critical facilities -- rather than simply "replacing what was there."

[10] NEMA Guidance on Evaluating Water-Damaged Electrical Equipment, available at http://www.nema.org/Standards/Pages/Evaluating-Water-Damaged-Electrical-Equipment.aspx

[11] The Stafford Act constitutes the statutory authority for most Federal disaster response activities especially as they pertain to the Federal Emergency Management Agency (FEMA) and FEMA programs.

Resilient and reliable power is critical for first responders and vital services including communications, health care, transportation, financial systems, homeland security, water and waste-water treatment, and emergency food and shelter.

Allowing disaster assistance to be used for installation of more resilient technologies was authorized In the wake of SuperStorm Sandy. The Committee Report accompanying H.R. 1 (112th Congress), the Disaster Relief Appropriations Act, 2013, provides:

> SEC. 1105. Recipients of Federal funds dedicated to reconstruction efforts under this Act shall, to the greatest extent practicable, ensure that such reconstruction efforts maximize the utilization of technologies designed to mitigate future power outages, continue delivery of vital services and maintain the flow of power to facilities critical to public health, safety and welfare. The Secretary of Housing and Urban Development as chair of the Hurricane Sandy Rebuilding Task Force shall issue appropriate guidelines to implement this requirement.

In addition, in its report entitled National Strategy Recommendations: Future Disaster Preparedness, FEMA endorses the need for change:

> Encourage and incentivize communities to consider more hazard-resilient and sustainable rebuilding, rather than simply replacing what was there before. This may include making funds available to reimburse investments that improve resilience in rebuilt infrastructure or homes or encouraging higher standards in rebuilding or hazard mitigation for critical public infrastructure.

Resilience can also be improved through installation of on-site backup power. On-site backup power provides a reliable and cost-effective way to mitigate the risks to lives, property and businesses from power outages. For many facilities, such as assisted living facilities and nursing homes, there is a life safety aspect to consider. Other facilities, such as cell tower sites, emergency call centers, and gas stations, have far-reaching social impact and availability of back-up power is critical.

Onsite backup systems use local generation at the facility site to provide power when grid power is not available. The backup power system may or may not be interconnected with the utility grid. On-site electric power generating systems are readily available in a wide variety of designs for specific uses and customer applications.

Hospitals and other critical facilities have long had on-site standby generators. As electricity has become more vital to leverage other energy sources, more facilities are required to have at least some level of standby generation. For example, Florida requires some gas stations to have on-site generators to run the pumps in the event motorists need to fuel up for an evacuation.

4. Allow use of federal Community Development Block Grant funds for restoration of privately-owned electric utility infrastructure.

***Description of Recommendation*:**

The Federal government should allow use of Community Development Block Grant (CDBG) funds for the repair and restoration of privately-owned electric utility infrastructure in the wake of extreme weather and other high impact, low frequency events.

***Background*:**

Under existing law (the Housing and Community Development Act of 1974, 42 U.S.C. §5305 (a)(17)(C)), CDBG funding can be used to provide assistance to "private, for-profit entities, when the assistance . . .meets urgent needs."

Under existing Department of Housing and Urban Development (HUD) regulations (24 C.F.R. § 570.201(l)), CDBG funds may be used "to acquire, construct, reconstruct, rehabilitate, or install the distribution lines and facilities of privately owned utilities, including the placing underground of new or existing distribution facilities and lines."

However, in connection with the allocation of CDBG disaster recovery funds in 2013 as part of the response to SuperStorm Sandy, HUD limited assistance to for-profit entities to only those entities that met the definition of a "small business."

This action effectively prevented the use of CDBG funds for the repair or restoration of facilities of privately owned utilities that were badly damaged by Hurricane Sandy.

In prior cases of exceptional damage to the electric grid (e.g. 9/11, Hurricane Katrina), funds were made available through the CDBG program to repair or rebuild privately-owned utility infrastructure. The determination of whether to provide assistance to private entities was made by the state or local jurisdiction receiving the CDBG funding.

Typically, the cost of repairing or replacing damaged or destroyed utility infrastructure is paid for by all utility customers through their state-regulated rates. However, if a state or local government deems it particularly important to avoid added cost burdens on low- and moderate-income electricity customers from high storm/disaster recovery costs, the CDBG program has offered a means to reduce the economic impact.

The limitation imposed in connection with Hurricane Sandy CDBG Disaster Relief funds should not become a precedent for the future. Federal policy should preserve the ability of CDBG recipients to use funds to restore electric infrastructure owned by privately owned utilities.

5. Allocate a common set of frequencies for communication with "intelligent electrical devices."

***Description of Recommendation*:**

The Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA) should allocate spectrum for exclusive use of electric utilities for the operations of the electrical power grid enabling faster restoration of power and efficient use of capacities. This could also improve grid security by regulating products operating in the specific frequency band.

