Forbes

CIO Network

INSIGHTS AND IDEAS FOR TECHNOLOGY LEADERS.

TECH | 7/11/2012 @ 2:20PM | 2,595 views

Living In The Dark: Why The U.S. Needs To Upgrade The Grid

Eric Savitz, Forbes Staff

Guest post written by Massoud Amin

Massoud Amin is director of the Technological Leadership Institute at the University of Minnesota, and an IEEE senior member,

Massoud Amin

In July 1977, I was a 16-year-old high school student visiting New York City, excited to see the Statue of Liberty, the Empire State Building and other iconic sights. While I was there, lightning triggered a 24-hour blackout that cut power to nine million residents. During the darkness, I witnessed both the chaos and kindness that result from severe power outages. Looters smashed their way into electronic stores, there were about 3,800 arrests, fires burned across the city and normal life came to a halt.

On that trip I saw a great city in distress due to the immense impact of power loss on the function of modern society and our economy. I saw an electric power system that desperately needed to be upgraded to meet the demands of modern living.

Yet, more than three decades later, our power system is still subject to extensive, long-term outages. In the past few weeks, massive storms left millions of Americans across nine states to struggle in the scorching heat without electricity for days on end. And, as witnessed during these recent blackouts, a loss of power literally puts a stop to our regular, daily activity. Our economy and quality of life fundamentally depend on reliable and disturbance-free electricity.

Stuck In The Past

The electric power grid system has been hailed by the National Academy of Engineering as the most influential engineering innovation of the 20th century. However, in the U.S., one of the most advanced economies in the world, we continue to operate our electric system with technology primarily from the 1960s and '70s. And, while power outages aren't national tragedies, the results are damaging. In the long-term, they are costly to our nation's prosperity, annually adding $80 billion to $188 billion to U.S. expenditures, and in the short-term, literally shutting down businesses, cities and normal

life as we know it for days.

What has caused this hindrance in development? Quite simply, we've wasted 10 years arguing the roles of the public and private sectors while our global competitors adapt and innovate. We need to renew public/private partnerships, cut red tape and reduce the cloud of uncertainty on the ROI of modernizing and upgrading infrastructure.

The electric power sector is second from the bottom of all major U.S. industries in terms of R&D spending as a percentage of revenue, exceeding only the pulp and paper industry. In fact, R&D represented a meager 0.3 percent of net sales between 1995 and 2000, declined even further to 0.17 percent between 2001 and 2006 and has continued to hover on the extreme low-end of the spending scale for the past decade.

However, as the digitization of society continues to expand, it becomes increasingly critical that we make investments in development if we want to accommodate the growing need for electricity. In fact, it is projected that the world's electricity supply will need to triple by 2050 to keep up with demand.

Consider that the end-to-end infrastructure it takes to keep up with our Tweeting habit is responsible for more than 2,500 MWh per week of demand on the grid that simply did not exist before the application's advent. Factor in other services such as Internet TV, video streaming, online gaming, the digitization of medical records and more, and it is clear we need a stronger and more efficient electrical-energy infrastructure.

Getting "Smart" About Infrastructure

I believe that the best solution to modernize and upgrade the U.S. electric power system is to transition to a self-healing Smart Grid. The Smart Grid is a highly developed electrical platform that engages consumers, enhances efficiency, ensures reliability and enables integration of renewable energy and electric transportation. The system works quite simply – the Smart Grid starts at the fuel supply, links to the electrical power generator and ends at your lamp, refrigerator or other electrical device.

A self-healing Smart Grid can provide a number of benefits that lend to a more stable and efficient system. Three of its primary functions include: real-time monitoring and reaction, which allows the system to constantly tune itself to an optimal state; anticipation, which enables the system to automatically look for problems that could trigger larger disturbances; and rapid isolation, which allows the system to isolate parts of the network that experience failure from the rest of the system to avoid the spread of disruption and enable a more rapid restoration.

As a result of these functions, a self-healing Smart Grid is able to reduce power outages and minimize their length when they do occur. A Smart Grid is able to detect abnormal signals, make adaptive reconfigurations and isolate disturbances, eliminating or minimizing electrical disturbances during storms or other catastrophes. And, because the system is self-healing, it has an end-to-end resilience that detects and overrides human errors that can result in power outages, such as when a worker error left millions of California residents without electricity in September 2011.

Implementing The Stronger and Smarter System

To transform our current infrastructure into a self-healing Smart Grid, several

technologies must be deployed and integrated.

The ideal Smart Grid system consists of microgrids, which are small, mostly self-sufficient power systems, and a stronger, smarter high-voltage power grid, which serves as the backbone to the overall system. Where do we begin?

The first step is to build a processor into each switch, circuit breaker, and transformer, which will allow transmission lines to securely communicate with each other and monitor their individual pieces of the grid.

From there, the millions of electromechanical switches currently in use will need to be replaced with solid-state, power-electronic circuits to handle the highest transmission voltages of 345 kilovolts and beyond. This upgrade from analog to secure digital, will allow the entire network to be digitally controlled, making the Smart Grid's key functions of real-time self-monitoring and self-healing possible.

The ideas behind a Smart Grid system are more than just conceptual. Engineers around the world are showcasing the benefits of Smart Grid through field-tests and implementation projects, some of which are featured in the IEEE Smart Grid Newsletter, a monthly online publication on Smart Grid developments and deployments.

Of course, as with any advancement, developing the Smart Grid system will require financing, which is why now is the time to get serious about gaining speed in infrastructure investments. It will cost an estimated $338 to $476 billion to realize the envisioned smarter, self-healing delivery system of the future, which translates into annual expenditures of $17 to $24 billion over the next 20 years.

While implementing the system comes with a high price tag, the investment in a Smart Grid system will nearly pay for itself by reducing stupendous outage costs, a savings of $49 billion per year, and improving energy efficiency, resulting in a savings of $20.4 billion per year.

As a nation, we must take action to improve our electric grid if we want to meet the power needs of a pervasively digital society. Americans should not accept or learn to cope with increasing blackouts. Nor should we rest on the notion that the technical know-how, political will or money to bring our power grid up to 21st-century standards do not exist. If we want our future to be bright, I believe the Smart Grid must be part of it.
