Understanding the **Energy Storage** Opportunity: Drivers and Risks

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Foreword

Energy storage is rightfully one of the hottest topics in the energy industry right now. The potential benefits and profitability has prompted plenty of excitement and questions among industry leaders, and for good reason: deployment of energy storage, especially batteries, will increase substantially in the next few years. GTM expects the U.S. energy storage market will almost double in 2018 alone, with more than 1,000 MWh of storage deployed by the year's end.

Three underlying trends in the energy markets will drive the growth:

1. Favorable federal and state regulations on energy storage;
2. Falling costs for batteries due to advances in technologies;
3. An improved ability by energy storage owners to tap into multiple revenue streams.

However, as with any novel technology, the array of opportunities for storage brings new types of risks. Project developers and investors need to understand the risks so that they can plan for contingencies and mitigate risks.

Our experts have developed this comprehensive guide to help utility executives, investors, and others to demystify those questions and prepare their business for a foray into this exciting arena. We have developed a robust guide to what will drive energy storage in the near-term future, the pace at which development will proceed, and the many potential risks that might coincide with investment in this relatively new field. At the same time, we have also detailed tactics to mitigate those risks and protect your assets—a critical step in our industry's changing landscape.

Regulatory Drivers

Until recently, storage was a square peg jammed into the round hole of historic regulation.

The existing federal regulation of wholesale power sales and transmission in interstate commerce was designed for a world largely devoid of any significant energy storage. Although pumped-storage hydroelectricity has been around for a long time, it has very different characteristics from modern storage technologies such as batteries, flywheels or thermal energy storage projects.

Today, federal and state governments are moving to encourage storage. Additionally, the Federal Energy Regulatory Commission (FERC) is clearing a path to wholesale market participation. The Commission has issued multiple orders in recent years that help energy storage. It also issued a notice of proposed rulemaking (NOPR) in November 2016 proposing transparent market rules for energy storage facilities to participate in organized markets run by regional transmission organizations (RTOs) and independent system operators (ISOs).

In February 2018, FERC issued its final rule (Order No. 841). The order requires ISO and RTO markets to establish market rules that properly recognize the physical and operational characteristics of electric storage resources and ensure that a storage resource participating in the market is eligible to provide all capacity, energy, and ancillary services that it is technically capable of providing.

This is an important step in removing barriers to the participation of storage and could provide strong incentives for the development of storage resources. For example, the ancillary services and capacity markets (where existing) could comprise the largest sources of revenues for a storage resource in the ISO or RTO markets.

The problem storage faces trying to participate in such markets today is the rules were developed for power plants and demand response resources and may unnecessarily limit the scope (and therefore compensation) of storage services.

The federal government also allows a 30% investment tax credit to be claimed on some storage facilities that are seen as part of solar and some wind projects. To be eligible, the storage equipment must be coupled to a renewable energy project and operated in a manner that it is considered power conditioning equipment or part of the generating equipment. At least 75% of the energy stored by the storage device should come from the renewable generator to which it is coupled. A stand-alone energy storage project would not qualify.

Many state governments have enacted (or are in the process of enacting) mandates or regulations to promote storage (Exhibit 2 page 9). States will probably lead the charge on storage development in the near term since they have smaller constituencies and tend to be more nimble than the federal government in responding to market conditions. Some state and local governments also have a stronger appetite for renewable energy deployment than the current federal government. For example, the governors of 16 states and Puerto Rico and the mayor of the District of Columbia committed to comply with the Paris Climate Agreement after the Trump administration ended U.S. participation.