***Background*:**

To fully enable utilities to meet demands for a stable electrical supply during normal operations and storm-induced outages, reliable communication to intelligent electrical devices located in substations and nodes is critical. Communication options are to build fiber, lease wired circuits or utilize wireless communication. Building fiber facilities or leasing wired circuits in many cases, especially to distributed devices, is typically too costly or often is not feasible.

Wireless communications solutions offer the most effective communication medium to support continued "Smart Grid" evolution in both urban and rural settings. However, current frequencies available to support communications is limited to a small set of licensed frequencies, with corresponding channel capacity, and un-licensed frequencies, with corresponding broadcast power limitations and interference with other uses. The only exception is a 50 MHz band located within the 4.9GHz spectrum. This spectrum was originally set aside for Public Safety organizations, but now is available to electric utilities who serve only municipalities.

Our recommendation is for a consistent approach, within the US and Canada, for use of 4.9 GHz Radio Frequency Spectrum – enabling manufacturers to build sufficient radio communication platform volumes to meet market economies, further enhancing development of Smart Grid applications.

6. The Federal Energy Regulatory Commission (FERC) should have backstop siting authority for interstate transmission lines, similar to authority they have for natural gas pipelines, including lead authority in coordinating environmental and other reviews.

Description of Recommendation:

- Congress should enact legislation to provide the Federal Energy Regulatory Commission (FERC) with targeted backstop siting authority for *interstate* transmission lines, similar to authority they already have for natural gas pipelines. This targeted authority should: apply solely to interstate projects of bulk-power delivery; afford states a reasonable review period for proposed siting permits; and preserve states' authority to permit alternate in-state routes coterminous with interstate plans, but give FERC backstop authority to issue permits if a state has failed to act or denied project permits without offering an alternative route.

- Amend Section 216(b)(1) of the Federal Power Act to clarify FERC's authority with regard to "backstop" siting. Currently, FERC has this authority but only for those interstate lines that are designated as "National Interest Electric Transmission Corridors" (NIETCs) and only when states fail to act on such requests within 12 months. However, FERC has only exercised this authority once since passage of the Energy Policy Act of 2005, where it was contested and subsequently denied under the facts of that case.[12] A separate case[13] before the U.S. Court of Appeals for the Ninth Circuit found that interstate transmission siting should not be left solely to the states. Ultimately, clarification by Congress is needed before FERC can exercise such authority in the future.

- FERC's authority should also include lead authority among federal agencies in coordinating environmental and other statutory reviews.

Background:

This proposal would retain states' primary authority to set transmission routes within their borders, yet remove their *de facto* veto of interstate projects through inaction or permit denials.

Despite efforts to streamline the interstate transmission siting process through the Energy Policy Act of 2005, the creation of Regional Transmission Organizations (RTOs), and interagency team efforts to expedite federal land reviews, *the permitting of interstate transmission projects remains complex, disjointed, expensive and uncertain.*

This dysfunction thwarts infrastructure investments required to meet shifting generation and delivery needs, with a particularly negative impact on the integration of renewable energy sources. Thirty-seven states and the District of Columbia currently promote the integration of non-fossil energy sources through renewable fuel standards or goals. However, renewable energy is often generated in *remote locations* far from major user population centers, requiring new transmission lines.

7. Facilitate installation of Smart Grid technologies that reduce transmission congestion by updating FERC Order 1000 on cost allocation.

Description of Recommendation:

Congress should facilitate installation of smart technologies that reduce transmission congestion by updating FERC Order 1000 on cost allocation. The cost allocation rules should be amended to eliminate the bias towards large projects.

Background:

FERC Order 1000 established a process for improved transmission planning within and among regions, and established six cost allocation principles – including that costs be allocated in a

[12] *Piedmont Environmental Council v. FERC,* 558 F.3d 304 [4th Cir. 2009]
[13] *California Wilderness Coalition v. U.S. Dept. of Energy,* 631 F.3d 1071 [9th Cir. 2011]

manner roughly commensurate with benefits.

Order 1000 allows transmission providers to form or join a region of their choosing and gives regions flexibility in planning and cost allocation methods. In addition, a "market efficiency process" requires planners to consider new technologies.

However, these new technologies are restricted by high dollar thresholds. For example, the California ISO[14] only evaluates the top 5 corridors for market efficiency improvements. In the NYISO[15], projects must exceed $25 million in cost in order to be considered as a CARIS[16] efficiency upgrade.

While the bias towards larger projects may have been appropriate in a traditional world with constantly increasing load growth, some areas of the grid require more targeted and granular improvements. Solutions that address new challenges such as unanticipated congestion or new flow patterns include Dynamic Line Ratings, FACTS[17] devices, and energy storage systems.

