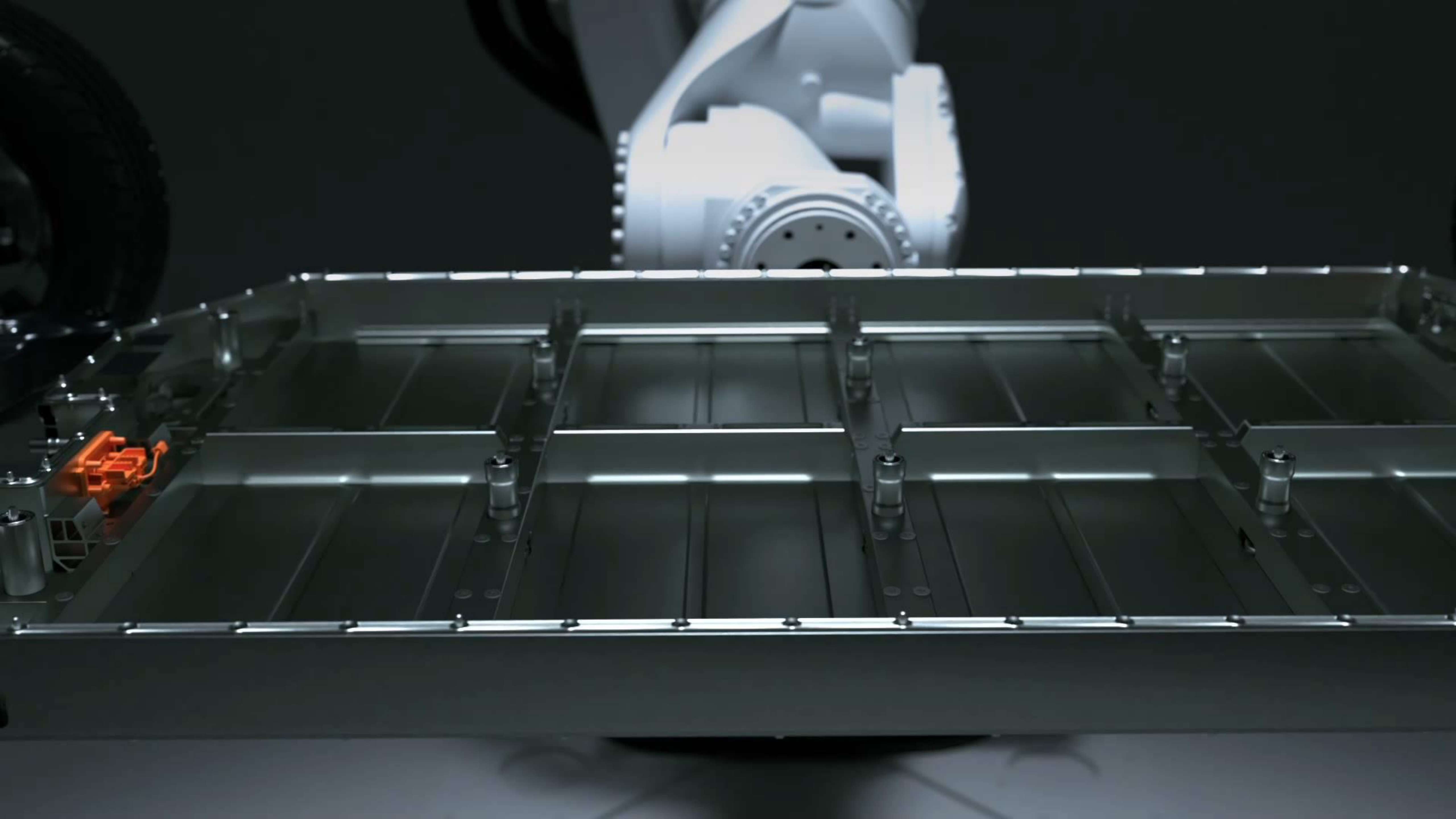
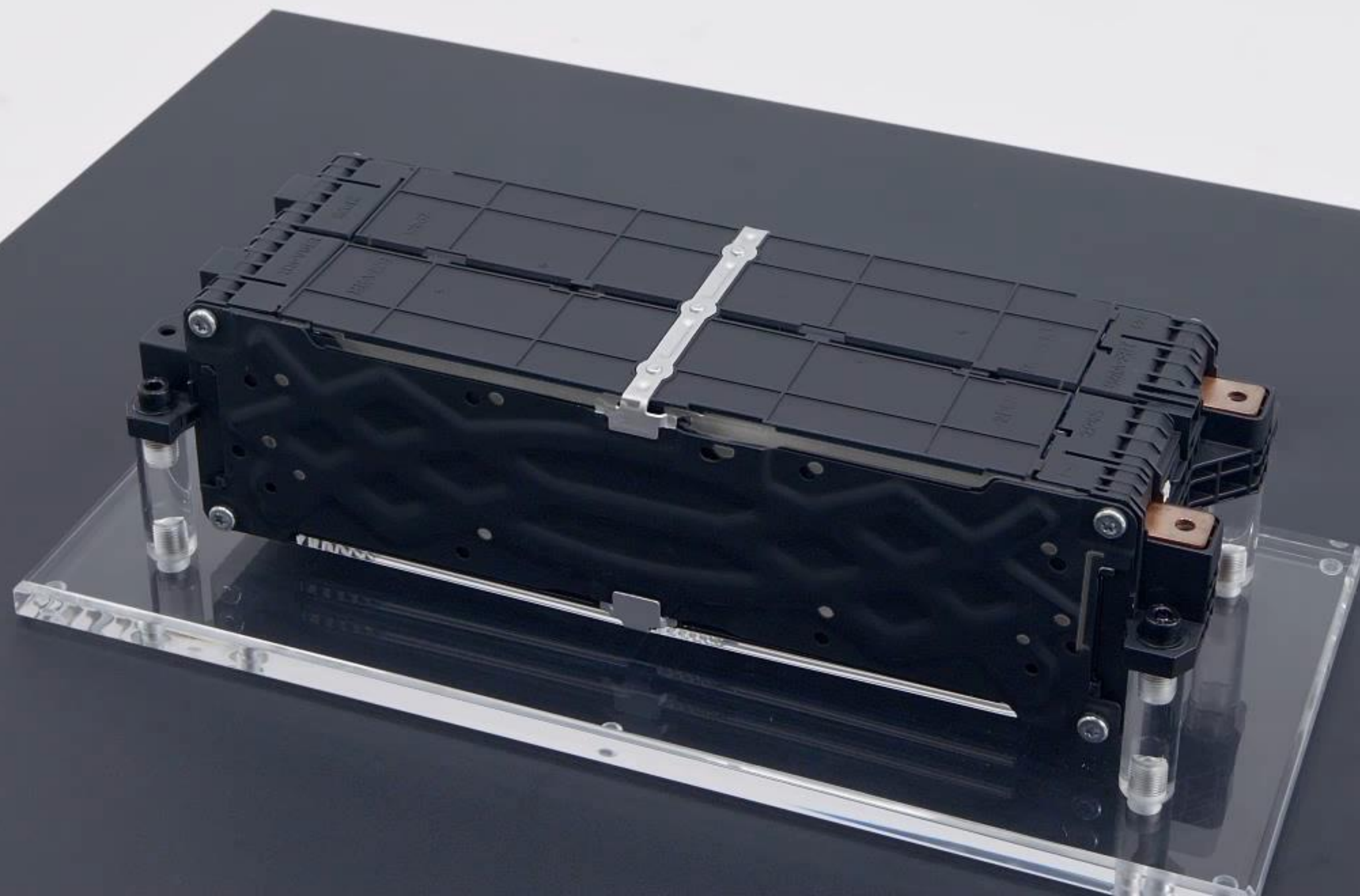


Thermal Management for Electric Vehicles



April 29, 2025
Thermal Management Expo
Jung Kim
Senior Engineer – Battery Simulation and Research
Hyundai America Technical Center, Inc.