Improving Economics

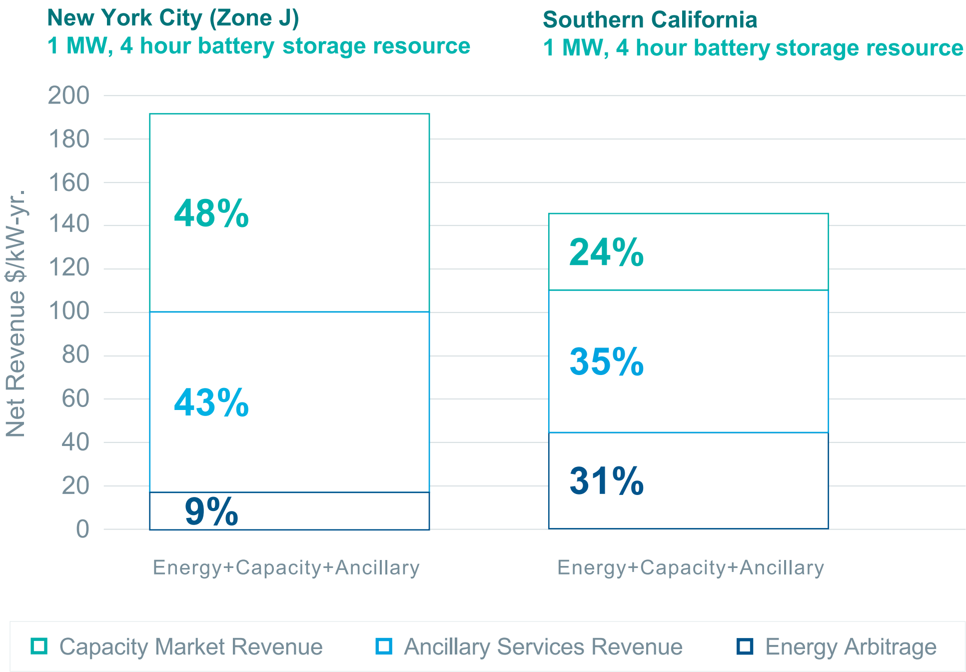
Energy storage is likely to follow the same pattern as other new technologies, such as solar. Battery cell costs declined from $3,000 a kilowatt hour in the 1990s to $200 a kilowatt hour by 2016.

Utility-scale energy storage systems with four-hour storage capacity installed in the third quarter of 2017 had a median price of $525 a kilowatt hour. GTM Research projects this price to drop to $450 a kilowatt hour by 2019. The cost per unit capacity for these systems was in the range of $1,300 to $1,500 a kilowatt in 2017. It is expected to decline to $800 to $1,100 a kilowatt by 2020. This compares to an installed cost of $978 to $1,100 a kilowatt for a combined-cycle gas-fired power plant today.

Bloomberg New Energy Finance (BNEF) projected in 2016 that the installation costs of battery technologies will decline at 6% a year, meaning that the unit installation cost should, by 2025, be half of what it was in 2015.

ICF recently simulated the operation of a utility-scale 4 MW, 1 hour battery storage device in New York City (NYISO Zone J) using actual historical prices for 2017 (as a backcast simulation). The simulation estimated that roughly $191/kW-year, would be earned from capacity, energy and ancillary services (Exhibit 1). While the energy arbitrage and ancillary services (regulation or synchronous reserves) was optimized based on historical price, the capacity revenue was added on all-hour basis using annual average capacity prices in the NYISO spot market for 2017. The same simulation was run for an asset in Southern California, and the results showed $152/kW-year in revenue. The modeled applications would be close to economically viable if we consider a conservative cost estimate range of $170-$250/kW-year.

EXHIBIT 1:
Revenue projections for a utility-scale battery resource in New York City and Southern California



Note: the revenue model was based on historical prices and assumes perfect price foresight, which is not the case in real world applications.

The true value of storage resources is not limited to capacity, energy and ancillary services. There are numerous sources of potential additional value (page 11). Many regions already have markets that let energy storage owners tap into some of these additional revenue streams, and others will follow as government policies change. Storage projects have unique risks stemming from unstable regulatory regimes, unprepared market structures, unique liability exposure, and unproven performance records. Creativity, flexibility, and preparedness will help manage these risks.

Regulatory Risks

There are two main types of regulatory risks

1. As is the case with many new technologies, a changing regulatory environment could prove challenging.
2. The investment tax credit may not be as beneficial as expected—or it might not be available at all.

A 2015 decision of the Nevada Public Utilities Commission offers a clear example of how risk could play out at the state level. In sum, the Commission substantialy lowered the state net metering revenues without protecting existing systems that were installed with the expectation of higher revenues. Rooftop solar companies announced they were pulling out of the state as a result. Although key aspects of the order were later revised, the experience is a lesson about potential regulatory volatility to anyone trying to develop a new technology that relies on favorable government policy for support.

At the federal level, lack of clarity about the regulatory treatment for energy storage is the biggest challenge. This is becoming more relevant in projects that combine energy storage with renewable power generation and make retail sales.