While installation of these technologies can result in extremely high cost-benefit ratios, they can be very low-cost in relation to traditional upgrades, and often do not meet the current threshold requirements. A reduction of these thresholds would help transmission owners propose and build transmission upgrades that utilize these new technologies in their most beneficial applications.

8. Develop better metrics to assess electric grid reliability.

Description of Recommendation:

The National Institute of Standards and Technology (NIST), in collaboration with DOE and industry, should develop better reliability metrics in order to facilitate transmission investments and improve reliability. New metrics should include an assessment of how much power interruptions and fluctuations in power quality cost consumers.

Background:

Traditional transmission planning utilizes deterministic methods, which specify that the grid must survive predetermined scenarios, such as the outage of a generator or a transmission line. These

[14] The CAISO oversees the operation of California's bulk electric power system, transmission lines, and electricity market generated and transmitted by its member utilities.
[15] The New York Independent System Operator (NYISO) manages New York State's electric system, operating the high-voltage transmission network, administering and monitoring the wholesale electricity markets, and planning for the state's future energy needs.
[16] 2013 Congestion Assessment and Resource Integration Study.
[17] A flexible alternating current transmission system (FACTS) is a system composed of static equipment used for the AC transmission of electrical energy.

scenarios are used without consideration of the probability that such events will actually occur. The result is that the grid may be over-reinforced in some areas and under reinforced in others.[18]

By explicitly incorporating probabilities into outage scenarios, probabilistic methods give decision makers much clearer information when making tradeoffs between reliability and economics. New metrics for reliability, such as Expected Unserved Energy (EUE) and Loss of Load Hours (LOLH) have already been identified as preferred metrics for comparing reliability.[19] Unfortunately, probabilistic planning requires substantially more complex inputs and computational methods. For example, add-on evaluations of value-based planning at both the distribution and transmission levels require data on the end user reliability valuations that have historically been difficult to obtain.[20]

NIST, in collaboration with DOE and industry, should develop the analytical tools to facilitate the use of probabilistic planning. These tools include advanced computational methods to reduce the time required to simulate complex power systems. Once developed, NIST and DOE should encourage transmission planners to utilize these methods.

New metrics for assessing grid reliability will help transmission planners clearly compare alternatives, including options that incorporate new and innovative technology. Federal support for new metrics and methods will facilitate planning for a more efficient and reliable power system for all users.

In addition, new metrics should seek to include an important piece of data that has been missing from rate discussions: how much power interruptions and fluctuations in power quality ("power quality events") cost U.S. electricity consumers. Accurately estimating these costs could help utilities accurately assess the potential benefits of investments in improving the reliability of the grid.

The complete wall-to-wall cost of a power outage that includes the consumer impacts is inconsistently applied in the U.S. A municipal-owned utility has the complete wall-to-wall costs to take into account, whereas an investor-owned utility does not – leading to different drivers for improving reliability of the electric grid.

[18] See a comparison of probabilistic versus deterministic planning in P. Zhang, "Probabilistic Transmission Planning: Summary of Tools, Status, and Future Plans," EPRI Technical Update 1008612, November 2004.
[19] NERC, "Probabilistic Assessment: Addendum to the 2012 Long-Term Reliability Assessment," June 2013.
[20] Michael J. Sullivan et al, "Estimated Value of Service Reliability for Electric Utility Customers in the United States," LBNL-2132E, June 2009.

II. SOLUTIONS TO IMPROVE GRID SECURITY

9. Cybersecurity: Promote industry-led consensus standards to protect the grid from cyber-attack; expand liability protection to incentivize innovations and the development of technologies to protect the electric grid from increasingly sophisticated cyber threats; maintain federal funding of cybersecurity research and development; and improve government-industry information sharing on cybersecurity.

***Description of Recommendation*:**

1. Promote industry-led, consensus-based cybersecurity standards.
2. Expand SAFETY Act liability protections to incentivize innovations and the development of technologies to protect the electric grid from increasingly sophisticated cyber threats.
3. Maintain federal funding for cybersecurity research and development.
4. Improve government-industry cybersecurity information sharing programs.

***Background*:**

Protecting the nation's electric grid and ensuring a reliable, affordable supply of power are the electric power industry's top priorities. Cybersecurity incidents have the potential to disrupt the flow of power to customers or reduce the reliability of the electric system. Key to the success of this effort is the ability to protect the grid's digital overlay against interruption, exploitation, compromise or outright attack of cyber assets, whether through physical or cyber means.