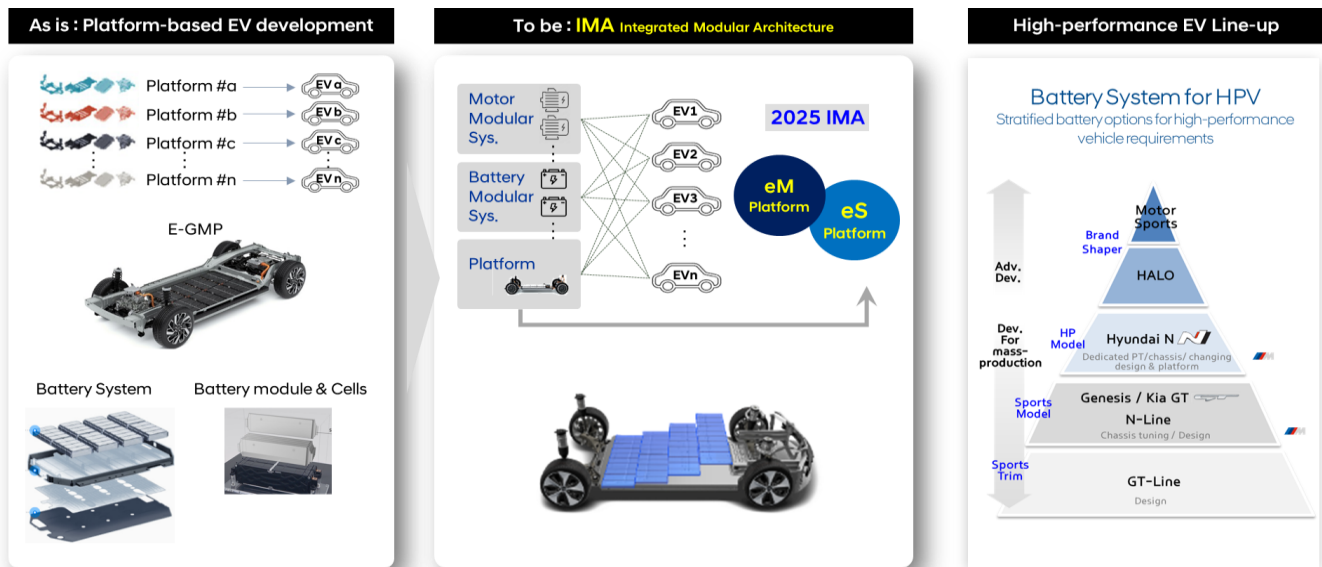


Core Technical Elements of Battery System

Through the advanced development of battery system technology, provide customers with safer and longer-range electric vehicles

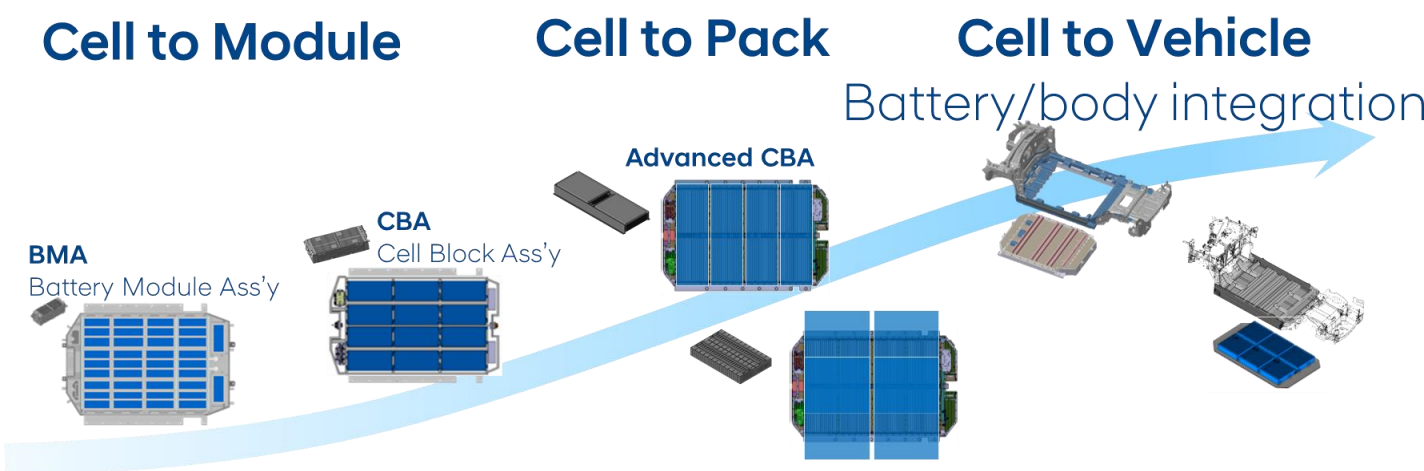
Modular System

Configuring standard modular systems for efficient operating and optimizing whole product family



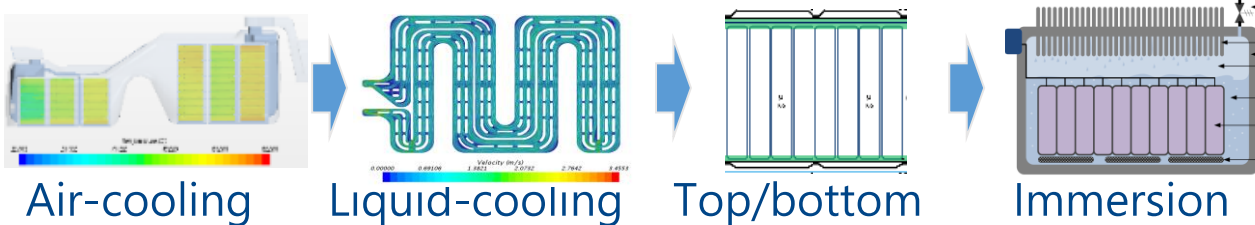
Energy & Packing Density

Maximize integration efficiency to improve energy density, flexibility and reduce cost



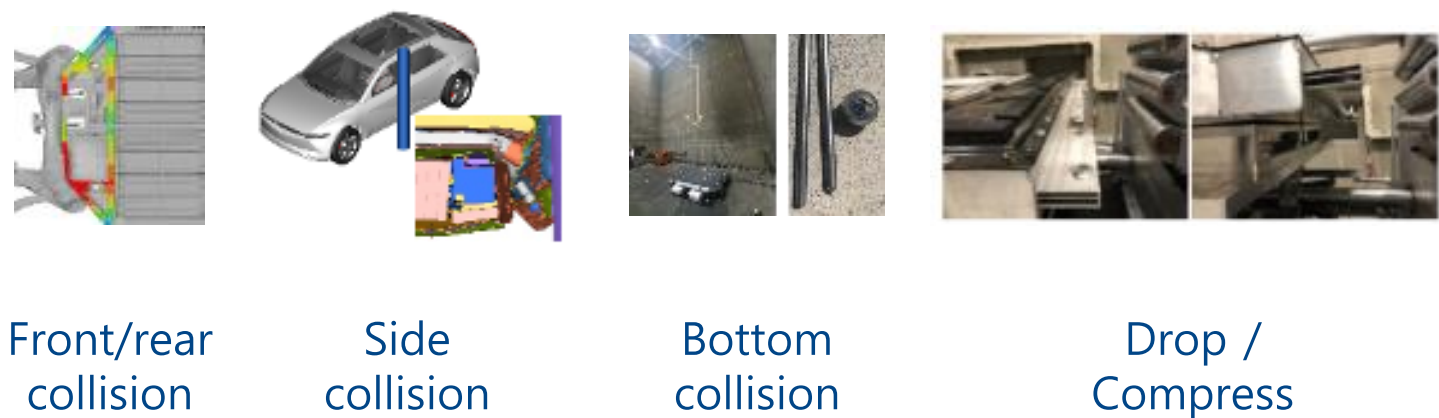
Thermal Management

Optimize thermal management system considering vehicle requirements and cell characteristics



