pv magazine energy storage+

November 2018

Between the lines

As big battery installations proliferate across the United States, electric vehicle charging could provide a game changing solution

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Special edition in collaboration with

ENERGY® STORAGE NORTH AMERICA

Dynapower doubles down on DC

Utility-scale developers see energy storage as the Swiss army knife of the grid: a single asset able to perform many functions. As economics improve, and the penetration of renewables increases, they have moved from asking if they need storage, to asking which functions should be prioritized. And the answer to that question shapes the topology.

Dynapower is spreading its bets with its recently launched DC-DC Converter series rounding out offerings of utility scale, behind the meter and fully integrated systems. It's an interesting choice, offering design flexibility while exploiting the final years of the ITC incentive.

First some basics. When solar and storage are paired, they can be connected in four ways:

1. Operate independently, with energy storage interconnected directly with the grid
2. Have inverters for both solar and storage that are then AC-coupled
3. Use a single DC-coupled (hybrid) inverter for both solar and storage
4. Connect both solar and storage into a tight DC-coupled system

How the batteries are charged depends on the topology: in the first, they are only charged by the grid, in options two and three, they can be charged by the grid and PV, and in a tight DC-coupled system, they are only charged by PV.

DC side charging

Dynapower's DC-DC Converters are used in the fourth topology. The 250 kW, 375 kW and 500 kW DPS bi-directional DC-to-DC converters can be scaled with up to 8 units for 2 MW, 3 MW or 4 MW of energy storage respectively. All three have a 98.2% average efficiency, a 550-1500 V input voltage range (both battery and PV), and are compatible with all batteries.

The arguments for the DC-DC connector fall into three buckets: a lower initial system cost, increased design flexibility, and potentially more attractive revenues.

The lower system cost is straightforward: there are fewer components, with the elimination of separate battery inverters, AC collection systems, transformers and switching gear. And streamlined BOS is likely to trim engineering and interconnection study costs as well.

A tight DC-coupled system also offers more design flexibility. Hybrid inverters require a 1:1 DC:AC inverter loading ratio. A tight DC-coupled system can support a more natural 1.4:1 or 1.5:1 DC:AC ratio. It's the revenue argument that deserves close modeling.

Revenue streams

A tight DC-coupled system offers all the standard storage revenue streams—capacity firming, curtailment, ramp rate control—plus the all-DC topology results in lower round-trip efficiency losses, which marginally improves the economics across the board. The topology's benefits start accruing once you add the value of recapturing energy usually lost to clipping caused by the inverter loading ratio as well as low voltage energy that isn't harvested before the inverter wakes.

The topology, however, trades off two very significant revenue streams: ITC incentives versus rate arbitrage.

One of the financial arguments for the DC-DC converter is contingent on the ITC: because the battery is never charged from the grid, there's no chance of ITC clawback. While that makes it easy to claim the full ITC, most battery management systems today already can, if desired, be set to prevent AC-coupled or hybrid systems from charging from the grid. And in the future, those AC-coupled or hybrid systems can be reprogrammed as the ITC is phased out or if it is extended with different rules.

The easy-ITC comes at the cost of the ability to take advantage of rate arbitrage: a tight DC-coupled system is only charged during the day, when rates are relatively high. Other topologies offer the flexibility to store from the grid when rates are at their lowest, enabling the system owner (or the battery management system algorithms) to do the math about whether it's preferable to keep full ITC benefits or sacrifice some in order to gain arbitrage revenue. In its 2017 paper Evaluating the Technical and Economic Performance of PV Plus Storage Power Plants NREL found that, without the ITC, the loss of arbitrage revenue puts the economics of a tight DC-coupled system behind all others except for fully independent systems. With ITC, its economics outperformed others.

NREL's study captures a moment in time, looking at 2014 incentives and 2016 estimated prices. The reality is that the market is moving so quickly that any developer considering energy storage needs to model the topologies based on today's conditions and evolving incentives. What Dynapower's new offering brings is another option to consider.

Photo: Dynapower

LG targets a bigger slice of the energy pie

Home energy storage has a new entrant: LG Electronics USA's LG Solar division. Revealed at Solar Power International in September, LG announced two mid-sized residential offerings: a 5 kW AC-coupled system which is designed as an add-on to existing solar but could also be used with LG's NeON AC modules, and a 7.6 kW DC-coupled system that provides a single inverter for solar and storage in new installs. The transformerless power conversion systems have 97.5% CEC efficiency, are designed for indoor or outdoor installation, and carry a 10-year warranty. Both units can be paired with up to two 9.8 kWh LG Chem RESU 10H batteries for a total 19.6 kWh capacity if needed. Each battery unit weighs in at 214 lbs, making them easier to handle than the 276 lb, 13.5kWh Tesla Powerwall.

