Energy storage economics lusaka

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Many people see affordable storage as the missing link between intermittent renewable power, such as solar and wind, and 24/7 reliability. Utilities are intrigued by the potential for storage to meet other needs such as relieving congestion and smoothing out the variations in power that occur independent of renewable-energy generation. Major industrial companies consider storage a technology that could transform cars, turbines, and consumer electronics (see sidebar, "What is energy storage?").

Identifying and prioritizing projects and customers is complicated. It means looking at how electricity is used and how much it costs, as well as the price of storage.

In our research, we were able to access data from both utility and battery companies. On this basis, we found that it is quarter-hour-by-quarter-hour or even minute-by-minute use that reveals where the opportunities are.

Using both public and private sources, we accessed data for more than a thousand different load profiles, dozens of batteries (including lithium ion, lead acid, sodium sulfur, and flow cell), and dozens of electricity tariff and pricing tables.

Our model, shown in the exhibit, identifies the size and type of energy storage needed to meet goals such as mitigating demand charges, providing frequency-regulation services, shifting or improving the control of renewable power at grid scale, and storing energy from residential solar installations.

The model shows that it is already profitable to provide energy-storage solutions to a subset of commercial customers in each of the four most important applications--demand-charge management, grid-scale renewable power, small-scale solar-plus storage, and frequency regulation.

Energy storage can smooth out or firm wind- and solar-farm output; that is, it can reduce the variability of power produced at a given moment. The incremental price for firming wind power can be as low as two to three cents per kilowatt-hour. Solar-power firming generally costs as much as ten cents per kilowatt-hour, because solar farms typically operate for fewer hours per day than wind farms.

At a residential level, the combination of solar and storage is only worthwhile when specific market and regulatory conditions are in place to make the value of storage greater than the cost of installing it. This can happen, for example, when excess production can be stored for later consumption; in that case, consumers need to buy less power from the grid and thus cut their costs.

Electricity grids experience continuous imbalances between power generation and consumption because millions of devices are turned on and off in an uncorrelated way. These imbalances cause electricity frequencies to deviate, which can hurt sensitive equipment and, if left unchecked and allowed to become too

large, even affect the stability of the grid. Storage systems are particularly well suited to frequency regulation because of their rapid response time and ability to charge and discharge efficiently.

Our model confirms that storage can be profitable in select frequency-regulation markets. The economics depend on the context. Ideally, batteries hover around a specific state of charge to minimize the amount of storage required.

Second, in some specific applications, nonlithium-ion technologies appear to work better. For demand-charge management and residential solar-plus storage, certain lead-acid products are more profitable than lithium-ion cells. For large-scale firming of wind power, our model shows that flow cells can be more economic than lithium-ion cells for all but the shortest periods (less than an hour) and are projected to continue to lead on cost through 2020.

Another issue is that tariffs are varied and not consistently applied in a way that encourages energy-storage deployment. Thus, customers with similar load profiles are often billed differently; some of these tariffs provide incentive for the adoption of storage to the benefit of the electrical-power system, while others do not. Pairing load profiles with appropriate tariffs and ensuring that tariffs are stable could help build the economic business case for energy storage.