

## Success Stories - Service Users

Ageing mechanism prediction of Automotive Li-ion cells

### Organisation Profile

CRF is an affiliate of the automotive Stellantis N.V. Group and is a private industrial research organisation having the mission to promote, develop and transfer innovation for providing competitiveness to its Company products. CRF attains this objective by focussing on the development of innovative products and advanced methodologies, the implementation of new manufacturing processes and materials. Priority areas of R&D include electrification activities on hybrid and electric vehicles.

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### Problem to be solved

Li-ion batteries are among the most widespread energy storage systems in electric vehicles but lifetime specifications necessitate strict control over ageing effects such as capacity fade. Furthermore, lifetime prediction requires detailed knowledge of degradation mechanisms and kinetics, and their correlation to external factors (e.g. powertrain profile). Ageing mechanisms estimation through numerical modelling would be beneficial to support the design of an appropriate lifetime profile with consideration of all the accelerating and stress factors and to prevent undesired failures.

### Solution provided by TEESMAT

Based on the state-of-the-art ageing models for Li-ion batteries, the most adequate one for this case was the physics-based ageing model as it offers the ability to simulate the ageing mechanisms. CEA and VITO have good experience with such models and decided to follow two similar but not identical modelling approaches.

As the objective of this user case is complex and the physics-based models are relying on multiple electrochemical input parameters, several characterisation techniques and thus additional service providers were involved in this case like CERTH (with RAMAN), ESRF (X-ray imaging), FINDEN (big data treatment). The model parameters were determined through ante mortem and post mortem analysis. The ageing behaviour was followed up with complementary non-destructive techniques using sensors like strain gauge (CEA), heat flux measurement (CEA and VITO) and acoustic measurements (CEA and VITO).

### Impact

The collaboration between the different service providers allowed the build-up of a robust model able to simulate the commercial cell behaviour. A series of non-destructive techniques and in-operando measurement helped identify the different ageing mechanisms involved during the accelerated ageing of the cells. These measurements helped better understand the degradation of the cells performance and work on defining a safe and optimum operating conditions that would prevent the cell from safety failures and optimise its lifetime.