LG's move is reflective of an industry-wide trend to develop integrated systems. Inverter companies have led the way, with SolarEdge and SMA offering solar, storage, and even EV-charging systems. Module manufacturers are particularly hungry to find ways to add to their razor-thin margins and LG is the first to go beyond simply offering smart PV with module-level power electronics. LG's heritage in consumer electronics gives it an advantage over most other module manufacturers.

Its solution, while complete, isn't sleek. By providing separate components for the Power Conversion System (PCS), Auto Transfer Switch (ATS), and batteries, LG is leveraging the volume manufacturing of the RESU battery unit, but doesn't offer the simple single-component feel of competitors such as Sonnen. Still, given LG's breadth of consumer product lines, their bundled approach is one way to step ahead of other leading module manufacturers.

Photo: LG

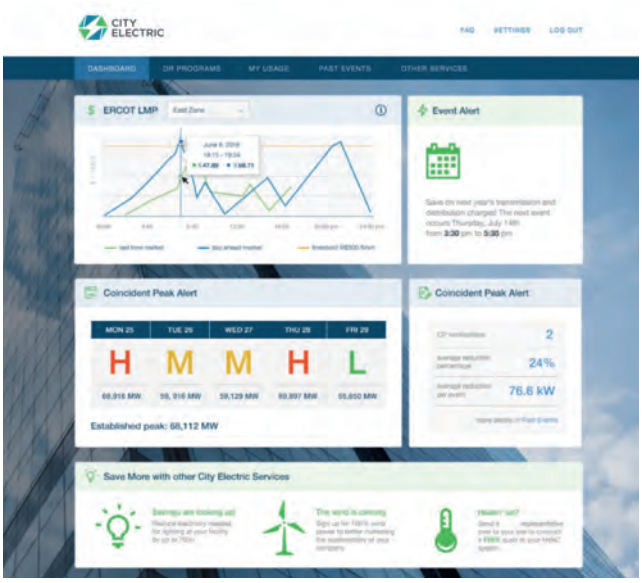

Photo: Autogrid

Autogrid: More, batteries, more use cases

As residential storage expands, more solutions are coming on to the market, looking to capture the full value of distributed energy storage. Aggregating residential assets together to provide ancillary services to the grid is one of the trickier slices of the energy storage value stack to capture, and one that will require a comprehensive energy management system.

AutoGrid was recently chosen by residential installer Swell Energy to aggregate its 35 MWh pipeline of distributed batteries in California. The partnership draws on AutoGrid Flex's flexible management platform, and AutoGrid Engage's customer-experience interface, and highlights the advantages of AutoGrid's expansive vision.

Flex is marketed as the "first truly integrated flexibility management suite" and provides a serious challenge to market entrants that have previously focused on managing a single asset, such as energy storage. It can manage distributed energy resources and demand response assets, residential, commercial and utility-scale customers, and offers capacity, energy and ancillary services for wholesale, transmission & distribution and behind the meter value streams.

Swell's partnership shows it can meet narrow needs, but AutoGrid Flex's true value will be seen as larger players implement it in scenarios where energy storage is simply one part of a more complicated story.

The Engage package, which comes in both commercial and residential flavors, offers a single-point of insight into disparate solar, storage, and other distributed energy assets. Its ability to be white-labeled makes it an easy product to build customer preference with, especially with AB testing potential that enables utilities to refine their customer messaging.

Eos Energy Storage: Grid, meet Zinc

There are reasons to look beyond standard lithium-ion batteries. Concerns about both supply chain and safety mean that it makes sense to stay on top of alternate battery chemistries. While some utility-scale energy storage companies are leaving cobalt-based lithium-ion batteries behind in favor of the safer, but less energy dense, lithium ferrous phosphate, others are exploring alternate chemistries including vanadium and zinc. Eos Energy Storage turned to zinc for its low cost, safety, and high depth of discharge.

Eos's Aurora utility-scale energy storage system is based on a zinc hybrid cathode that they call Znyth. The Gen 2 Eos system is scalable, with modular, plug and play components. Its basic building block is a 100kW unit with a 4-hour discharge time, configured into a 1MW 4MWh DC battery system. The units have a projected 5,000 cycle, 5-year life, which is low by lithium standards but reasonable given the price is closer to affordable but short-lived lead-acid. Unless HVAC is added, the Aurora is a fine weather friend, with a narrow 10-45°C (50-113°F) operating range. And any cost-benefit analysis of the "ultra-low cost" solution has to take into account its 75% round trip efficiency, and short one-year warranty.

While still relatively new to the market, Eos recently secured a partner, Holtec International, that brings not only funding but also manufacturing expertise in order to help them implement their distributed manufacturing strategy. For utility-scale installations where energy density is low on the wish list, it's a product worth exploring.

Photo: Eos Energy Storage