FLASH BATTERY

A tailored approach to off-highway electrification

iVT EXPO
INDUSTRIAL VEHICLE TECHNOLOGY
Stand 4080

FLASH BATTERY'S SCALABLE ENERGY ARCHITECTURE IS HELPING AN OEM ELECTRIFY AN ENTIRE DUMPER RANGE, NOT JUST A SINGLE MODEL

The electrification of off-highway machinery is playing an increasingly central role, driven by the growing need to reduce emissions, noise, and total cost of ownership (TCO). However, electrifying off-highway vehicles is far from simple. These machines operate in harsh conditions, exposed to dust, vibrations, and intensive duty cycles, often in temporary or remote job sites where access to the power grid is limited or unavailable. In this context, electrification cannot be reduced to the simple replacement of the internal combustion engine but requires a comprehensive design of the entire energy system. This is where Flash Battery's engineering approach comes into play.

A scalable starting point

The project originated in 2023 from the need of an international construction equipment manufacturer to develop its first electrified product range, starting with a dumper designed to operate in demanding conditions. The goal was not limited to developing a single electric model, but rather to create a scalable energy architecture adaptable to machines of different sizes, power levels, and applications. This strategic choice made it possible to reduce engineering complexity and optimise production processes, helping to overcome one of the main challenges of off-highway electrification: the need to develop specific solutions for each individual model, resulting in increased costs and development time.

From the early stages, it was clear that the challenge was not only technical, but also strategic. Off-highway vehicles operate in difficult environments, and the solution had to be compatible with both full electric machines and hybrid configurations equipped with an onboard generator.

A blank sheet approach

To address these needs, Flash Battery supported the OEM through a co-engineering process, starting from a true "blank sheet" approach. Leveraging extensive expertise and a highly customised design methodology, Flash Battery developed a system capable of operating at two

MAIN IMAGE: **Electric off-highway dumper equipped with a modular Flash Battery energy system**

RIGHT: **Modular lithium batteries developed by Flash Battery for the electrification of dumpers and off-highway machines**

voltage levels (51.2V and 102.4V), with capacities ranging from 11kWh to 94kWh depending on the configuration. This modularity allows the same "energy building blocks" to be used across different machines, adapting total capacity to specific application needs. It is not only a technical choice, but also a strategic lever for OEMs – enabling the development of entire ranges of electrified machines while maintaining design consistency, reducing variants, and simplifying industrialisation.

Technical features

Among the most relevant design features are the development of custom firmware for managing charging via generator and advanced cell balancing logics. Flash Battery's proprietary Flash Balancing System has played a key role in preserving battery performance, lifespan, and safety under non-standard conditions. Lithium iron phosphate (LFP) chemistry was selected for its high thermal stability, safety, and long service life – essential characteristics for construction applications. The batteries also integrate CAN bus communication with the vehicle control system, high-voltage safety components, an enclosure with IP65 protection rating, and both on-board and off-board charging options.

Beyond a single model

The impact of the project goes beyond the technical solution. Thanks to the adoption of a modular and scalable architecture, the manufacturer was able to accelerate the development of its electric range, bringing to market an entire family of electrified machines. This enabled access to new business opportunities, particularly in urban job sites and projects with strict environmental requirements. The shift from hydrostatic to electric drive also significantly improved overall vehicle efficiency, contributing to a reduction in TCO without compromising performance.

This case study demonstrates how close collaboration between OEMs and highly specialised technology partners such as Flash Battery can successfully address the complexities of off-highway electrification. Through an integrated and forward-thinking approach, Flash Battery has transformed a complex technical challenge into a scalable energy system ready for the future evolution of construction machinery. **iVT**

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