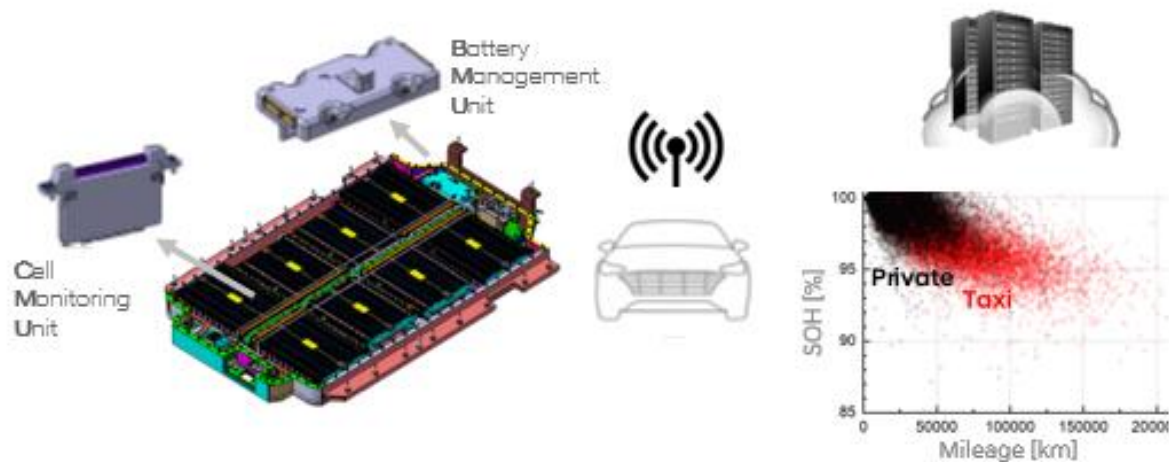
Structural Safety

Securing structural safety through various collision tests of EV



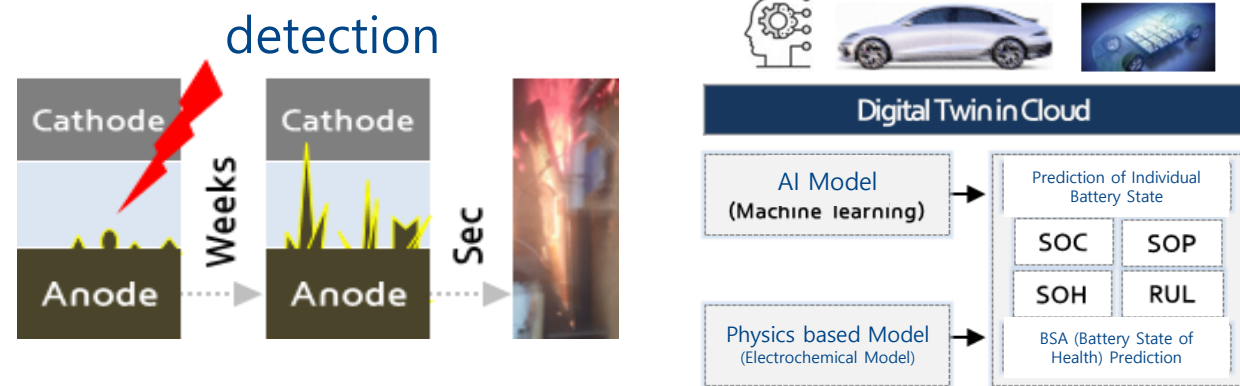
BMS & Electronics

Accurate battery monitoring and cloud-based battery modeling

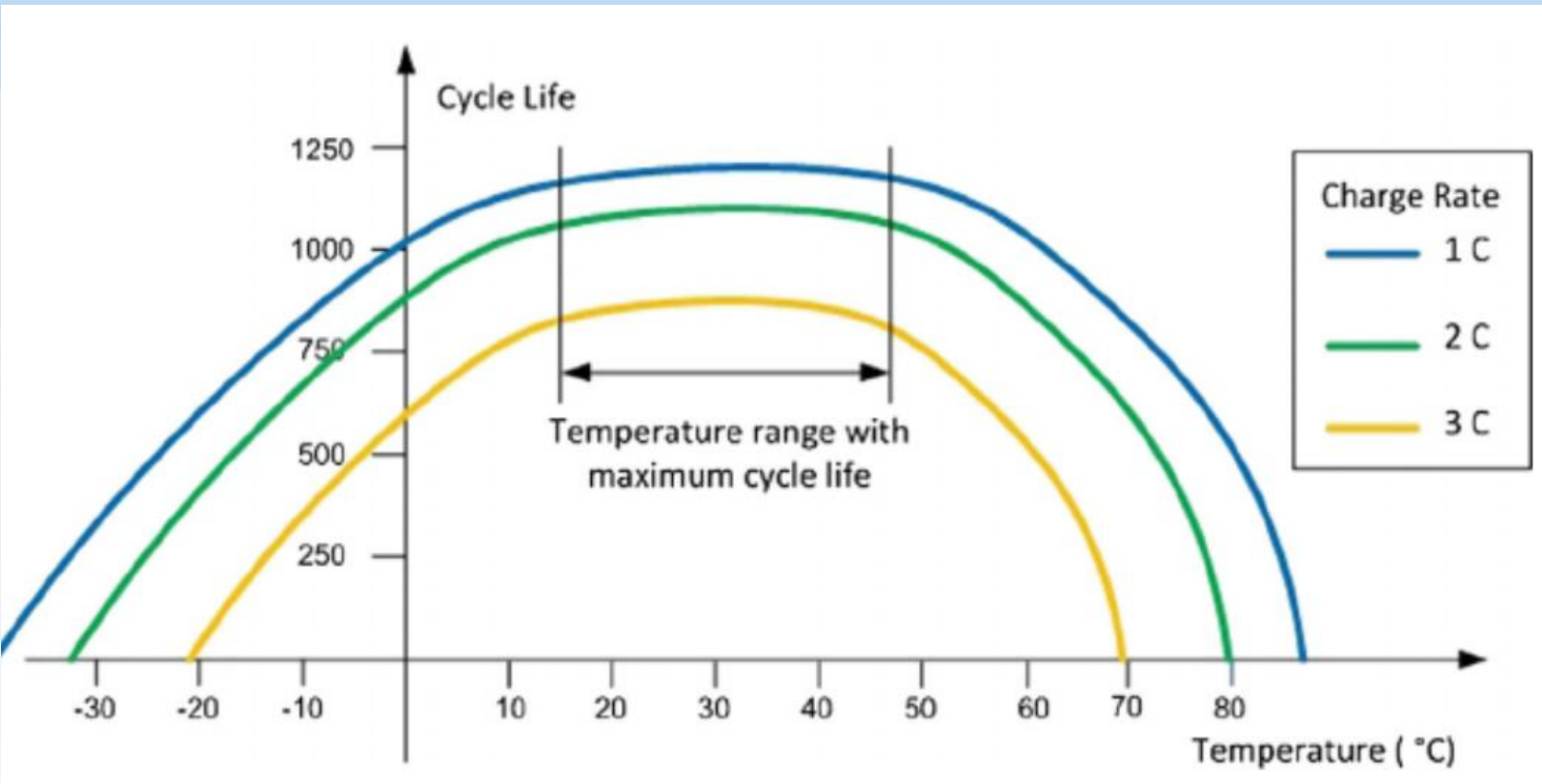
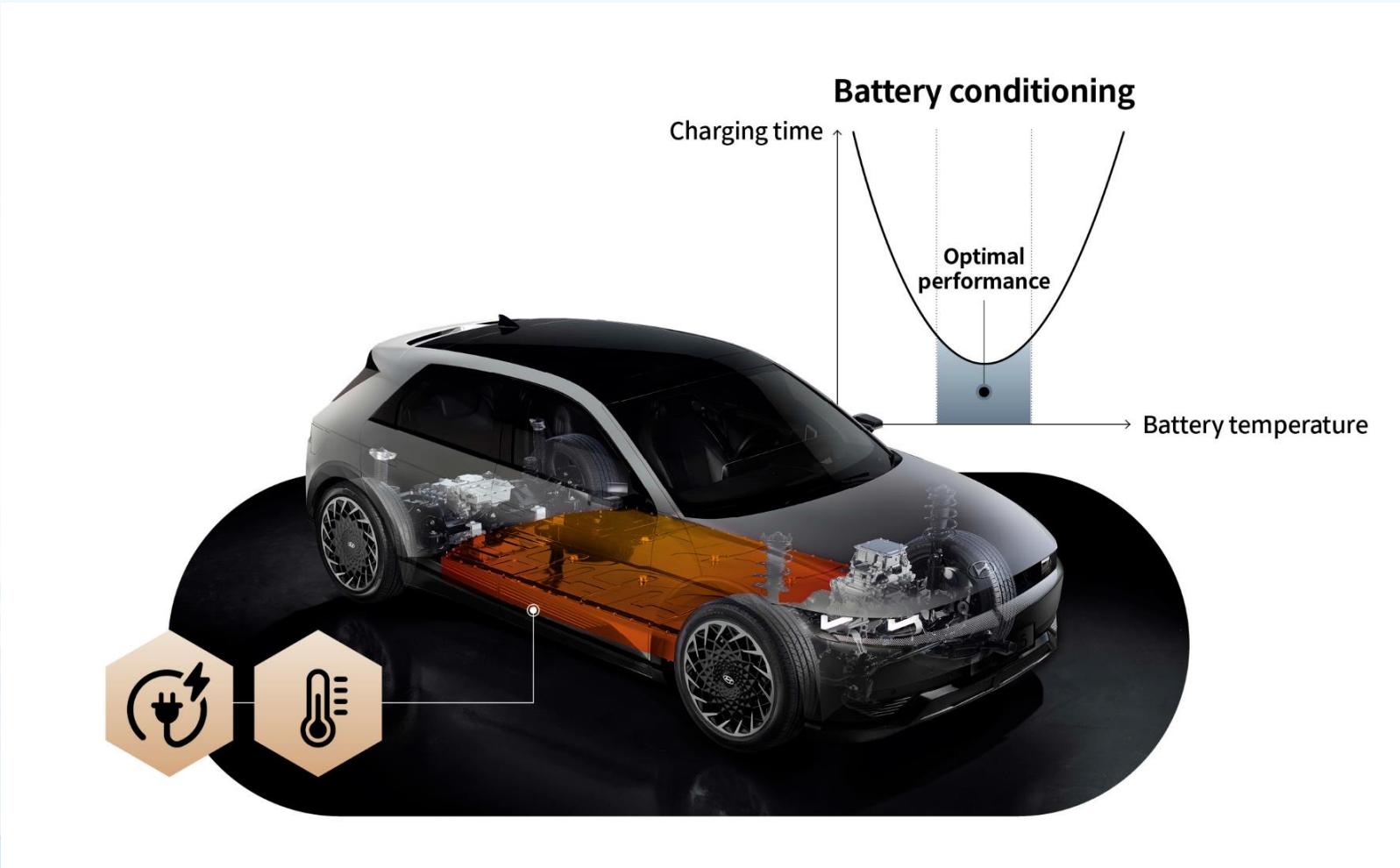
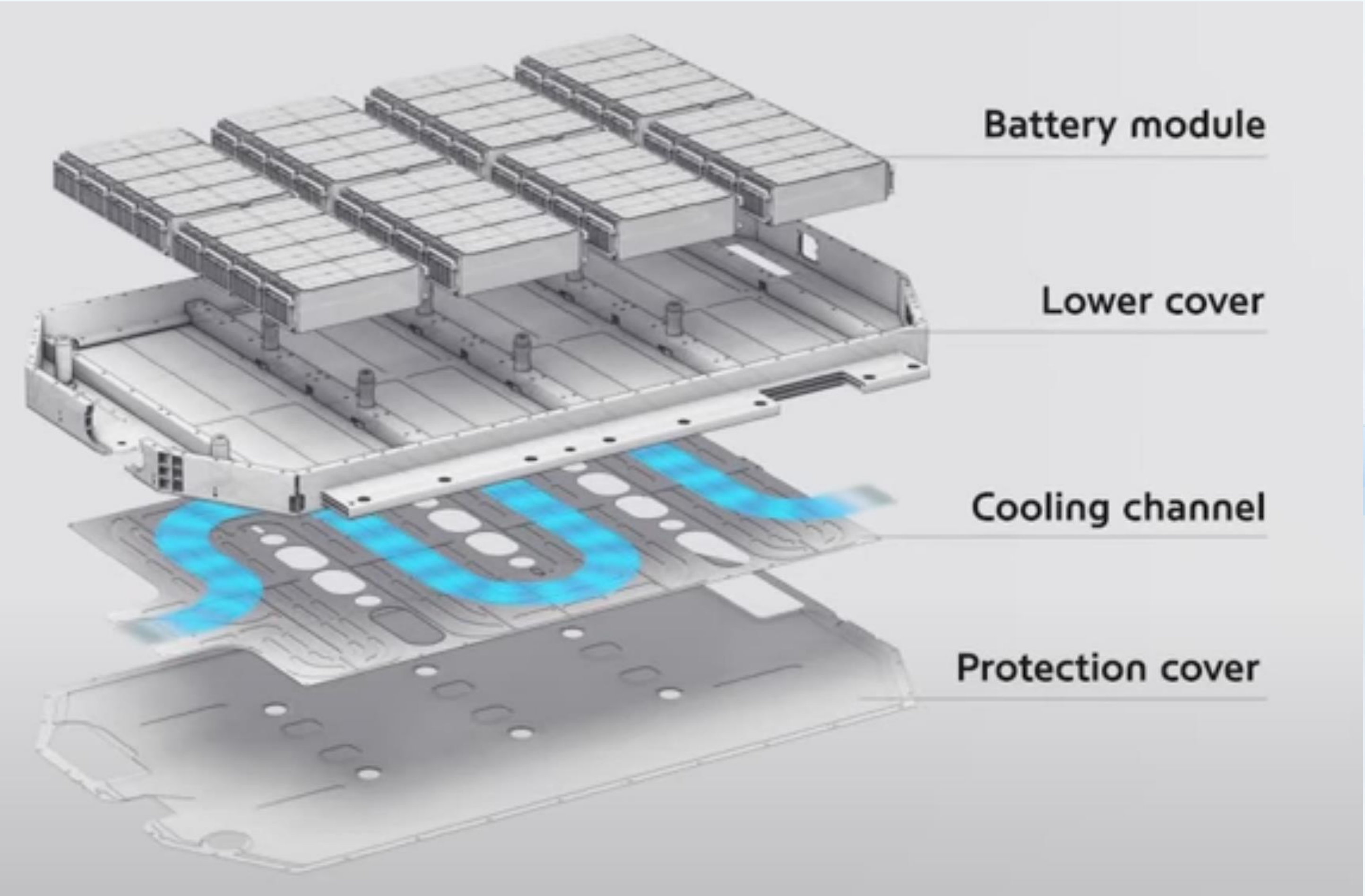


