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Berkeley Lab Study Estimates $80 Billion Annual Cost of Power Interruptions

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BERKELEY, CA – A study conducted by Lawrence Berkeley National Laboratory (Berkeley Lab) researchers Kristina Hamachi-LaCommare and Joe Eto for the U.S. Department of Energy's Office of Electric Transmission and Distribution estimates that electric power outages and blackouts cost the nation about $80 billion annually.

Berkeley Lab researchers Kristina Hamachi-LaCommare and Joe Eto estimate that electric power outages and blackouts cost the nation about $80 billion annually.

The costs of these power interruptions, which can last from just seconds to days, is a key missing element from recent discussions to modernize the grid. "The big blackout that hit the northeast in the summer of 2003 really focused attention on the state of the electric power grid," says Hamachi-LaCommare, who, like Eto, is a staff scientist with Berkeley Lab's Environmental Energy Technologies Division. "Immediately after the blackout, there were calls for investments to modernize the grid ranging from $50 and 100 billion. We wanted to add a key missing piece of information to these discussions, namely, the value these investments might bring in the form of improved reliability or fewer or shorter power interruptions."

The starting point lies in establishing a baseline on how much these interruptions cost businesses and consumers today. After reviewing the literature and finding significant gaps in previous estimates, Hamachi-LaCommare and Eto began to systematically assess and fill these gaps.

The Berkeley Lab study aggregates the best available data from three sources: surveys on the value electricity customers place on uninterrupted service, information recorded by electric utilities on power interruptions, and information from the U.S. Energy Information Administration on the number, location and type of U.S. electricity customers. Based on the data available, the researchers divided power interruptions into those that last less than five minutes, and those that are longer. The longer interruptions are generally characterized by their duration (length of time of each interruption), and frequency (number of interruptions per service territory).

The researchers caution that there are uncertainties in the available data on power interruptions, and

these gaps could mean that the true costs of interruptions could be higher or lower by tens of billions of dollars. They have called for a national effort to collect better information on these costs.

Costs by Sector

The study estimates the total cost to the U.S. of power interruptions at about $80 billion per year. Of this, $57 billion (73 percent) is from losses in the commercial sector and $20 billion (25 percent) in the industrial sector. “The reason for the commercial sector’s high share of these cost is the large number of commercial sector customers, which includes small as well as large businesses, and the high cost per outage per customer,” notes Hamachi-LaCommare. The industrial sector’s cost per outage per customer is significantly higher than those of the commercial customers, but there are only 1.6 million industrial customers, compared to 14.9 million commercial customers.

The authors estimate residential losses at $1.5 billion, or only about 2 percent of the total. Yet, Eto notes, “It is difficult to put a dollar value on the inconvenience or hassle associated with power interruptions affecting residential electricity customers. In addition, our method did not take into account the effects on residential customers of extended outages lasting many hours or days, since these are very rare occurrences, according to the data we were able to collect. A problem with the data is that some utilities, by convention, do not include outages caused by major natural events, such as hurricanes or ice storms, in their statistics.”

Momentary electric power interruptions, because of their frequency, have a bigger impact on total costs than sustained interruptions, which are less frequent.

Another important conclusion of the study is that momentary interruptions, which are more frequent, have a bigger impact on the total cost of interruptions than sustained interruptions, which are less frequent. Momentary interruptions were responsible for two-thirds of the cost, at $52 billion, while sustained interruptions of five minutes or more caused $26 billion. “This finding underscores that fact that, for many commercial and industrial customers, it is the length of the ‘down-time’ resulting from a loss of power that determines the cost of interruption, not necessarily the length of interruption itself,” according to Eto.

Uncertainties in the Estimates

Hamachi-LaCommare and Eto estimated how their assumptions about the key parameters of power interruptions might have biased their results. Assuming that all power interruptions take place on hot summer weekday afternoons when power costs are high (an assumption known to be false) leads to an estimate of $119 billion in annual cost. Assuming that large commercial/industrial consumers experience higher levels of reliability than do residential consumers leads to a cost as low as $23 billion. Commercial and industrial customers may invest in more reliable power, (e.g., energy storage or distributed generation), or a utility’s design of its distribution systems may provide it to them.

Another problem is the lack of data on power quality. A “power interruption” refers to a complete loss of electrical power, but the grid also experiences “power quality events,” which occur when the power supplied to customers deviates from the standard that electric utilities try to deliver. That standard is 60

cycles per second, alternating current at 120 volts for residential and 480 volts for commercial industrial customers. Electronic equipment, from computers to industrial control systems, can stop functioning or suffer damage during a power quality event, so power quality has become a larger concern of the commercial and industrial sectors. However, the Berkeley Lab study found that there was currently not enough data available to estimate the costs from power quality problems.

For these reasons, Hamachi-LaCommare and Eto recommend that the utility industry and its regulators improve the collection of data on power interruptions and power quality. They encourage policy-makers, regulators, and industry to coordinate their collection of power interruption data, improve the recording of frequency and duration data, and collect more information on the costs and efforts of consumers to recover from power outages. Eto concludes “Given the high stakes involved in decisions regarding who should invest how much to improve the grid, it is imperative that we rely on the best possible information on one of the key expected benefits from these investments, namely improvements in electricity reliability.”

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Additional Information

- For more information, contact Joe Eto **(510) 486-7284** , JHEto@lbl.gov
- A copy of the full report, which is titled, *Understanding the Cost of Power Interruptions to U.S. Electricity Consumers,* can be downloaded from the following URL under the category **Electricity Reliability and Power Quality**: http://certs.lbl.gov/CERTS_P_Reliability.html

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