# The Coming Charge: Energy Storage Impacts on Project and Corporate Credit Quality

Governments, businesses, investors, and other key stakeholders are doubling down on efforts to decrease carbon emissions from the electric grid to mitigate climate change. Wind and solar power deployments have grown exponentially and are expected to continue representing most of the new generating capacity in the coming years, particularly in the U.S. and Europe. While the continued growth of renewable energy is vital for reducing carbon emissions, the intermittent nature of wind and solar creates operational challenges for balancing electric supply and demand. As a result, energy storage is likely to be a critical piece of the clean energy transition as it can store excess clean energy for later discharge when supply outpaces demand. While storage development remains limited to date, continued maturation and cost declines of storage technologies coupled with expanding revenue-earning opportunities are likely to support accelerated growth of this technology.

In this report, Kroll Bond Rating Agency (KBRA) examines some of the key considerations around energy storage, including how the technology may impact both project finance and corporate credit quality.

## Key Takeaways

- While energy storage technologies and use cases continue to evolve, there is broad consensus that the technology is likely to play an increasingly important role in facilitating a transition to a clean energy economy. As such, KBRA anticipates a growing number of energy storage project finance transactions and greater likelihood for electric utility companies to actively consider the technology as a key component of their long-term growth strategies.
- Like other project finance transactions, KBRA evaluates energy storage projects based on their ability to generate revenues sufficient to cover future debt service obligations.
- Given their relevance to the counterparty exposure and competitive position credit determinant within project finance transactions, KBRA monitors how both (1) federal regulatory and policy actions, and (2) energy supply and demand evolution may materially impact an energy storage project's creditworthiness.

## A Primer on Energy Storage

There are many elements to consider when determining the likely impacts of an energy storage project. In this section, KBRA provides a short overview of the technology types that fit within the broader energy storage bucket as well as the range of services energy storage can provide.

### Technology Types

While energy storage refers to a broad resource type, there are important differences between the varying technologies comprising this category. The following represents a simplified breakdown of commercially available energy storage technologies that are undergoing research, development, and demonstration activities:

- **Batteries:** Entails a bevy of electrochemical solutions, including advanced chemistry batteries (e.g., lithium-ion, lead acid, sodium, etc.), flow batteries, and capacitors.
- **Thermal:** Heating and cooling applications to store and release energy (e.g., ice storage, dispatchable hot water heaters, etc.).
- **Mechanical:** Technologies that leverage kinetic or gravitational energy to store electricity (e.g., flywheels, pumped hydro power, etc.).
- **Emerging Technologies:** A range of technologies that are still in more nascent stages of development (e.g., compressed air, superconducting magnets, hydrogen, etc.).

There are important differences between these technologies, including their energy storage capacities (energy density), the maximum rate of charging and discharging (power density), the amount of energy lost between charging and discharging (roundtrip efficiency), and cost ($/MW and $/MWh). While the Use Cases section expands on the importance of these differences, there is one key common factor across these technology types that characterizes the broader energy storage resource type: all can only hold (and discharge) a finite amount of energy. Consequently, energy storage is considered a duration-limited resource because it cannot sustain a charge or discharge indefinitely; at some point, the storage device is fully charged/discharged. While wind and solar resources have limitations due to the intermittent nature of their fuel source, energy storage must contend with duration limitations.

Most commercially available energy storage technologies have durations ranging from less than an hour to approximately four to six hours.[1] However, there is growing attention to developing long-duration (i.e., at least 10 hours) energy storage technologies that can enable large-scale decarbonization of the electric grid.[2] With the anticipated growth of intermittent renewables in the coming decades, long-duration energy storage may become increasingly important to ensure power is always available, even when the wind is not blowing and the sun is not shining.[3] Recognizing this need for long-duration energy storage to help meet President Joe Biden's goal of 100% clean electricity by 2035, the U.S. Department of Energy (DOE) recently announced a new 90% reduction target for the cost of grid-scale, long-duration energy storage by 2030. This comes after the European Union in 2020 set an ambitious target to have 40GW of electrolyzers (i.e., systems that, through a process known as electrolysis, use electricity to separate water into hydrogen and oxygen) installed within its borders by 2030 to support the development of green hydrogen, another potential source of long-duration energy storage.

