Executive Insights

Battery Energy Storage: Choosing a Winning Path in a Rising Tide

Battery energy storage in the U.S. has quickly emerged as a critical solution to support renewables development and electrification. It addresses the need for load management, grid flexibility and backup power for utilities, transmission network operators and electricity end users. Growth forecasts in the market are promising, with expectations for battery energy storage megawatt (MW) deployments to increase 30%-40% year over year through 2025.

The booming demand has most notably been driven by dollar-per-megawatt-hour cost reductions of 80%-90% over the past decade and improvements in storage optimization software, which are strengthening existing use cases and identifying new ones. But use cases for battery energy storage go beyond grid-supporting utility-scale applications. Residential solar-plus-storage is also gaining traction as homeowners seek grid independence and commercial and industrial facility owners adopt microgrid solutions to mitigate operational risks. The expansion of use cases is spawning new species of businesses across the storage value chain, from battery pack suppliers to integrators — that much is clear. What is less clear, however, is how these models will evolve, which ones are set up to win, and how new entrants and investors can maneuver to take advantage of the opportunity.

A store of use cases

The global transition to a lower-carbon energy system is spurring the rapid development of renewable energy generation and electrification of the transport sector. In the U.S. this shift has already translated into progress on multiple fronts: an energy market that currently surpasses 100 gigawatts (GW) of installed solar capacity, a national goal supporting an offshore wind project pipeline expected to add approximately 30 GW of capacity by 2030, a more stable onshore wind installation landscape, and the commitment by leading U.S. auto manufacturers to a future of 100% electric vehicle fleets.[1] While these developments are certainly supportive of long-term climate goals, they are also creating considerable challenges for utilities and transmission operators amid their efforts to maintain a reliable, flexible and resilient power grid.

While several approaches may bolster the power grid — expansion of transmission and distribution infrastructure, use of performance analysis software to optimize solar and wind generation, and a buildout of reserve capacity from conventional resources — energy storage has emerged as the solution that best addresses the combined needs of cost-effectiveness, capital efficiency, ease of deployment into operations, dispatchability and the ability to meet policy objectives.

Battery Energy Storage: Choosing a Winning Path in a Rising Tide was written by **Amar Gujral**, **Nilesh Dayal** and **Franco Ciulla**, Managing Directors in L.E.K. Consulting's Energy practice. Amar, Nilesh and Franco are based in Houston.

For more information, contact industrials@lek.com.

L.E.K.

There are a number of energy storage technologies such as pumped hydro, thermal, compressed air and even hydrogen; however, battery-based energy storage — more specifically, variants of lithium-ion technology such as lithium iron phosphate (LFP) and lithium nickel manganese cobalt oxide (NMC) — is emerging as the front-runner and will account for 85% of new MWs added this year.[2] Utility and developer comfort with the technology and the inherent flexibility in sizing to the required application are supporting the emerging incumbency status, but the key moat is the cost advantage. Battery energy storage also benefits from scale gained in the electric vehicle market, which has seen investment flow into battery cell, module and pack manufacture. In turn, costs of battery energy storage have fallen by more than 80% over the past decade, and they are projected to fall further.

Beyond supporting grid resiliency, battery energy storage's appeal is also in its extensive set of use cases that unlock value through cost avoidance, loss mitigation and new income streams. For utility-scale applications, battery storage reduces and delays capital-intensive investments in transmission infrastructure, offers a source of backup generation, and captures additional revenue in markets willing to pay for resource adequacy and ancillary grid services. In the residential market, battery energy storage enables homeowners to increase self-consumption of solar assets — and in some markets, sell more power to the utility during high-rate periods — by charging during the day and discharging at night, managing time-of-use around variable electricity rates, and providing backup power for shorter-duration needs. On the commercial and industrial side, value capture is similar to residential and also benefits from demands for cleaner crucial backup power when solar and storage are paired with conventional fuel generators to support hospitals, data centers and other critical infrastructure. Finally, as energy storage reaches a critical mass within utility service areas, utilities will benefit from aggregating disparate systems into a connected virtual power plant that can serve as a low-cost source of generation while avoiding the cost of adding new generation sources.

