International Conference on Green Innovation and Circular Economy

Reusability Metrics of Electronic and Mechanical Components for Second-Life Battery Systems

Dimitra Spanoudaki[1], Vasileios Apostoloudas[1], Elisavet Elvanoglou[1], Sotiris Athanasiou[2]

[1]Sunlight Group Energy Storage Systems, 67200, Xanthi, Greece
[2] Sunlight Group Energy Storage Systems, 14564, Attica, Greece

Corresponding Author: Dimitra Spanoudaki, Sunlight Group Energy Storage Systems, d.spanoudaki@sunlight.gr

Abstract

In the near future, the number of electric vehicle (EV) batteries, no longer appropriate for automotive use, will dramatically increase. At the end of their warranties the expected EV batteries nominal capacity will vary between 70 – 80 %. This is also the First-Life End-Of-Life threshold adopted by most within the automotive industry. Whereas these EV batteries will not be appropriate for automotive applications, they could be repurposed for stationary energy storage systems as Second-Life batteries.
The new Battery Regulation of the European Union is enforced as of July 2023 and ensures that batteries within the EU have a low carbon footprint due to the reduction of resources required, the reduction of raw materials (from non-EU countries) and an increase of reuse and recycling in Europe. The result of this act is the shift to a circular economy growth model, the increase in security of supply for raw materials and energy overall and the enhancement of the EU's strategic autonomy.
Working towards the direction of the circular economy growth model, we present the first steps a battery industry must take for the repurposing of 1st life traction batteries (industrial EV's) for an industrial stationary energy storage system.
More specifically, we address the issue of the reusability of first life electrical and mechanical components (except for the lithium-ion cells), and we introduce quantitative and decision-making tools for an automatic and safer choice of these components for the Second-Life applications.
The methodology of the reusability analysis of a Second-Life battery, includes the evaluation of the Bill of Materials (BOM) list of the battery system, the grouping and sorting of the different materials, their evaluation from engineers and blue-collar workers and the final assessment with a decision matrix. The criteria introduced in the decision matrix include the price, the volume, the warranty, the environmental impact, the availability (in the market) and the recyclability of the electrical and mechanical components. The results of this assessment show a trend on how many of the electrical and mechanical components are suggested to be recycled or repurposed for Second-Life applications based on each one of the main criteria we introduced in the decision matrix.
Whereas the reusability analysis tool, we introduce in this research, is built on the BOM list of a battery system, it can be adopted by other industries (automotive, electronics, etc.) as well. We must note that, although it gives a good estimation of the battery components that we should repurpose or recycle, the first question that should put on the table regarding the reusability of any electrical or mechanical component, is if this reused component is safe for the consumer.

The transition from a linear to a circular economy growth model demands the transition from the theory to practice, breaking out of old models and introducing novel methodological approaches. The lessons of the circular economy approaches are accumulating – as they show that the gains from making the transition outweigh the effort and the economic risk.

Keywords: *Green innovation, circularity, Second-Life batteries, reusability, lithium-ion batteries*