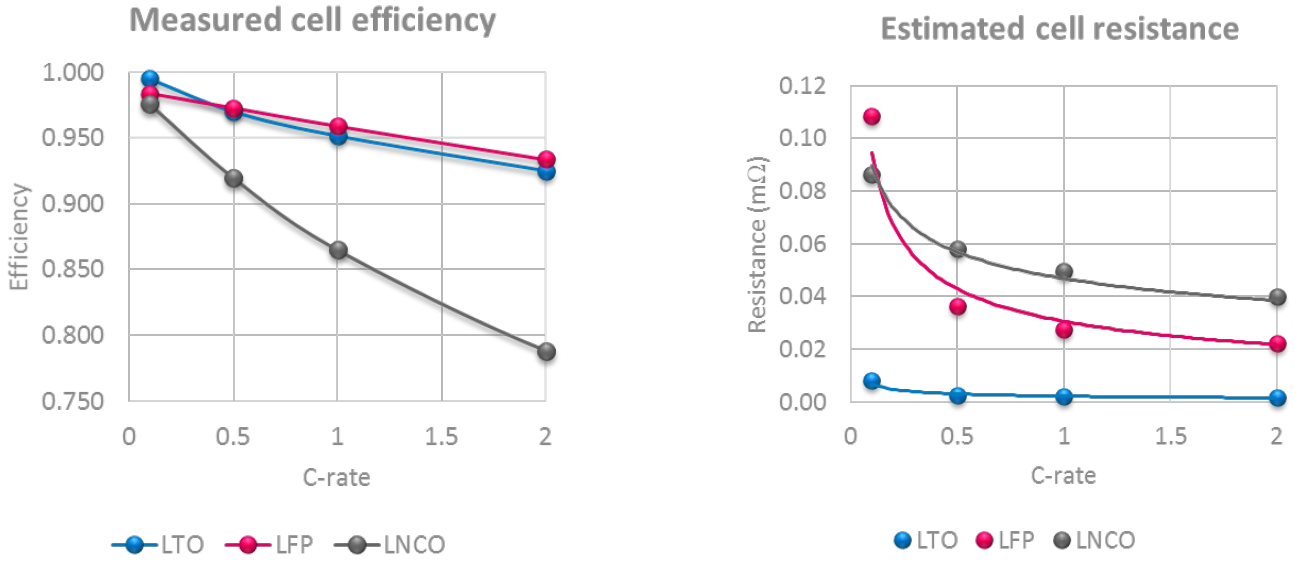
BFH-CSEM Energy Storage Research Center

Battery Research

Application-independent protocol for predicting the efficiency of BESS

The risk associated to the investment in Battery Energy Storage Systems (BESS) is high despite a continuous reduction of battery cell prices. Available testing procedures are not adequate to evaluate the performance of these systems in real operation. We developed a novel application independent procedure to predict the efficiency of lithium BESS from a single set of measurements and we have applied the novel procedure on three different lithium-ion cell technologies. We hereafter illustrate the accuracy of our procedure for the example of grid-connected BESS used for primary control reserve (PCR).

Our ad-hoc test procedure is able to evaluate the battery resistance as a function of the C-rate for a given temperature and it provides general "capability charts" based on which the efficiency can be evaluated under arbitrary operation profiles. The procedure consists of three main blocks: cell preparation, cell cycling at constant current for efficiency stabilization and efficiency computation.



Capability charts: measured cell efficiency (left) and derived cell resistance (right) at 25°C for three battery technologies: lithium titanate (LTO), lithium iron phosphate (LFP) and lithium nickel manganese cobalt oxide (LNCO).

In PCR the BESS is used to compensate grid frequency deviations by injection or absorption of active power. Since frequency deviations are stochastic, the current profile applied to the BESS in operation can be extremely variable. Results investigated for LNCO technology show that, if the regulation band is moderate and the SoC excursion is between 20% and 80%, the error between measurement and estimation is below 0.5%.

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