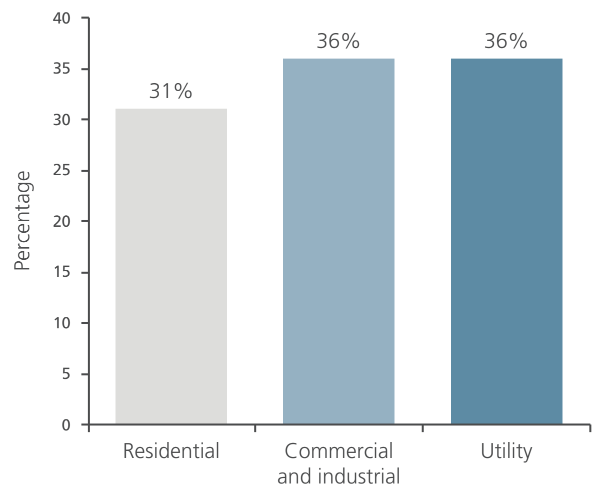
Perhaps the most critical use case, though, is battery energy storage paired with a new solar installation — whether utility-scale, commercial and industrial, or a residential project — enabling dispatchability for what would otherwise be an intermittent resource. However, this creates a governor for storage demand, in the near term at least, as storage demand is driven in part by new solar demand.

An early chapter in a long growth story

Earlier this year, we shared our views on the near-term growth expected from the U.S. solar development market and the resulting beneficiaries across the value chain.[3] Battery energy storage was among those noted, and its enhancement of photovoltaic solar's value proposition has driven its increasing storage-to-solar attachment rate. We estimate utility-scale attachment ranges of approximately 15%-25% today, with California at the higher end, while behind-the-meter (residential; commercial and industrial) attachment has a wider 2%-20% range depending on the geographic region, with California again representing the higher end of the spread.

The compounding effect of solar installation growth and the related attachment rate trend translates into an expected 30%-40% per annum growth rate for battery energy storage deployments in the U.S. market from 2020 to 2025 (see Figure 1).

Figure 1
U.S. battery energy storage MW deployments
5-year CAGR (2020-25E)

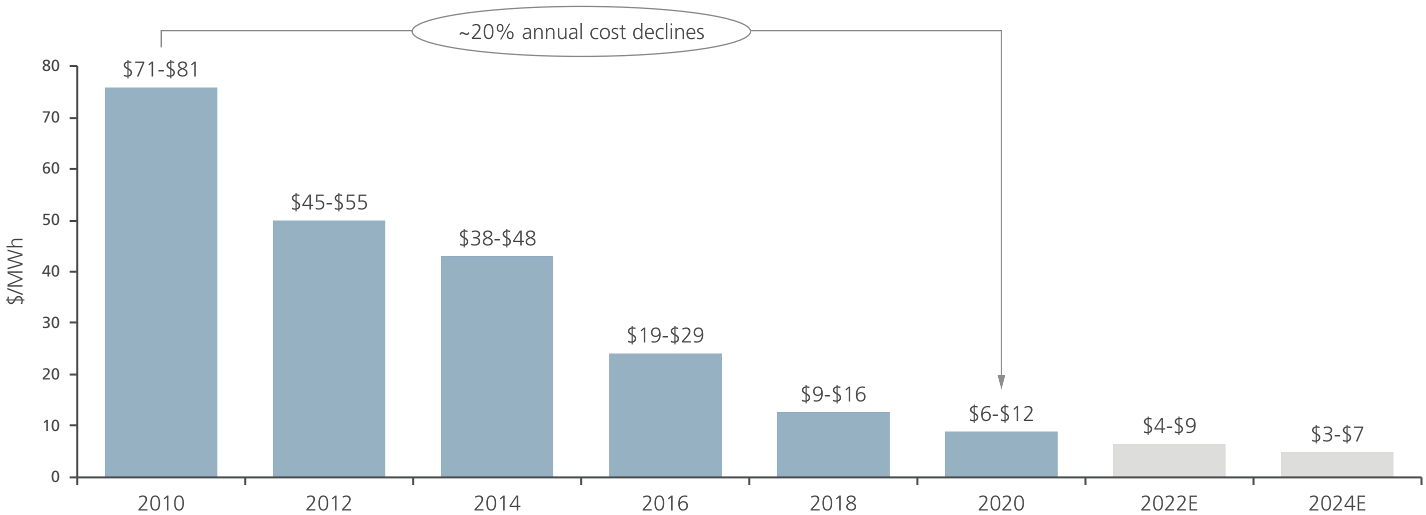


Source: Wood Mackenzie Power and Renewables; L.E.K. research, interviews and analysis

Developers; utilities; engineering, procurement and construction companies; and other stakeholders across the value chain accept the growth narrative, while some consider it understated. Their confidence in battery energy storage growth potential continues to revolve around three main factors.

