A model platform for life cycle assessment of lithium-ion battery production and use

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Life cycle assessment (LCA) studies of lithium-ion batteries (LIB) often show a large variation in results. Explanations to this diversity can be found in different modelling approaches and shifting quality of data, e.g. a lack of primary data and use of outdated data, but also a large variety in cell formats, chemistries, and designs analysed [1], [2]. Meanwhile, LCA of LIBs is becoming increasingly important as a tool to guide technology selections towards increased sustainability. To bridge existing data gaps, a multidisciplinary cooperation has been initiated aiming to develop a model platform for conducting LCA of LIBs in vehicle applications, covering both production and the use-phase. This model platform (***Fig. 1***) will comprise a cell design computation model, a cell performance model, a vehicle model, and a production LCA inventory model, which provide input the overall LCA.

In this contribution, the cell design computation model and cell performance model will be presented. The cell design computation model provides input for the production LCA inventory and cell performance models. For a given capacity, the model calculates required masses of constituent materials, electrode areas and thicknesses by assuming common cell design aspects and the volume for the selected cell format. Input data is based on publications and teardown analyses of commercial cells. The cell performance model utilises the physics-based Doyle-Fuller-Newman model implemented in COMSOL Multiphysics. From this, the cell capacity, potential, and impedance can be simulated for any cell design. Both these data models then supply data further to the production LCA inventory model and the vehicle model, in turn enabling the overall LCA.

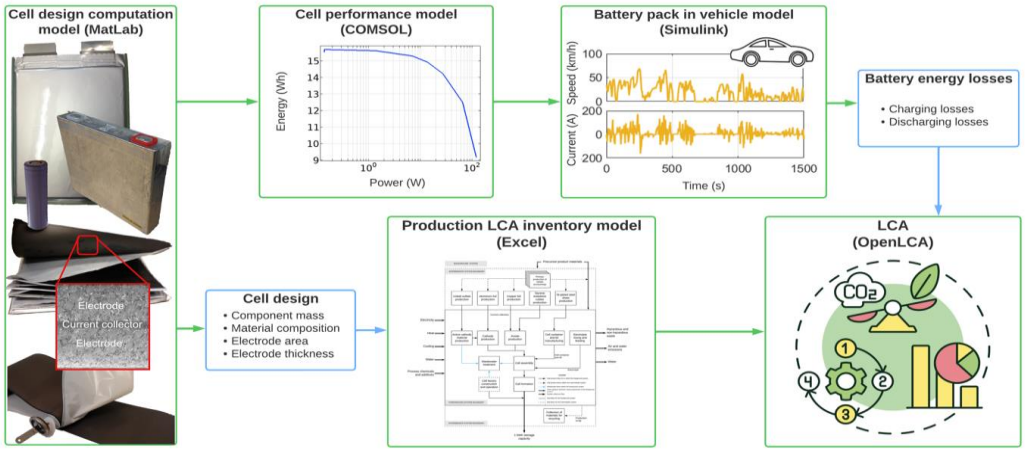

Fig. 1 Overview of the model platform, from cell design parameters to LCA calculations.

References

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