Pre-diagnosis and Prediction

Enhanced BMS: Battery System Control + Advanced Pre-safety Diagnostics and Remaining Life Assessment Technology Provide Customers with Differentiated Value



Battery Pack Thermal Management

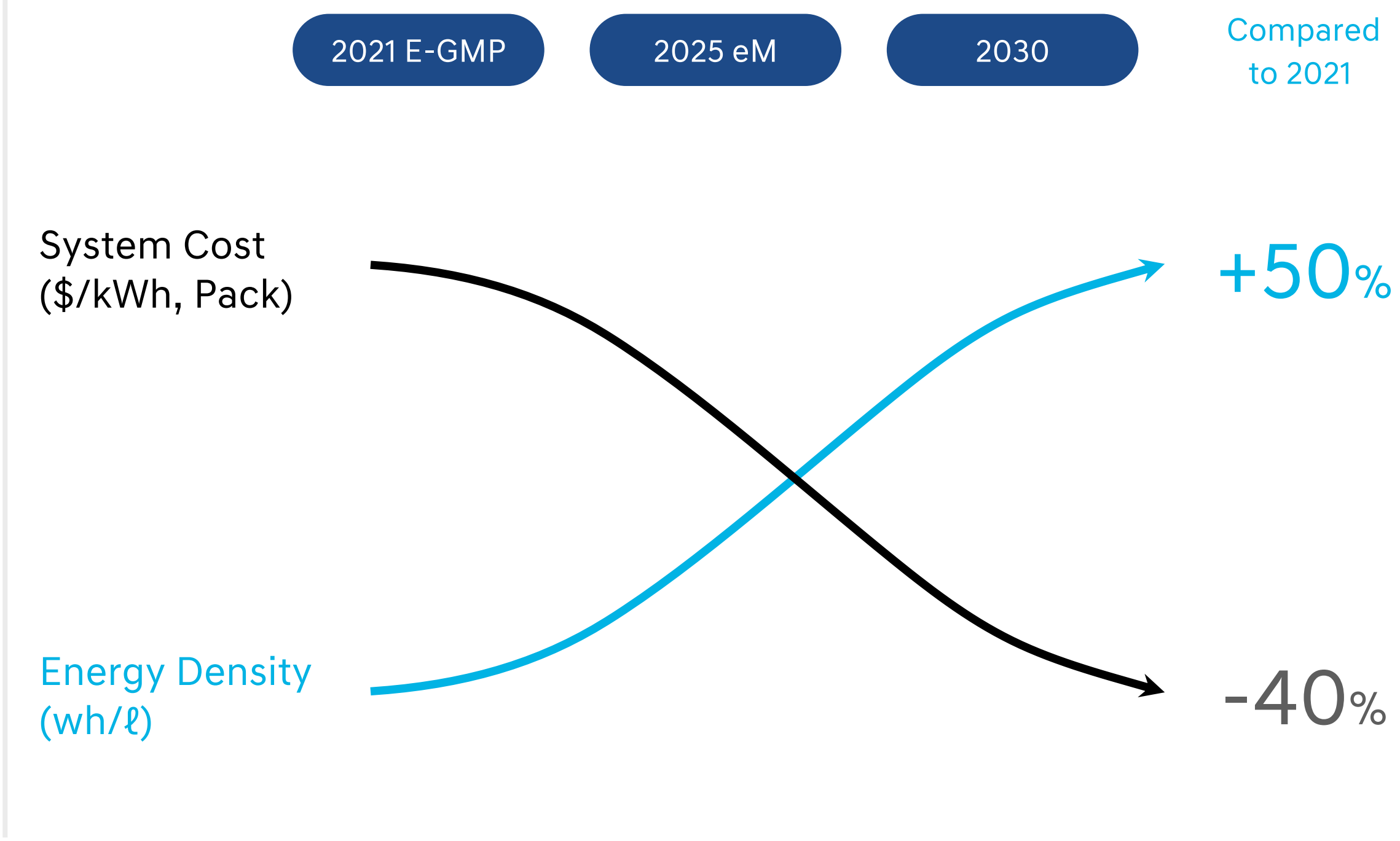


Rezvanizani, Seyed Mohammad & Liu, Zongchang & Chen, Yan & Lee, Jay. (2014).

