Superstorm Amplifies Need for Power Grid Modernization

by J. Michael Barrett, John Thorne and Jeff Harner Wed, December 05, 2012

As several million Americans continue to struggle with the devastation wrought by Superstorm Sandy, it is worth asking how the nation can better prepare to weather future natural and manmade disasters. This is particularly important in considering one of the storm's most important impacts – namely, its near-total destruction of the electrical power grid and associated infrastructure in the states hit hardest by the storm (and the nor'easter that followed). The national electrical grid has been described by the National Academy of Engineering as the greatest engineering achievement of the 20th century. Another disaster similar to Superstorm Sandy, however, might make it the most vulnerable infrastructure weakness of the 21st century.

The electrical power grid was also the foundation, for 100 years, of the most profound and dynamic economic growth the world has ever seen, providing a reliable source of energy for America's industrialization and modernization. Access to dependable and affordable electricity, of course, remains critical to continued productivity and prosperity of any modern economy so heavily reliant on digital devices and ever-flowing data streams. However, the increasing frequency and severity of natural disasters and weather events in recent years, the potential impact of cyber or terrorist attacks, and the constantly growing energy needs of a still growing population all require a more resilient and reliable electrical grid that can satisfy the national demand and mitigate the risks posed by additional systemic failures.

Assessing Risks & Setting Goals

Here it is important to note that most risk estimates are based both on the likelihood of an event and its potential severity – which means that frequent but minor events such as thunderstorms trigger different policies and safeguards than are required to cope with much more serious events including terrorist attacks. However, previous calculations of the risks to the U.S. electrical grid are proving to be both inaccurate and obsolete. For instance, storms such as Hurricane Katrina and Superstorm Sandy were once considered extremely rare events and for that reason it was not believed, by the general public as well as government officials, to be cost effective to invest in large-scale preventive measures.

In recent years, though, that view is changing, and there is general (but not universal) agreement that both the frequency and the severity of destructive weather events are increasing. If that view is correct, it means that earlier cost-benefit analyses are dangerously out of date. In fact, a recently declassified 2007 report – entitled "Terrorism and the Electric Power Delivery System" and released in November 2012 by the National Academy of Sciences – suggests that the entire U.S. electrical grid system is now vulnerable to attacks by terrorists using little more than high-powered rifles at a few key locations. Although the likelihood of such an event may be quite low, the severity of a well-planned attack still could be devastating with a significant loss of life caused by the power outages that would follow. In today's massively interconnected world, small and seemingly isolated events can quickly escalate into

major systemic disruptions affecting large areas of the country. Such disruptions were demonstrated not only by Superstorm Sandy, but also by the massive 2003 northeast power blackout when some 50 million people lost power across the Northeast and Midwest for up to four days.

Given such examples, and the fact that even more massive disasters – terrorist attacks as well as weather events – are entirely possible, it seems clear that the policies in place to protect the nation's entire electric grid must be upgraded to become smarter, more resilient, and more reliable. To meet that ambitious goal, though, requires well-coordinated and factually based policy decisions.

Gaining Efficiencies by Updating & Standardizing

Fortunately, some of the changes needed are obvious. For example, former New York Governor George Pataki, writing in the 25 November 2012 issue of *The Wall Street Journal*, focused special attention on an emergency relief policy that exposes some of the fundamental weaknesses of the current system. Specifically, the Federal Emergency Management Agency (FEMA) provides funding to electric utility companies to replace damaged electrical components only when those funds are used to purchase components based on the same technology. In other words, the new components are often outdated and just as vulnerable to disruption as the old components when the next event occurs.

This highly inefficient policy not only hinders innovations and either slows or prevents rational upgrades but also actually encourages utilities to maintain inventories of technologically obsolete components – some of which are more than 30 years old. Moreover, and largely because the system was built piecemeal, such backward-looking policies create missed opportunities to foster standardization and interchangeable parts, which could cut costs by streamlining logistics and repair work.

One simple policy solution is to require the use of interchangeable parts and standardized designs for components that either can be replaced in whole or as separate modules serving discrete purposes. Adoption of this policy would make it easier for utility companies to maintain a sufficient stock of spare parts. Implementing such a policy also could modernize and standardize the interfaces of other material assets ranging from gaskets and valves to interoperable control systems and computers using seamlessly integrated enterprise software systems.

