

Battery Technologies for Electric Vehicles: Historical Progress, Contemporary Applications, and Future Prospects

G. Sai Kumar¹; N. Akhil²; B. Pavan³; D. Karthikeya⁴; R. Vardhan⁵;
M. Narendar⁶; P. Ramesh⁷; T. Akhilesh⁸

^{1,2,3,4,5,6,7,8}BE, III Year, Department of Electronics and Communication Engineering Methodist College of Engineering and Technology (Autonomous) Hyderabad, India

Publication Date: 2026/04/27

Abstract: The transition to electric vehicles (EVs) has been largely propelled by ongoing advancements in battery technologies, which have profoundly shaped the automotive industry's trajectory towards sustainability and reduced carbon emissions. This article presents a comprehensive study that traces the historical evolution of battery technologies used in EVs, beginning with early lead-acid batteries and moving through significant milestones such as nickel-cadmium (NiCd), nickel-metal hydride (NiMH), and the groundbreaking rise of lithium-ion (Li-ion) batteries, which currently dominate the market. The discussion highlights key technological breakthroughs, the drivers behind material and design innovations, and the challenges each era faced, including limitations in energy density, weight, charging times, cost, and environmental impact. The analysis then shifts to current applications, examining how Li-ion batteries have enabled the production of commercially viable EVs with extended range, enhanced safety, and improved performance. It further explores ongoing research into solid-state batteries, lithium-sulfur, and other emerging chemistries that promise higher energy densities, longer lifespans, and enhanced safety profiles. The article also considers the role of battery management systems, advancements in fast-charging infrastructure, and the integration of second-life batteries for energy storage as critical components supporting the widespread adoption of EVs. Looking ahead, the abstract evaluates future prospects in battery technology, focusing on the pursuit of cost reduction, sustainable material sourcing, recycling solutions, and innovations that can meet the demands of a rapidly growing EV market. It underscores the challenges associated with scaling up production, addressing supply chain constraints, and ensuring environmental responsibility, while also emphasizing the potential for transformative technologies to reshape mobility and energy consumption patterns globally. Ultimately, the study provides a nuanced understanding of how past achievements and present innovations are shaping the trajectory of electric vehicles, offering insights into the technological, economic, and environmental factors that will define the future landscape of battery-powered transportation.

Keywords: *Electric Vehicles, Lithium-Ion Batteries, Solid-State Batteries, Energy Density, EV Energy Storage, Battery Technology, Sustainable Transportation.*

How to Cite: G. Sai Kumar; N. Akhil; B. Pavan; D. Karthikeya; R. Vardhan; M. Narendar; P. Ramesh; T. Akhilesh (2026) Battery Technologies for Electric Vehicles: Historical Progress, Contemporary Applications, and Future Prospects. *International Journal of Innovative Science and Research Technology*, 11(3), 4049-4057. <https://doi.org/10.38124/ijisrt/26mar2085>

I. INTRODUCTION

In recent decades, the global automotive sector has undergone a paradigm shift, driven by mounting environmental concerns, regulatory pressures, and the urgent need to transition toward sustainable mobility solutions. The escalating impacts of climate change, urban air pollution, and the finite nature of fossil fuel resources have compelled governments, industries, and consumers to reconsider traditional internal combustion engine (ICE) vehicles. Electric vehicles (EVs), powered by advanced battery technologies, have emerged as a promising alternative that addresses these multifaceted challenges by offering zero

tailpipe emissions, higher energy efficiency, and the potential for integration with renewable energy sources. The push toward electrification is further accelerated by international agreements such as the Paris Climate Accord, which set ambitious targets for decarbonizing transportation sectors worldwide. As a result, EVs are no longer viewed as niche products but as a central component of future mobility, commanding significant investment, research, and policy attention. This introductory section sets the stage for an in-depth exploration of the battery technologies that underpin the ongoing EV revolution, outlining the motivations, societal drivers, and economic imperatives that

have brought battery-powered vehicles to the forefront of global transportation strategies[1], [2].

