2009 INFRASTRUCTURE FACT SHEET

ASCE American Society of Civil Engineers

Progress has been made in grid reinforcement since 2005 and substantial investment in generation, transmission, and distribution is expected over the next two decades. Demand for electricity has grown by 25% since 1990. Public and government opposition and difficulty in the permitting processes are restricting much needed modernization. Projected electric utility investment needs could be as much as $1.5 trillion by 2030.

FACTS ABOUT

ENERGY

ENERGY 2009 GRADE D+

RAISING THE GRADES

SOLUTIONS

THAT WILL WORK **NOW**

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

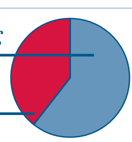
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **ENERGY**

Total investment needs
$75 BILLION

Estimated spending
$45.5 BILLION

Projected shortfall
$29.5 BILLION



- ★ **MAINTAIN** and **EXPAND** power generation and transmission infrastructure to meet increased demand projections and maintain the nation's energy security;
- ★ **IMPROVE** the electricity infrastructure system to support an integrated operation and control scheme that provides reliable and safe electricity;
- ★ **DESIGN** and construct adequate transmission infrastructure to provide reserve margins and operating capacity;
- ★ **CREATE** incentives to promote energy conservation and the development and installation of highly efficient fossil and nuclear generation and renewable technologies;
- ★ **ESTABLISH** a long-term generation research and development plan to extend current energy supplies through new and potential energy sources;
- ★ **CONTINUE** research in areas related to improving and enhancing the nation's transmission and generation infrastructure;
- ★ **EDUCATE** the public and government officials of the function that the transmission infrastructure plays in the role of our society and the need for new transmission lines to support those expectations.

CONDITIONS

There are more than 3,100 electric utilities in the United States. Among them are 213 stockholder-owned utilities that provide power to about 73% of the customers; 2,000 public utilities run by state and local government agencies that provide power to about 15% of the customers; and 930 electric cooperatives providing power to about 12% of the customers. Additionally, there are nearly 2,100 nonutility power producers, including both independent power companies and customer-owned distributed energy facilities. The bulk of the power system consists of three independent networks: the Eastern Interconnection, the Western Interconnection, and the Texas Interconnection. These networks incorporate international connections with Canada and Mexico. Overall reliability planning and coordination is provided by the North American Electric Reliability Council, a voluntary organization formed in 1968 in response to the Northeast blackout of 1965. America operates about 157,000 miles of high-voltage (greater than 230 kilovolts) electric transmission lines.[1]

While annual investment in new transmission facilities has generally declined or been stagnant during the last 30 years, there has been an increase in investment during the past 5 years.

The U.S. generation and transmission system is at a critical point requiring substantial investment in new generation, investment to improve efficiencies in existing generation, and investment in transmission and distribution systems. The transmission and distribution system has become congested because growth in electricity demand and investment in new generation facilities have not been matched by investment in new transmission facilities. This congestion virtually prohibits outages required for proper maintenance and can lead to system wide failures in the event of unplanned outages. Electricity demand has increased by about 25% since 1990 while construction of transmission facilities decreased by about 30%. While annual investment in new transmission facilities has generally declined or been stagnant during the last 30 years, there has been an increase in investment during the past 5 years. Substantial investment in generation, transmission, and distribution are expected over the next two decades and it has been projected that electric utility investment needs could be as much as $1.5 to $2 trillion by 2030. Some progress in grid reinforcement has been made since 2005, but public and government opposition, difficult permitting processes, and environmental requirements are often restricting the much-needed modernization.[6]

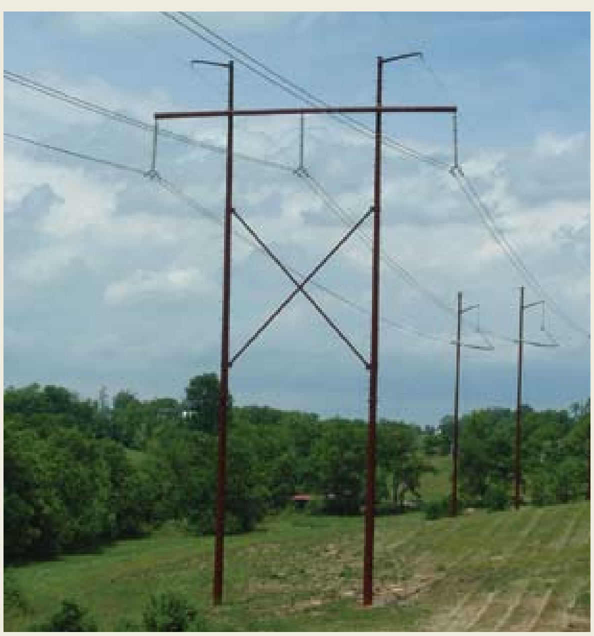
Congested transmission paths, or "bottlenecks," now affect many parts of the grid across the country. One recent estimate concludes that power outages and power quality disturbances cost the economy between $25 billion and $180 billion