While these kinds of policy objectives can help spur growth of the long-duration energy storage industry, further work is needed to create viable revenue-earning opportunities for the unique capabilities of these technologies. Although wholesale markets, retail-level programs, and offtake agreements are typically not structured to provide compensation for long-duration storage capabilities, there may be an evolution in how markets, utilities, and other offtakers provide compensation for this type of capability as the technologies mature.

## Use Cases

One of the reasons for the significant attention on energy storage as a critical component of the clean energy transition is its versatility; some have dubbed energy storage as the Swiss Army Knife[4] of the electric grid. This versatility stems from the various ways energy storage can provide value to the electric grid and end-use customers, referred to as use cases. Storage assets can be large scale and connected directly to the transmission and distribution systems; smaller in scale and sited at residential, commercial, and industrial facilities; or used directly within transportation systems.

To date, and despite significant work across the industry, there is no single universally adopted taxonomy to describe the types of energy storage use cases. As part of its Energy Storage Grand Challenge, the DOE developed a framework on how energy storage can support six potential high-level use cases (see Figure 1):[5]

1. **Facilitating an Evolving Grid:** Enabling a transition to a clean electricity system, especially under high penetration of variable renewable energy. Storage would provide system flexibility to deal with an increasingly complex grid. Includes provision of resilience services in the face of heightened weather, physical, and cybersecurity threats.
2. **Serving Remote Communities:** Providing clean, resilient, and cost-effective grid services to island, coastal, and remote communities. Helps alleviate challenges from high fuel supply costs and fuel supply disruptions.
3. **Electrified Mobility:** Supporting integration of clean transportation solutions, both in terms of energy storage solutions as part of electric vehicles and to manage grid impacts of charging infrastructure.
4. **Interdependent Network Infrastructure:** Sustaining and enhancing normal operations of other infrastructure critical to the electric grid, such as natural gas, water, communications, information technology, and financial services.
5. **Critical Services:** Providing resilience to key critical sectors, including defense, emergency services, government facilities, and health care.
6. **Facility Flexibility:** Supporting greater flexibility, efficiency, and value enhancement for commercial and residential buildings and energy-intensive facilities.

[1] Measures of nameplate duration are typically based on a resource discharging at its full rated power. For example, a 1MW/4MWh battery has a four-hour duration when discharging at its full rated power of 1MW. However, if the battery instead discharged at a rate of 0.5MW, then it would have a duration of eight hours (i.e., 0.5MW multiplied by eight hours equals 4MWh).

