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FEATURE: HURRICANE SANDY

The Microgrid Solution

by Lakis Polycarpou | 5.15.2013 at 12:15pm | 1 Comment

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Last October, Superstorm Sandy provoked widespread frustration and fear after it left more than 7.5 million people in the New York Metro area without power. In the hardest hit areas, outages lasted two weeks or more; in high rise buildings, the elderly and disabled were left stranded, often without access to food and unable to flush toilets for extended periods. Meanwhile, outages throughout suburban New York and New Jersey shut down gas stations, leading to long lines and runs on gasoline in many places.

These failures led many observers to wonder if America's aging electrical grid—once the most reliable in the world—was up to dealing with emerging climate and other challenges.

Observers of the electrical utility market suggested that the need to manage an increasingly large percentage of intermittent power generation from renewable sources, along with increased risks from events like Sandy, will require a much "smarter" grid—a grid that makes use of new information technology and automated computer controls to respond dynamically to changing conditions.

For their part, major utilities have mostly responded to the increased threat of Sandy-like events by touting their efforts to maintain service by investing heavily in storm protection infrastructure.

A few weeks ago at Columbia University, a panel of experts discussed a very different approach—one that has the potential to entirely transform how electrical power is delivered in both the developed and the developing world.

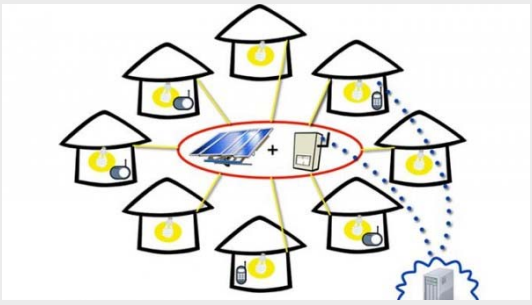

Diagram of Shared Solar Microgrid. Source: Millennium Villages

Strictly speaking, microgrids are not new. As panelist Mohommed Shahidehpour explained, a microgrid is essentially nothing more than an electrical grid that can operate from its own power without a long-distance transmission system or connection to a broader grid. Power on airplanes and ships are common examples of systems that operate as microgrids. According to Shahidehpour, what makes the new generation of microgrid applications worth paying attention to is that that the elements of a modern microgrid have themselves gotten smart, to the point where they can easily shift loads based on different needs and desired outcomes. "The customer decides when he wants to use power, how much he wants to use." In this way, a smart microgrid "empowers smart users."

Shahidehpour knows what he's talking about: as the director of the Robert W. Galvin Center for Electricity Initiative at the Illinois Institute of Technology, he led the installation of a campus-wide microgrid project that for the university that reduced campus baseload energy consumption by 20 percent and peak load consumption by more than 50 percent. The project incorporates on-site solar and wind generation, backup generators and an advanced system controller that communicates with building controllers, meters and smart switches and uses real-time price signals and weather reports to automatically manage demand. The IIT microgrid is the flagship "Perfect Power System" of the initiative, a project that envisions a transformation of the national grid by prototyping smart grid approaches though a series of microgrid projects.

Diagram of the IIT microgrid. Source: Galvin Center for Electricity Innovation.

Pareto Energy takes a similar approach, by designing, building and operating peer-to-peer microgrid networks. Panelist Matthew Fairy, Pareto's director of sales, described a vision in which the national grid is gradually replaced over time by clusters of interconnected microgrids. This is the only way, he said, that we will be able

to move to a smarter grid system. “The move to the smart grid is impossible to achieve in one big operational mass,” he explained, “Breaking it into bite-sized pieces—this is the future of the microgrid market.” Fairy described the shift to microgrids as analogous to the move from land lines to cellular phones—a shift that will “make the end product much more versatile and user friendly.”

Josh Milberg, a smart grid expert with Willdan energy consultants, explained that the biggest advantage of a microgrids is the ability of a large facility to optimize energy use “based on what is most important to you as a customer. You have the opportunity to optimize for reliability, for cost, for sustainability, or some combination. That is the really exciting opportunity. You have the opportunity to making decision for your own facility rather than being at the mercy of the larger grid operator, who is really making decisions to make sure that the entire grid is as stable as possible.”

Applications for smart grids are of course not limited to the industrialized world. According to the Earth Institute’s Vijay Modi, it’s worth remembering that under normal circumstances some 200 million people in India have no access to electric power at all. Combined with some 500 million people in Africa and another 200 million in other places, this means that as much as one sixth of the world’s population still does not have access to electricity.

Like Fairy and Shahidehpour, Modi and his team believe that the application of smart microgrid technology might be part of the solution, but from the opposite direction. Rather than finding ways to scale down break up giant grids into smaller pieces, he is looking for opportunities for small scale, local investment to create microgrids with local power generation and storage for communities in the developing world that aren’t yet served by utilities. He believes such systems, built in bite-sized pieces, could eventually be connected to the larger grid.

So what is preventing faster adoption? Modi suggested that the problem was that until now, migrogrid projects have been one-offs—each requiring custom engineering and individual permitting. If, however, there were a way to simultaneously permit microgrid systems for 100 blocks of similar buildings in New York, he said, it could “break the bottleneck.”

However, Modi pointed out that from the utility’s perspective, any time a customer reduces consumption or adds local generation—even if it’s from a solar panel on the roof—the utility loses revenue, while not really lowering its fixed costs, which in New York account for three-quarters of expenditures. David Roberts of Grist made a similar point recently, pointing to the utilities own research suggesting that “solar power and other distributed renewable energy technologies could lay waste to U.S. power utilities and burn the utility business model.”

Fixed costs notwithstanding, Shahidehpour says, the increase in reliability and efficiency offered by widespread deployments of microgrids can only benefit utilities, which in many places spend millions of dollars each year to respond to a few hours of peak demand. And, Fairy added, there is no reason utilities couldn’t own and operate microgrids themselves; it’s just a different business model.

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