New Studies Reveal Customer Demand and Cost of Supplying Power During an Outage

MCLEAN, Va. (July 5, 2017) - Long-lasting electrical outages can lead to severe individual and societal impacts, including significant economic losses and even death. A set of companion papers recently published in Risk Analysis found that it would be economically feasible and socially advantageous for electrical companies to provide a partial backup service to customers during a blackout.

Against a backdrop of economic, environmental and security-related challenges, the aging U.S. power system must continue to provide reliable service to customers. A string of natural disasters and prolonged blackouts have motivated consumers to invest in personal generators at unprecedented rates, but a low-ampereage backup service would better serve the people and their wallets.

The pair of papers, “Assessing the cost of large-scale power outages to residential customers” and “Providing limited local electric service during a major grid outage - A first assessment based on customer willingness to pay,” examined residential power users’ willingness to pay (WTP) for full or partial backup services during a theoretical 24-hour blackout and then determined the investments required by the electrical provider to implement these services.

Large power outages are expected to become more frequent as the result of a changing climate, where the frequency and intensity of extreme weather events is increasing, as well as geomagnetic storms and attacks on grid infrastructure. According to the authors, new technologies have made it possible to sustain critical social services and serve high priority customer loads during an extended blackout.

The researchers, Sunhee Baik, M. Granger Morgan and Alexander Davis, from Carnegie Mellon University, developed an elicitation framework (a systematic set of questions and tasks) to obtain judgments from residents of Allegheny County, in western Pennsylvania, about their WTP for full and partial backup service during a 24-hour power outage during a hot summer weekend. The 73 participants were recruited locally throughout the county for participation in a face-to-face interview in addition to three surveys.

The project found that respondents valued backup service for their high priority loads such as basic lighting and refrigerators more than that for their low priority loads including speaker docks, DVD players and televisions. As respondents received more information about potential monetary losses and inconveniences, their WTP for the partial backup service to meet HP loads increased by 56% (from $0.75/kWh to $1.20/kWh) while their WTPs for power to serve LP loads decreased. The initial WTP for HP loads was valued at $0.75/kWh while the value for serving LP loads was significantly lower at $0.51/kWh.
Utilities can substantially reduce their disruption costs, as well as social costs, by continuing to supply at least a small amount of electricity to serve HP demands during outages. Whether making the investment to provide this service makes sense depends on three factors: 1. An assessment by the community of the likelihood of future long-term outages; 2. The incremental cost of system upgrades to provide the service; and 3. The willingness of individuals and the community to cover the costs of the incremental investments.

To estimate the cost to upgrade control and protection equipment for a feeder (low voltage wiring that supplies peoples’ houses), the researchers consulted with the director of distribution planning for a major urban utility. The total cost was about $100,000 for a feeder covering 2,500 customers with additional annual operation and maintenance costs of approximately five percent of the initial capital cost. It is assumed the upgraded technologies will last 20 years. Basic smart meters will also need to be upgraded to include a battery backup for supplying low-amperage service during an outage at a cost of $50 per meter.

If the region suffers a 24-hour outage once every five years, on average, the backup service can be justified when all residential customers pay $63. The price increases to $95 and $170 when blackouts only occur once every 10 years and 20 years, respectively.

“Order-of-magnitude calculations suggest that implementing a low-amperage backup service appears to be more cost effective than having each homeowner buy a portable generator and storing diesel or gasoline for fueling, especially if a region is expected to suffer more frequent and longer widespread outages,” says Sunhee Baik, lead author and doctoral student in engineering and public policy at Carnegie Mellon University.

Some of the variation in WTP choices is likely due to customers’ varying assessments of the degree of inconvenience to themselves, but some is also likely related to ability to pay. If a community implements a backup service system, the authors suggest that it cross-subsidize service to very low-income residents. This could be done by adding a small monthly backup service insurance charge, of less than one dollar, to all customer bills, assuming that various financial assistance programs that cover energy bills would cover the insurance costs. A general tax also could be added, which would be roughly proportional to individual incomes.

A low-amperage backup system can also generate non-monetary benefits that were not studied by the researchers during the assessment. Some disaster-prone regions might be able to secure funds from Federal stimulus and disaster relief programs to cover upgrade costs.

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