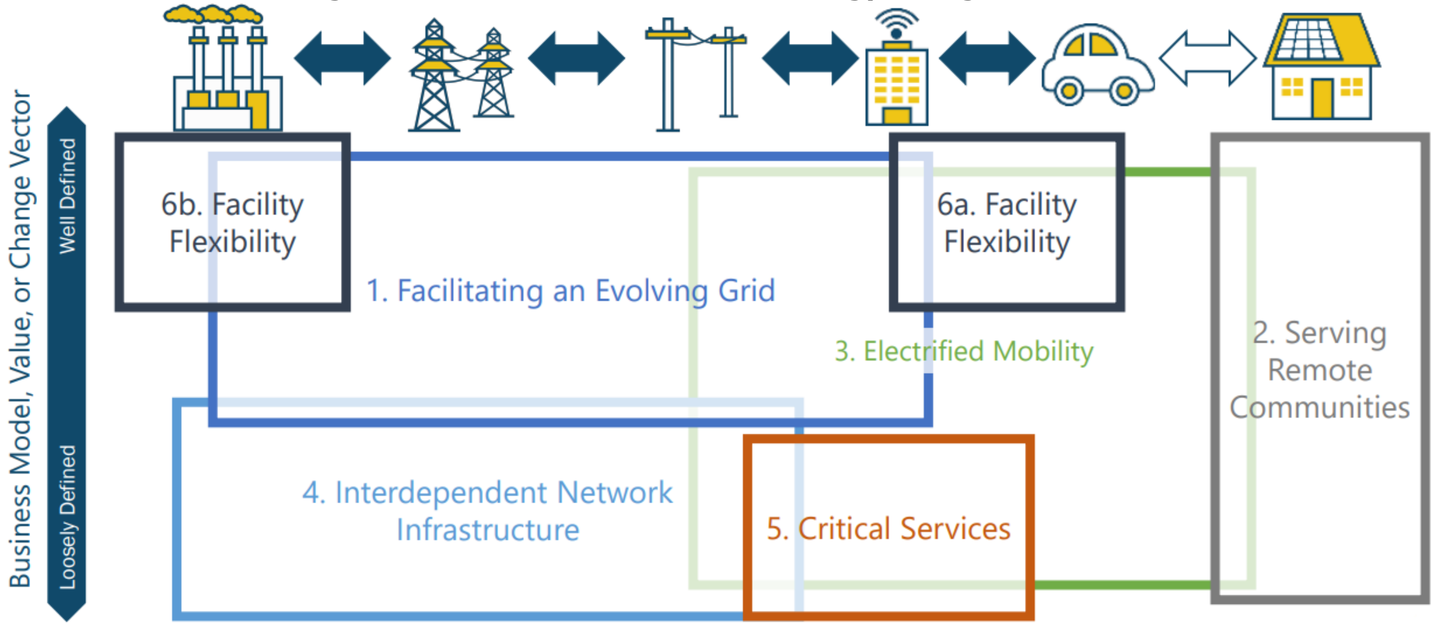
[2] Pumped hydro storage is currently the largest source of long-duration storage on the grid, with durations up to approximately 20 hours.

[3] Form Energy, a startup, disclosed in July 2021 that its batteries are made with an iron-air composition. The company says its batteries have a duration of 150 hours and could be one-tenth the cost of lithium-ion batteries, which is the most prevalent battery technology deployed today. https://www.wsj.com/articles/startup-claims-breakthrough-in-long-duration-batteries-11626946330

[4] https://www.greentechmedia.com/squared/storage-plus/swiss-army-knife-of-storage-how-frequency-regulation-launched-an-industry-then-tapped-out

[5] https://www.energy.gov/sites/default/files/2020/06/f75/ESGC%20Use%20Case%20Deck%20051320_508.pdf

**Figure 1: Illustrative Breakdown of Energy Storage Use Cases**




*Source: DOE*

Although DOE's framework represents just one approach for defining energy storage use cases, it illustrates that use cases can span multiple domains of the electricity system (i.e., generation, transmission, distribution, and customer) and have varying levels of specificity in terms of defining the business model or value proposition. As the energy storage industry continues to grow and mature, there is likely to be a greater need for guiding frameworks to support assessment of energy storage projects based on the use cases they seek to support. These frameworks could help answer key questions including:

- Who benefits from the use case and what, if any, is the revenue-earning opportunity associated with the use case
- What performance requirements or technical constraints are associated with the use case
- Which energy storage technologies are technically capable of meeting the use case

## Project Finance Considerations

Although credit-rated project finance transactions have so far only included energy storage to a limited degree, KBRA expects this technology could play a more prominent role in future project finance deals. Like other project finance transactions KBRA rates, the most critical consideration centers on how the inclusion of energy storage in a project finance deal impacts expectations around future cash flows. The following subsections provide examples of analytical considerations related to energy storage in terms of the credit determinants in KBRA's Project Finance Global Rating Methodology, published on January 19, 2021.

### Construction

Some already completed energy storage projects have demonstrated an ability to be constructed in much shorter timeframes than traditional generation projects, which could be a credit positive outcome by minimizing the potential for construction issues or unforeseen delays. However, given the nascent stage of the energy storage industry, contractors have a more limited history of constructing these projects, providing less historical data for comparative purposes. Contracts could be constructed in a fixed rate structure with corresponding financial incentives and penalties to mitigate risk.

