Dc coupled storage

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New technologies and designs aimed at driving down the cost of energy storage facilities are currently the focus of intense industry R& D. Sara Verbruggen reports on DC coupling, an emerging system architecture that many believe will soon become the industry standard,in a paper which first appeared in PV Tech Power's Energy Storage Special Report 2019.

As the costs of solar PV modules continue to reduce, and those of batteries follow a similar downwardtrajectory, solar-plus-storage is in growing demand among utilities and solar developers.

The US is leading the trend, where these types of clean energy power stations are starting to produce electricity competitively with gas peaking plants, especially when other revenue streams from grid services are factored in.

To further push down the levelised cost of energy (LCoE) of solar-plus-storage and maximise the amount of megawatt hours (MWh) of solar-generated electricity that can be fed into the grid, energy suppliers and developers are turning to direct current (DC) coupling these installations.

Compared with alternating current (AC) coupling, DC coupling the PV array and the battery storage system in front-of-meter installations, such as utility-scale plants, is a much newer, less standardised approach. This had led some US utilitiesto begin piloting these configurations to see how the technology performs. On the supply chain side, balance of plant (BoP) equipment manufacturers are delivering more standardised and simpler to use power electronics equipment for enabling DC-coupled plants.

In AC-coupled solar-plus-storage installations there are two inverters, one for the PV array and another for the battery energy storage system.

With this system configuration, both the battery and solar array can be discharged at maximum power and they can be dispatched independently or together, providing the operator with more flexibility in terms of how they operate and dispatch the asset. Located at the same site the solar array and energy storage facility can either share a single point of interconnection to the grid or have two separate interconnections.

In DC coupling, the co-located solarand energy storage assets share the same interconnection, are connected on the same DC bus and use the same inverter. They are dispatched together as a single facility. DC coupling reduces efficiency losses, which occur when electricity current is converted, such as from DC to AC (Figure 1).

According to Wood Mackenzie analyst Mitalee Gupta: “Hybrid approaches emerged in the past where you would seeboth PV and batteries connected to the grid via one multiport inverter, a configuration more

common in behind-the-meter DC-coupled systems. But one of the disadvantages for the front-of-meter market has been cost of multiport inverters.”

The newer variation of DC architecture that has emerged for front-of-meter solar-storage, which Gupta is referring to, is a DC-DC converter. This piece of hardware is tied to the batteries and connects to the PV inverter along with the PV array, allowing for a single interconnection only.

Since interconnection can make up anywhere between one fifth to over a third of BoP costs, DC coupling can help reduce these costs. Co-locating different assets, be it solar and storage, solar and wind or solar, wind and storage, will always reduce BoP costs, compared with a standalone installation of a solar or wind plant, simply through sharing costs associated with land acquisition or leasing, labour, project management and permitting.

The US National Renewable Energy Laboratory (NREL) estimates that by 2020, BoP costs for co-located DC-coupled solar-plus-storage will be 40% lower and those for AC-coupled solar-plus-storage will be 30% lower.