HMG's Battery Competitiveness

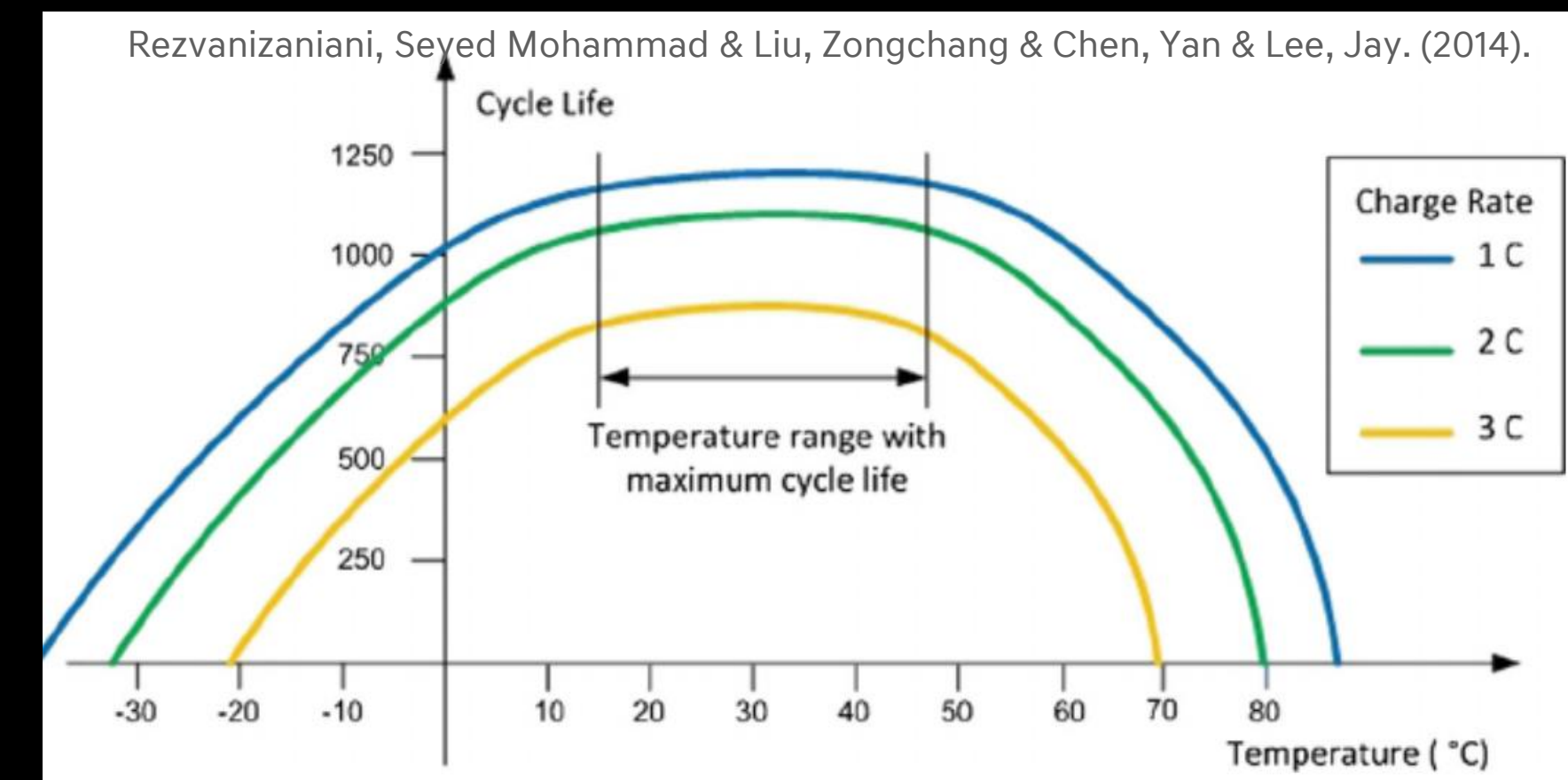
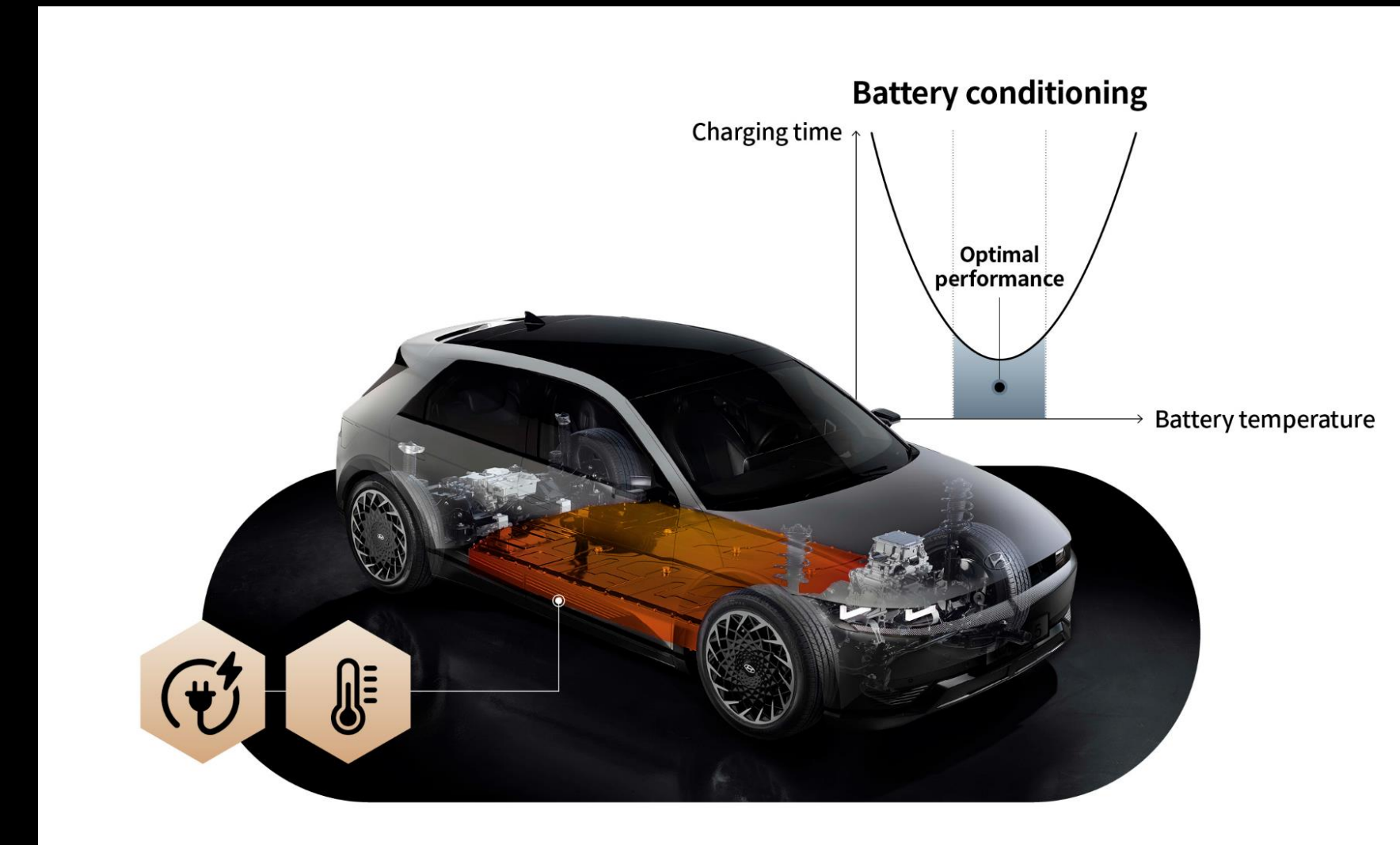
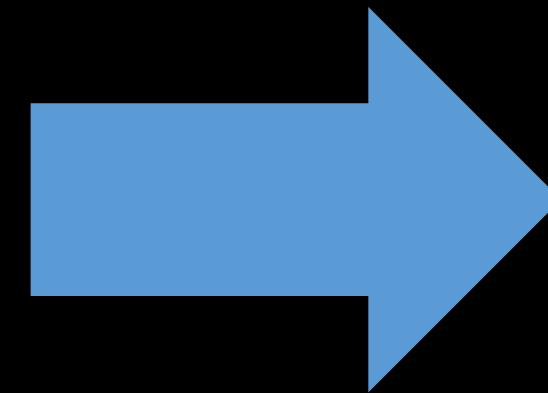
Strengthen competitiveness considering battery energy density, cost, new technologies, etc

