

PV-Storage integrated devices: perspectives, advantages and challenges in interfacing solar cells, batteries and supercapacitors

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Hundreds of scientific studies have shown that 100% renewable energy systems can be achieved globally, regionally, and nationally by 2050. The number of published studies affirming this has grown by 27 percent per year since 2010 and continues to increase every year. Most of the models agree that total electrification of the energy system must be accelerated to reach the goal of zero emissions, and solar energy is placed as a cornerstone of a sustainable energy system combined with energy efficiency policies. On the other hand, effective solutions must be found to the inherent intermittency of photovoltaic power generation.

In this talk we address a potentially disruptive research solution: the integration of photovoltaic and storage devices of comparable size into the same system. Such a hybrid system would enable the manufacturing of a "smart" PV module, where the energy converted from PV is buffered by a battery or supercapacitor fabricated monolithically on the same substrate before being supplied to a load, with no power loss due to the connecting cables. On the other hand, this kind of intensive integration brings some significant technological, electrical, and efficiency issues that will be discussed in-depth in this talk. A fully comparison between the pros and cons of various "PV+Storage systems", including discrete systems, monolithic systems, and more complex systems assisted by boost or buck DC-DC converters, is carried out.

Lastly, given the peculiar nature of these integrated hybrid systems, customized characterization protocols for deducting and comparing electrical performances are presented.