Energy Storage: Are We There Yet?

By **Paul Kraske and Zahir Rahman** (June 22, 2018, 4:15 PM EDT)

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In October 2015, employees at the Aliso Canyon natural gas facility in Los Angeles, California, discovered a methane leak that resulted in closure of the facility, and California Gov. Jerry Brown issuing a state of emergency. In addition to the related environmental and health concerns, regulators worried about how the leak would impact availability of electricity for the region, and weeklong blackouts seemed inevitable.

The solution to this problem was for utility Southern California Edison to rush energy storage projects online on an emergency basis. Within nine months, 60 MW of battery storage facilities were sited, constructed and operating, providing peak-demand energy at a time of concern and instability. Since then, developments in battery technology, state executive and legislative policies and the recent Federal Energy Regulatory Commission Order 841 have continued to push energy storage into the national spotlight, signaling its role as a pillar of energy policy in the U.S.

According to the Energy Information Administration's May 2018 report "U.S. Battery Storage Market Trends," at the end of 2017, 708 MW of power capacity representing 867 MWh of energy capacity of large-scale (greater than 1 MW) battery storage capacity was operational in the U.S. — two-thirds of which was installed in the past three years. Approximately 90 percent of large-scale battery storage is installed in regions covered by regional transmission organizations, or RTOs, and independent system operators, or ISOs.

In fact, nearly 40 percent of existing large-scale battery storage power capacity (and 31 percent of energy capacity) lies in the Pennsylvania-New Jersey-Maryland Interconnection, or PJM, region while another 18 percent of existing large-scale battery storage power capacity (and 44 percent of energy capacity) lies in the California Independent System Operator region. According to the EIA report, as of December 2017, 239 MW of planned large-scale battery storage is expected to become operational in the U.S. between 2018 and 2021, with California accounting for 77 percent of that amount.

Advances in Storage Technology

Over the last 20 years, the energy industry has tested many different types of energy storage technologies, but for the first time, a market-tested front-runner has emerged: lithium-ion batteries. While nickel-based, sodium-based, lead acid and flow batteries have been deployed in the U.S., lithium-ion batteries comprised over 80 percent of all U.S. large-scale (greater than 1 MW) battery storage capacity by the end of 2016.

Typically, lithium-ion batteries are designed to implement 365 cycles per year, with a four-hour capability per cycle, and have a lifetime of 20-30 years. As seen in the deployment of the California battery storage facilities, with a four-hour duration battery, a standard 20 MW lithium-ion energy storage facility can deliver 80 MWh of capacity to meet peak demand.

One of the most attractive aspects of these batteries is that the cost of lithium-ion technology has been rapidly decreasing; between 2010 and 2016, the price of lithium-ion batteries dropped 73 percent, a decrease primarily driven by Chinese electric vehicle demand. The total installation cost of lithium-ion battery storage (including inverters and balance of plant) was approximately $1,300-$1,500 per kilowatt in 2017, and Bloomberg New Energy Finance has predicted that these installation costs will continue to drop 6 percent per year over the next 10 years.

Competitive Advantages

The most alluring proposition related to energy storage is that storage can serve multiple purposes. Typically, energy assets serve one purpose in the energy system, but energy storage can act as generation when connected to the grid and as transmission when it is transmitting power. This is in addition to alleviating load stresses, as needed.

Overall, energy storage has capacity and grid-balancing capabilities, and can regulate frequency, provide voltage support and enact blackstart capability services. As evidenced after the Aliso Canyon leak, energy storage can be deployed quickly, making it an ideal solution under circumstances of natural resource shortage, weather or incident-related outage, natural disaster or necessary growth of distributed generation.

Within the context of renewables, energy storage also has other advantages over solar and wind technologies. Whereas solar and wind often are subject to fluctuating output and rapid ramp-up and ramp-down, energy storage is stable for grid purposes, as it often features short charge and discharge cycles and responds better to fluctuating outputs.

Further, energy storage can reduce stress on the electric system by addressing "duck curve" issues, increasing demand off-peak and increasing supply during peak times. For example, two utilities in California and Arizona are proceeding with battery storage systems offering peaking capacity, as in the case of San Diego Gas & Electric's 40 MW (160 MWh), four-hour duration battery storage facility in Fallbrook, California, and the Salt River Project (SRP)'s 10 MW (40 MWh), four-duration battery storage facility in Chandler, Arizona.

Finally, under market environments with great load uncertainty driven by economic development, population shifts and expanded distributed energy needs, the employment of energy storage is ideal for policymakers who are concerned about making large investments that are both expensive and time-consuming. Energy storage can be used to avoid huge costs that would otherwise cause a plant or project to become an overbuild, as energy storage can be designed to meet exact offtake needs and help mitigate forecast error risk and costs.

Aggressive State Goals

State policymakers have recognized the technological advancements in energy storage as well as its competitive advantages and have in turn pursued executive and legislative policies to pursue front-of-the-meter energy storage. The nation's leader in forward-thinking energy storage policy is California, which in 2013 passed a collective mandate requiring its investor-owned utilities, or IOUs, to procure 1,325 MW in energy storage by 2020.

Last year, the California Public Utilities Commission implemented Assembly Bill 2868, and issued an order requiring the IOUs to procure up to an additional 500 MW of distributed energy storage. In 2015, Oregon passed a mandate to hit 5 MWh per utility by 2020.

Not to be left behind, states on the East Coast have pledged support for energy storage as well. Earlier this year, New York issued a deployment initiative to reach 1,500 MW in energy storage by 2025, and Gov. Andrew Cuomo proposed that the NY Green Bank commit $260 million for energy storage-related investments. At the end of last year, Gov. Cuomo signed legislation that encourages the New York Public Service Commission to pursue and develop policies that will promote energy storage proliferation in the state.

