Building Resilience: 6 Lessons from Superstorm Sandy

Published on **20 Dec 2012**

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Posted in **Advocacy and policy**

Utility crews at work in Seaside Heights, N.J., after Superstorm Sandy. Photo credit: Western Area Power Admin via Flickr

Superstorm Sandy forced many people to abandon the homes, offices, schools, churches and stores in their communities for extended periods of time to seek refuge. This extreme event placed a heavy burden on those affected and was a test of how well these buildings were designed and operated. The results were mixed.

As we reflect on how well our buildings and energy systems met the challenge and how we can do better moving forward, we should consider three overall objectives of building resilience: 1) minimizing damage to critical infrastructure during the event; 2) maintaining operational integrity and critical services immediately following the event; and 3) returning the building to normal, safe operating conditions as soon as possible. The following are six lessons that should help guide the redesign and reconstruction of our buildings, cities and energy infrastructure to be more resilient.

1. Reduce the initial damage to building systems and infrastructure.

Major electrical and mechanical equipment that provides critical services should be installed in locations unlikely to be flooded. This can be accomplished by installing equipment above ground level or providing underground storm water holding areas or diversion paths. Burying electrical lines underground is another practice to increase reliability and robustness. These practices need to make their way into building codes, as they are much more practical and cost-effective to implement during initial construction or reconstruction.

2. Improve the reliability of emergency backup systems.

Anecdotal estimates suggest that up to half of New York City buildings' emergency backup generators failed to start when they were needed. This was due to a lack of maintenance and regular full-load testing. Many generators ran out of fuel in a day or less, as they were unable to receive supplemental fuel deliveries. The conventional practice of storing one day's worth of fuel supply on-site needs to be reconsidered, given the increasing likelihood of severe storm events in the future.

3. Have buildings support limited critical services for extended periods of time.

After Superstorm Sandy, most grid-connected solar photovoltaic (PV) systems were not operational because of safety systems installed to protect utility workers and grid integrity on restart. This was a surprise to many business- and homeowners who had invested in solar PV systems, expecting their buildings to be powered at least during daylight hours. Availability of even a limited amount of renewable energy, such as solar or microwind, combined with energy storage and a secure grid disconnect mechanism, would allow buildings to provide critical services over extended periods of time.

4. Designate and upgrade select buildings to provide critical community services.

With so many people displaced from their homes and workplaces, designated locations should be established in each community to provide critical services such as shelter, food, water, electricity and communications. Renewable energy with energy storage, or microgeneration with on-site fuel supplies, could help meet critical needs at schools, community centers, churches and other designated locations.

5. Use passive design principles to increase building resilience.

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Passive approaches to providing electrical power, such as renewable energy, and passive building designs can increase building resiliency. Passive design principles — including building envelope, natural ventilation, shading, and water capture and storage — allow buildings to provide adequate comfort and water without requiring a significant energy supply. When severe storms or other events are accompanied by excessively hot or cold weather, providing comfortable and safe environments using minimal energy resources is highly desirable. An additional benefit is that buildings designed using passive principles will be significantly more energy efficient and have a lower environmental impact during normal day-to-day operation.

6. Use distributed generation and microgrids to increase community resilience.

Dependence on a centralized electrical grid is a definite liability given the extended time that is sometimes required for utilities to bring entire communities back online after a severe storm event. During Superstorm Sandy, large numbers of overhead power lines went down over an extended distance, making repair-crew logistics challenging. Microgrids, supported by distributed energy generation, are a potential solution, as they allow decentralized energy distribution at a community scale. At a community scale, the application of district heating, cooling and energy plants and renewable energy generation is more scalable, cost-effective and resilient than their use in individual building applications. Water treatment and other critical services can also be provided more cost-effectively within a community-scale microgrid. The U.S. Department of Defense is at the leading edge of designing and installing microgrids to maintain operational integrity and improve resilience, and it can set an example for cities, communities and campuses to follow.

Many of us involved in designing and operating the built environment have been promoting the environmental, economic and social benefits of more efficient and sustainable buildings for decades. There have also been strong voices in the sustainable energy industry calling for the greater use of renewable energy, distributed generation and district energy systems as a more cost effective and environmentally sound approach to meeting future energy needs. As we learned in Superstorm Sandy, many of the same design and operational principles that lead to greater sustainability can also lead to greater resilience. As if improving efficiency, reducing costs, creating jobs and protecting the environment weren't enough, we can now add increasing resilience to the list of benefits resulting from more sustainable buildings and energy systems.