### Technology

Energy storage technologies are assessed to validate operating characteristics and determine if they can provide targeted use cases. Aside from pumped hydro storage, most energy storage technologies still lack significant performance history given the nascent stages of deployment. Lithium-ion remains the dominant battery chemistry in commercial use today, but others may become more prevalent in the future. Most energy storage technologies commercially available today have shorter lifetimes than other power and renewable technologies, requiring consideration to potential costs associated with replacing the battery and other key components.

### Operations & Maintenance (O&M)

There are at least two important O&M elements to consider. The first entails an assessment of who is responsible for ongoing O&M, accounting for the reputability of the O&M provider and existence of a service agreement. The second relates to how the O&M provider operates the energy storage system, given its duration-limited nature and assessing any warranties or other contractual arrangements in place to govern how the system is operated (e.g., X number of cycles per day; depth-of-discharge no greater than Y%; etc.).

### Resource Assessment

Since energy storage does not generate its own electricity, consideration is given to the charging source(s) for the energy storage system. Energy storage could charge through wholesale and retail purchases of electricity or directly from the output of co-located generation, such as solar and wind.

### Counterparty Exposure

Energy storage is similar to other project finance transactions, whereby the core focus is on which counterparties are involved, as well as their creditworthiness and how they structure contractual terms; the latter of which could be assessed in the context of the energy storage system's operational attributes to determine the feasibility of complying with all terms and conditions.

### Competitive Position

This is similar to other power and renewable energy projects, whereby energy storage could provide services to the merchant market and/or directly to an offtaker through a long-term agreement. This includes customer-sited energy storage systems that target customer bill savings.

### Transaction Structure

Similar to other project finance transactions, whereby the core focus is on the financial structure of the deal rather than the underlying project.

While the above represents a high-level overview, the following two sections provide further discussion about two key developments that are likely to inform energy storage value proposition: (1) federal regulatory and policy drivers, and (2) energy supply and demand evolution. These developments are most closely related to the Counterparty Exposure and Competitive Position credit determinants.

## Federal Regulatory and Policy Drivers

Existing and prospective federal regulatory and policy actions are likely to continue playing a critical role in facilitating greater revenue potential for energy storage projects. In December 2018, the U.S. Federal Energy Regulatory Commission (FERC) issued Order 841, requiring all FERC-jurisdictional independent system operators (ISOs) and regional transmission organizations (RTOs) to develop a wholesale market participation model that allows energy storage resources to provide and to be compensated for all wholesale market services they are technically capable of providing. Subsequently, in September 2020, FERC issued Order 2222, requiring all FERC-jurisdictional ISOs/RTOs to develop a wholesale market participation model allowing aggregations of distributed energy resources (DERs)[6] to provide and to be compensated for all wholesale market services they are technically capable of providing. These orders expand opportunities for energy storage to participate directly in wholesale markets, either on a stand-alone basis (minimum size requirement of 100kW per Order 841) or as part of an aggregation (no minimum size requirement for individual DERs comprising an aggregation per Order 2222). While more progress has generally been made on compliance with Order 841, ISOs/RTOs are actively developing and implementing plans to comply with Order 2222.

Another regulatory development relates to co-located hybrid resources, where storage is co-located with solar or wind. FERC held a technical conference in July 2020 and published a white paper in May 2021 on the topic to explore potential wholesale market design reforms needed to ensure there are no undue barriers for these resources to participate in the wholesale market. There are many topical areas related to hybrid resources, but some of the most critical include interconnection issues, market design and operation, and calculation of capacity value. Separately, states like New York are investigating the types of metering configurations that are required for storage when co-located with distributed generation to ascertain whether storage is charging from "green" electricity.