Industry-led, consensus-based cybersecurity standards. Governments have recently begun to respond to the threat of malicious cyber-attack with policies and guidelines for owners and operators of critical infrastructure. Owners and operators, systems integrators, and equipment suppliers are focusing considerable attention on the security-related attributes of products, systems integration, asset management, and enterprise connectivity. The community of stakeholders is investing in the development and maintenance of relevant cybersecurity standards applicable to these products and systems.

NEMA recommends that government cybersecurity policies rely to the greatest extent possible on consensus-based industry standards. The field of cybersecurity is constantly changing and our nation's response must be similarly agile as we manage our response to new risks. The private sector's leadership in standards development will ensure our nation is up to the challenge.

Two recent developments are relevant. Executive Order 13636, "Improving Critical Infrastructure Cybersecurity," directed the National Institute of Standards and Technology (NIST) to develop a voluntary risk-based cybersecurity framework ("Framework") based on existing industry standards and best practices.

In accordance with this directive, NIST recognized private sector leadership in standards development, collaborated extensively with industry, and produced a document that serves a cross-mapping of consensus-based industry standards and best practices. The NIST Framework therefore did not "reinvent the wheel" with regard to standards, rather it wisely chose to promote, rather than compete with, the consensus-based approach being led by industry.

The result is a guiding document that provides private-sector actors, both large and small, with a widely accepted starting point for evaluating their cybersecurity posture and roadmap for improving it. Other federal agencies interested in promoting cybersecurity should similarly point to consensus-based industry standards rather than attempting to develop their own points of view on the subject.

Further, the Office of Management and Budget is currently updating its A-119 Circular which, among other things, speaks to how the federal government should interface with consensus-based industry standards. One proposed revision to Circular A-119 would:

> *…establish a general preference for using voluntary consensus standards in Federal regulations and for other Federal agency uses. The current Circular prefers voluntary consensus standards over government-unique standards (as is required under Section 12(d) of the NTTAA). The revision continues this preference and establishes a further preference for voluntary consensus standards over other types of standards (including voluntary standards that are developed by voluntary non-consensus bodies)* [21]

Provide liability protections to facilitate development and adoption of cybersecurity technologies. Many of the technologies and techniques needed to defend our nation's critical electric infrastructure are rapidly developing through active research and development, as well as more robust industry standards. However, barriers remain to further development and deployment of cybersecurity technologies. One barrier is the vulnerability of manufacturers and vendors to liability in the event of a successful cyber-attack.

Under current law[22], entities that sell or deploy products that can be used to deter, respond to, or mitigate "acts of terrorism" are eligible to receive liability protections. However, with the growing threats to the electric grid and other critical infrastructure, we recommend that liability protections be expanded to cover critical infrastructure industrial control systems, associated software, and other cybersecurity technologies.[23]

Additional protections are essential to incentivize innovations and the robust development of technologies designed to protect the electric grid from increasingly sophisticated cyber threats. Additional liability protections will also encourage a more performance-based approach to developing innovative cybersecurity technologies.

Maintain federal funding for cybersecurity research and development. The federal government, including the Department of Energy, has for decades been a leader in research and development. Cybersecurity R&D is a relative newcomer but its role in securing our society and supporting our way of life cannot be overstated. NEMA believes the federal government's

[21] http://www.whitehouse.gov/sites/default/files/omb/inforeg/revisions-to-a-119-for-public-comments.pdf

[22] After the 9/11 attacks, Congress enacted the Support Anti-terrorism by Fostering Effective Technologies Act of 2002 (the "SAFETY Act") as part of the Homeland Security Act of 2002, P.L. 107-296. By providing certain liability protections for anti-terrorism technologies, the SAFETY Act was aimed at incentivizing the development and deployment of these technologies. SAFETY Act protections are available to sellers of Qualified Anti-terrorism Technology (QATT) as determined by the Department of Homeland Security.

[23] See 32 Yale Law & Policy Rev. 239.

cybersecurity research and development funding is critical and should continue in partnership with NEMA manufacturers and other private sector technology experts.

Improve cybersecurity information sharing programs between industry and government. The majority of critical infrastructure is owned and operated by the private sector. At the same time, the government is the leader in gathering cybersecurity threat information from owners and operators. The missing link is an information sharing program between government and industry that allows a robust and rapid two-way flow of actionable cybersecurity threat information. NEMA supports the creation of an information sharing program that provides the private sector with information required to effectively defend the power grid.

10. Physical Security: the federal government should work with industry to establish standards for physical hardening of transformers and substations and require deployment of advanced sensing equipment at critical junctures in the electric grid.

***Description of Recommendation*:**

In the wake of the recent assault on the PG&E[24] Metcalf substation in California, the federal government should work with industry to establish standards for physical hardening of transformers and substations. Current guidelines should be updated to include the deployment of advanced sensing equipment at critical junctures in the electric grid to prevent intentional damage to assets and avoid major outages. Proactive substation design, including compact gas-insulated substations, will allow critical facilities to be fully enclosed and secured for greater protection.