BATTERY
SYSTEM
COMPETITIVE
-NESS

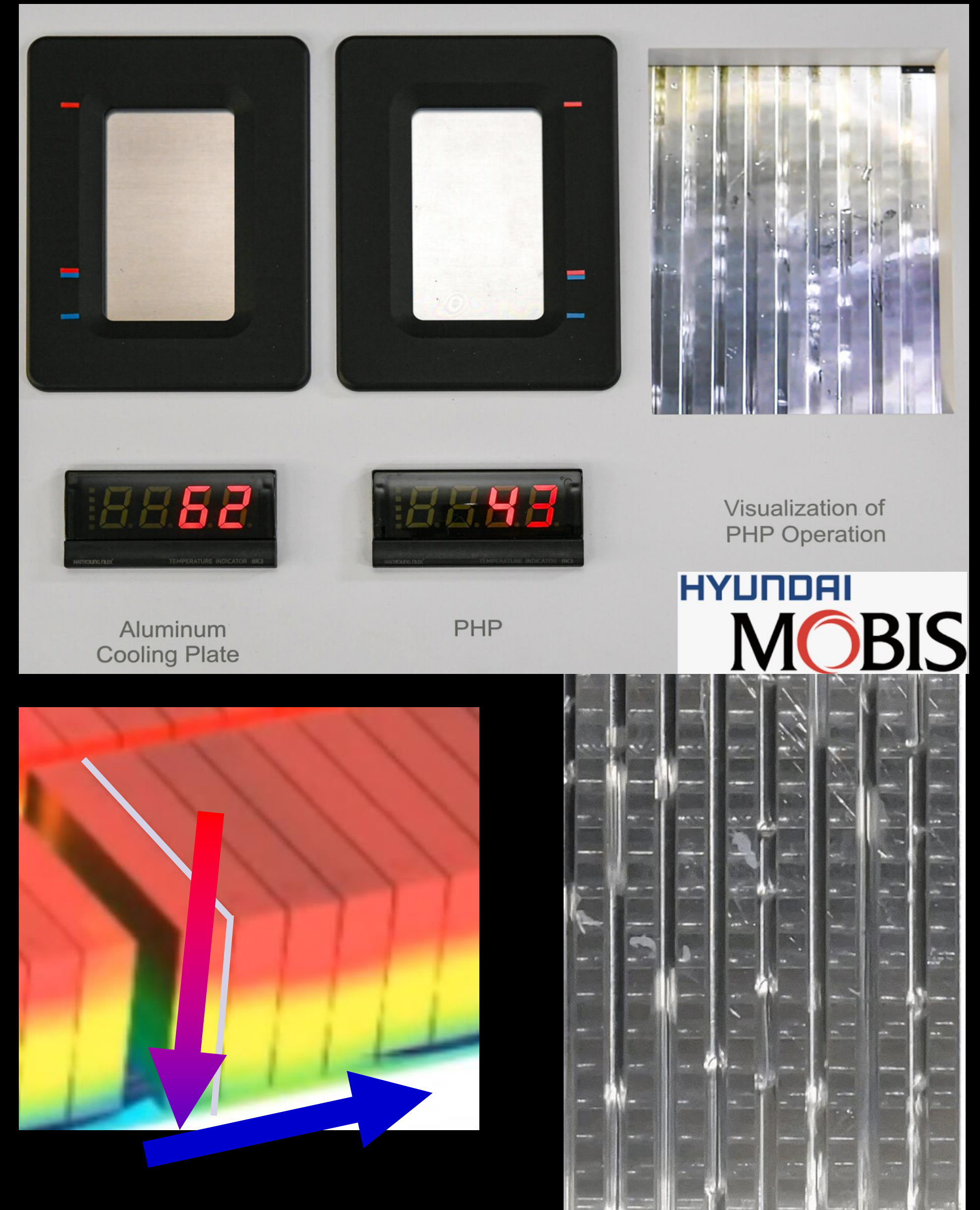
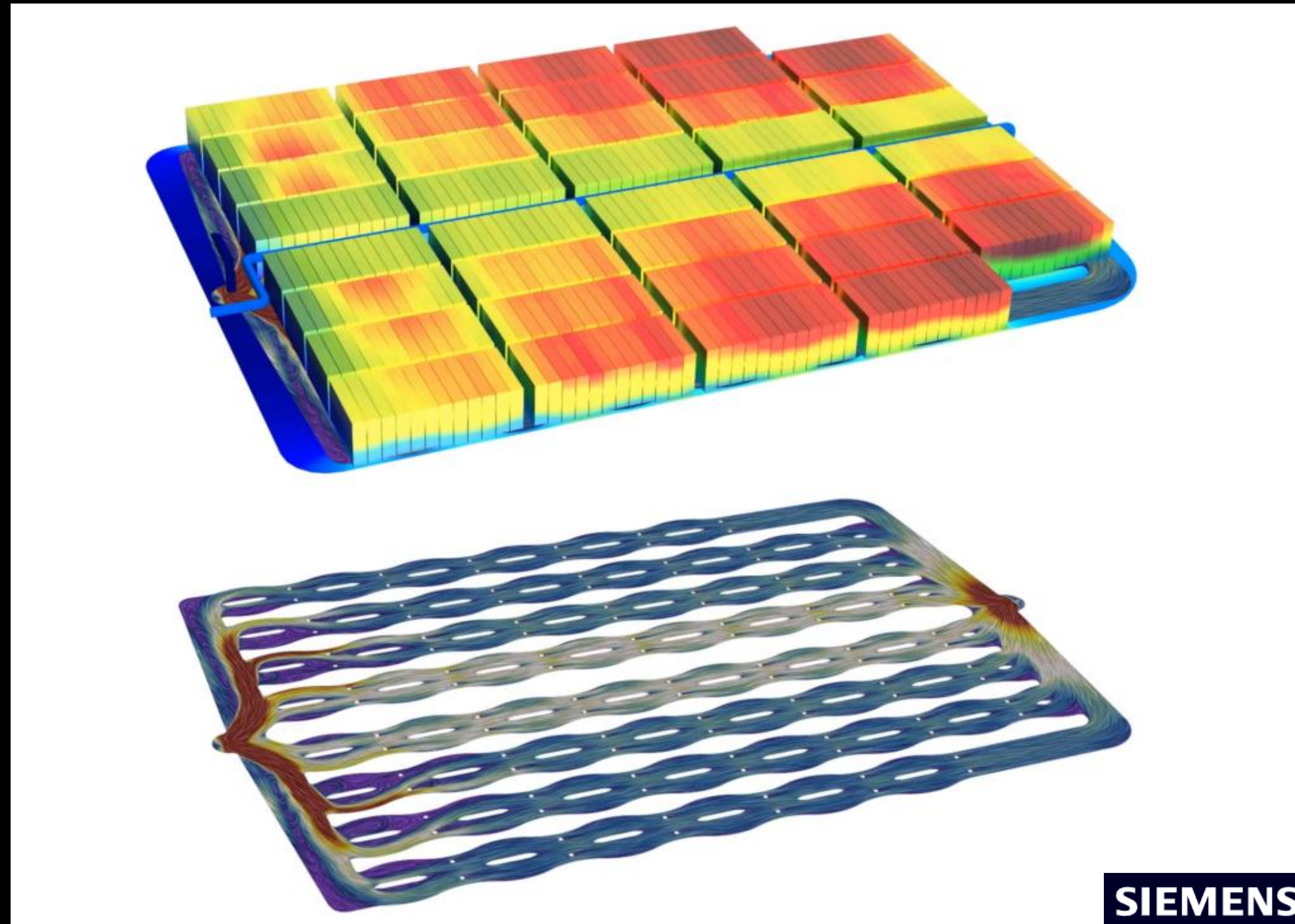


Strategies for competitiveness	
Cost	<div>- Enhancing system efficiency through the application of modular architecture</div> <div>- Diversification of Chemistry using low-cost Materials</div>
Density	<div>- Cell to Module → Cell to Pack</div> <div>- Application of Next-Generation batteries (LMB, SSB)</div>