- **Costs.** Four-hour-duration battery storage that once cost ~$80/MWh is now $6-$12/MWh and on track for $3-$7/MWh by 2024 according to NextEra (see Figure 2). From cell manufacture to pack assembly, the battery value chain, stimulated by urgency from the global electric vehicle market, is expanding capacity and driving costs down through scale and increased proficiency. This dynamic is benefiting the lagging, yet still massive, battery storage market as solar asset

Figure 2
Four-hour battery storage adder*



*Four-hour battery storage at 25% of nameplate solar capacity
Source: NextEra Energy June 2021 investor presentation; NREL; L.E.K. analysis

owners and developers realize value in the storage proposition at current cost levels.

- **Policy.** Similar to the solar installation targets set in the early years of renewable portfolio standards goals, states are now setting energy storage targets as part of their clean energy deployment goals. Today, California, Connecticut, Maine, Massachusetts, Nevada, New Jersey, New York, Oregon and Virginia have such goals (see Figure 3).
- **Event-driven spotlight on use cases.** The freezing temperatures in Texas in February 2021, widespread wildfires in California and recurrent hurricanes along the East Coast have all brought the critical resilience of the power grid into the spotlight. With each event, myriad solutions are proposed, including, most often, a call for pairing battery storage with renewables in order to support grid reliability.

This market and the lofty forecasts are, of course, not without risk. And for battery energy storage, the most meaningful risk may be caused by its own success.

The rapid cost decline, wide-ranging use cases and demand from other battery end markets (namely the passenger car electric vehicle market) have placed enormous stress on the battery supply chain, so much so that battery storage players are finding it difficult to keep pace. Market anecdotes of Tesla failing to meet full-year product allocations to its dealers is just one example of many constraints in the market during 2021. Such high demand is also too sudden for manufacturers and integrators to enter the market and build a track record. This has created a barbell-shaped dynamic in market structure with, on one end, leading, trusted players that are in high demand (e.g., Tesla, LG Chem) and on the other end, a set of smaller, untested startups sourcing input materials from Tier 2 manufacturers in Asia. The challenges here are bankability and the reluctance of solar developers to accept unknown battery storage providers given both project value risk and heightened sensitivity around battery safety.

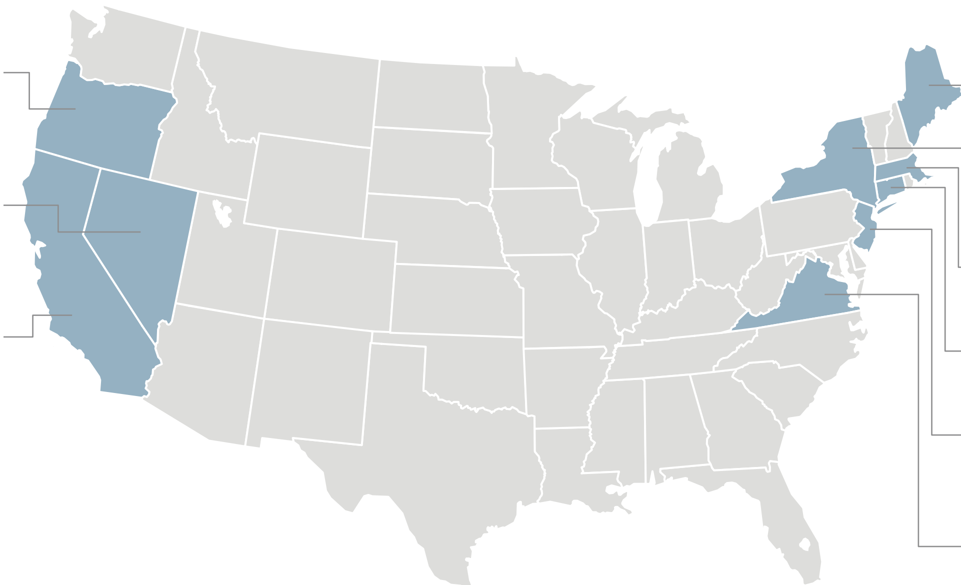
Ultimately, realizing growth expectations will require not only robust demand but also an established and trusted battery storage supply chain.