***Background*:**

Updating current guidelines: Current guidelines and standards from NERC (North American Reliability Corporation)[25] and IEEE (Institute of Electrical and Electronics Engineers) for the physical security of substations were written 10 to 15 years ago when attacks such as the recent assault on the PG&E Metcalf substation were considered random acts of vandalism rather than intentional attacks on the electric grid. The guidelines make little or no mention of organized attacks that could occur far outside the range of substation surveillance and detection. The existing standards are focused almost exclusively on responding to unauthorized entry into substations.

[24] Pacific Gas and electric Company

[25] The **North American Electric Reliability Corporation (NERC)** is a nonprofit corporation based in Atlanta, Georgia, and established in 2006, as the successor to the National Electric Reliability Council (also known as NERC). The original NERC was formed in 1968 by the electric utility industry to promote the reliability of bulk power transmission in the electric utility systems of North America. NERC oversees eight regional reliability entities and encompasses all of the interconnected power systems of the contiguous United States, Canada and a portion of Baja California in Mexico. NERC's major responsibilities include working with all stakeholders to develop standards for power system operation, monitoring and enforcing compliance, assessing resource adequacy, and providing educational and training resources as part of an accreditation program to ensure power system operators remain qualified. NERC also investigates and analyzes the causes of significant power system disturbances in order to help prevent future events.

However, attacks utilizing easily acquired weaponry, such as firearms, could render current substation security measures ineffective and cause significant damage to equipment, without being detected. There are currently no standards or guidelines for the hardening of substation equipment against such attacks.

Revised standards and guidelines should recommend methods of protecting key substation components against a range of plausible physical attacks based on a current risk analysis. The recommendations should be based, in part, on standards developed by the Department of Defense to prevent access, increase surveillance range, block line of site, install appropriate barriers, add armor protection, replace vulnerable components, or locate to more secure locations.

In addition, the guidelines should provide the necessary flexibility to protect personnel, installations, projects, operations, and related resources against capable threats from terrorists, criminal activity, and other subversive or illegal activities.

An interagency working group should be created including the U.S. Departments of Defense (DoD), Energy, Homeland Security and Justice and the Federal Energy Regulatory Commission to work with electric utilities and electrical manufacturers in order to adapt DoD's experience in this area to the electric grid.

Requiring deployment of advanced sensing equipment: Many transmission assets that are susceptible to damage are remote and are not monitored for damage or security. If an asset fails or is damaged, system operators do not have critical information to make informed decisions. For example, if a transmission tower collapses in a remote area, the system operator will know that the line has failed but will not be able to assess what measures are required until a crew is ultimately sent to survey the entire line after a prolonged outage.

Advanced sensors measuring temperature, vibration, tilt, tension, water level, and motion (in addition to existing terminal monitors for voltage and current) would give transmission operators a significant advantage in detecting and responding to physical issues resulting from intentional attack, severe weather or earthquakes.

Proactive substation design, including compact gas-insulated substations, will allow critical facilities to be fully enclosed and secured, and even hidden for greater protection.

11. Authorize the Department of Energy to require strategic siting of: spare power transformers; long lead-time components; and regional pools of equipment reserves.

Description of Recommendation:

Increase coordination and transparency between utilities, regulators and equipment manufacturers to ensure there are sufficient numbers and types of spare power transformers and other vital equipment reserves available near critical electrical infrastructure to allow for rapid response to a wide range of security breaches. Develop standards and guidelines for reserves of critical long lead-time substation components, such as large transformers.

Background:

Currently, there is minimal coordination between regulators, utilities and equipment manufacturers on the availability of spare power transformers for critical sites. While information on spare power transformers is shared between some utilities, there is insufficient coordination in the selection, specification and storing of spare power transformers to allow them to be rapidly deployed.

The Departments of Energy and Homeland Security and the Federal Energy Regulatory Commission should work with states to establish regional pools of equipment reserves – strategically placed to enable the prompt restoration of the bulk power system in the event of a security breach.

III. FINANCING GRID MODERNIZATION

12. Accelerated depreciation for Smart Grid technologies.

***Description of Recommendation*:**

In 2012 the NEMA Board of Governors adopted a policy supporting corporate tax reform and a system that is "predictable, efficient and has rates that are comparable to those of other advanced economies" – achieving this by broadening the tax base and lowering tax rates.