RAISING THE GRADES
CASE STUDIES

VA / WV ★ American Electric Power's (AEP) Jacksons Ferry-Wyoming 765 kV Transmission Line

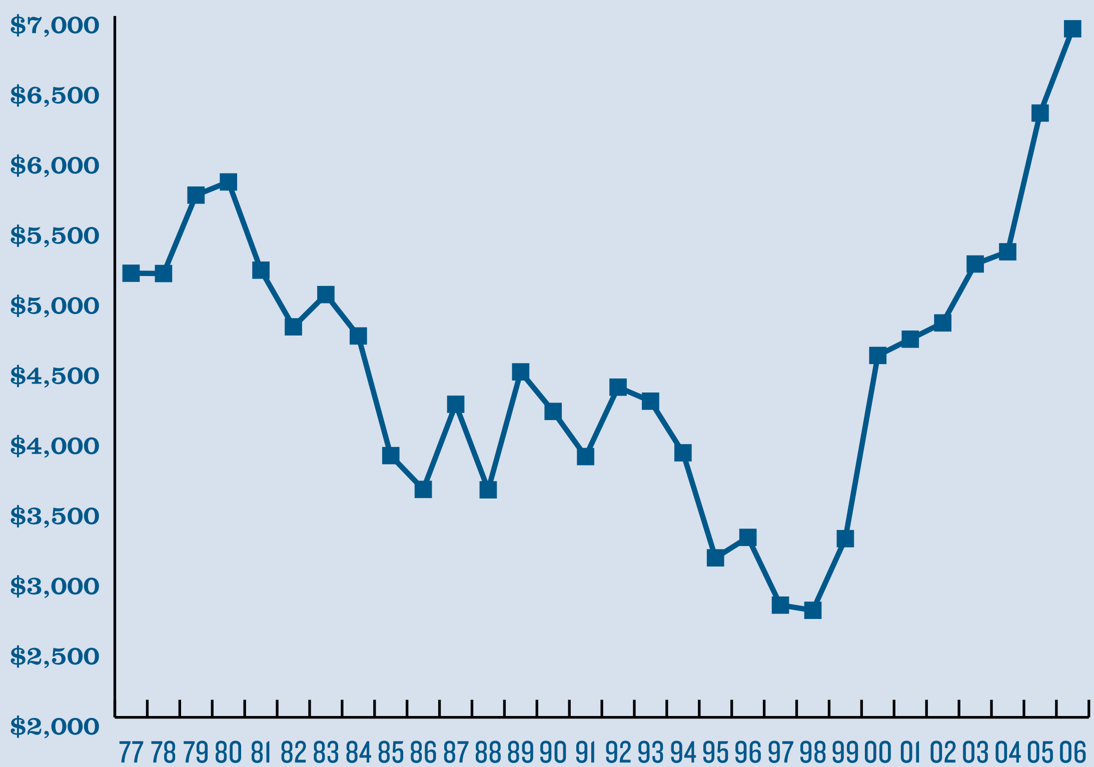
AEP's Jacksons Ferry to Wyoming 765 kV line stretches across 90 miles of mountainous terrain from southern West Virginia to southwest Virginia. The project was built to reinforce system reliability and meet the need of increasing load in an area that had not had a major reinforcement in more than 35 years. It was energized in June 2006 and is one of the most technologically advanced transmission lines in the United States. The line is North America's first utilization of a six-conductor bundle, which greatly reduces line losses and audible noise. Permitting for the line began in 1990 and the final permit was obtained in 2002. The project's construction required approval from two states and three federal agencies. *Photo courtesy of American Electric Power.*

KENTUCKY ★ Smith to North Clark 345 kV Transmission Line



East Kentucky Power Cooperative has constructed one 345 kV line and another is under construction in central Kentucky. The 19-mile Smith to North Clark 345 kV transmission line was completed in 2006 and the 36-mile Smith to West Garrard 345 kV transmission line is currently under construction and due to be completed in 2009. These EHV lines were constructed to complete a second EHV path across Kentucky to accommodate the high level of north-south transfers that are common for the region. *Photo courtesy of East Kentucky Power Cooperative.*

FIGURE 15.1 ★ Construction Expenditures for Transmission in Millions of 2006 Dollars: 1977–2006



SOURCE Edison Electric Institute Statistical Yearbook 2006

annually. These costs could soar if outages or disturbances become more frequent or longer in duration. There are also operational problems in maintaining voltage levels. Transmission problems have been compounded by the incomplete transition to fair and efficient competitive wholesale electricity markets. Because the existing transmission system was not designed to meet present demand, daily transmission constraints or "bottlenecks" increase electricity costs to consumers and increase the risk of blackouts.[3]

Many new transmission lines have been proposed to either alleviate these congested paths or to provide redundancy so that existing portions of the transmission system can be temporarily taken out of service for proper maintenance and modernization. In many cases funding is not the primary reason why these critical lines are not being built. Overly stringent permitting requirements, lawsuits, and other regulatory issues often inhibit construction of transmission lines.

