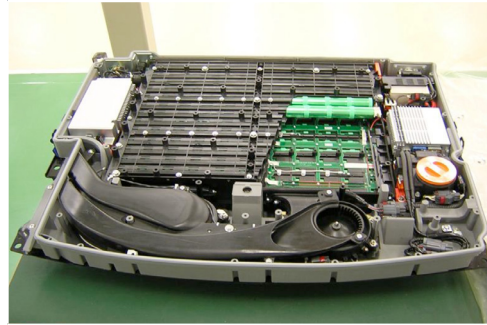




Battery Evolution

Battery technology is rapidly evolving. This comparison shows how new battery technology, such as the nickel metal hydride batteries in today's Hybrid Electric Vehicles (HEVs) and the lithium-ion battery technology of next-generation electrified vehicles compare to the traditional 12-volt lead-acid battery.



Lead-Acid

Nickel Metal Hydride (Ni-MH)

Lithium-Ion (Li-ion)

First Commercial Use	1859	1989	1991
Current Automotive Use	Traditional 12-volt batteries	Battery technology developed for today's generation of hybrid vehicles	Under development for future hybrid electric and battery electric vehicles
Strengths	Long proven in automotive use	<ul style="list-style-type: none"> • Twice the energy for the weight as compared to lead-acid • Proven robustness 	<ul style="list-style-type: none"> • About twice the energy content of Ni-MH and better suited to future plug-in electrified vehicle applications • By taking up less space in the vehicle, provides far greater flexibility for automotive designers
Weaknesses	Heavy; its lower energy-to-weight ratio makes it unsuitable for electrified vehicle usage	High cost (four times the cost of lead-acid); limited potential for further development	<ul style="list-style-type: none"> • Although proven in consumer electronics, this technology is still under development for automotive applications • Expensive until volume production is reached
Specific Energy (Watt hours per kilogram)	30-40	65-70	100-150
Recyclability	Excellent	Good	Very Good

