# New Drivers for Campus Microgrids: Resiliency, Community, Research, Jobs & Cost Savings

Colleges and universities were among the first to adopt microgrid technology in North America. Initially they did so to ensure electric reliability on a grid that had yet to fully develop.

Today, a new generation of campus microgrid development is underway, as it becomes clear the technology solves other problems unique to our times. Institutions of higher education are installing microgrids to address climate change, recruit green-leaning college applicants, and position students for jobs in the growing clean energy economy.

Microgrids also help schools better serve the public good, allowing them to act as electrified shelters during power outages caused by storms and other disasters. Economics plays a significant role, too, as higher education tries to better manage energy costs. Microgrids can offer colleges and universities sophisticated and effective approaches to not only save money, but also earn revenue from energy markets.

Microgrid Knowledge partnered with Hitachi in writing this paper to examine this new microgrid trend and show colleges and universities the initial steps to become part of the movement.

What is a Microgrid?

**History of campus microgrids**

Some of the oldest, largest and most sophisticated microgrids in the world are located at U.S. institutions of higher education. A few date back to before the United States developed a national electric grid. On their own, these institutions had to develop self-sustaining energy systems. At the University of Texas, Austin what began in 1929 as a campus microgrid expanded and transformed over the years into one of the nation's largest microgrids. The system provides 100 percent of the power, heat and cooling for a 20-million square-foot campus and its 150 buildings.

More recently, campus microgrids have made the news during natural disasters because they continue to provide power for the school, even as the community around them goes dark due to central grid failure. During Superstorm Sandy, several colleges and universities demonstrated this ability, among them Fairfield University, New York University (NYU) and Princeton.

"If anyone ever doubted the value of a campus microgrid, they only need to look to NYU during Sandy. Most of Lower Manhattan was without power but not NYU. This had meaning not only to the students, but workers at the college. NYU is one of the largest employers in New York City," said Brian Levite, senior manager of energy solutions at Hitachi America.

Levite noted that the microgrid was part of $126 million upgrade to NYU's campus, which includes combined heat and power (CHP), natural gas generators, and small steam generators and turbines. The investment paid off during Superstorm Sandy as the system demonstrated one of the key features of microgrids – their ability to island from the central grid when it is failing. Sensing a disruption, the microgrid automatically separates itself from the trouble and provides power to the campus independently via its onsite generators.
Microgrids also offer a way for campuses to meet climate goals and green their power supply.  NYU's microgrid, for example, has reduced nitrogen oxide, sulfur dioxide, and carbon dioxide emissions 68 percent for the campus – a significant step toward its commitment help New York City meet climate goals.

The University of California San Diego stands as an example of how to integrate a range of clean, efficient and advanced distributed energy technologies. Known as one of the greenest campuses in the nation, the 40-MW microgrid provides more than 90 percent of UCSD's annual electricity from such sources as fuel cells, solar, CHP and energy storage.

Other colleges are adding or expanding campus microgrids. Tufts University is modernizing its central energy plant and incorporating a microgrid, which it expects to unveil in late 2017. Wesleyan recently added solar to a CHP microgrid, and now can generate about 85 percent of its energy onsite. The University of Bridgeport in Connecticut went live with a fuel cell microgrid. In Ontario, Algonquin College demonstrated how to optimize a microgrid for return on investment.

"The list is long and getting longer of colleges and universities employing microgrid technology," Levite said. "Higher education is on the vanguard demonstrating the future of energy."

**New impetus for microgrids**

Timothy Carter observes the microgrid trend in higher education from a unique vantage point. Carter is the president of Second Nature, which has worked with more than 4,000 faculty and administrators at hundreds of colleges and universities since 1993. Focused strongly on climate change, the Boston-based organization helps institutions take the step from commitment to action so that sustainability becomes fundamental to every aspect of the campus.

*Resiliency*

Second Nature recently called upon schools to take climate action one step further, expanding behind sustainability into resiliency measures. Resiliency describes the ability to withstand and recover from climate change pressures. Microgrids are a key way to make a campus more resilient; they help operations recover sooner after a disaster by ensuring electric supply.

Carter has seen colleges and universities evolve in their approach to meeting climate goals.  Five years ago, they tended to pursue the "low hanging fruit," often

low-cost and easy-to-install energy efficiency measures, such as LED lighting, he said.

Now they are digging deeper to reduce their carbon footprint, according to Carter. Simultaneously, renewable energy prices have fallen, offering institutions an easier inroad into microgrid development. Many new microgrids include some form of renewable energy. In doing so, they provide a way for schools to capture both sustainability and resiliency in one energy technology.

Microgrids fit in with a new forward-looking way colleges and universities are addressing climate. Carter says that schools are moving toward more "adaptive" action as opposed to mere "adaptation." Adaptation involves response to a current hazard, while adaptive action is about "bounding forward," assessing how a campus should be designed to respond to the future.

