Innovative cell monitoring devices and diagnostic algorithms to predict aging mechanisms and residual useful life

To reduce the carbon footprint of electrochemical storages, it is essential to maximize the usage of existing batteries by developing tools that improve their sizing, monitoring, and diagnostics. The presentation focuses on the diagnostic and optimal management of electrochemical energy storage systems. Two tools useful for this scope have been developed and tested, i.e. a residual useful life-RUL forecast algorithm and a State of Charge-SOC/State of Health - SOH estimator algorithm.

The first one is able to estimate the residual battery lifetime even in correspondence of complex load profiles characterized by the overlap of many different stress factors and operating conditions. The algorithm is based on a semiempirical aging model of the battery, developed using laboratory tests. The second algorithm is able to calculate the up-to-dated residual maximum capacity of a lithium-ion battery, from which the SOC and SOH values can be derived, during operation, without necessity of a system shutdown, and is based on machine learning techniques.

Both the tools will be used in a digital twin of a battery system. A specific use case has been identified to test the digital twin, implementing, and validating the models and algorithms described.