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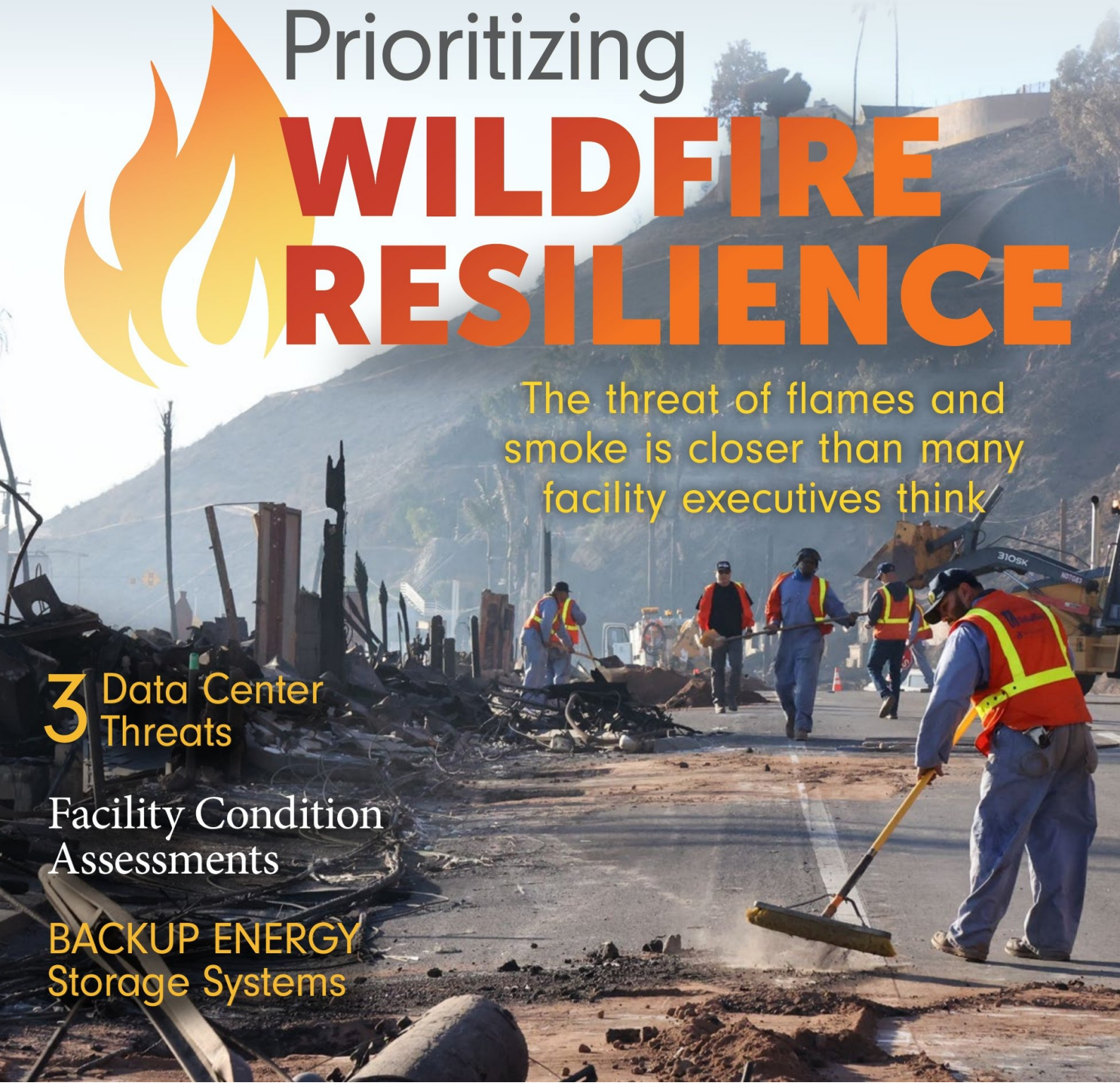

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BACKUP ENERGY Storage Systems

Improving Backup Power Options

By Joel Williams, Contributing Writer

Battery energy storage systems bring power stability and cost efficiency to facilities

Mission-critical facilities such as hospitals and data centers need a constant source of 100 percent reliable energy to run and power their equipment. Battery energy storage systems (BESS) ensure power redundancy and stockpile renewable energy for use during peak demand periods when utility costs are higher, and grid reliability is more vulnerable.

As solar and wind power generation capacity expands across the United States, the demand for BESS continues to grow at an unprecedented rate. According to the U.S. Energy Information Administration, battery energy storage capacities were expected to double in 2024, with 14.3 gigawatts (GW) of new storage projects added to the existing 15.5 GW network.

This rapid growth trend builds on a nearly 70 percent annual increase in BESS capacity during 2023 when 6.4 GW of new battery storage was added to the U.S. power grid. For perspective, the average annual electricity consumption in the U.S. was around 438 GW in 2020.

Demand continues to grow

BESS technologies are critical to our nation's electrification goals, grid reliability and energy independence, says Patrick Hughes, senior vice president of Strategy, Technical, and Industry Affairs for the National Electrical Manufacturers Association (NEMA).

"Energy storage is rapidly growing in importance, with U.S. electricity demand projected to increase by more than 50 percent by 2050," he says. According to the association's forthcoming Grid Reliability Study, BESS market growth is fueled by expansions in data centers, electric vehicles, commercial and industrial building resilience and demand management, utility-scale grid stabilization and integration of renewable energy generation.

Last year, NEMA introduced a BESS performance measurement standard to help users evaluate and select the correct storage systems.