In June last year, the Massachusetts Department of Energy Resources announced a 200 MWh energy storage procurement target for electric distribution companies to be achieved by Jan. 1, 2020. This was in accordance with bipartisan energy diversification legislation passed last year. Earlier this year, a new clean energy bill was introduced in the Massachusetts Senate that had included an energy storage target of 1,766 MW by 2025.

In Arizona, a proposed plan would require 3,000 MW in energy storage by 2030. In May this year, as part of new renewable energy legislation, New Jersey adopted energy storage targets of 600 MW of energy storage by 2021 and 2 GW of energy storage by 2030, among the most aggressive in the U.S. New Jersey's energy storage targets are the first to be set in a PJM region state.

More states are expected to follow with announcements of energy storage targets and mandates. Some states are now also requiring utilities to include energy storage in their integrated resource plans.

Impact of FERC Order 841

As states set aggressive energy storage goals across the country, and battery technology became more accessible and common in the marketplace, critics still found that FERC's traditional rules surrounding energy storage left them "financially hobbled" due to burdensome technical requirements contained in many RTO/ISO market rules. FERC's limits on preventing energy storage from earning revenue from multiple streams also proved to be a roadblock for developers.

Breaking this tradition and signaling a massive change in energy policy, in February this year, FERC issued Order 841, aiming to remove those market barriers that prevented "electric storage resources" from participating in wholesale energy markets. Specifically, FERC Order 841 requires "each RTO and ISO to revise its tariff to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources," facilitate the participation of such resources in the RTO/ISO markets.

The RTOs/ISOs are directed to accomplish four principal objectives:

- Make changes such that an electric storage provider can fully participate in all capacity, energy and ancillary services markets;

- Ensure that electric storage resources can be dispatched and that an electric storage provider can set the wholesale market clearing price as both a wholesale seller and wholesale buyer;

- Account for the "physical and operational characteristics of electric storage resources through bidding parameters or other means;" and

- Set a minimum size requirement for participation in the wholesale markets that does not exceed 100 kW.

FERC Order 841 marked the first time that the nation's leading energy regulatory body recognized that electric storage resources are different from other energy assets, because such resources can deliver power into the grid and also withdraw it as both potential sellers and buyers.

Prior to FERC Order 841, each electric storage provider was required to pay retail rates for electricity it took off the grid, making such participation prohibitive. Under FERC Order 841, each RTO/ISO has 270 days from the publication date of the order in the Federal Register to make a compliance filing and an additional 365 days to take action and implement the tariff revisions. Most experts agree that these target dates will likely be pushed back due to related comment and hearing delays.

Energy storage proponents have praised FERC Order 841 for promoting energy storage projects in the U.S., though some critics are concerned that the order does not do enough for the industry. Some say that by issuing FERC Order 841, FERC "passed the buck" to the RTOs/ISOs, relying on them to drive the energy storage markets. In fact, most projections of energy storage growth are in transmission and distribution, sectors that are beyond FERC's immediate jurisdiction.

Under FERC Order 841, states still have the flexibility and discretion to adapt rules to meet their particular energy needs, allowing grid operators to set minimum run time requirements, design their own bid standards, set rules for charging policies and determine if energy storage projects are permitted to sell ancillary services without directly participating in the regulated energy markets. Evidently, FERC Order 841 has given the green light to states to engage and promote energy storage, but the states themselves will need to drive energy storage to the finish line.

Future of RFPs

Due to the various pro-energy storage state policies and goals described, we expect to see states, motivated by executive and legislative mandates, use their FERC-granted discretion to integrate energy storage into electricity requests for proposals in a meaningful way. RFPs that included energy storage prior to FERC Order 841 may have been open to bid packages that included energy storage, but they did not preference or tailor requirements to suit it.

For instance, Arizona's SRP power company issued an RFP earlier this year, before FERC Order 841 was released. The SRP RFP invited bids for 100 MW of capacity and stated, "Proposals with a battery storage component are also encouraged (as long as an alternative proposal without storage is also provided)" and that "[bids with] a renewable energy project with a storage component must also include a separate bid without the storage component." This RFP treated energy storage as ancillary to, and severable from, bid packages, and it did not acknowledge the multiuse or other positive benefits of energy storage.

It is interesting to note that last year, SRP signed a 20-year power purchase agreement

with NextEra Energy Resources for the now-completed 20 MW Pinal Central Solar Energy Center photovoltaic solar project, paired with a 10 MW (40 MWh) lithium-ion battery storage system. In May this year, NextEra Energy Resources closed on a $45 million loan provided by prominent project financing institutions Mitsubishi UFJ Financial Group and Mizuho Bank for the project that is Arizona's largest utility-scale solar-plus-battery storage system.

Once FERC Order 841 is implemented by the RTOs/ISOs, we expect RFPs to be tailored to accommodate — and, most likely, require — energy storage as part of the bids. In addition, as the state-set goals for energy storage capacity approach, the RTOs/ISOs may feel pressure to issue RFPs that explicitly award preference for bid packages that substantively incorporate energy storage.

Energy Storage Has Arrived

2018 has proven to be a major milestone and turning point for energy storage in the U.S. A perfect storm of more affordable, reliable batteries and ambitious, state-initiated capacity goals, along with FERC Order 841 has created an ideal environment for energy storage to grow at a fast rate and play an integral role in national energy policy.

As the RTOs/ISOs begin to alter their approach to energy storage pursuant to FERC's directive, it is safe to say that energy storage has finally arrived. Lower costs, increased deployment and ever-growing regulatory support will make project financing energy storage, particularly for lithium-ion, a more viable proposition in the future.

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