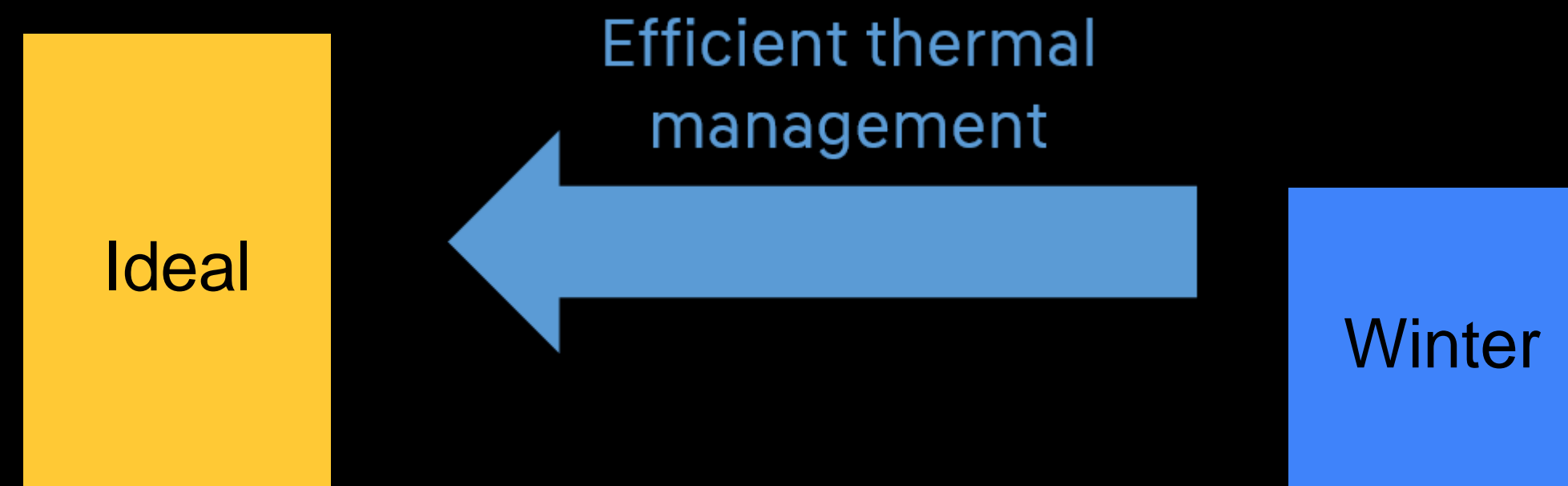
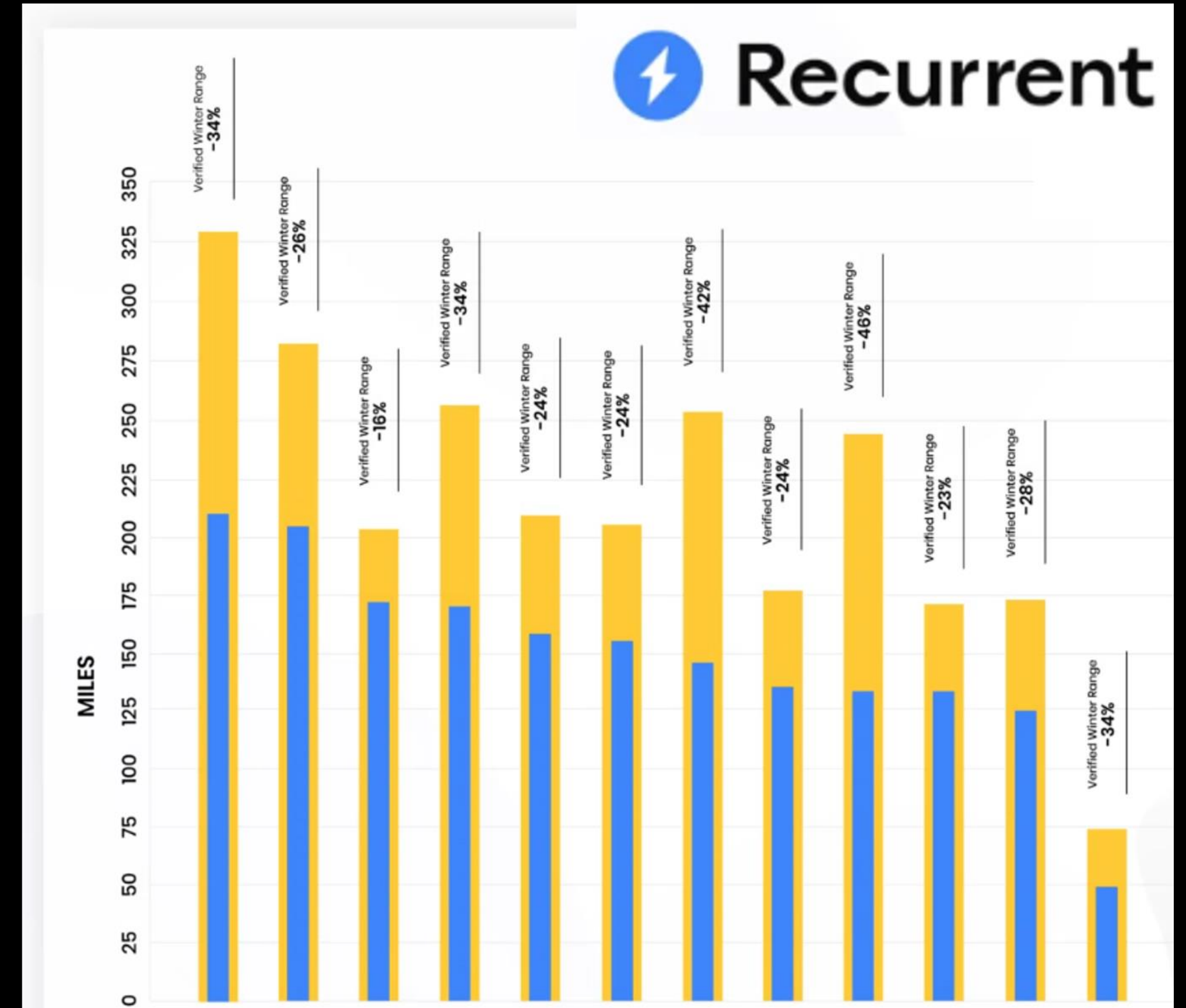
Maintaining Battery Temperature at Various Conditions