If Congress deems it appropriate to broaden the tax base and retain a limited number of simplified, high priority incentives, we propose enactment of **three technology-neutral energy efficiency tax incentives:**

- 5-year accelerated depreciation for electric grid modernization;
- deductions to encourage installation of equipment and systems to maximize or improve energy efficiency in new and existing buildings; and
- 5-year accelerated depreciation for investment in energy efficient industrial technologies.

Greater energy efficiency is a national priority that will boost economic productivity and competitiveness, enhance U.S. energy security, mitigate outages and reduce emissions. Click here for the full NEMA tax reform proposal.

***Background*:**

America's Smart Grid is a 21st century electric grid that uses two-way communications and two-way power flows to maximize the efficiency, reliability and resilience of electricity. These technologies help to isolate problems, repair them remotely, and recover more quickly from extreme weather outages; in addition, two-way power flow accommodates the integration of renewables, distributed generation and energy storage into the grid.

The proposed technology-neutral tax incentive for modernizing the electric grid would accelerate depreciation to five (5) years for investment in "smart grid technologies," the primary purpose of which is to manage or reduce energy consumption by:

(1) Sensing, collecting, monitoring or controlling energy or data on an electric distribution grid;

(2) Providing real-time, two-way communications to monitor or manage such grid;

(3) Providing real-time analysis of data that can be used to improve electric distribution system reliability, quality, and performance;

(4) Enabling grid-connected renewable generation sources, distributed generation and energy storage capacity;

(5) Improving the safety, efficiency, quality and reliability of electrical transmission through enhanced control of voltage and power flow;

(6) Reducing peak demand through demand-response systems that remotely adjust power consumption thereby reducing the need for additional power generation capacity; or

(7) Enhance the ability of the electric grid to withstand cyber or physical threats.

The proposed tax incentive will be cost effective in modernizing the grid with the following technologies:

Broad deployment of smart meters,[26] fault detection, isolation and restoration (FDIR) systems, and wireless communication networks will alert utilities when there is an interruption in power due to extreme weather events or security breaches and re-route electricity to minimize the scope of outages and enable faster restoration of services.

Advanced metering infrastructure (AMI) including smart meters will also measure consumption and empower consumers to make energy efficient decisions.

Demand-response (DR) technologies focus on reducing demand for electricity, for example devices that lower the electricity consumption of home water heaters during typical work hours. Demand-response is also a means of easing the integration of more intermittent or distant renewable resources such as wind and solar.

High voltage direct current (HVDC): HVDC transmission lines transfer power across long distances with 25 percent lower electrical losses. Moreover, by serving as a barrier between AC grids or between variable generation sources or other sensitive equipment and the surrounding grid, HVDC creates firewalls to prevent the spread of cascading outages and manage grid disturbances. Power-flow controls can also provide the electrical stability to enable black starts and interconnection of otherwise incompatible AC power networks. In addition to long-distance interconnections, HVDC is frequently used to transmit remote renewable power to major user populations.

Grid-connected storage will improve reliability; increase power quality through voltage, reactive power, and frequency support; relieve transmission congestion; extend the life of distribution equipment; increase utilization of renewables; and mitigate outages.

[26] In 2008, Congress passed the Emergency Economic Stabilization Act of 2008 which, inter alia, amended the Internal Revenue Code at Section168(e)(3)(D) to reduce the depreciation schedule of smart electric meters from 20 years to a 10 year depreciation schedule. More, recently the IRS was presented with a case late in 2012 (TAM 2012-44-015) which examined the capabilities of modern smart electric meters and found notwithstanding the 10-year depreciation scheduled mentioned above, modern two-way and remotely programmable meters qualify under another section as computer equipment and are entitled to a 5-year depreciation schedule. Unfortunately, in many states modern electric meters are saddled with the long regulatory life of their analog predecessors. Some states still impose an asset life of over a quarter of a century while other states, such as Texas, have placed a much more reasonable 7-year regulatory asset life. The average seems to be approximately 15+ years. NEMA supports a shorter, 5-year depreciation schedule for smart meters.

New technologies for easily transported spare power transformers such as single phase transformer banks will enable easier transportation and the higher likelihood of connecting with the grid at multiple points.

Modular, standardized Extra High Voltage (EHV) rapid recovery transformers will serve as temporary spares for the most vulnerable components of the grid—large power transformers. While standard high voltage and EHV transformers have replacement lead times of a year or more, these modular rapid recovery systems can be delivered and energized in under a week to provide bridge capacity.

Voltage/ VAR management[27] technologies have been used by the power industry for over 30 years to reduce electric line losses and increase grid efficiency. Today those technologies have advanced to include Volt/Volt-Ampere Reactive Optimization (VVO) sensors, equipment and software capable of reducing overall distribution line losses by 2%–5% through tight control of voltage and current fluctuations.

13. Offer federal incentive grants to states to adopt model performance-based regulatory models that reward modernization and efficiency rather than increased consumption.

