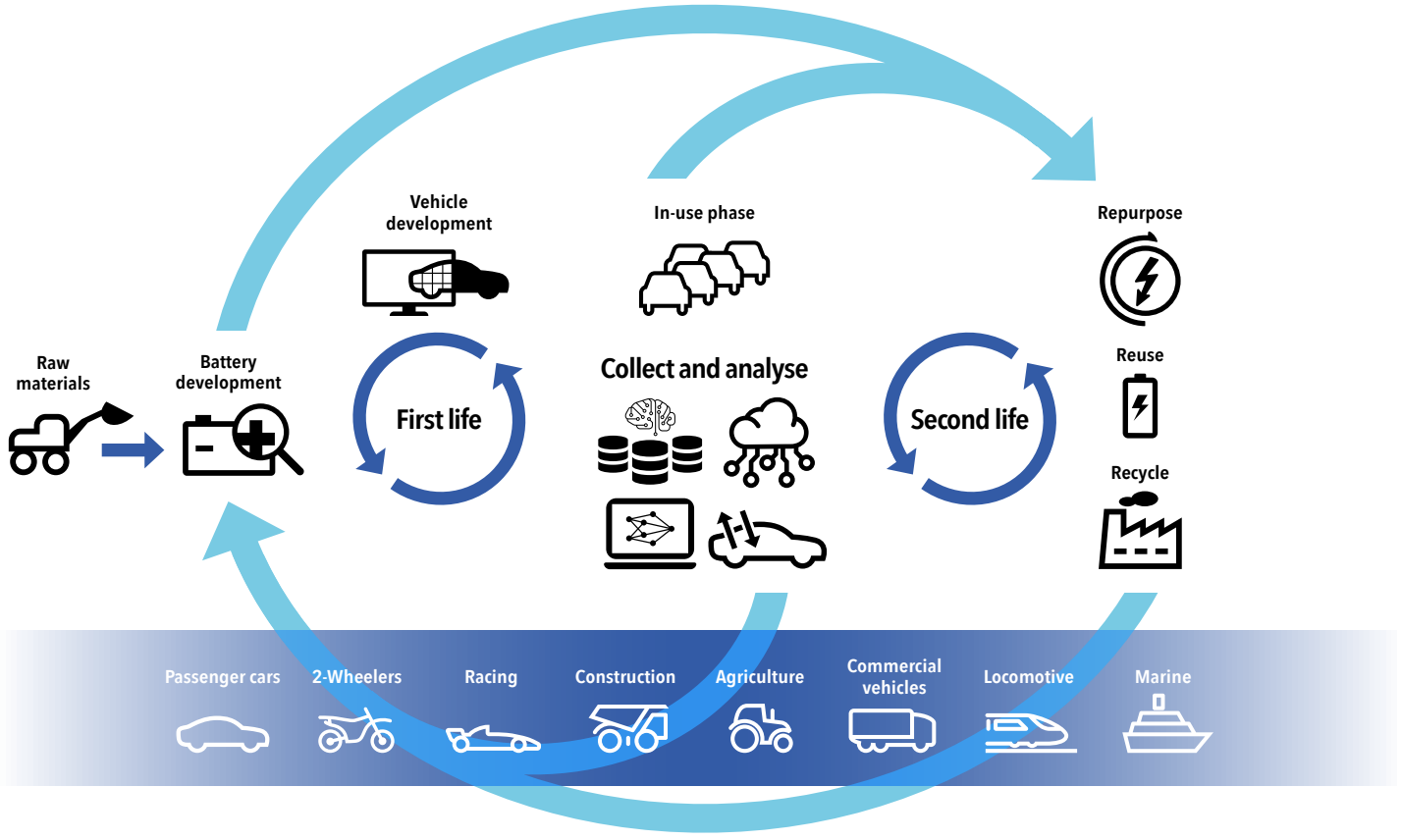
AVL Battery Lifecycle Management

The life of a battery – from cradle to grave

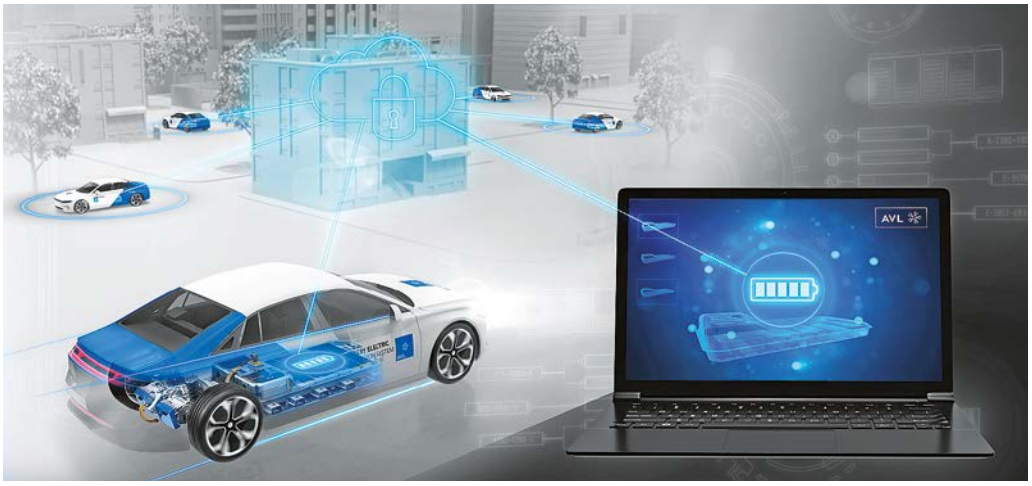
— As well as being a key component and the most expensive part in an electric vehicle, the battery only has a limited lifetime. Complex chemical and physical interactions inside a battery cell lead to degradation and aging which, over time, result in a loss of battery capacity and power. This directly impacts the range, performance and safety of the electric vehicle, and is the reason why automotive batteries are declared dead after 20–30 % capacity loss and handed over for second life applications or recycling.



How batteries age over time is heavily affected by the battery cell chemistry, battery cell, module and pack design and the battery management system. We support our customers in cell selection, testing, simulation and the development of batteries to maximize performance and lifetime, as well as in optimizing designs for battery repurpose and recycling. We have tools, methods, testing solutions and advanced data-driven methodologies to support our customers and partners throughout the life of a battery – from raw material extraction to battery production, vehicle development and in-use fleet operation, right through to second life applications and recycling.

WE HAVE TOOLS, METHODS, TESTING SOLUTIONS AND ADVANCED DATA-DRIVEN METHODOLOGIES TO SUPPORT OUR CUSTOMERS AND PARTNERS THROUGHOUT THE LIFE OF A BATTERY.

While deriving lifetime requirements from battery testing during battery development is the core target in the concept phase and basis for the quality assurance of the battery, the final operation of the battery in the vehicle needs to be included to validate and complement this approach. At AVL we utilize battery data from the vehicle fleet in-use phase and combine it with real-time capable simulation models – known as digital twins – to drive battery development and optimize and predict in-use operation. Finally, we use advanced data-driven and cloud-based methods combined with years of battery know-how, from battery production to the end of its lifecycle, to determine the remaining value of the battery after its first life. This enables us to define its second life destiny: reuse, repurpose, or recycle.



