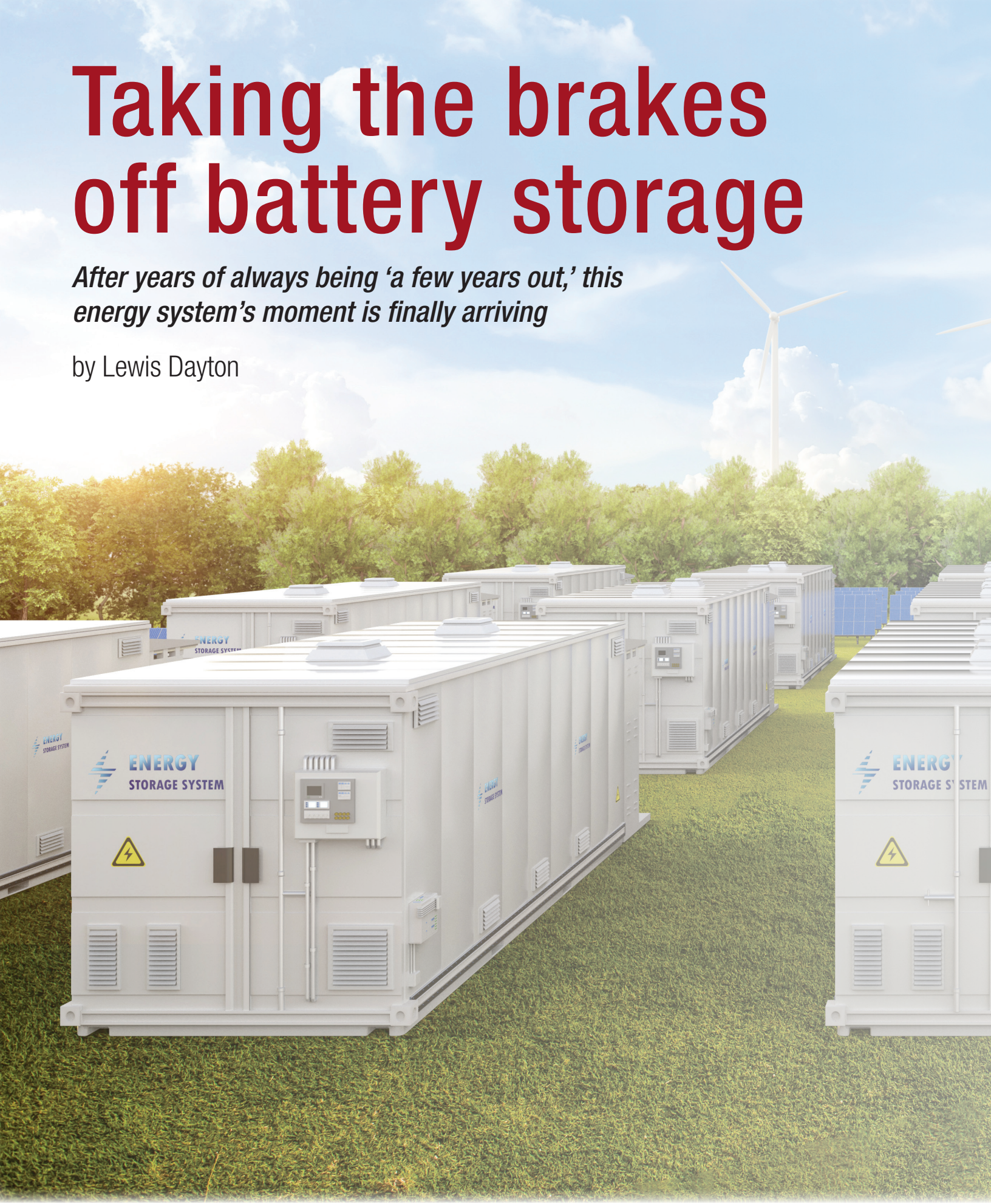
Taking the brakes off battery storage

After years of always being 'a few years out,' this energy system's moment is finally arriving

by Lewis Dayton



More than a decade ago, in 2010, the energy capacity of large-scale battery storage in the United States amounted to 22 megawatt hours. In 2020, that capacity had increased to 2,378.2 megawatt hours, and by the end of 2022 it had climbed exponentially to 22,385.1 megawatt hours.