[6] FERC defines a DER as "any resource located on the distribution system, any subsystem thereof or behind a customer meter. These resources may include, but are not limited to, electric storage resources, distributed generation, demand response, energy efficiency, thermal storage, and electric vehicles and their supply equipment." https://www.ferc.gov/sites/default/files/2020-09/E-1_0.pdf

With respect to these first two developments, although KBRA generally considers long-term contractual arrangements (e.g., power-purchase agreements, or PPAs) as a more secure revenue source relative to merchant market revenues, these are still both positive developments for energy storage merchant revenue potential. However, since these kinds of developments are still fluid and can materially affect the revenue potential of energy storage projects (both stand-alone and hybrid), it is critical to continue monitoring their evolution to ascertain potential impacts to estimated future cash flows.

Another relevant development relates to the federal Investment Tax Credit (ITC). Under the current structure of the ITC, stand-alone storage systems are not eligible for the ITC, but storage combined with an ITC-eligible wind or solar project may be eligible.[7] As part of this eligibility, the energy storage system must charge at least 75% of the time from the co-located wind or solar system.[8] However, on March 9, 2021, the Energy Storage Tax Incentive and Deployment Act (H.R. 1684) was introduced in the House of Representatives to propose expanding the existing ITC to stand-alone storage systems with a capacity of at least 5kWh. Although this bill is yet to become law, its passage would represent a positive development for energy storage revenue potential as projects could monetize the ITC either directly or through tax equity arrangements.

### Energy Supply and Demand Evolution

A second emerging development relates to underlying drivers of changes to the energy supply mix and demand levels. With respect to the supply mix, and as described above, the emphasis on transitioning to a cleaner electricity mix is likely to result in greater penetration of variable renewable energy, while coal is likely to see its share of electricity generation continue to decline. As the supply mix becomes more variable due to the reliance on intermittent resources, there is a greater role for energy storage to “firm up” intermittent resources and be a key source of grid flexibility. However, it remains to be seen how quickly renewable energy and storage resources are deployed and what that means for the incremental value potential of storage resources. For example, if storage deployment becomes oversaturated relative to grid needs resulting from renewable deployment, there may be less revenue potential available for storage resources.

The other side of the equation is electricity demand. While many utilities have experienced relatively flat—or even declining—load growth in recent years (at least partly due to an emphasis on efficiency measures), there is increasing emphasis on building and transportation electrification as an enabler of economy-wide carbon emissions reduction. Although the aggregate impacts of electrification may not immediately shift demand levels and patterns, it could have a material impact in the coming decades (e.g., significantly higher peak load and/or shifting from summer-peaking to winter-peaking).

Collectively assessing potential changes on both the supply and demand side could inform a deeper understanding of the potential revenue storage can derive. This is particularly relevant for energy storage systems participating in the merchant market since supply and demand trends are likely to have important implications for capacity, energy, and ancillary services pricing.

## Corporate Considerations

Although energy storage is likely to have a more pronounced effect within project finance transactions, there are also important considerations within the context of corporate credit quality. In particular, electric utility companies are most likely to be materially affected by the growing deployment of energy storage.

Within the context of corporate credit ratings, electric utilities generally have lower risk relative to other corporate entities, when assessing competitive position, given the regulatory support they receive in terms of having minimal competition and being part of a near-monopoly market providing an essential public service. However, the utility industry is amid a significant transformation not seen in over a century. While the industry has largely avoided the fate of the purported utility death spiral, there are still crucial challenges—and opportunities—the industry must tackle with respect to preserving its growth and competitive position. Central to these strategic considerations is how utilities approach energy storage.

Under a traditional cost-of-service ratemaking approach, regulators approve funding requirements for utilities that allow them to recover their costs and earn a reasonable rate of return. As a result, utilities have traditionally earned money in two primary ways: (1) selling more electricity (i.e., MWh) and (2) investing in infrastructure (i.e., capex). While the impact of energy storage on these earnings pathways has so far been limited in comparison to a utility’s total balance sheet, it may have growing relevance as deployment accelerates, both in terms of a utility’s bottom line and broader strategic objectives.