The origins of electric vehicle technology can be traced back to the 19th century, well before the advent of gasoline-powered cars. Early experiments with electric propulsion relied on rudimentary batteries, such as the lead-acid cell invented by Gaston Planté in 1859. These early batteries, though primitive by modern standards, demonstrated the fundamental viability of electric vehicles and were widely used in the first wave of EVs at the turn of the 20th century. However, the limited energy density, heavy weight, and high costs of these batteries, coupled with the mass production of affordable gasoline vehicles, led to the decline of early electric cars. Over the ensuing decades, battery technology continued to evolve, with the introduction of nickel-cadmium and nickel-iron chemistries offering incremental improvements in performance and longevity. Nevertheless, it was not until the latter part of the 20th century, with the advent of nickel-metal hydride and subsequently lithium-ion batteries, that the prospect of practical, mass-market EVs began to take shape. This historical perspective underscores the iterative nature of battery innovation and provides a foundation for understanding the current technological landscape[3], [4].

Lithium-ion (Li-ion) batteries, first commercialized in the early 1990s, represent a watershed moment in the evolution of battery technology and electric mobility. Characterized by high energy density, low self-discharge, long cycle life, and declining costs due to economies of scale, Li-ion batteries quickly became the standard for consumer electronics and subsequently found their way into automotive applications. The adoption of Li-ion technology by leading automakers enabled the development of EVs with ranges, performance, and reliability that could compete with—and in some cases surpass—traditional ICE vehicles. This transformative impact has been further reinforced by advancements in battery cell chemistry, thermal management, and manufacturing processes, which have collectively driven down costs and improved safety standards. Today, lithium-ion batteries are at the heart of virtually all mainstream electric vehicles, from compact city cars to high-performance sports models and commercial fleets. Their success has also catalyzed a surge in research and development aimed at addressing persistent challenges, such as resource scarcity, recycling, and further enhancements in energy density[5], [6].

The modern landscape of battery technology for electric vehicles is marked by rapid innovation and intense competition among automakers, battery manufacturers, and research institutions. Current-generation EVs predominantly utilize lithium-ion batteries, featuring various cathode chemistries such as lithium nickel manganese cobalt oxide (NMC), lithium iron phosphate (LFP), and lithium nickel cobalt aluminum oxide (NCA), each offering different trade-offs between energy density, cost, safety, and longevity. The widespread adoption of EVs has also spurred significant advancements in battery management systems (BMS), which are critical for monitoring cell health, optimizing

charging, and ensuring safety. In addition, the development of fast-charging infrastructure, improvements in battery pack design, and integration with vehicle thermal management systems have collectively enhanced the user experience and accelerated mainstream acceptance of electric vehicles. However, despite these advances, challenges remain in reducing costs, increasing range, shortening charging times, and ensuring the sustainability of supply chains for critical raw materials such as lithium, cobalt, and nickel[7], [8].

As the limitations of current lithium-ion technology become more apparent, research efforts are increasingly focused on next-generation battery chemistries that promise to overcome existing barriers. Solid-state batteries, for example, have garnered widespread attention for their potential to deliver higher energy densities, improved safety due to the elimination of flammable liquid electrolytes, and longer operational lifespans. Other promising avenues include lithium-sulfur and lithium-air batteries, which offer theoretical energy densities far superior to current technologies but face significant technical hurdles in terms of stability, cycle life, and manufacturability. Startups, academic institutions, and industry giants are investing heavily in the development and commercialization of these new battery systems, recognizing that breakthroughs in energy storage are fundamental to achieving widespread EV adoption and meeting global climate targets. This relentless pace of innovation underscores the dynamic nature of the field and the critical importance of sustained investment in research and development[9], [10].

While the adoption of battery-powered electric vehicles offers significant environmental benefits by reducing greenhouse gas emissions and mitigating air pollution, the lifecycle impacts of battery production, use, and disposal warrant careful consideration. The extraction and processing of raw materials such as lithium, cobalt, and nickel can have significant environmental and social consequences, including habitat destruction, water usage, and labor rights concerns in mining regions. Battery manufacturing is also energy-intensive, and end-of-life management poses challenges related to recycling, reuse, and safe disposal of hazardous materials. As the global EV fleet expands, addressing these issues becomes increasingly important to ensure that the transition to electrified transportation is genuinely sustainable. Recent developments in battery recycling technologies, closed-loop supply chains, and the use of alternative, less harmful materials are promising steps toward minimizing the ecological footprint of battery production and use. Effective policy frameworks, industry standards, and public awareness campaigns are also crucial in promoting responsible practices across the battery value chain[11], [12].

The rapid growth of the electric vehicle market has profound implications for the global automotive industry, energy sector, and economy at large. Falling battery costs, driven by technological advancements and economies of scale, have played a pivotal role in making EVs more affordable and accessible to a broader range of consumers.