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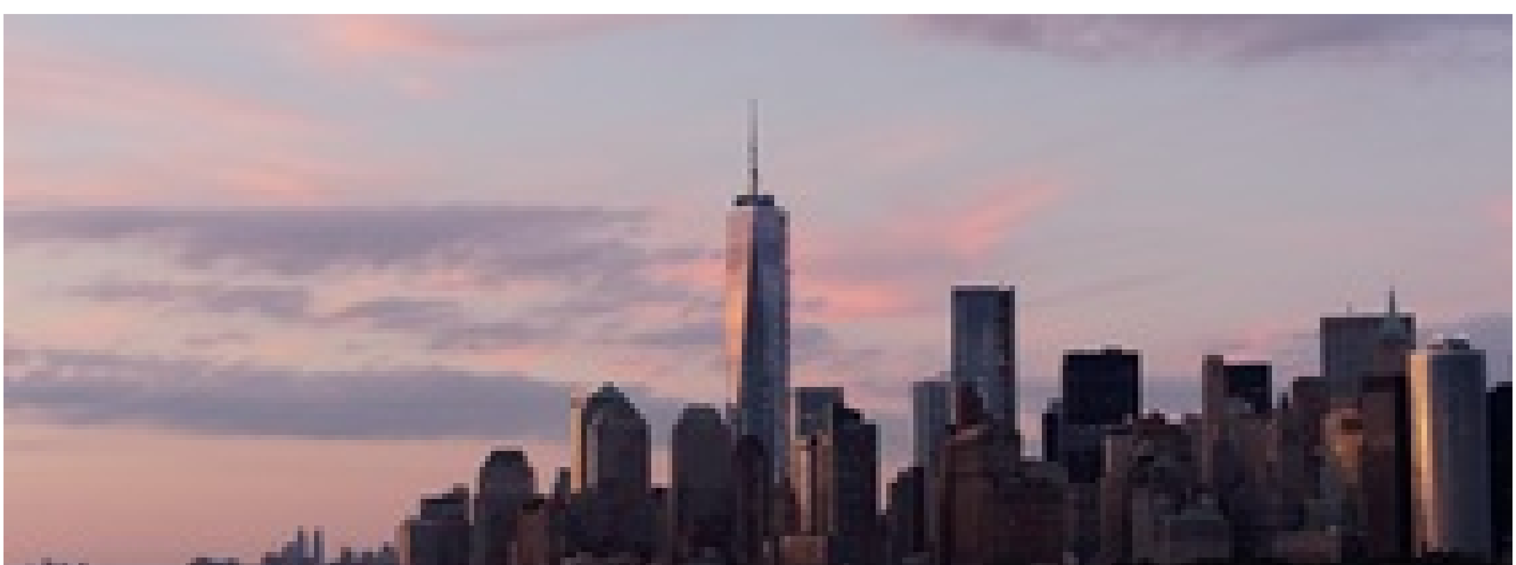

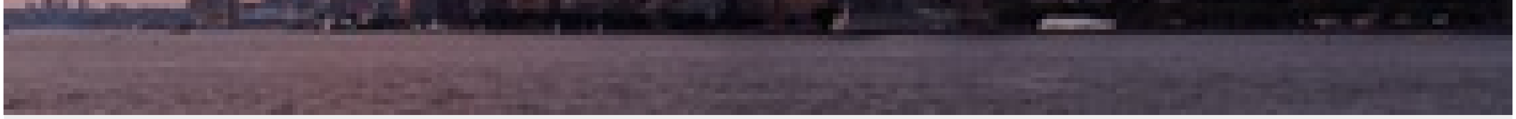

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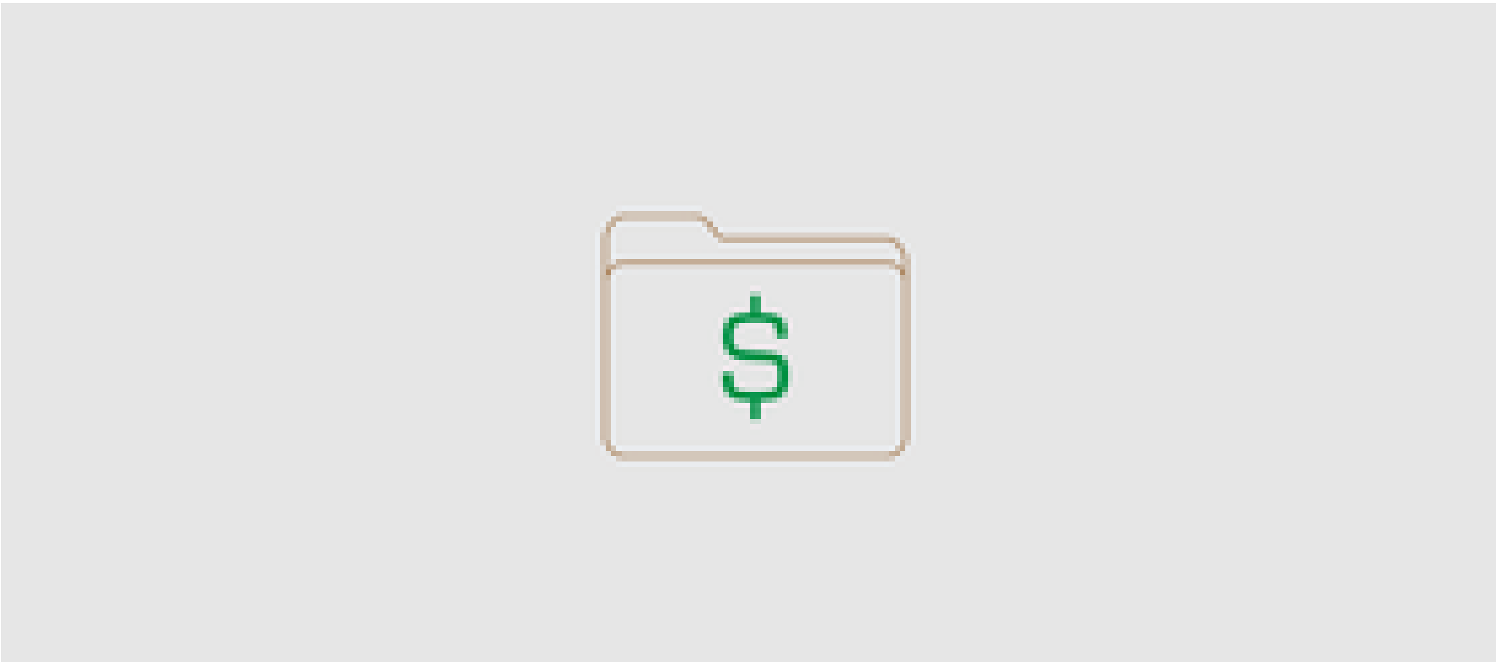

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