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PERP Report 2017S9: Advances in Battery Technology for Electric Vehicles

"Advances in Battery Technology for Electric Vehicles" is one in a series of reports published as part of the 2017 Process Evaluation/Research Planning (PERP) Program.

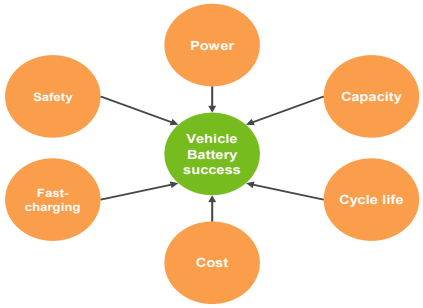
Report Overview

Between 2005 and 2016, the number of electric vehicles (EVs) on the road globally increased from less than 2000 to over two million, reflecting a compounded annual growth rate of 94 percent in this period. However, EVs still account for less than 0.1 percent of the global road vehicle fleet, estimated to stand at over 975 million vehicles in 2016.

Battery costs fell by 67 percent between 2010 and 2015, whereas battery energy density increased over two fold during the same period, meaning that EVs became more cost effective with a longer range. Furthermore, member governments of the Electric Vehicle Initiative (EVI) enacted policies and incentives to address the gap in cost and performance between EVs and conventional cars. The increase in the number of publicly available charging stations in these countries also made EVs a more viable alternative to internal combustion engines (ICE) vehicles.

A significant amount of attention and research has been put into evaluating and reducing the cost of battery production. The success of battery use in electric vehicles is also, however, dependent on the other major factors such as power, capacity, safety, charging speed and battery life which are often understated. This PERP report provides the perspective and tools to critically review the research on battery technology and help understand the challenges of moving towards a vehicle industry increasingly dominated by electric vehicles.

VEHICLE BATTERY KEY SUCCESS FACTORS



Battery Technology

The report provides a historical perspective on the evolution of battery technology and its role in driving EV competitiveness, as well as the current market situation for both EVs and batteries. This insight is key to understanding future technical and market trends for the battery industry, and their likely impact on EV market development.

Battery types (lead acid, nickel-metal and lithium-ion), chemistries, battery components (electrodes, current collectors, electrolytes, separators) are discussed to identify their different strengths and limitations.

Commercial and Emerging Technologies

Battery incorporation into EV production is a key success factor for the sector, but is less widely discussed in public literature than other issues. This analysis provides an understanding on why this is as critical to EV development as the "headline" goal of reduced battery cost. Key developing technologies that show significant potential for cost reductions are also examined in this report, as well as the limitations that have yet to be overcome in order to make these technologies commercially viable.

Economic Analysis

The report includes production cost estimates for the main types of cathode batteries, such as NCA by Tesla/Panasonic, NMC by 3M/Umicore, and LFP by BYD. Investment costs and usage spend over vehicle lifetime are also examined.

Non-Cost Related Issues

Charging facilities in major EV markets and life-cycle analysis (LCA) are discussed, to highlight the adequacy level as well as the electricity source by fuel type. This helps evaluate the overall attractiveness of the use of EVs that cannot be captured by analyzing battery economics alone.

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