The expansion of gigafactories and battery manufacturing capacity worldwide has further intensified competition, fostering innovation and driving down prices. Moreover, government incentives, regulatory mandates, and investments in charging infrastructure have created a favorable environment for EV adoption. However, the market is also characterized by volatility in raw material prices, supply chain constraints, and geopolitical factors that can impact the availability and cost of critical battery components. The interplay between these economic drivers and technological developments will shape the pace and trajectory of the electric vehicle revolution, influencing consumer choices, industry strategies, and policy decisions in the years to come[13], [14].

National and regional policies have played a decisive role in accelerating the adoption of electric vehicles and shaping the direction of battery technology development. Comprehensive regulatory frameworks, such as emission reduction targets, fuel economy standards, and zero-emission vehicle mandates, have compelled automakers to invest in electric mobility solutions and phase out conventional ICE models. Incentive programs, including tax credits, rebates, and subsidies for EV buyers, have further stimulated demand and reduced barriers to entry. At the same time, governments are investing in the development of charging infrastructure, research and development grants, and public-private partnerships to support innovation across the battery value chain. International cooperation on standardization, safety regulations, and environmental guidelines is also critical in promoting the harmonization of best practices and facilitating the global diffusion of advanced battery technologies. The success of these initiatives will depend on sustained political will, stakeholder collaboration, and a holistic approach that integrates technological, economic, and societal considerations[15], [16], [17].

The future of electric vehicles and battery technologies is marked by both tremendous promise and significant uncertainty. On one hand, ongoing advancements in energy storage, coupled with supportive policies and growing consumer awareness, are likely to drive exponential growth in EV adoption over the coming decades. Emerging battery chemistries, improvements in charging speeds, and the integration of artificial intelligence in battery management systems have the potential to further enhance vehicle performance, safety, and convenience. On the other hand, the industry must contend with persistent challenges related to raw material supply, recycling, grid integration, and the management of used batteries. The ability to balance these competing priorities will determine the pace of the transition to electrified transportation and the extent to which EVs can contribute to global efforts to combat climate change. Collaborative efforts among automakers, battery manufacturers, researchers, policymakers, and consumers

will be essential in overcoming these challenges and realizing the full potential of battery-powered mobility[18], [19].

This article aims to provide a thorough and balanced analysis of battery technologies in electric vehicles, encompassing their historical evolution, current state, and future prospects. By drawing on a wide range of academic studies, industry reports, and expert opinions, the following sections will systematically examine the key technological milestones, challenges, and opportunities that have defined the development of EV batteries. The article is organized to first offer a historical overview of battery technology, followed by a critical assessment of present-day applications, including the dominant lithium-ion systems and ongoing innovations. Subsequently, it will explore the environmental, economic, and policy dimensions of battery technology, highlighting both the achievements and unresolved issues facing the sector. Finally, the article will outline future directions, emphasizing the importance of continued research, responsible industry practices, and supportive policy frameworks in driving sustainable progress. Through this comprehensive approach, the article seeks to contribute to the broader discourse on electrified mobility and inform stakeholders engaged in shaping the next generation of transportation solutions[20].

II. PROPOSED METHODOLOGY

Proper classification of battery technologies forms the basis for meaningful analysis and comparison. In this study, battery technologies for electric vehicles are categorized based on their electrochemical composition, operational characteristics, and stage of market maturity. The primary categories include lead-acid batteries, nickel-cadmium (NiCd), nickel-metal hydride (NiMH), and various lithium-ion (Li-ion) chemistries (such as NMC, NCA, and LFP). Emerging technologies, such as solid-state batteries, lithium-sulfur, and lithium-air, are also delineated as next-generation candidates. Each category is further subdivided according to specific cell configuration (e.g., prismatic, cylindrical, pouch), electrolyte type (liquid, gel, solid), and intended application (passenger vehicles, commercial trucks, buses, etc.). The study also considers hybrid solutions and secondary use-cases, such as repurposed EV batteries for stationary storage. This classification enables a structured comparison across a spectrum of attributes, including energy density, cycle life, safety profile, cost, and scalability. Furthermore, the classification framework facilitates mapping of technology adoption trends, highlighting which chemistries are dominant in current markets and which are gaining traction for future deployment. By establishing clear taxonomies, the methodology ensures that subsequent evaluations and comparisons are grounded in a precise understanding of the technological landscape.