BATTERY HEALTH FOR ELECTRIC VEHICLE FLEETS

EV batteries have a tough life. Subjected to extreme operating temperatures, hundreds of partial cycles a year, and changing discharge rates, they degrade strongly during the first years of operation. The challenge for every vehicle fleet provider is to maintain performance, maximize lifetime and optimize residual value for second life applications.

We provide customized solutions to monitor vehicle fleets and battery conditions on the road by using the Internet of Things (IoT) and cloud-based analytic platform solutions. By connecting all vehicles in the fleet and sending this data to the cloud, big data and battery lifetime methodologies can be applied to analyze the fleet operation and provide recommendations on operation and charging strategy, as well as prediction of the battery's end of life and failure probability.

Our tools enable tasks such as:

- Real-time battery observation of all fleet vehicles
- Real-time battery status monitoring
- Route, operation strategy and charging optimization
- Time and cost savings with predictive maintenance

DEAD BATTERIES DESERVE A SECOND LIFE

The continued global growth of electric vehicles will lead to terawatt-hours of batteries that no longer meet the requirements for EV use, but are still useful in less demanding applications. While this is an emerging opportunity for the stationary storage power sector, certain challenges need to be overcome to enable an economic and sustainable process along the battery value chain, such as a standardization of state of health definition as well as the actual value of a battery after usage.

Working closely with recycling companies and second life service providers, we are tackling these challenges by combining data-driven battery lifetime methodologies with state-of-health measurement tools and technological standards. The outcome is a method for deriving the remaining value of a used battery, while considering economical factors, sustainability and design for reusability and recyclability.