Energy storage is a unique animal, hybrid in the sense that it shares some features in common with generating facilities and other features in common with transmission assets and load. This means it should be able to provide, in theory, a broader range of services than these other assets individually. The FERC order on storage resources is one step toward integration of new storage technologies into wholesale markets, but a lot of work remains to be done to realize the full potential of storage.

Stakeholders can take a few steps to tackle these risks

1. **Combine energy storage with other generating assets.** For example, many rooftop solar companies are deploying storage alongside solar installations. Combining storage with generating assets with stable revenue and well-defined market participation rules helps mitigate the risk that changes in market rules may reduce or eliminate revenues from a specific project.

2. **Take steps to resolve uncertainty.** For example, one can ask for interpretive guidance or a declaratory order from FERC stating how the Commission will apply its regulations to a certain set of facts. These options typically require both time and filing fees, but they could help settle important questions. Some state regulators also offer a procedural option of requesting declaratory relief or an advisory opinion on regulatory matters. For example, in September 2017, Tesla obtained an advisory ruling from the Massachusetts Department of Public Utilities that said certain small-scale batteries paired with solar generating facilities are eligible for net metering. The ruling was issued in fewer than four months after Tesla filed a petition and prompted Massachusetts to open a general docket on eligibility of energy storage for net metering.

3. **Draft storage contracts to address potential changes in the regulatory regime.** This could mean including a mechanism to revisit pricing in the event of a change in law. Alternatively, the parties could be required to enter into good-faith negotiations to restore the benefit of each party's bargain after a change in law.

Another risk is that an investment tax credit will be claimed on the cost of a storage facility, but then the mix of electricity stored changes over the first five years when the credit is exposed to full or partial recapture. The IRS requires no more than 25% of the energy stored come from other sources than the solar or wind facility of which the storage device is a part and then the percentage of other energy storage determines the amount of investment tax credit that can be claimed. For example, if 10% of the storage energy is from other sources the first year, then only 90% of the full ITC can be claimed. If the percentage of other energy stored increases in any of the next four years, the credit is subject to partial recapture.

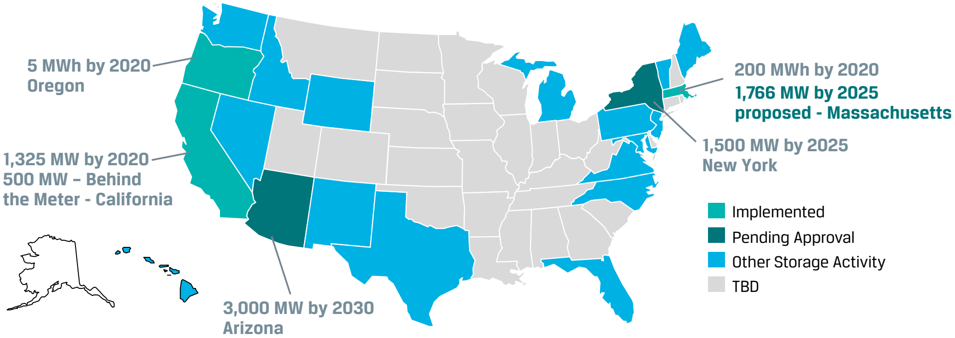
The best mitigation method for this type of risk is thorough and accurate modeling of system operation under the full range of operating conditions, and with the system providing all anticipated energy services, to estimate the fraction of charging energy supplied by the linked solar or wind project. To the extent the offtaker has a right to control charging, the owner may want to build in a right to recover any ITC-related recapture or losses caused by the offtaker.

Market Risks

Independent system Independent system operator (ISO) and regional transmission organization (RTO) market rules allowing "merchant" storage are often the same rules developed for conventional generators and, as such, may not adequately reflect operating capabilities or performance risks that are unique to energy storage. This may limit the ability of storage to compete in the market and make the potential revenue stream more unpredictable than it is for other market participants.

FERC regulations designed to provide fair compensation for the unique operating characteristics of energy storage would eliminate some of these risks. FERC adoption of the 2016 NOPR would also help. Until that point, though, stakeholders should become intimately acquainted with the rules of the market you intend to participate in, and to write into contracts a right to re-negotiate the allocation of market penalties, costs, and revenues should market rules change.