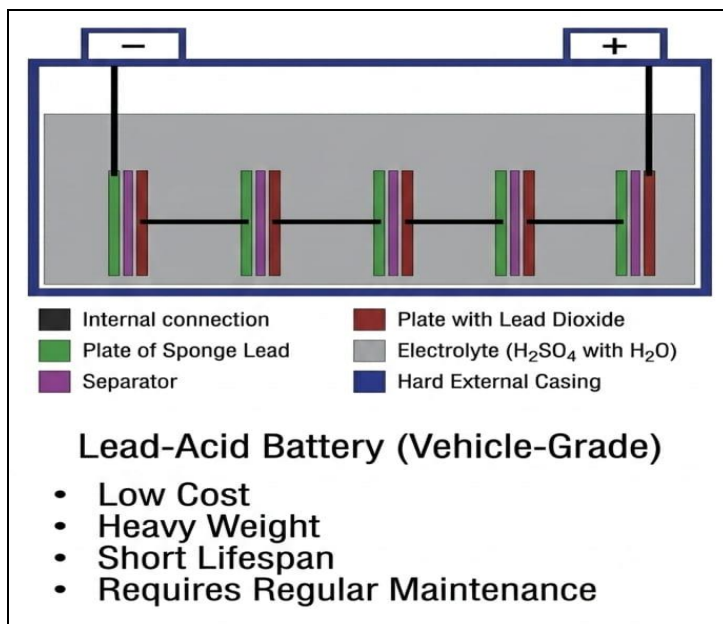


Fig 1 Lead-Acid Battery

This section of the methodology focuses on the quantitative assessment of key performance parameters for each battery technology. The primary criteria evaluated include energy density (Wh/kg and Wh/L), power density, specific energy, cycle life, efficiency, safety, fast-charging capability, cost per kilowatt-hour, operating temperature range, and environmental impact. Data is sourced from both manufacturer specifications and independent laboratory test results to ensure a robust and unbiased assessment. Where available, real-world performance data from EV field trials and commercial deployments are integrated to validate laboratory findings. The methodology applies normalization techniques to account for differences in test conditions,

ensuring comparability across chemistries and manufacturers. Advanced statistical methods, such as regression analysis and principal component analysis, are utilized to identify correlations between performance metrics and real-world outcomes, such as vehicle range, charging time, and total cost of ownership. The evaluation also considers degradation mechanisms and aging effects, which are critical for understanding long-term reliability. By systematically analyzing and benchmarking these parameters, the study provides a comprehensive performance profile for each battery technology, forming the basis for subsequent comparative and scenario analyses.

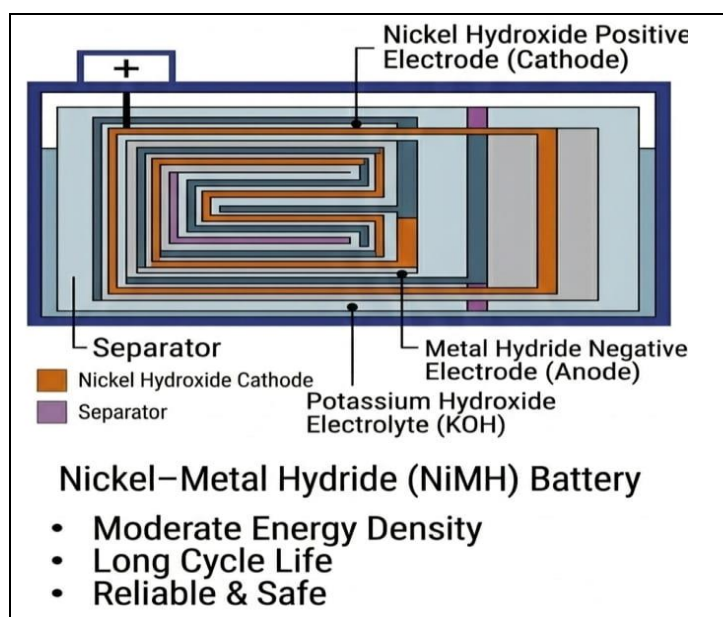


Fig 2 Nickel-Metal Hydride Battery

Integration of batteries into the EV powertrain is a crucial aspect influencing overall vehicle performance, safety, and consumer acceptance. The methodology

examines the engineering and architectural considerations involved in battery placement (e.g., underfloor packs, rear compartment), thermal management systems, battery

management systems (BMS), and interfaces with electric motors and power electronics. The study evaluates how different battery types impact vehicle weight distribution, structural integrity, crash safety, and interior space utilization. Special attention is given to the development and optimization of BMS, which monitor cell health, balance charge/discharge cycles, and safeguard against overcharging, thermal runaway, and other failure modes. The integration process is also examined through the lens of

manufacturability and serviceability, exploring modular designs, ease of replacement, and recycling potential. Case studies of leading EV models are used to illustrate best practices and highlight challenges encountered during integration. By analyzing these aspects, the methodology provides insights into how battery technology choices influence vehicle design, performance, and safety, as well as the broader implications for production scalability and after-sales support.