Example: Managing High Temperature



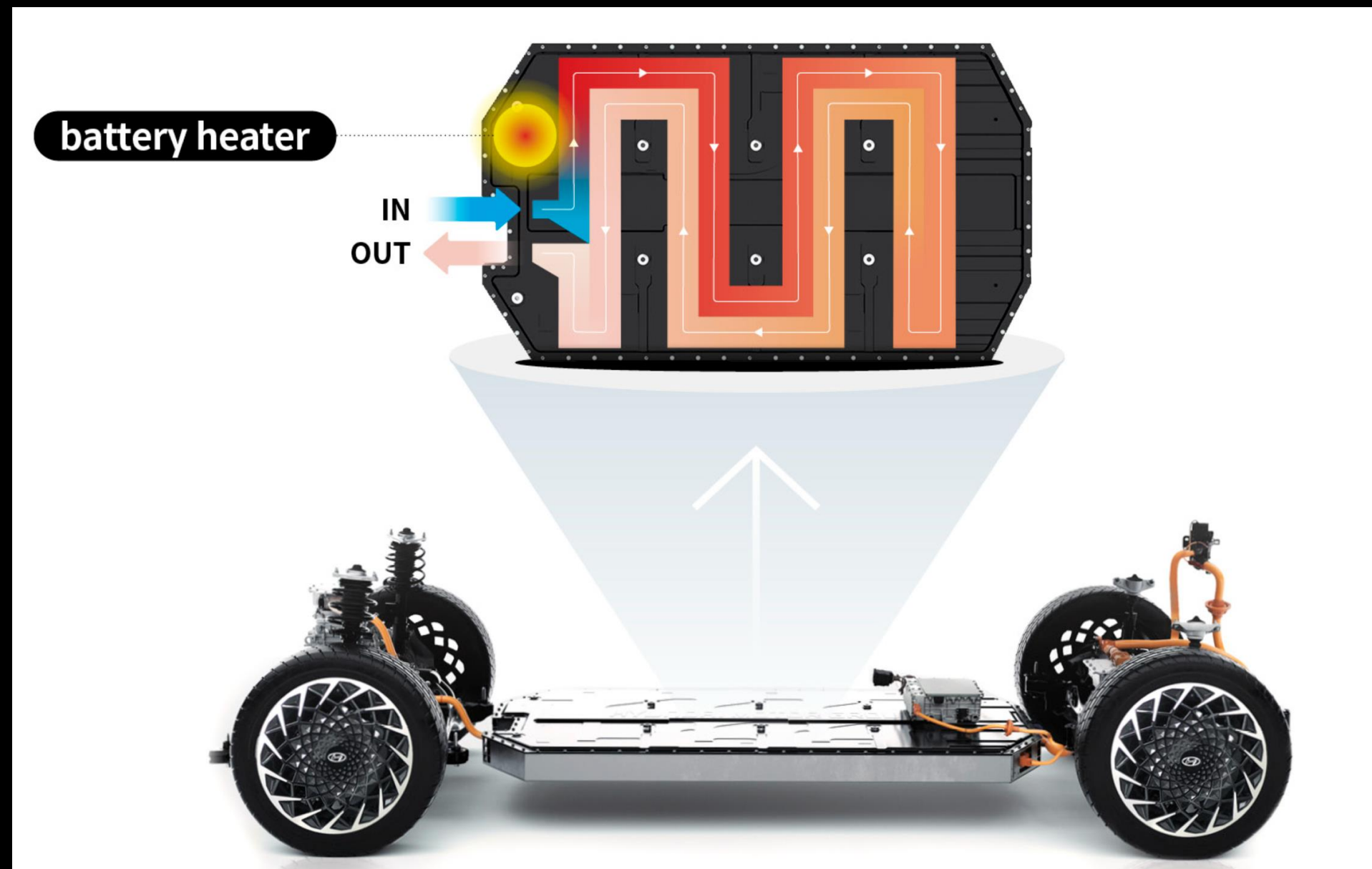
Example: Managing Low Temperature



Example: Managing Low Temperature



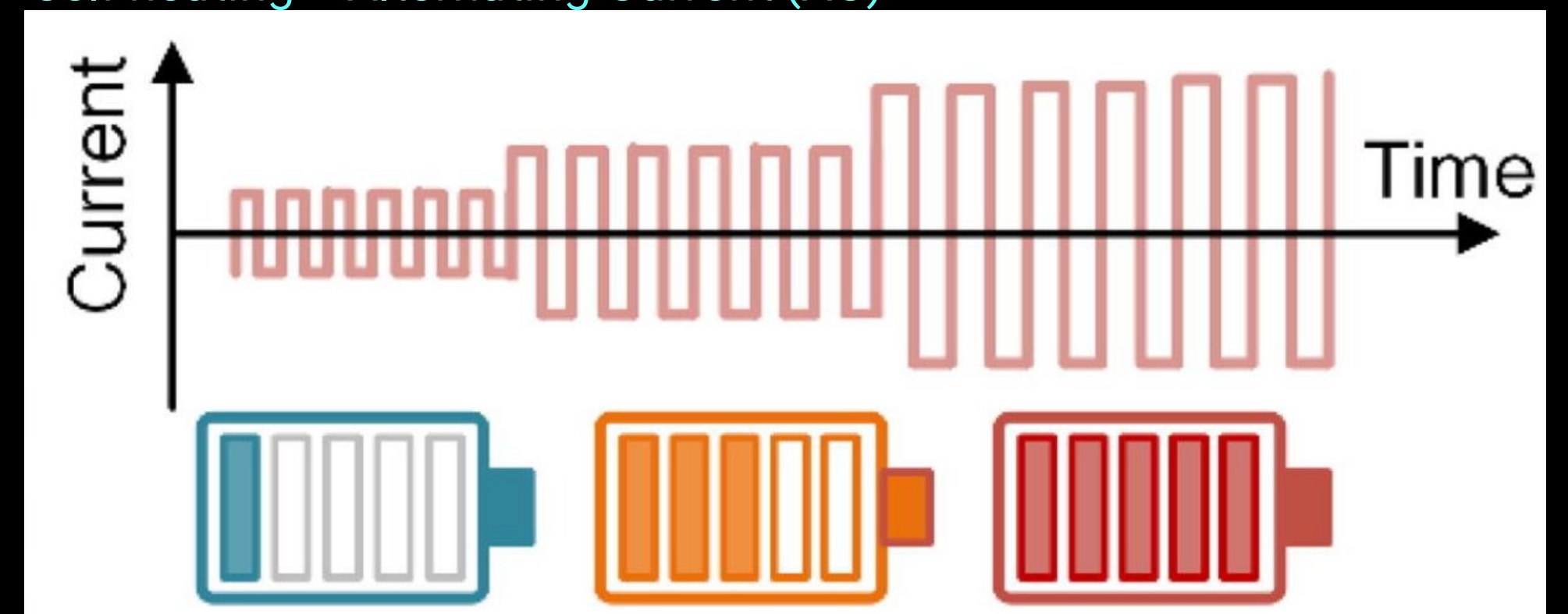
Coolant heating



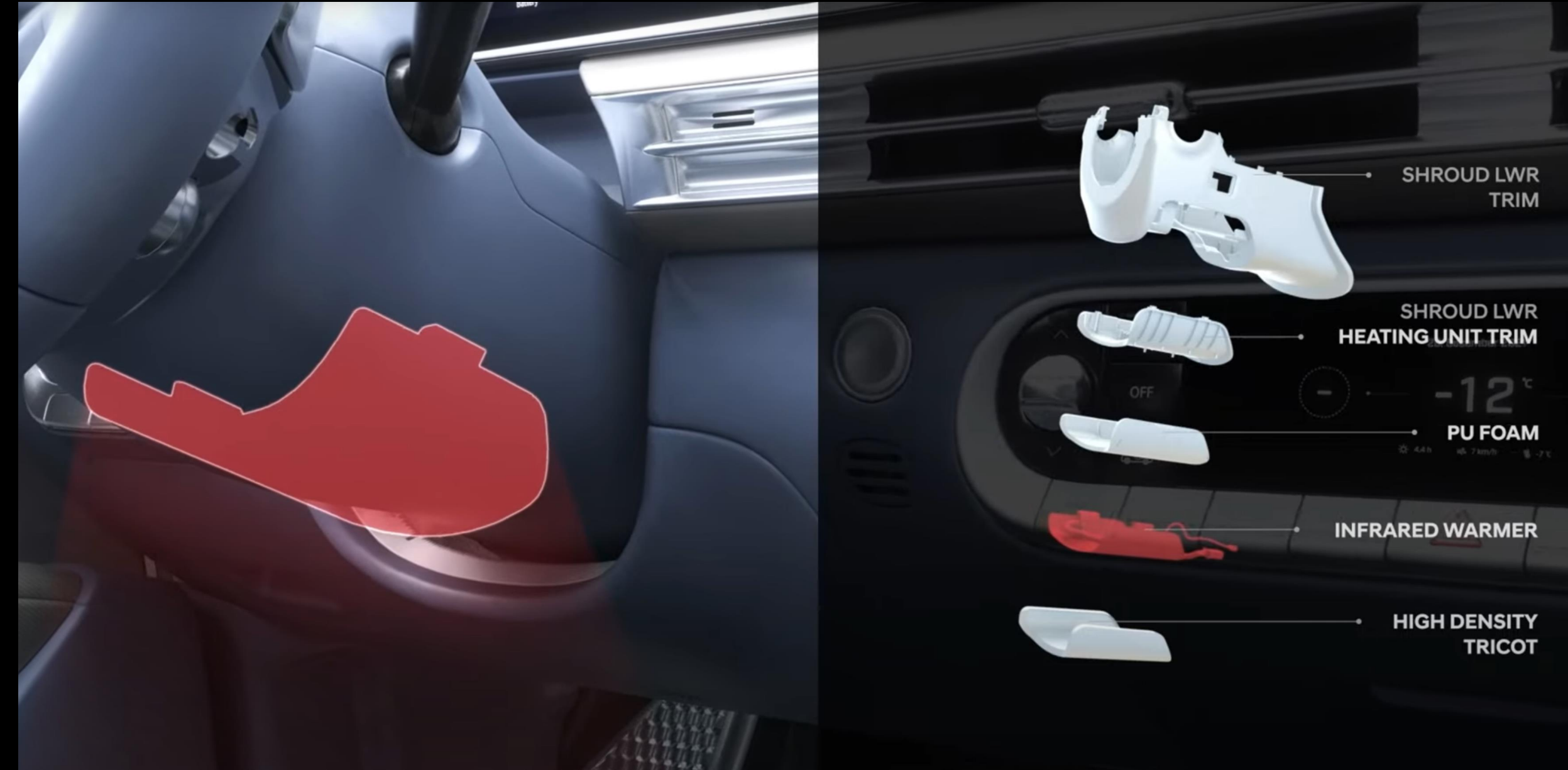
Direct heating on battery surfaces



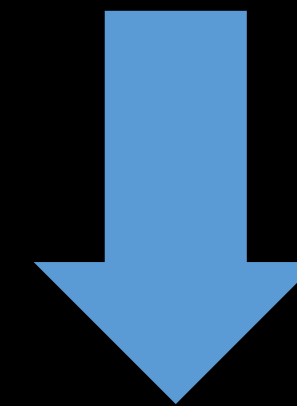
Self heating – Alternating Current (AC)



Example: Managing Low Temperature



Under conditions of -7°C



17% less energy for
cabin comfort



8% increased
electric range

Launch 21 Models by 2030

casper
Affordable EV



HYUNDAI
Mass-market EV
Compact - Large



GENESIS
Luxury EV
Total 6 models / lineup



N GENESIS
High-performance EV
Hyundai N (vision 74)
/ Genesis Magma



Strengthening HEV Competitiveness

Expansion of HEV line up and Improvement of Performance/Fuel Efficiency



Introduction of Next-generation Hybrid
Introduction of TMED-II with significant improvement in performance and fuel efficiency over TMED

Improvement of Cost Competitiveness
Cost reduction and profitability enhancement

Coverage Expansion
Full lineup deployment including Genesis considering the role of HEVs

Product Value Enhancement
Application of HEV exclusive premium technologies

EREV
(Extended Range Electrified Vehicle)



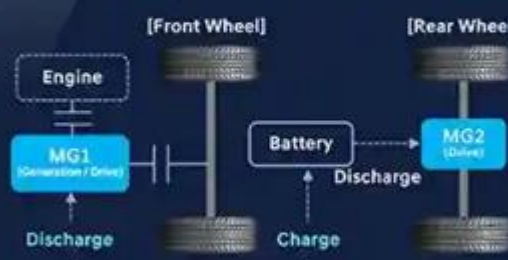
Charging / Fueling
ICE Long Driving Range



Driving Comfort
EV Eco-Friendliness

HMC's Unique EREV System

Other OEMs with 3 Motor System
(1 Generation & 2 Drive)
vs.
HMC's 2 Motor System
(1 Integrated (Generation / Drive) & 1 Drive)



EREV Powered by only electricity,
and engine is used only for charging

Shaping The Future of Mobility Together



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