



A longer first life — key to lowering cost and total emissions

#5

Integrating data analysis from cell chemistry to fleet level – driving, charging and temperature – provides valuable insights

The key to lowering cost and total emissions

Battery technology is a cornerstone of the sustainable off-highway vehicles that bring electrification to our industries, harbors and logistics centers. With batteries accounting for 40% of the total vehicle cost, optimizing their lifespan is not just an environmental imperative, but also a financial one.

Alelion's decade-long expertise and data-driven approach offer key insights into extending the first life of batteries, thereby optimizing Total Cost of Ownership (TCO). At the same time, we can substantially reduce the CO₂e emissions by extending the lifetime of the battery. The new product line will incorporate it all.

Increasing the depth of analysis has an advantage

What sets Alelion apart is our ability to integrate data flows from multiple levels — cell, module, battery, vehicle, and fleet — into our analysis (see fig 1). This comprehensive approach allows us to pinpoint inefficiencies and optimize performance in a way that is unparalleled in the industry. Our proprietary BMS and cloud-based analytics platform are essential tools. They not only provide real-time insights but also offer the flexibility to adapt to changing conditions and requirements.

Choosing the Right Cells – Design for Circularity

On the design side, deciding on the right cell, both in terms of chemistry and supplier, has a big effect on extending the first life of the battery. It is also important for its recyclability using the current set up of recycler. A shorter battery life and lower rate of recycled materials will result in a higher total CO₂e imprint. Alelion's expertise in cell analysis and software development was greatly added to by our Cell Test Lab. It is aimed at verifying cell manufacturer's product data and mitigating these environmental risks, while ensuring our battery systems are designed and optimized for a long and healthy life. We also use our lab to verify our algorithms, and consequently develop our own algorithms faster.

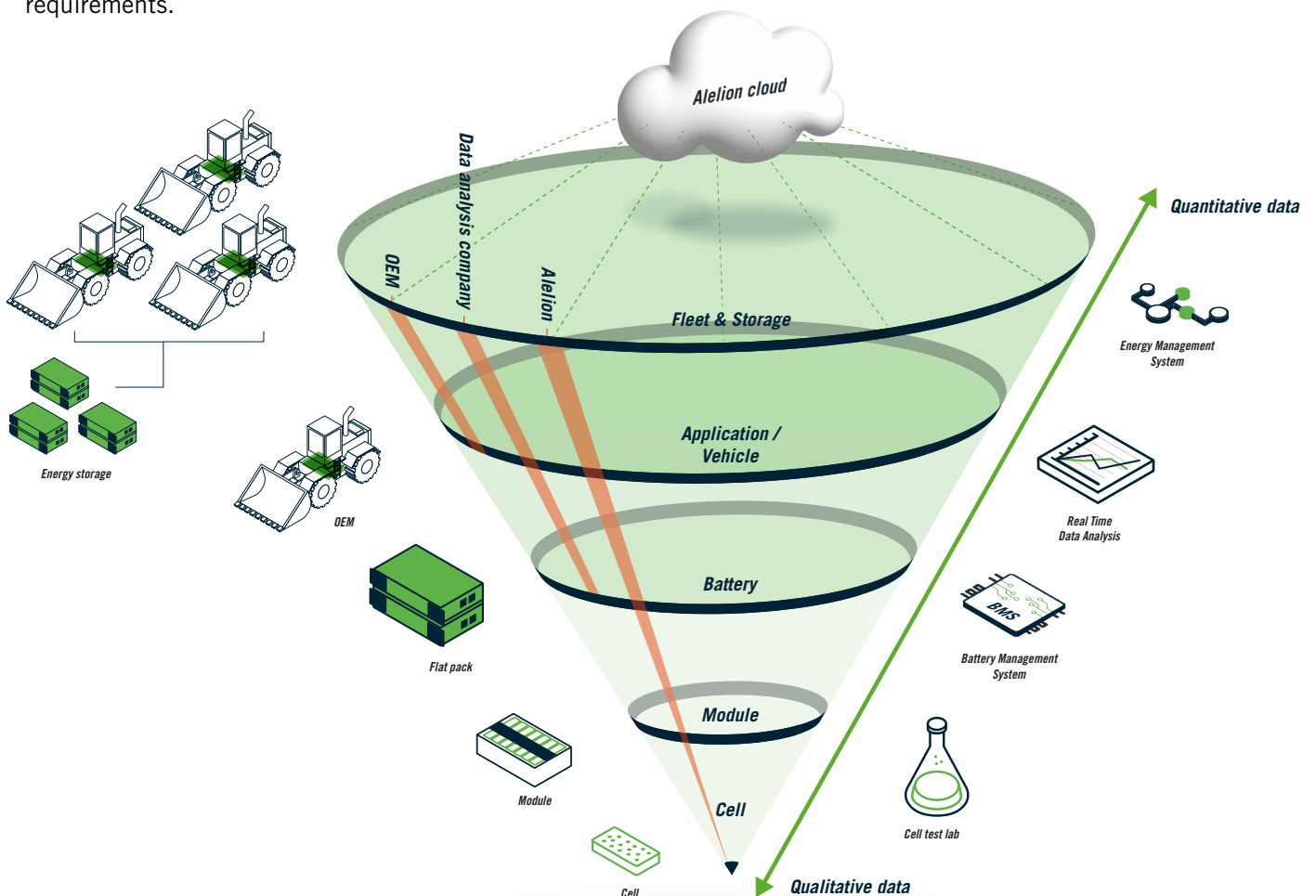


Fig. 1: Alelion analytics - the value of depth

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Driving, Charging and Temperature are three main variables