As Lucy Fan, principal at North Sky Capital and an energy storage expert for North Sky's infrastructure team, says, "Now that there are commercial opportunities across the different ISOs [Independent System Operators], I would say energy storage has arrived."

Technologically, battery capabilities have improved; logistically, the large amount of invested capital and human ingenuity during the past decade has helped to advance mining, refining, manufacturing and deploying capabilities for the energy storage sector; and regulatorily, governments around the world have been passing legislation to make battery energy storage systems (BESS) more economically viable.

BESS are being built for a variety of use cases, from microgrids that provide energy resilience for hospitals to home solar outfits, to large-scale operations that enable solar, wind and other renewable sources to more efficaciously transmit their energy to end users.

Yet, despite the significant progress in the sector, there is still a long way to go if the ambitious climate targets of many countries around the world are to be reached. "Globally, energy storage capacity needs to increase by a factor of at least 40 times by 2030," says Saji Anantakrishnan, head of infrastructure, Australia and Asia, with PATRIZIA.

The Energy Sector Management Assistance Program, a coalition governed by representatives from an assortment of nations and chaired by the senior director of the World Bank's Energy and Extractives Practice Group, estimates countries will collectively have to add 120 gigawatts of grid-scale battery storage each year by 2030 for the world to meet its net-zero goals. The amount of grid-scale battery storage added around the globe in 2022 was 11.1 gigawatts.

Although large amounts of solar and wind are being deployed each year, only a corresponding fraction of battery storage systems has been built. Until recently, the significant costs and the challenges of scalability for BESS have held it back from commercialization. Now that BESS have become less expensive and better understood, opportunities abound for their deployment, and the sector is poised for exponential growth throughout the next decade.

UTILITY PRICING MECHANISMS

Some of the most important measures to date that have made BESS in the United States more affordable and economically viable have been the array of pricing mechanisms supplemented by various utilities.

Independent System Operators such as ERCOT in Texas and PJM in New Jersey and Pennsylvania use liquid pricing to set prices at each given location and time, a feature that has proven to be "a key piece in the economics of battery storage projects overall," says Ken-Ichi Hino, energy storage portfolio manager, Real Estate & Private Markets, UBS Asset Management.

With a real-time pricing mechanism, developers and aggregators are given the ability to get paid for the actual value of their energy distribution, corresponding to the supply and demand characteristics at the time of end use.

In New York, reliable offtake is established with the VDER (value of distributed energy resources) framework. "The reason that we like the VDER model," says Fan, "is because when you're funding development of assets, when you participate in a program like VDER … then you have a knowable revenue stream, and that is very important because you're not going out and siting land, getting interconnection with the big question mark around what your offtake is going to look like. So, the fact that there is programmatic offtake is compelling."

Meanwhile, in some regions, such as Florida, there is no liquid pricing. "What that means," says Hino, "is it's difficult for third parties [non-incumbent utilities] to capture above-market returns through operational advantages and innovation."

Florida's NextEra Energy, the owner of Florida Power and Light — Florida's major utility — thus has an upper hand in building out its own BESS infrastructure, an undertaking it has directed capital toward in recent years.

THE JUMPSTART OF GOVERNMENT INCENTIVES

Aside from utility pricing mechanisms, government incentives and policies have been significant contributors to the current scalability of BESS.

The Inflation Reduction Act (IRA) of 2022 extended eligibility for a 30 percent investment tax credit (ITC) to standalone battery storage systems (previously, it had been available

only for BESS only when they were BESS-combined-with-solar installation projects). The IRA also includes additional bonus credits for BESS, including a 10 percent credit for projects sited in communities that once had operating fossil fuel facilities and a 10 percent credit for developers who use project equipment manufactured in the United States. Hino notes the IRA and the expansion of the ITC have "been a boon to standalone energy storage developers."

Further, the IRA gives tax-exempt organizations and government entities the ability to access benefits comparable to those of tax-paying organizations via the incorporation of elective pay (also referred to as direct pay) and transferability options. With these pathways, the IRS either pays the tax-exempt organizations directly for their ITC and production tax credits (elective pay), or the IRS exchanges funds to organizations for transferring their tax credits to a third party (transferability). Fan says transferability has "increased the overall number of participants within the tax equity market because it decreases the transactional complexity, and it will streamline dealmaking."

