

Case Study



How We Unlocked ~\$300K in Annual Energy Savings for our Client with Next-gen Battery Thermal Management Systems

Objective

A global automotive player partnered with leB to evaluate next-generation thermal management solutions for mobility applications, with a specific focus on battery thermal management systems. The objective was to assess advanced technologies that improve heat dissipation, optimize climate control, and enable reliable thermal regulation across electric and autonomous vehicles, while enhancing energy efficiency, sustainability, and system performance.

Our Strategic Approach

To deliver measurable gains in battery energy efficiency, leB applied a technology-led, application-focused framework to evaluate next-generation thermal management solutions across the mobility ecosystem, aligning performance requirements with energy optimization and scalability.

Battery Thermal Management Assessment

Evaluated state-of-the-art battery thermal management architectures, including liquid cooling, phase-change materials, and integrated thermal loops. Assessed their effectiveness in maintaining optimal battery operating temperatures, improving safety, and extending battery life under varied operating conditions.

Heat Dissipation & Climate Control Optimization

Analyzed heat dissipation strategies across power electronics, battery packs, and cabin systems. Evaluated opportunities to optimize HVAC integration and reduce parasitic energy losses associated with cooling and heating processes in EVs and autonomous platforms.

Autonomous & Multi-Application Thermal Regulation

Assessed thermal regulation requirements for autonomous vehicle systems, including sensors, computing units, and energy storage. Identified adaptable thermal solutions capable of serving multiple emerging applications such as EVs, stationary energy storage, and next-generation mobility platforms.

Snippets

Emerging Battery Management Systems

The most efficient and cost-friendly methods to implement in a BMS include the balancing of the battery pack charging and discharging control and temperature monitoring, which help improve the performance of the battery

ILLUSTRATIVE

Key Functions and Innovations around Battery Management Systems

Key Functions	Cell Monitoring	 Low Power Cell Monitoring monitors and alert the BMS to wake up and run appropriate checks if they detect any potential concerns.	 Multicell battery monitoring and balancing ICs include current measurement and balancing capability to equalize cell voltages.	 Detecting individual cell over-voltage and under-voltage conditions by connecting multiple high-accuracy battery monitors on separate printed circuit boards.	 Ultra-thin, pressure, and temperature sensors, users can collect spatially resolved data from individual battery cells.	Single Cell Monitoring with Electrochemical Impedance
	Thermal Protection	 Integrated thermal and engineered material solutions that enable smaller, ruggedized, lighter, and more reliable batteries.	 The advanced system detects any increase in temperature beyond the set limit and would hence cut off the battery operations immediately	 Accommodate the cyclical expansion of both pouch and prismatic cells and prevent or delay the propagation of heat.	 Friction Systems is known for innovative multifunctional thermal insulation solutions and is a pioneer for lightweight battery heat shields.	High Performance Cooling amid temperature fluctuations
	Cell Balancing	 Wireless cell supervisor circuit passive-cell balancing enables control over the high-voltage battery stack.	 Module Balancer charges or discharges the new replacement module to the same state of charge as the other modules.	 The balancing circuit tries to have more control over the cell voltages and extracts the full capacity of the cells to use.	 Energy balancing circuit for battery cells connected in series based on modifying the bidirectional Cuk converter	
	Communication	 4G LTE cellular technology, Bluetooth, and Wi-Fi connectivity for connected circuitry diagnostics	 Advanced bidirectional communication in smart grid applications to help manage and balance energy flow.	 Reliable CAN-to-fiber Solutions achieve long-distance communication and make multiple device configurations easier.	 The communication protocol is an easy-to-use, Sub-GHz, wireless network completely embedded in an RF module	
	Energy Recovery	 Ultium Platform's energy recovery system can increase a vehicle's range, reduce battery energy needed for heating, increase charging speed	 Battery charging power and non-working motor resistance loss, a torque optimization minimizes the energy loss of the regenerative system.	 Novel conductive membrane that recovers critical materials from end-of-life electric vehicle batteries using up to 10 times less energy	 Taycan system is responsible for deciding how much electric motor braking and how much traditional hydraulic brakes will be used.	
Key Innovations & Players						

Source: IEBS Analysis

Key Features

- Safety
- Long Life
- High Energy
- Gentherm Focus Areas**

Impact

This engagement translated thermal innovation into measurable efficiency and growth outcomes by:

- Delivering **~12%** improvement in overall energy efficiency, resulting in approximately **\$300,000** in annual energy cost savings.
- Enabling the client to develop a scalable thermal management solution applicable across **5-10 emerging use cases**, including EVs, energy storage systems, and autonomous mobility platforms.
- Strengthening the client's positioning as a provider of **efficient, reliable, and sustainable thermal management solutions** for future mobility.

Conclusion

Through a focused evaluation of battery thermal management, heat dissipation, and system-level optimization, leB helped the client identify high-impact opportunities to reduce energy consumption and enhance system efficiency. The insights supported the development of versatile thermal management solutions, enabling the client to address emerging mobility applications while delivering tangible cost and performance benefits.

Ingenious Brain

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