Temperature fluctuations, driving patterns, and charging behaviors are key variables affecting battery life. Our proprietary Battery Management System (BMS) and the data we generate provide the foundation for the in-depth analysis needed to understand them. By maintaining optimal conditions, we see that we can significantly extend the battery's first life.

Having the strength of a proprietary BMS allows us to collect data and update the algorithms for optimization of the system on the most lifetime affecting parameters for a battery and its cell: driving pattern, charging pattern and temperature. The untapped potential of battery optimization is made possible through a first life extension approach. A prerequisite for a successful service product is access to driving data, battery data, automated data analysis capabilities and the ability to modify BMS parameters. Alelion is developing a solution to address this, however not available at Tiger introduction.

The Vital Role of First-Life Extension

First-life extension is a matter of protecting your investment. Given that the battery is 40% of the total vehicle cost and the cells constitute 60% of the battery cost, extending the first life of the battery is crucial (see fig. 2). In the context of off-highway vehicles, it's important to note that our vehicles often operate in several shifts per day and generally have a high utilization rate. This results in a substantial Return on Investment (ROI) in terms of CO₂e emissions when compared to diesel-powered alternatives, as well as from a fuel perspective. In contrast, a typical electric car is parked 90% of the time. Our high utilization rate underscores the critical importance of optimizing battery systems to achieve both financial and environmental sustainability.

Conclusion

Alelion's first decade of data collection and analysis offers invaluable insights into optimizing battery systems for both performance and sustainability for current and future product lines. By focusing on first-life extension, leveraging in-depth data analysis, and employing the right technical platforms, we can significantly lower the TCO and make battery technology a viable, long-term solution for off-highway vehicles.



Fig. 2: The vital role of first life extension

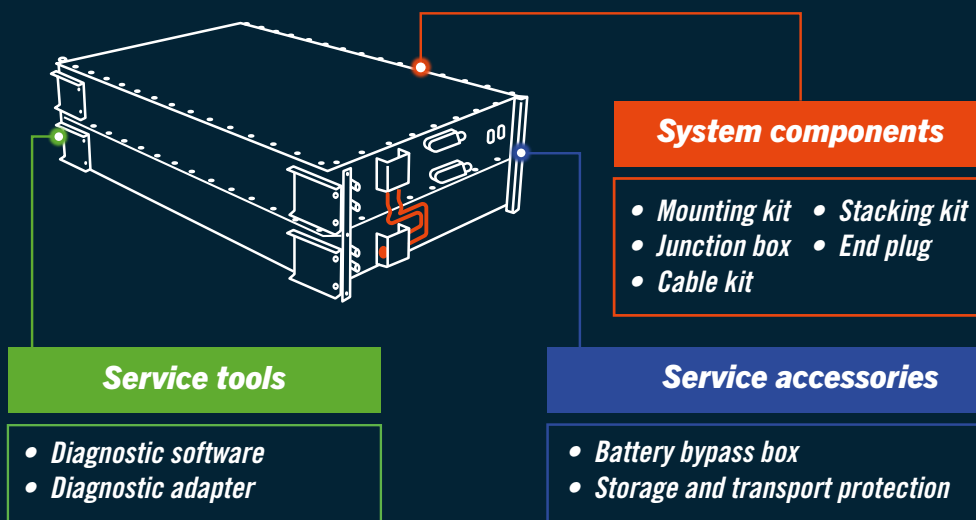
Tiger 670-33 is designed for recycling, what does this mean?

Our early presence in the Li-ion industry along with collaboration with recycling leaders has given us valuable insights into how to design batteries that can be easily and cost-effectively recycled with a smaller CO₂ footprint.

Our battery systems are designed to be ready for dismantling and recycling, including our choice of cells as well as our serviceability which improves the recyclability. Recycling becomes increasingly important due to scarcity of virgin material; hence an effective recycling process is vital for circularity which is driven by EU regulations.

Lack of potential future recycling driven by less recyclable chemistries will oblige OEMs to consider not only future cost associated with end-of-life batteries but a significantly higher life cycle CO₂e footprint.

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Alelion – Sharing knowledge and experiences

Alelion is an established developer, manufacturer, and supplier of advanced battery systems and service products for off-highway vehicles in a number of different segments. With more than 15 years of experience, we now share our key learnings in a series of white papers.



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Read all of our white papers [here](#).