Federal Energy Regulatory Commission (FERC) order 2222, approved in 2020, was another important step taken by the government to promote BESS development, according to Doug Mackenzie, vice president, energy resilience, with JLL. FERC order 2222 seeks to make it easier for distributed energy resources (DERs) aggregators to work with utilities so that individual DERs providers (such as homes with solar) can get compensated for their energy without having to individually seek out and negotiate deals with regional utility operators.

"Batteries are kind of like a Swiss Army knife of the energy world," notes Mackenzie. "They can be used in a number of different ways, and the more market access that these technologies have, the more value economically you can extract from them."

OPPORTUNITIES OUTSIDE THE UNITED STATES

The increase in activity in the United States' BESS sector since the IRA passed in 2022 has had rippling effects in the broader global market. Anantakrishnan says, "From a global perspective, the American Inflation Reduction Act created this hoovering effect of global private capital because those incentives are material, and a lot of institutions are viewing American projects as offering a better risk/reward payoff."

That doesn't mean opportunities don't exist in other markets. Anantakrishnan says countries that have had a rapid uptake of renewables but have not had a similar concentration of capital directed toward transmission are well positioned for BESS investment. Deploying BESS projects in areas with high renewable capacity, but that also experience high curtailment, allows developers to provide a tool that more efficiently captures and distributes that energy, all while being remunerative.

Anantakrishnan points to Japan as one country with significant opportunity for BESS investment. "Japan is obviously a big target," he says, "because post-Fukushima there was a very generous tariff, which led to a significant development and build out of renewables. Yet, the country has not seen a similar build-out of battery storage systems to support its grid infrastructure."

Many industries rely on energy resilience, something that is starkly clear in countries that experience regular intermittent energy outages. Batteries offer such customers a safeguard for when the grid trips unexpectedly. It's also worth mentioning that a battery as backup, rather than a diesel generator set, facilitates sustainable outcomes for the surrounding community, according to Anantakrishnan.

"If you put batteries behind the meter into these [locations]," says Anantakrishnan, "not connecting into the grid per se, but actually saying, look, here's an industrial case that,

for Toshiba or Nissan that produces cars in Thailand — well, why don't you stop using a diesel generator set and go for a more sustainable solution."

Europe also has been a supportive market for BESS development, as many European countries seek to transition to more reliable, environmentally friendly energy sources. Hino says Europe is interesting because it consists of smaller markets, which can provide better opportunities for energy storage projects. One thing to note with European markets, Hino observes, is that it takes significant due diligence to develop projects, as it is necessary to understand each country's legislative, legal and energy logistical nuances to effectively build out BESS.

From a regulatory perspective, Hino says the United Kingdom, in particular, is a leading market because it has granular pricing policies and a significant amount of wind energy.

The United Kingdom's government is targeting deployment of 30 gigawatts of battery storage capacity by 2030. To facilitate that expansion, the government has lifted size restrictions for project planning, helping to wave in larger-scale projects such as Alcemi's 500-megawatt facility in Coalburn, Scotland, and Zenobe's 300-megawatt BESS development in Blackhillock, Scotland, which is currently under construction.

Rystand Energy predicts by 2030 the United Kingdom will be responsible for 9 percent of the world's utility-scale battery systems capacity.

In March 2023, the European Union published its *Commission Recommendation on Energy Storage,* which imparted to E.U. countries that they should remove barriers to BESS development, such as double taxation (a practice in some E.U. nations whereby developers are taxed as "consumers" of energy when they store it, and "suppliers" of energy when they later distribute it to the grid), and that they should help facilitate permitting procedures and ensure that system operators assess flexibility needs when planning BESS developments.

In November 2023, the developer Kyon Energy received approval to build a new large-scale battery storage project in the town of Alfeld in Lower Saxony, Germany. At the same time, German regulators extended the grid-fee exemptions for new BESS systems by three years to 2029, further incentivizing developers to build out BESS in the country.

These regulatory steps, combined with greater BESS cost efficacy and the heightening demand for energy storage, is a promising sign for the further development of the BESS sector in Europe.

