Are we about to experience a DC boom with the growth of solar plus storage?

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In case you missed it, Bloomberg New Energy Finance just revised its already bullish estimates for the growth in storage deployments upward – again, predicting a 122-fold boom in the installation of stationary energy storage over the next two decades. For its part, solar continues its high double-digit growth, making it the fastest-growing form of new generation.

Hanan Fishman

Solar plus storage is rapidly entering the vernacular of popularly associated words and will no doubt soon be joining the ranks of peanut butter and jelly and ham and cheese in frequent use. Like those classic culinary combinations, solar and storage just go so well together. Pairing storage with solar allows solar to move from an intermittent source of energy to a dispatchable one. Achieving the base-load reliability storage offers solar will be a major step to allowing us to achieve our renewable energy goals and combat climate change.

Besides for their more frequent concatenation, solar and storage share another feature common: They are both DC energy sources, batteries are actually both DC sources and loads. When the sun's rays hit solar panels, they generate DC current. Batteries store energy in DC. Of course, our distribution grid transmits power in AC. Amazingly though, most collocated solar and storage projects today connect the solar panel and the batteries on the AC side of the inverter, a technique referred to as 'AC coupling.' With such a topology, the energy generated from the Solar panels needs to make a long 'round trip' from the PV field, through an inverter back through another inverter before arriving at the battery.

While AC coupling still represents the most common way of connecting Solar and Storage, it does seem a rather unintuitive way to connect to a DC source (PV) to a DC load (storage). As logic would dictate, there is another method to combine solar and storage – DC coupling.

DC coupling vs AC coupling

Unlike AC coupling, with DC coupling, Solar and Storage are connected on the DC side of the inverter. This means the DC-current never has to be converted to AC current through a solar inverter and then back to DC through a second battery inverter in order to charge the battery. In a DC coupled system, a second inverter is replaced with a DC-DC optimizer, a device that manipulates DC voltage and current on the input to a different level of DC voltage and current on the output. In the 'old days' of solar and storage, these devices were also known as charge controllers, though those devices are puny and wholly inappropriate for today's larger scale solar and storage deployments. DC-DC optimizers are needed to DC couple solar and storage because batteries typically require a different level of DC voltage to charge and discharge themselves than PV generates.

> 'One of the hallmarks of our products is that they feature galvanic isolation, a technique that creates electromagnetic isolation between the input and output.'

In reality, DC-coupling has a number of advantages over AC-coupling, including:

1. Reduced cost: optimizers can cost less than inverters and an additional set of AC switchgear, so you can save money on a DC-coupled system by needing less equipment.

2. Increased energy yield: coupling solar and storage on the DC side provides a significant opportunity to increase the yield of your PV assets, particularly if you have a high DC to AC ratio, i.e. more PV panel capacity than name plate inverter capacity. When a PV plant has a DC overbuild, PV capacity can be 'clipped' when DC energy production exceeds that of the inverter.

   By coupling PV and storage on the DC side, this excess DC capacity can be diverted directly to the battery. As a result, such a system can better divert PV energy at times of higher supply and lower demand to be available during times of higher energy demand and low solar energy supply (i.e. evening time). This phenomenon of an overabundance of PV energy on the grid during the midday is known as the 'Duck Curve' for the shape of energy demand curve relative to solar production.

   The shape of the curve resembles a duck and shows the imbalance between peak demand and renewable energy supply. DC-coupling is particular helpful method for flattening out this curve by syphoning more of that extra PV generation in the middle of the day and allowing it to be discharged later.

3. Fewer roundtrip losses: roundtrip losses are the amount of energy lost as power passes from the energy source into the batteries and back out again when that energy gets put onto the grid. In the DC-coupled concept, there are fewer conversions, typically about half as much loss as an AC coupled system.

4. More ITC: for systems built in the United States, when charging your storage on the DC side, 100% of the cost of the storage system can be deducted for investment tax credit (ITC) purposes. Claiming ITC on AC coupled systems can be difficult if not impossible. As the cost of storage is significant, taking this deduction can appreciably improve the ROI of a solar plus storage deployment.

5. Retrofit Possibility for Existing PV Systems: DC-coupling batteries does not change the AC rating of existing PV plants; thus, it can be quite possible to retrofit existing PV plants with storage without having to alter their interconnect agreement.

If DC-coupling is so great, why isn't everyone already doing it?

In the paragraphs above, we lay out some pretty compelling benefits for DC-coupling of solar and storage over AC coupling. This begs the question: If DC coupling is so great, why isn't being deployed more frequently – yet?

The answer to that question is nuanced, however one reason is that it isn't particularly well understood by industry because it has not yet been deployed extensively.

Additionally, there is not a lot of equipment to choose from to deploy DC-coupled systems at scale. As a result, today, large scale DC-coupled solar plus storage systems are still talked about more than they are actually installed.

Making DC-coupling a reality

Here at Alencon Systems, we build DC-DC optimizers that can be used to DC couple solar and storage. One of the hallmarks of our products is that they feature galvanic isolation, a technique that creates electromagnetic isolation between the input and output.

As more DC-coupled projects come to fruition, engineers are rapidly beginning to understand why using a galvanically isolated DCDC converter is critical to a successful and cost-effective deployment. Galvanic isolation offers system designers a great deal of flexibility in choosing grounding schemes for both the solar and storage part of the system. Additionally, having galvanic isolation offers a great deal of added safety to these systems. Galvanically isolated DCDC optimizers also allow wide voltage gaps between PV and batteries to be easily bridged onto the same DC bus.

In short, having a galvanically isolated DCDC optimizer can be the difference between talking about DC-coupling and successfully deploying such systems and unlocking their myriad technical and economic benefits explained here.

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