RAISING THE GRADES CASE STUDIES

ARIZONA ★ Palo Verde to Pinal West 500 kV Project

On October 15, 2008, the Palo Verde-Pinal West Project went into commercial operation. The PV-PW Project will serve Pinal and Maricopa counties in Arizona and consists of a new 55-mile single circuit 500kV transmission line that connects the Palo Verde area to the new Pinal West Switchyard. The PV-PW Project has 6 Participants: Electrical District 2, Electrical District 3, Electrical District 4, Salt River Project, Southwest Transmission Cooperative and Tucson Electric Power Company. The capacity of the line is 1,400 MW and will increase the Arizona transmission system capacity in Pinal and Maricopa Counties. *Photo courtesy of Black & Veatch.*

The distribution side of the grid system includes substations, wires, poles, metering, billing, and related support systems involved in the retail side of electricity delivery. The need to expand the distribution infrastructure and install new distribution equipment to meet population and demand growth will require continued investment. Electric companies are estimated to spend $14 billion per year on average over the next 10 years on distribution investment. Over the next decade, distribution investment is likely to exceed capital spending on generation capacity as well.

There is also a need to design our distribution systems for a higher reliability. During Hurricane Wilma, a Category 2 hurricane, the winds were substantially below the design wind loads required by the National Electric Safety Code (NESC). The NESC excludes facilities less than 60 feet high from these wind load requirements in the belief that most of these facilities are taken down by flying debris. But 75% of the distribution poles failed because of wind loads only. If these structures had been designed for the 90 mph winds required by NESC on transmission structures, distribution outages would have been reduced. The NESC and utilities need to address the design of these structures to meet the current transmission loading criteria. Utilities that make an investment to "harden" their distribution system should also be guaranteed a rate of return on their investment.

RESILIENCE

The national electric grid currently lacks a significant degree of resilience. Utilities are generally prepared for local and regional responses; however, the national electric grid as a whole lacks a significant degree of resilience should a much broader response be required. Future investments in the system must improve system robustness, redundancy, and rapid recovery. Additionally, new technologies and behavioral changes focused on reduction and increased efficiency are necessary. True system resilience will require a national effort to modernize the electric grid to enhance security and the reliability of the energy infrastructure and facilitate recovery from disruptions to energy supply, from both natural and man-made hazards.

CONCLUSION

The "information economy" requires a reliable, secure, and affordable electric system to grow and prosper. Unless substantial amounts of capital are invested over the next several decades in new generation, transmission, and distribution facilities, service quality will degrade and costs will go up. These investments will involve new technologies that improve the existing electric system and possibly advanced technologies that could revolutionize the electric grid. While much is still left to be accomplished, recent efforts have raised the grade to a "D+" in the 2009 *Report Card*. ★

RAISING THE GRADES CASE STUDIES

WISCONSIN ★ Arrowhead to Weston 345 kV Transmission Line

The American Transmission Company completed the 220-mile Arrowhead to Weston 345 kV transmission line in 2008. This project recently earned the ASCE State of Wisconsin Category D (over $20 million) Engineering Achievement Award. Originally proposed by Wisconsin Public Service Corporation and Minnesota Power in 1998, the American Transmission Company (ATC) took over the Arrowhead to Weston project in 2002. In January 2008, 10 years after the project was first proposed and 4 years after the start of construction, crews completed the line, marking the first high-voltage infrastructure addition to the system in nearly 30 years.

At a total cost of $435 million, the Arrowhead to Weston project offered several major challenges in the development, design, and construction phases. Now that the line is in service, it offers a significant benefit to the local and regional grid. Arrowhead Weston provides a reliable interstate connection to cheaper western generation, as well as the opportunity to perform much needed maintenance on the other lines that could not be accessed before. *Photo courtesy of the American Transmission Company.*

SOURCES

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3 U.S. Energy Department, Office of Electricity Delivery and Energy Reliability, *2009 Congestion Study*: www.congestion09.anl.gov/ and comments at www.congestion09.anl.gov/involve/searchcomment/index.cfm.

4 Edison Electric Institute, *Industry Issues,* 2008.

5 Edison Electric Institute, *EEI Principles on Transmission Investment,* 2005.

6 KEMA, Inc. for Florida Power & Light Company, *Technical Report: Post Hurricane Wilma Engineering Analysis,* January 12, 2006: www.psc.state.fl.us/utilities/electricgas/EIProject/docs/FPL_Pre_Workshop_Responses-Wilma.doc.

7 U.S. Energy Department, Office of Electricity Delivery and Energy Reliability, *Gridworks,* 2008: www.energetics.com/gridworks/grid.html.

8 U.S. Energy Department, *National Transmission Grid Study,* 2002.