Investment opportunities and positioning to win

Battery energy storage has developed into a varied, multifaceted landscape for prospective players in terms of market, value chain and business model. The parameters to consider and choices to make include:

- **End market:** utility-scale; commercial and industrial; residential
- **Value chain:** raw material or inputs for cathode, anode and cell manufacture; battery module manufacture and pack assembly; system integration and installation; asset management and operations and maintenance

Figure 3
Energy storage targets by state



Source: State filings

- **Business model or "way to play":** integrated battery system supplier (e.g., LG Chem, Tesla); battery-scale player (e.g., CATL, BYD, Panasonic); inverter-plus provider (e.g., Enphase or SolarEdge offering storage with inverters); integrated solar solutions provider (e.g., SunPower offering storage product with turnkey rooftop solar); niche end-market player (e.g., Sonnen serving the residential market or Stem serving commercial and industrial); turnkey integrator (e.g., Fluence); or software solutions provider (e.g., Autogrid)

In the near term, battery energy storage system players participating across the value chain are all expecting strong growth given the fundamentals bolstering the storage proposition. However, as the market develops, we expect winning models to emerge. These front-runners will exhibit qualities that ensure their long-term stability and competitive edge. They'll demonstrate supply chain resilience and risk mitigation, with direct integration up the value chain or with long-term contracting to secure critical material inputs.

Leading players will also have a focused scale in an end market (e.g., utility-scale or residential) as cost becomes a more critical differentiator than service breadth. They'll have ample capabilities to optimize energy storage systems and maximize returns for asset owners through advanced software solutions developed in-house or through strategic partnerships. Finally, they'll demonstrate consistent flexibility as the market evolves. Like most early-stage markets, the perceived value from battery energy storage will be understood and effectively employed only in the long term.

Battery technology appears to be the likely energy storage solution of choice for future U.S. market deployments, but we're still on the cusp of this development. Though clear use cases and strong fundamentals are supporting growth projections, the successful models of today aren't necessarily the long-term way to play. We are already seeing the shift to LFP batteries from NMC, along with more focus on the benefits of solid state (albeit, mostly geared to electric vehicles rather than stationary storage) and potential advances in anode materials. As technology evolves and utility, developer, asset owner and other stakeholder customer needs change over time, players will be forced to adapt. Those who do so adeptly will come out on top.

If this chapter in the energy transition is about establishing the use cases, achieving scale and accelerating growth, the next will be about advancing the technology and shaping the long-term commercial models.

Endnotes

[1]"General Motors to eliminate gasoline and diesel light-duty cars and SUVs by 2035," January 28, 2021: https://www.washingtonpost.com/climate-environment/2021/01/28/general-motors-electric/

[2]Guidehouse, 2021

[3]"Is the Value in Renewables Starting to Shift Downstream?", February 10, 2021: https://www.lek.com/insights/value-renewables-starting-shift-downstream

About the Authors

Amar Gujral is a Managing Director and Partner in L.E.K. Consulting's Houston office. Amar is focused on growth and commercial strategy, M&A, and due diligence in the energy sector. He has supported strategy engagements and M&A processes with major and midsize E&Ps, oilfield service companies, utilities, equipment manufacturers, private equity firms, and other financial institutions. Prior to L.E.K., Amar was on the energy deals team at Strategy& and covered oilfield services at Guggenheim Partners.

Nilesh Dayal is a Managing Director and Partner in L.E.K. Consulting's Houston office. Nilesh is head of the firm's Energy practice and is also focused on the oil and gas and chemicals sectors. He has more than 20 years of experience advising clients on growth strategies related to acquisitions, divestitures and new business venture launches; corporate restructurings; supply chain management; public sector and regulatory strategy; profitability and operations improvement; and post-merger integration and planning.

Franco Ciulla is a Managing Director and Partner in L.E.K. Consulting's Houston office. Franco has 25 years of experience working for the oil and gas industry in technical, operational, commercial and strategic roles, with a focus on upstream activities and oilfield supply chain strategies. He specializes in aboveground risk assessment, oil and gas asset performance analysis, cost and supply chain strategies, fiscal benchmarking and optimization, competitiveness assessment, M&A support, and corporate growth strategy.

About L.E.K. Consulting

L.E.K. Consulting is a global management consulting firm that uses deep industry expertise and rigorous analysis to help business leaders achieve practical results with real impact. We are uncompromising in our approach to helping clients consistently make better decisions, deliver improved business performance and create greater shareholder returns. The firm advises and supports global companies that are leaders in their industries — including the largest private- and public-sector organizations, private equity firms, and emerging entrepreneurial businesses. Founded in 1983, L.E.K. employs more than 1,600 professionals across the Americas, Asia-Pacific and Europe. For more information, go to www.lek.com.