CONSCIENTIOUS BESS

Although the sweeping tide of BESS development is encouraging and necessary to meet net-zero goals, BESS sourcing, manufacturing and deployment also comes with its own set of societal and environmental impacts that need to be considered if the renewable-energy transition is to be as just and sustainable as possible.

A few years ago, a lot of what was being commercially deployed were NMC batteries, a type of lithium-ion battery made of a combination of nickel, manganese and cobalt. "And obviously, with cobalt, that component carries pretty significant social impact due to the associations with supply chain and modern slavery," says Fan, referring to the Democratic Republic of Congo's cobalt mining industry and its association with significant human rights violations. Commercial BESS projects are now more often being sourced with a different lithium-ion chemistry: lithium iron phosphate (LFP), which does not use cobalt. "With LFP," says Fan, "we're able to get a longer lifespan and lower degradation, and improve discharge and charge efficiency — and they're also safer."

By the very nature of being more effective, LFP battery systems are better economically and less impactful environmentally "because if you can keep the same battery around for longer,

then you don't have to replace it or augment it as frequently," says Fan.

The switch from NMC to LFP has been a step in the right direction, yet mining and refining lithium, nickel and other materials, and manufacturing and deploying BESS are not harmless processes; they are intensive on land and water use and can harm the communities they disrupt.

With the demand for lithium and other materials set to increase dramatically in the coming years as the transition to renewables continues, an emphasis on lithium recycling and waste management is needed. Movement in that direction is building, but questions remain around how quickly solutions will develop and whether the scalability of such solutions will be fast enough.

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Fan and Hino both point to the potential for effective supply chains to emerge that recycle auto lithium batteries for use in standalone energy storage systems. However, these processes are still in their infancy.

"The simple problem right now is that there aren't that many [electric] cars that are old enough to have spent batteries, and there aren't many energy storage projects that have gone through their useful life on the battery side either," says Hino. "And so, without that, it's hard to scale your manufacturing facilities, which means it's hard to get cheap on the processing or reprocessing of that material."

"So, this could certainly be competitive in the longer term, but in the near term it's going to take a little time to get that supply chain up to the scale that makes it competitive with manufacturing from new materials," adds Hino.

Another question for energy storage systems is whether any alternatives to lithium-ion will present themselves as scalable solutions. Lithium-ion batteries are effective for short-term energy storage capacity (typically up to four hours), but other energy storage systems will be needed for medium- and long-term storage capabilities.

"We've got an eye on pretty much everything that's out there in terms of alternate technologies," says Hino. "But while we think there's certainly a need for those, the large-scale opportunity is a little bit later on in the transition to renewables versus where we are now, in our view."

Hino's view seems to be the consensus. Lithium-ion is the most ready and practical method for BESS today (in most scenarios) and will be so until alternative systems, such as flow batteries or iron-air batteries, get up to par and make economic and logistic sense.

"That said, I don't think this is a one-technology-takes-all market," says Hino. "I think there is room, for it's too big a market and there are too many different applications of energy storage for one to ultimately be the winner. There's room for at least two, if not five to eight different core technologies to have roles in the energy transition."

SUPPLY AND DEMAND FUNDAMENTALS

The scope of the energy transition is vast, and while the amount of solar, wind and batteries in existence today may seem like a lot, magnitudes more are needed to reach net-zero targets.

Such a feat may seem daunting to many, but for investors it harkens back to the elementary principle of supply and demand. Significant infrastructure advancements commonly follow a process of technical progress, followed by initial forays and deployments, after which comes the heightened demand and a corresponding supply to meet that demand.

In *Lifelines of Our Society: A Global History of Infrastructure,* Dirk van Laak writes, "Elements combine into infrastructures only when supply and demand run on parallel tracks and users incorporate them into routine practices. For this to occur, the new offerings cannot offer technological benefits alone."

BESS is making its way along such a path now. Supply (both supply chains and deployment) is being ramped up to meet demand, and BESS isn't just providing a sound and reliable way to source energy for household, industrial and commercial purposes, it's also one of the keys to moving toward a carbon-free energy future. ❖

Lewis Dayton is associate editor at **Institutional Real Estate, Inc.**