Exhibt **2:**
State Targets Promoting Storage



The ISOs and RTOs also offer various working groups and stakeholder forums in which to raise issues and become involved in market design. It may be prudent to take full advantage of these opportunities if a substantial investment is anticipated.

Interconnection Risks

Because few utilities have significant experience with storage, developers proposing novel storage projects to inexperienced utilities should expect that the interconnection process will take time.

In addition, if a proposed project provides any service that may r requires on-peak charging, the utility might need costly network upgrades that would otherwise not be necessary.

As more utilities gain experience with storage, the duration of the interconnection agreement process will decline. Until then, developers can minimize delays by:

1. ensuring that their interconnection applications are clear and complete,
2. responding rapidly to utility information requests, and
3. maintaining frequent communication with utility personnel.

The cost of interconnection network upgrades may be reduced by avoiding services that will require on-peak charging from the grid, but the value of such services may exceed the incremental cost of the network upgrades. To get in front of this, developers can help identify the least expensive interconnection location by asking the utility to do an interconnection feasibility assessment early in the process.

Litigation Risks

State programs to encourage particular types of participants in wholesale markets are at an increased risk of litigation following the 2016 Supreme Court decision *Hughes v. Talen Energy Marketing.* The case, which involved efforts by a state to encourage construction of new gas-fired power plants, found that the state crossed the line between state and federal jurisdiction because its actions affected wholesale power markets. Various subsequent proceedings have arisen that seek to further clarify the jurisdictional "line."

Energy storage is also subject to other general litigation risks (environmental, human impact and intellectual property) due to its novelty. Environmental risk —like battery leakage and equipment disposal—can vary greatly depending on the technology and siting. Further, the evolving nature of the storage market and rapid deployment of new technology makes storage a prime target for intellectual property challenges. Suppliers may demand heightened confidentiality regarding proprietary technology and operation processes.

Performance Risks

New technology carries obvious performance risks. Poor performance jeopardizes contracts and could subject developers to heavy non-performance penalties in certain wholesale markets.

Manufacturer warranties and other performance guarantees and even insurance policies can help. Developers should also make sure that adding storage to other forms of generation will not invalidate any performance guarantees attached to the generating facility.

Performance risk should be considered both in terms of initial system performance risk and long-term performance risk.

Examples of Possible Sources of Energy Storage Value

Capacity	Energy	Reduced reserve requirement	RTO/ISO ancillary services	Reduced uneconomic dispatch
Reduced revenue sufficiency guarantee payments	Improved renewable resource integration	Reduced renewable resource curtailment	Reduced fuel price volatility risk	Improved black start capacity
Fast ramping capacity	Voltage/ VAR optimization capacity	Energy arbitration	Deferred capital investment	

Developers usually buy batteries directly from the manufacturer and focus primarily on system integration. If the developer does not have a comprehensive understanding of battery capabilities and limitations, such as maximum charge and discharge rates, thermal requirements and cycle life, there is a strong possibility that the control room will mismanage the battery, and the overall system will be unable to satisfy power purchase agreement performance expectations, with the potential for adverse financial impacts or litigation.

The primary mitigation for this type of risk is to have a thorough understanding of battery capabilities and limitations and to design a system that will reliably provide all contracted services for the duration of the contract.

This requires accurate modeling of battery system operation. Some battery services, such as fast ramping, demand-charge reduction and spinning reserve, can be much more taxing on some batteries than on others. This should be reflected in the model.

Many PPAs have terms that exceed expected battery lives. If storage services are required for 20 years, then the developer must plan for battery replacement at appropriate intervals and contract for appropriate outage and maintenance rights. Earlier replacement will be required for batteries that allow deep discharge than for storage devices that are designed primarily for backup power and frequency regulation. Developers frequently underestimate the costs of system operations and maintenance.

The main mitigation for this risk is to come up with an appropriate O&M plan based on a thorough understanding of how the battery will work. In addition to periodic battery replacement, this includes having spare power conditioning equipment (inverters, voltage converters) and service technicians available to address unplanned outages or degraded capabilities. Most energy storage systems have continuous monitoring, and, to an increasing degree, developers are providing this service in-house. This enables faster detection and resolution of system performance issues. Independent engineers evaluating system design usually also evaluate the O&M plan.

Authors

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