[7] https://www.jdsupra.com/legalnews/are-investment-tax-credit-changes-in-8883438/

[8] This requirement has been effectuated through Internal Revenue Service (IRS) private letter rulings for specific applicants, but private letter rulings do not legally bind the IRS to maintain these determinations for other applicants.

In relation to selling more electricity, energy storage can be an enabler of those seeking to self-serve their own energy needs.[9] As seen across the country—and globe—in recent years, increasing frequency and severity of extreme weather events has increased an emphasis on ensuring resilience of the electric grid and critical infrastructure (e.g., police and fire departments, hospitals, military establishments, etc.). Consequently, there is growing interest in the role that microgrids[10] can play in helping to meet localized energy and resilience needs—with energy storage playing a critical role to provide the kind of firm backup power that solar and wind cannot do alone. Although microgrid development could represent a reduction in load otherwise purchased from the incumbent utility (assuming the storage resource charges from generation resources within the microgrid), there are some utilities actively exploring microgrid investments to provide resilience and other local benefits.

Alternatively, since energy storage requires a charging source, increased deployment of this technology type could also put upward pressure on electricity sales if charging from the grid. Additionally, and as discussed earlier, energy storage within the transportation sector (both as batteries for vehicles and to modulate load profiles of charging infrastructure) can similarly increase utility electricity sales. Given these potentially countervailing forces, it is important to understand what the net effect might be for individual utilities when assessing storage's impact on electricity sales.

Separately, energy storage can inform utility investment decisions. With the wide range of grid services energy storage can provide, many utilities are exploring opportunities to directly invest in, own, and operate energy storage as a critical grid resource to meet system needs. Directly investing in energy storage provides utilities an opportunity to earn a regulated rate of return and increase their earnings (including, as discussed earlier, monetizing a potential federal ITC). Alternatively, and typically as a result of a regulatory mandate, some utilities are exploring opportunities for energy storage to serve as an alternative to traditional utility infrastructure investments, like a substation upgrade or replacement (typically referred to as a non-wires solution, or NWS). Although utility earnings mechanisms for these types of NWS vary state by state, they generally provide less of a financial benefit for utilities compared to directly owning the energy storage resource because there is typically some form of sharing mechanism, whereby utility customers capture some portion of the cost savings (i.e., relative to a traditional utility investment).

Even though the focus on cost-of-service ratemaking is much broader than just energy storage, this resource type still plays an important role in shaping these discussions. There has been growing attention on the role that utility performance-based regulation can play in aligning utility and customer incentives more effectively (i.e., moving beyond cost-of-service regulation, where utilities earn revenue by selling more electricity and investing in capital infrastructure). While there are still limited instances across the globe of jurisdictions implementing these alternative incentive mechanisms, expanded adoption could influence the role that energy storage plays within utility business models moving forward. For example, jurisdictions could tie utility financial earnings to the amount of energy storage adopted within its service territory, thereby creating an incentive for the utility to support the resource's deployment even if not directly owned by the utility.

## Conclusion

KBRA believes the increasing prevalence and potential of energy storage as a critical grid resource warrants continued attention, as this resource type more directly impacts project finance and corporate credit ratings. While it is still early days for this technology, the potential for exponential growth in the coming years may have wide-ranging effects, from merchant pricing trends to electric utility business model evolution. KBRA will continue to monitor and report on key developments related to energy storage, including how the multiple layers of complexity it introduces get factored into KBRA's assessment of credit quality.

[9] There have been discussions in the industry about "grid defection," whereby end-use customers adopt energy technologies (e.g., solar, storage, etc.) to fully meet their energy needs, enabling them to stop receiving electric service from their utility. However, since full defection from the grid can represent a significant cost (both to the defector and remaining utility customers), it is useful to think about these newer energy technologies in the light of "load defection," whereby customers still rely on the utility to some degree, but the overall amount of energy purchased from the utility declines.

[10] There are variations in how people define a microgrid, but DOE has defined it as "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode." https://www.energy.gov/sites/prod/files/2016/06/f32/The%20US%20Department%20of%20Energy's%20Microgrid%20Initiative.pdf

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