*Community*

As part of their resilience obligation, schools must include the local community in their planning. Microgrids offer the opportunity for colleges and universities to fulfill this commitment. When the power fails during a crisis, schools may offer the public access to cafeterias or stadiums, which can serve as shelters or an electrified oasis where community members can get a hot meal or charge cell phones. Some institutions are installing electric vehicle charging stations as part of their microgrid development, so car charging may eventually be an additional community service offered during a power outage.'

*Research*

U.S. colleges and universities spend more than $68 billion annually on research and development, according to the National Science Foundation. Temperature-controlled rooms, refrigerators and freezers preserve specimens that in some cases involved years of research. If a power outage lasts several hours, the specimens may deteriorate and even become unusable. This can cost research institution years of work and millions of dollars.

Many labs have back-up generators. But history has shown that emergency generators are prone to failure. Because they do not use the generators on a daily

basis, lab workers may be unaware that a generator is not working until a crisis when it is expected to perform.  Microgrids, on the other hand, run 24/7/365, so any problem is detected quickly and can be repaired. This makes a microgrid preferable for protection of important research.

*Job training*

Santa Fe Community College announced in April 2017 that it plans to build a microgrid training center, which will focus on product development, testing and workforce training. The college sees the center as way to draw clean energy jobs to Sante Fe, New Mexico and help students better position for those jobs.

Having the technology on-site gives their engineering students an edge in preparing for the grid of the future. Students with such training enter a burgeoning career path. The Environmental Defense Fund estimates that the sustainability sector in the U.S. is responsible for 4-4.5 million jobs, up from 3.4 million in 2011. More growth is expected as the renewable energy sector continues to expand.

“Two-year institutions have such a great history in workforce development,” Carter said. “They are uniquely positioned to take advantage of deployment and training around microgrids.”

He added that such microgrids give students a “tangible” way to increase their understanding of energy, much the way a community garden project offers insight into food systems.

*Student recruitment*

Colleges and universities – even prominent Ivy League institutions– have experienced a decline in student applications in recent years. Higher education leaders say several factors at work, but mainly a larger number of colleges and universities are vying for a smaller pool of college-bound students.

Such competition has schools seeking new ways to differentiate themselves and their campuses. Demonstrating use of clean and advanced energy offers a model. Some surveys indicate that students consider environmental commitment in selecting schools.

“In some cases, it might be a tipping point on the margin,” Carter said.

**Campus microgrids for cost savings**

With capital budgets increasingly constrained, higher education is understandably concerned with costs. As appealing as a microgrid may sound, where does the money come from to make the investment?

Fortunately, microgrids are increasingly offered under no-money down models that have been demonstrated for years in the energy industry with other types of projects, such as energy efficiency installations. Under these long-term savings agreements, a third party makes the capital investment and then shares savings derived from the microgrid with the school.

The object of such arrangements is to either lower the institution’s energy bill or keep it level. So the college or university gains the microgrid benefits – reliability, resiliency, clean energy supply, etc. – without any extra cost. Several variations exist to this approach. For example, the school may instead lease the microgrid. Whether this approach will work depends on many factors, including the cost of utility power where the institution is located. As a result, microgrids tend to be most cost-effective in regions where electricity rates are high, such as the Northeast and California. However, there are exceptions to this rule.

To determine if a microgrid will work for your institution – and save money on energy bills – it’s important to start by securing a reputable partner that can access your facility.

“The first step is not, ‘Let’s start designing a microgrid.’ The first step is working with an experienced partner that can model your campus to uncover potential cost saving,” Hitachi's Levite said.

A campus may be able to reduce its microgrid costs by installing energy efficiency measures to lower energy demand. This assures “right-sizing” of the microgrid’s generators – not installing more solar panels or gensets than is needed, which adds unnecessary costs.

Further, microgrids are often built in increments – expanded as need and budget allows. A campus may already have building blocks that can be included in the initial design, such as a combined heat and power plant. When such infrastructure already exists, it can significantly reduce the cost of the microgrid.

Robert Braun, a principal at Genesys Engineering, a Wildan Company, added that it is crucial to assess the condition of the existing utility infrastructure.

“In many cases, said existing equipment will include the current utility infrastructure of the university campus. If the university’s utility equipment is incorporated into the microgrid, it must operate reliably and be available for service when it is needed,” he said.

Braun pointed out that campus microgrids are intended to operate either:
(1) In parallel with the utility, in which case they use the utility’s distribution system for a portion of the power and energy supply requirements of the campus.
(2) Grid isolated or “islanded” and use on-site generation to supply the campus
When connected to the grid, the microgrid may sell ancillary services, leverage utility pricing, dispatch power, or participate in demand response events – activities which allow it to either earn revenue or save money for the campus. So the grid connection typically improves the economics of the microgrid. Advanced microgrid software can determine which mode of operation is optimal and automatically configure generation use accordingly.

**Conclusion**

Clearly, microgrids are a technology for today’s forward-thinking colleges and universities. Microgrids are especially well-suited for institutions where electric reliability is a priority, and sustainability, resiliency and energy cost management is a priority.