Updated Battery Energy Storage Technology Overview Report Shows:

Cooperatives Add Battery Storage Projects As Prices Fall

Key Findings

- Lithium-ion batteries remain the nearly universal choice for deployments of battery energy storage systems (BESS) for stationary applications in 2019. With its industry-leading cost point nearing the tipping point for widespread deployment, lithium-ion is poised to remain the first choice for a range of applications from residential to large utility-scale systems.
- While utility-scale installations are on the rise, industry projections show that behind-the-meter systems will comprise half or more of the installed capacity of stationary energy storage over the next decade.
- Flow batteries are the technology to watch for utilities that need a long-duration, large-capacity battery that can handle the repeated cycling of solar and wind production without degradation. Currently lagging in price and market maturity, flow battery production is moving from custom to standardized system design in an effort to reduce costs and attract buyers.
- At least three electric cooperatives have initiated or installed new BESS projects since the NRECA and three partners released a report on BESS in July 2018. Case studies of these projects and eight others are included in an update released last month.

What has changed?

In April, NRECA, the National Rural Utilities Cooperative Finance Corporation, CoBank and the National Rural Telecommunications Cooperative issued an updated version of **Battery Energy Storage Overview**, a joint publication originally released in July 2018. The update reflects the potency of battery energy storage as a technology relevant to changing electric cooperative needs, and the continued drop in the pricing of lithium-ion, the dominant battery type.

The report focuses on lithium-ion and flow batteries, the technologies that have emerged as the leading short- and long-term choices for stationary battery energy storage systems (BESS).

The average price of the lithium-ion battery module has dropped by 85 percent since 2010 and reached a new low in 2018 of $176/kwh, fast approaching the $150/kWh that industry experts believe is the threshold for significant investment in stationary energy storage.

Lithium-ion has been chosen for the vast majority of grid-connected electric energy installations in the past few years, from systems supplying homes and businesses to large utility-scale projects. Lithium-ion offers

unique scalability and dominates a range of markets from hand-held digital electronics to the electric grid. It excels among battery chemistries in being able to quickly deliver intense bursts of power, such as that required by an electric car. Its high efficiency, power density, and low price (largely a byproduct of the global production of batteries to supply the electric vehicle market) make it ideal for the fast output required by a utility demand management program, while also suitable for the large-scale, longer duration storage of energy tied to distribution or transmission systems.

Flow batteries in many ways resemble a fuel cell, using pumps to move an electrolyte fluid through a membrane, and have only recently shifted from the demonstration stage into limited commercial deployment. Flow batteries hold tremendous promise for an application of particular interest to electric utilities: absorbing the intermittent production from wind and solar, and storing that power for a long period. Unlike lithium-ion chemistries, which degrade over time, flow batteries with proper maintenance have a theoretically unlimited cycle life.

Flow batteries are more expensive than lithium-ion, but prices are coming down. As one way to reduce costs, flow battery vendors are moving from custom-built systems to prepackaged designs.

What is the impact on cooperatives?

Lithium-ion and flow batteries can help electric co-ops and their members integrate intermittent renewable energy production, manage demand, and increase resiliency, among other applications. The updated report includes three new co-op case studies that illustrate the potential benefits of cooperative BESS deployments for a range of uses, including:

- Storing excess solar output for use in peaking shaving,
- Integrating residential storage to align with utility system needs, and
- Reducing demand charges for the co-op as a whole and for an individual commercial and industrial (C&I) member.

In December 2018, **Connexus Energy** in Ramsey, MN, brought two large lithium-ion phosphate battery systems (6 MW of power/12 MWh of capacity and 9 MW/18 MWh) to full operation at two co-op substations. Each BESS was connected to multiple megawatts of solar, and set up to utilize the stored solar to help lower peak demand for the co-op.

Two BESS projects were installed at **Vermont Electric Cooperative** in Johnson, VT in 2018 and 2019. One is a small (5 kw/30 kWh) battery installed at a C&I member seeking to control its monthly demand charge. Though the battery is behind-the-meter, it is controlled by the co-op. The technology is the saltwater or aqueous hybrid ion battery that holds promise, but has limited deployment. The other project is a larger (1 MW/ 4 MWh) lithium-ion battery installed by the co-op at a substation to reduce its peak demand charges from the New England Independent System Operator (ISO).

Four distribution cooperative members of **Dairyland Power Cooperative** of La Crosse, WI have recently completed the installation of small (8 kw/16 kWh) lithium-ion iron phosphate batteries at individual residential member homes. The project will provide the generation and transmission company (G&T) and its members a hands-on test of everything from the installation experience to the practicality and performance of

networking batteries to meet system goals, while providing behind-the-meter value to the consumer-members.

What do cooperatives need to know or do about it?

The report provides cooperatives with the information to be in a position to look beyond the price tag on a BESS and analyze whether the value returned by the energy storage solution justifies the investment.

Cooperatives will arrive at different conclusions about whether a BESS makes sense depending upon a range of factors, including potential costs a cooperative is trying to offset, operational problems it needs to solve, state and federal policies, applicable market rules and regulations, available financing, and consumer expectations.

Choosing the right energy storage technology includes gaining an understanding of factors including:

- Is a certain level of ***power*** the critical need? In that case, it is important to focus on the kilowatt or megawatt rating.
- Is the amount of **energy** to be stored over time the critical need? In that case, it is important to focus on the kilowatt-hour or megawatt-hour rating.
- What are the uses cases or applications under consideration? The report tracks eight essential applications for BESS that a cooperative might face. Greater return on investment will follow, if a cooperative can utilize multiple applications (called *value stacking*).

The report emphasizes the importance of looking beyond battery cell or battery module costs, to the levelized cost of storage. A LCOS calculation takes the total cost of a BESS (which includes the battery pack, balance of system hardware, construction costs, and other "soft" costs of a project) and divides it by the energy it is expected to provide over the useful life of the system.

The case for a cooperative investment in battery energy storage is evolving as the falling price of the leading lithium-ion chemistries is driving interest and increasing feasibility. Co-ops need look no further than **Kaua'i Island Utility Cooperative** in Lihue, HI for evidence that a significant investment in energy storage today can be successful given the need. KIUC is one of the leading utilities in the U.S. in the installation of BESS. The cooperative stuck with battery storage after its first utility-scale deployment (an advanced lead acid battery) failed, moving to a more suitable and commercially proven lithium-ion technology. In KIUC's case, the drivers for energy storage included the high cost of conventional energy and the impacts of high solar penetration on an island grid. These factors made the investment not only reasonable, but one critical to the cooperative's future.

Cooperatives should also be aware that utility customers – from residential to commercial and industrial – will enjoy growing opportunities to make cost-effective investments in behind-the-meter energy storage as lithium ion BESS prices reach and fall below $150/kWh in the next few years.

The full report, Battery Energy Storage Technology Overview and Case Studies, may be found on NRECA's website: https://www.cooperative.com/topics/distributed-energy-resources/Pages/Battery-Energy-Storage-Overview-Report.aspx.

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America's Electric Cooperatives

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