

Reasons why to choose DC and/or AC coupled solar in Off-grid Power Systems

Introduction

Off grid systems have traditionally used DC coupled solar. This was an easy choice because batteries are also DC. As off-grid systems have become larger now also AC coupled solar is used. AC coupled solar systems use strings of solar panels configured in 100-600 Vdc strings going to a grid feed inverter which converts directly to 230 Vac

A DC coupled solar system looks like this:

A AC coupled solar system looks like this:

Using both DC and AC coupled solar

The big advantage of the DC solar system is its simplicity. It is a very 'robust' design that allows a very reliable and efficient charging of batteries.

However it depends on the battery inverter do all the work on supplying the 240V loads.

Also, as DC solar strings are typically much lower voltage, the wiring requirements are larger. Often only 2 or maybe up to 6 panels to a pair of 4-6 mm wires.

In very large systems with 20 panels or more, this can require a lot of cable runs.

If the solar array is very far away from the battery and other DC distribution, it is a lot more efficient with wire cost to run AC back, rather than ELV (<120V DC) solar.

Solar Inverters Supporting Loads

Very large systems will typically have large loads.

AC solar inverters can support these daytime loads and increase the sustained and total kW power that the system can supply.

Battery Charging

Victron DC MPPT control is very quick and very precise, much less than a second.

When the AC solar inverter MPPT is governed by a signal sent from the CCGX, and then inverted by the inverter/charger back to DC, there is additional delay and 'chunkiness' added to the charge profile.

Depending on the battery technology (lead acid or lithium) this can lead to other issues where the only charge supply source is the AC solar due to lack of fine current or voltage fidelity (eg inrush current and overshoot).

Black Starts

When a system reaches a critical low level of battery, Many of the services shut off to protect the batteries from permanent damage.

One of those services is the AC output of the battery inverter. This provides the grid forming service that the AC solar inverter requires to start up. So even though there is abundant solar, if the battery inverter has shut down, it will not be able to charge the batteries.

DC Solar does not require any other components to be active, and can charge dead flat batteries and be powered from the solar panels.

This is critically important in lithium batteries, where parasitic self discharge loads can permanently destroy a battery.

Heat

Heat is the enemy of all electronic equipment. The first thing to do is use the most efficient equipment available (in-efficiency is lost to heat).

Using a solar inverter removes some of the (daytime) load from battery inverter, and means it generates less heat.

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