The efficiency gains achieved from the use of standardized and interchangeable parts would result not only by having many fewer parts in the overall inventory but also from making it easier to quickly replace a portion or all of a damaged system with equivalent "off-the-shelf" (as opposed to custom-designed) spare parts. This approach is already being used in many modern industries, but it was not a feature of the original designs used in the decentralized U.S. power grid infrastructure. As a result, there now is a great variance in the sizes, power requirements, weight, and other characteristics of numerous critical generation, transmission, and distribution parts.

Greater uniformity would facilitate more, and more cost-effective, repair solutions by eliminating the need to have fully redundant components in place that may go unused for days, months, and even years. An added benefit of shifting to a more uniform approach is that the various stockpiles of spare parts can quickly and easily be shared across regions – and across industry partners – and thus more broadly spread out the system-wide cost of buying and storing the same items. There would be an important safety and operational bonus as well – namely, in the event of a widespread power outage, utilities and

emergency relief services could more quickly and efficiently make needed repairs to the system in order to restore electricity.

Tough Leadership Decisions

The choice in this area facing decision-making officials at all levels of government is clear: Do they face up to the difficult challenge ahead by capitalizing on the opportunities made possible by preventive pre-event improvements, or continue business-as-usual policies based on obsolete technology and no-longer viable policies? Disturbingly, a 2009 study on natural disasters by Professors Andrew Healy and Neil Malhotra, entitled "Citizen Competence and Government Accountability: Voter Responses to Natural Disaster Relief and Preparedness Spending," found that voters rarely reward preventive spending on disasters, but they do highly reward post-event public expenditures. For that reason alone, it was no surprise that, in the aftermath of Superstorm Sandy, the voter-approval rating of New Jersey Governor Chris Christie reached an all-time high.

As history has shown, however, true leadership is demonstrated by doing what has to be or should be done, even if it is not widely recognized as important – regardless of the positive and/or negative political factors involved. Americans must better understand the current and future risks to the nation's electrical grid system – and the likely costs of failing to modernize it for the 21st century. It also would be helpful if the nation's leaders – again, at all levels of government – take the actions needed to protect and advance the vital interests in national and economic security by making the "greatest engineering achievement" of the last century viable again, both financially and technologically, for the next 100 years.

For additional information on:

Andrew Healy and Neil Malhotra, 2009, "Citizen Competence and Government Accountability: Voter Responses to Natural Disaster Relief and Preparedness Spending," visit http://myweb.lmu.edu/ahealy/papers/healy_prevention_070808.pdf

National Academy of Sciences, 2012, "Terrorism and the Electric Power Delivery System," visit http://www.nap.edu/catalog.php?record_id=12050

George Pataki, 2012, "In Sandy's Wake, Time to Upgrade the Power Grid," The Wall Street Journal, visit http://online.wsj.com/article/SB10001424127887324735104578119002091499238.html

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J. Michael Barrett is the CEO of Diligent Innovations, a D.C.-based strategy and policy consulting firm, and Adjunct Fellow with the Lexington Institute. A national security expert and noted author with an extensive background in defense policy, military intelligence, and support to U.S. counter-terrorism operations, his extensive national security credentials include serving as the Director of Strategy for the White House Homeland Security Council, Intelligence Officer for the Office of the Secretary of Defense, and Senior Analyst for the Chairman of the Joint Chiefs of Staff. He is also a former Fulbright Scholar to Ankara, Turkey.

John Thorne is a Senior Analyst at Diligent Innovations focusing on science and technology policy for national security needs. A strategic and counterinsurgency expert with an extensive background in national security and stability operations, he formerly served with the U.S. Army in Kandahar, Afghanistan, and as a Social Scientist with a Human Terrain Team at Forward Operating Base Spin Boldak. He holds an MA in International Relations from the Johns Hopkins School of Advanced International Studies.

Jeff Harner is a Senior Analyst at Diligent Innovations supporting the Office of the Secretary of Defense. An experienced business and economic analyst with an extensive background in finance, national security, and economics, he formerly served as a Department of Army Civilian in Wardak and Logar provinces, Afghanistan, and as a Social Scientist with the

Human Terrain Team. He holds an MA in International Relations from the Johns Hopkins School of Advanced International Studies.