

“Hybrid Energy Storage Systems: perspectives, challenges and applications”

Abstract: Energy Storage Systems (ESSs) are the keystone to improve the Renewable Energy Sources (RESs) penetration and achieve zero-emissions transportation systems. However, no single energy storage solution is suitable for every application. In many cases, the optimal solution is to use a hybrid ESS (HESS), which consists of two or more ESS with complementary characteristics. The attractive features of HESS are the increased flexibility, to possibility to avoid the oversize of the single ESS and the increase of the lifetime of the system. On the other hand, using HESS poses several challenges. Firstly, to take full advantage of the HESS, an appropriate Energy Management System (EMS) must be designed. The EMS main duty is to collect information from individual storage and tries to combine them to provide the best solution in terms of power sharing. Secondly, the optimal sizing of a HESS is a complex task. The HESS sizing must consider several aspects such as achievable performances, installation, operational and maintenance costs, lifetime, weight and volume.

The first part of this keynote will provide a state-of-the-art analysis of the main energy storage technologies and hybrid energy storage system topologies. The second part of the keynote will focus on the different approaches for energy storage management and the optimal sizing algorithm available in literature. In the last part, the main hybrid energy storage system current applications and future trends will be discussed.