Description of Recommendation:

The American Society of Civil Engineers estimates there is a *transmission and distribution infrastructure investment gap of approximately $11 billion per year, which will result in an aggregate gap of more than $730 billion by 2040.*[28] Unfortunately, utilities are hindered by antiquated business models and regulatory structures that do not properly incentivize transmission and distribution infrastructure investments. Modernized utility business models and regulatory structures are needed to encourage the investments needed to make the U.S. electric grid more reliable, more efficient, and cleaner.

Local distribution utilities are between a rock and a hard place: they are expected to improve reliability, resiliency, efficiency, and replace outdated and aging infrastructure – all at a time when their revenues are relatively flat or even declining. Electricity consumers are proving to be the game-changer in this arena as evidenced through growth in the use of distributed (decentralized) generation. Commercial and industrial customers, especially those who require higher reliability to support their operations (e.g., data centers) are even seeking out ways to supply their own generation, essentially leaving their utility and the grid behind.

With limited incentives to maintain a grid that performs beyond the standard of generally "safe and reliable service," utilities struggle to find certainty that they will be able to recover investments made in grid modernization. Cost-of-service rate-of-return (ROR) regulation remains the most commonly used regulatory model across the country. It has been used since

[27] VAR or Volt-Amphere Reactive is a unit used to measure reactive power in alternating current.
[28] American Society of Civil Engineers. "Failure to Act: The Economic Impact of Current Investment Trends in Electricity Infrastructure," 2011, accessed June 10, 2014, http://www.asce.org/uploadedFiles/Infrastructure/Failure_to_Act/SCE41%20report_Final-lores.pdf.

the inception of the monopoly, investor-owned public utility in the early 1900s. The cost-of-service is determined by state public utility commissions (PUCs) and reflects the total amount that must be collected in rates in order for the utility to recover its costs and earn a reasonable return.

While cost-of-service regulation has served the nation well in times of sustained growth and relatively low cost, it is not well suited to accommodate the large investments required to modernize our nation's grid.   Therefore, we recommend competitive federal incentive grants to states to adopt model performance-based regulatory structures that reward modernization and efficiency rather than increased consumption.

***Background*:**

The U.S. electric sector has seen decreased electricity sales in four of the past five years, and the annual rate of growth in electricity demand has decreased every decade since the 1950s. Driven primarily by technological advances in energy efficiency, distributed generation, and energy storage, as well as by government policies and market trends, electric utilities are facing a market where consumers are using less electricity, generating their own electricity, storing their own electricity, and thus relying less on grid-supplied power, or even disconnecting from the electric grid entirely. If American utilities and their regulators cannot identify a new business model and regulatory structure, the sector could face significant upheaval, including electricity price volatility, decreased reliability, and potentially utility insolvency.

As utilities continue to sell less electricity, they will be forced to increase prices to recover the costs of fixed infrastructure investments, thus increasing the cost-effectiveness of energy efficiency and distributed generation and further decreasing utility sales – a positive feedback loop known as the "utility death spiral" or "cascading natural deregulation." To address this looming problem, some European countries have begun to transition toward performance-based and incentive-based utility regulation.

United Kingdom: Revenue = Incentives + Innovation + Outputs (RIIO)

In the United Kingdom, the Revenue = Incentives + Innovation + Outputs (RIIO) model is an incentive-based regulatory mechanism that rewards utilities for meeting performance outcomes in the areas of safety, environmental impact, customer satisfaction, reliability, conditions for connection (e.g., distributed generation interconnection speed), and social obligations (e.g., services for low-income customers).

When discussing the decision to move to an incentive- and performance-based regulatory model, the UK's Office of Gas and Electric Markets (Ofgem) noted that:

> The demands of moving to a low carbon economy and meeting our renewable targets whilst maintaining safe, secure and reliable energy supplies will lead to profound changes in the way Britain produces, uses and transports gas and electricity…. Business as usual is not an option. Networks will need to be smarter, integrating increasing local renewable and intermittent sources of gas and electricity production and encouraging customers to make their demand more flexible aided by the rollout of smart meters. To accomplish this, the RIIO system places constraints on revenues, creates incentives for

> performance, encourages technological and business model innovations, and sets clear expectations for performance outputs.
>
> We are committing to a price control framework that encourages network companies to deliver in response to commercial incentives with the potential to earn higher returns and face less intensive regulatory scrutiny if they innovate and outperform in delivering a safe, secure and low carbon energy sector and value for money. Companies that do not deliver will see lower returns and more intensive regulatory scrutiny. They may also face a risk of enforcement action and potential licence revocation.[29]

By tying revenues to incentives, innovation, and outputs instead of infrastructure investments and inputs, the United Kingdom's RIIO model has revolutionized electric utility regulation. Because it allows utilities to profit by efficiently providing the outcomes that consumers want – clean, safe, reliable, and affordable electricity – the RIIO model could be used as a prototype for America's state public utility regulators to follow as they attempt to change the rules by which utilities play to help them survive in an era of upward cost pressure, limited growth, and changing customer expectation and demand.