A study from McKinsey & Company describes three segments in BESS configurations: front-of-the-meter (FTM) utility-scale installations — the largest segment — which are typically greater than 10 megawatt-hours (MWh); behind-the-meter (BTM) commercial and industrial installations, which usually range from 30 kilowatt-hours (kWh) to 10 MWh; and BTM residential installations, which are generally less than 30 kWh.

Most facility managers and building operators manage behind-the-meter battery storage systems, says Robert Anderson, senior vice president of Energy Advisory Services for JLL.

"The growing application for BESS and other microgrid technologies has evolved and expanded the role of facility managers to include supply side/behind-the-meter technologies — and how they interact with the grid," Anderson says. "Facility managers and building engineers have always been the front line of defense when it comes to effectively managing energy at the point of use. A core aspect of their role is looking for opportunities to increase energy efficiency while maintaining operational continuity and security."

One of the most attractive benefits of energy storage technology for commercial building owners and facility managers is energy arbitrage, which involves shifting electrical consumption to off-peak hours. The stored energy may be sold back to utilities or used when there is no access to grid power.

"BESS technology can help regulate supply and demand by amassing power when needs are low and utility power is cheaper, and utilizing that energy when power needs are high, and power is more expensive," says Graham McLeod, principal of AlfaTech.

Renewables alone are not always the answer, thus a need for an energy alternative.

"Wind and solar power renewables often cannot provide adequate power during peak-demand periods and, even more often, provide excess power during low-demand periods," says colleague Michael Fluegeman, PE, senior principal of AlfaTech.

In California, for instance, during peak solar production hours (10 a.m. to 1 p.m.) in 2023, battery charging accounted for approximately 8.3 percent of the California Independent System Operator (CAISO) balancing area's load. This indicates a significant use of BESS for

absorbing excess solar energy during low-demand periods, which can then be discharged during peak-demand times.

In addition to this type of peak-shaving — when a facility supplements its grid energy use with another source such as batteries — BESS can lower energy costs, according to David Borchardt, P.E., senior mechanical engineer, for MD Energy Advisors.

Incorporating AI into battery management systems enables more predictable maintenance schedules and reduces these costs through self-learning.

"In many energy markets, the utilities charge for energy at different rates depending on the time of day due to the demand on the grid," Borchardt says. "Moreover, utilities measure energy usage to help them determine the rate they will charge each customer in the coming year based on their peak demand. Batteries help customers reduce their demand from the grid during these peak times when the energy grid is strained."

Beyond energy production

Batteries offer the grid other benefits besides energy storage. Because of their fast response times, batteries are ideal for balancing very short-term differences in supply and demand, such as frequency regulation and rapidly managing load-generation imbalances.

"Mission-critical facilities such as hospitals, data centers and factories need a constant source of 100 percent reliable energy to run and power their equipment," Borchardt says. "Therefore, batteries act as a buffer for the time it takes emergency generators to start producing power."

Further, he says that batteries and other equipment can ensure a facility's power supply is "clean" as momentary spikes, surges, sags, or outages can harm electric equipment.

BESS equipment can also increase power resiliency for commercial and institutional building owners, says Fluegeman.

"Battery storage cannot yet fully replace standby or emergency backup power generators, largely due to their limited runtime of plus or minus four hours," he says. "Generators typically include at least 24 hours of onsite fuel runtime with easy refueling or operating from the natural gas utility."

In 2022, 60 percent of our nation's electricity was generated from burning fossil fuels, mainly coal and natural gas, according to the U.S. Energy Information Administration.

Renewable energy, particularly solar and wind, has become as affordable as — or often cheaper than — traditional fossil fuels but remains dependent on the time of day. Thus, energy storage is the key hurdle to making renewables fully reliable — finding efficient ways to store excess power when sunlight and wind are unavailable or during peak energy usage periods when energy is most expensive.

Solving this challenge is crucial for a sustainable, grid-independent future.

Shifting energy priorities

As the country's energy policy shifts toward oil, gas and coal production, how will energy storage technology fare under new federal policies?

"While priorities are shifting away from some particular sources of renewable energy and toward other technologies like natural gas or even those with longer lead times, like nuclear or geothermal power, it's clear that we will need a balance of multiple sources of generation to meet America's growing energy demands," Anderson says. "It's a great time for organizations with large energy demands or those concerned about grid reliability to think about the potential benefits of 'behind-the-meter' solutions for their own needs, including on-site energy such as solar or gas or demand management solutions like battery storage or microgrids."

According to Hughes, growing energy independence is another key driver for expanding energy storage systems and technologies.

"Key energy tax incentives found within the 2022 Inflation Reduction Act have offered consistent policies for renewable energy and storage developers and helped the BESS industry by establishing energy tax credit structures," Hughes says. "These tax credits have laid the groundwork for innovation and expansion of energy storage systems and technologies."

What are the next steps for the industry?

"Policymakers will continue to refine and create standards that foster cost-effective energy storage solutions while enhancing system performance, grid reliability, and environmental stewardship," Hughes says. "These developments are essential for accelerating the widespread adoption of battery storage technologies, contributing to cleaner, more resilient energy systems globally."

Anderson says the introduction of artificial intelligence (AI) is one of the most exciting energy storage developments on the horizon.

"Incorporating AI into battery management systems enables more predictable maintenance schedules and reduces these costs through self-learning," he says. "Customer energy demand changes could drive new value in flexible loads, where load shifting with BESS and similar 'behind-the-meter' technologies would be invaluable (both potentially as a revenue stream, as well as an energy-resilience play). This also supports the utility's focus on grid stability while supporting decarbonization." ■

Joel Williams is a freelance writer based in Frankfort, Illinois.