Americans for a Clean Energy Grid

# Introduction

On August 14, 2003, the United States experienced the worst electrical blackout in its history. About 50 million people lost power for up to two days, the cost of the blackout was estimated at $6 billion, and worse, at least 11 people lost their lives. [1]. The nature of the blackout was a “cascading failure,” where the failure of one high voltage transmission line overloaded other high voltage transmission lines in different parts of the electric grid, causing them to overheat and fail themselves [2]. With multiple high voltage transmission lines down, electricity produced by power plants in the region had nowhere to go, and they were forced to shut down [2]. It can take extended periods of time to get the system back up and running at full capacity. Utilities and state and federal regulators should have seen this coming. Increases in transmission capacity were occurring at a far slower rate than were increases in electricity demand, resulting in a system that could not ensure a reliable supply of electricity. Additionally, the system lacked the communications and wide area monitoring capabilities that could have averted or reduced the scope of the electric blackout. In summary, these transmission system inadequacies and more caused the 2003 blackout [2].

The transmission network in the United States is antiquated, with roughly 70% of the high voltage transmission lines being 25 years old or more [2]. Learning from the 2003 electrical blackout, the federal government, utilities and independent transmission companies are heavily investing in the transmission system to make it more resilient, more efficient, and more reliable and to increase the penetration of remote renewable energy sources. In 2012, $14.8 billion was invested in the transmission system, and transmission investments for 2013 are predicted to be $17.5 billion [3]. Investments in the transmission system are necessary to ensure that the system continues to transmit electricity both reliably and affordably. These investments are often directed towards building new transmission lines to alleviate congestion, or building new lines to transmit renewable power such as wind and solar from remote locations to demand centers. Investments are also directed towards upgrading existing infrastructure to more efficient technologies, and reducing line losses.

Beyond those basic investments, there are a number of technologies in various stages of deployment. Synchrophasors, dynamic line ratings, grid-scale energy storage, volt-VAR optimization, high voltage direct current transmission, high-temperature low-sag transmission lines, and smart solar inverters are some technologies that create incremental improvements of the transmission system. All of these technologies will help address the inadequacies of the grid in their own ways, whether that be through increasing reliability and resiliency, increasing efficiency, decreasing costs, or reducing emissions that contribute to climate change. This report analyzes each of the above mentioned technologies; it explains how they work, what benefits they offer, what is the cost of their deployment, and gives examples of pilot and demonstration projects that deploy these technologies.

**References**

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[3] Edison Electric Institute, Transmission projects: At a glance. Accessed on July 9, 2014. Retrieved from http://www.eei.org/issuesandpolicy/transmission/Documents/Trans_Project_executivesummary.pdf