Germany: Peer Performance Benchmarking

Germany has also incorporated elements of incentive-based regulation in its regulatory model by benchmarking utilities against each other. In Germany, regulators set allowed returns for utilities based on three types of costs: inefficient, efficient, and non-influencible. German regulators determine inefficient and efficient costs by benchmarking utilities against their peers – if a utility is paying more than one of its peers to deliver a similar service, then that would be considered an inefficient cost. German regulators have determined that inefficient costs should be eliminated by 2018. *Efficient costs* take into account the cost of providing services based on the performance benchmark adjusted for both the rate of inflation and cost reductions due to technological advances; these are kept low through regulator-set performance targets. Finally, *non-influencible costs* (e.g., employee benefits) are not bound by regulatory incentives.

To set a utility's benchmark, first an engineering model is used to identify the drivers behind utility costs and how peer utilities are delivering similar services. The criteria measured include the number of connection points (i.e., customers), the total network length, the area supplied, annual peak demand, the number of transformer stations, and the installed capacity of distributed generation resources. Next, a preliminary benchmarking study is published. Then, the benchmarking study is put through multiple rounds of public discussions before the final benchmark performance levels are established.

Transmission and distribution operators will maintain their natural monopoly status for the foreseeable future (it is not cost effective for multiple competing sets of transmission and distribution lines to be built), so it makes sense to include an operational efficiency benchmark as one incentive mechanism for utilities. By benchmarking utility performance, regulators can inject an element of competition into an otherwise monopolistic industry. This can be helpful in ensuring that customers are receiving quality services at least cost.

[29] Ofgem. "RIIO: A New Way to Regulation, Final Decision," October 2010, accessed March 22, 2014, https://www.ofgem.gov.uk/ofgem-publications/51870/decision-doc.pdf.

Utilities could be benchmarked on a number of metrics from reliability to the carbon content of their generation mix to the efficiency levels achieved by their customers. If a similar utility has found a way to deliver solar PV to customers at a lower cost per watt, then its peers could be encouraged to improve their operational efficiency to deliver that service at the same or lower cost, and rewarded or penalized for doing or not doing so.

14. Establish a national infrastructure bank (NIB) to incentivize modernization of the electric grid and other U.S. infrastructure.

Description of Recommendation:

A transition to performance-based or outcome-based rate regulatory models is a longer-term solution to financing grid modernization. In order to incentivize grid modernization investment in the short-term, we recommend Congress consider establishing a national infrastructure bank (NIB)[30] to leverage private sector investment in modernizing the electric grid and close gaps between the rate of return the private sector requires and the revenues that current rate structures can generate.

There is ample precedent for federal support of grid modernization. For example, the Rural Electrification Administration administers a $5 billion loan program that finances the operation of generating plants, electric transmission and distribution lines or systems.

Background:

The concept of an NIB has grown out of a broader need to address America's aging and inadequate infrastructure. The World Economic Forum's 2013-14 Global Competitiveness Report ranks America as nineteenth in quality of overall infrastructure.[31] The NIB could be structured to address the broad infrastructure needs of the nation -- transportation, ports, railroads, water, and electrical infrastructure – or could be focused specifically on modernizing the grid.

In either case, the Infrastructure Bank should have the following attributes:[32]

- Legislation should establish the NIB, chartered as a government corporation for the purposes of financing infrastructure improvements in the United States.

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[30] Based on a proposal by William A. Galston and Korin Davis at the nonpartisan Brookings Institution; paper released December 13, 2012: http://www.brookings.edu/research/papers/2012/12/13-infrastructure-bank-galston-davis

[31] http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf

[32] Derived from proposals in the Brookings Institution paper referenced above.

- The Charter should clearly state that the NIB does not compete with private sector lenders, but rather provides financing for infrastructure projects that would otherwise not take place because commercial lenders are either unable or unwilling.
- The bank should be initially capitalized by congressional appropriation in each of the first several years, with the goal of financial independence. The amount of appropriation would depend on the scope of the bank, i.e. broad infrastructure needs, or focused specifically on grid modernization.
- In order to achieve leverage and eventual financial independence, the bank would have to attract private investor-depositors. In addition, projects should generate a stream of revenues through user fees.

Questions about the recommendations presented in this white paper can be directed to the following NEMA staff at (703) 841-3200 or by emailing QER@NEMA.org.

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