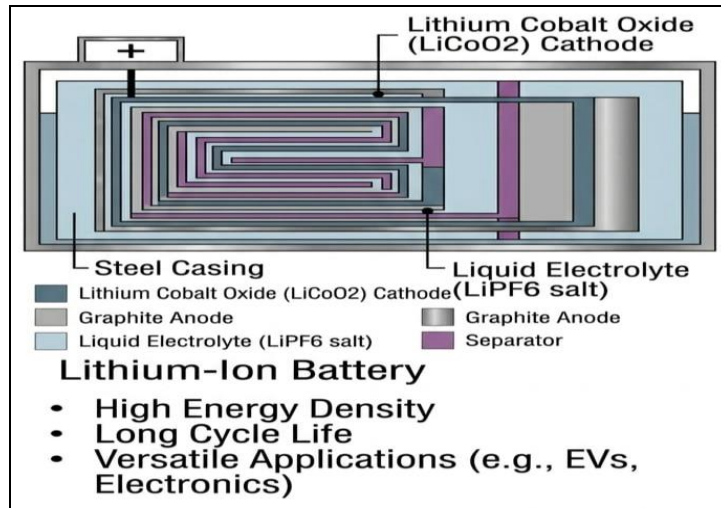


Fig 3 Lithium-Ion Battery

A core component of the methodology involves a systematic comparative analysis across the classified battery technologies. Using the performance parameters outlined previously, each technology is benchmarked against standardized criteria, allowing for a direct assessment of strengths, weaknesses, and trade-offs. The analysis employs multi-criteria decision analysis (MCDA) tools, assigning weighted scores to key attributes such as energy density, cost, safety, cycle life, and scalability. Both current and projected future values are considered, reflecting technological advancements and anticipated market trends. The comparative framework also incorporates qualitative

factors, such as supply chain resilience, ethical sourcing of materials, and the maturity of recycling infrastructure. Sensitivity analyses are performed to examine how variations in input parameters (e.g., raw material prices, manufacturing scale) impact the relative rankings of each technology. The results are synthesized in comparative tables and visualizations, providing clear guidance for stakeholders regarding optimal battery choices based on specific use cases, geographic regions, and policy priorities. This approach ensures a nuanced evaluation that transcends simple cost or performance metrics, addressing the complex realities of EV battery adoption.

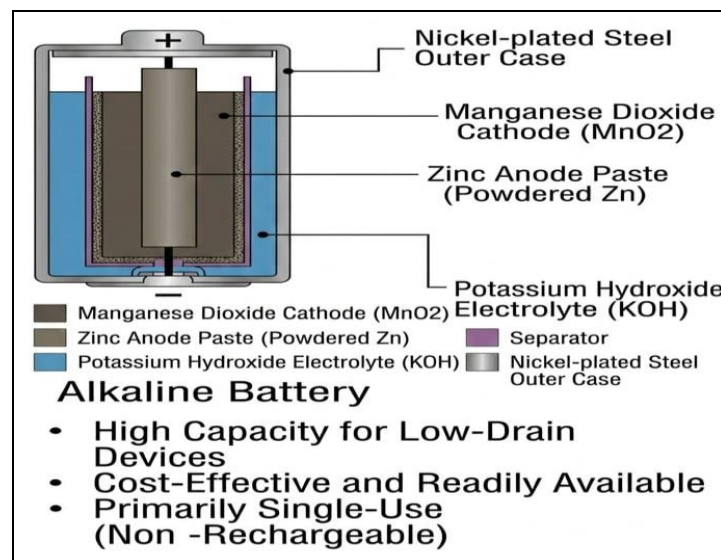


Fig 4 Alkaline Battery

Recognizing the rapid pace of innovation in the battery sector, this section of the methodology is dedicated to the evaluation of emerging and next-generation technologies. The study employs technology roadmapping and scenario planning techniques to forecast the potential of solid-state batteries, lithium-sulfur, lithium-air, and other cutting-edge chemistries. Expert elicitation methods, such as the Delphi technique, are used to gather consensus on the likely timelines for commercialization, expected performance improvements, and barriers to adoption. The evaluation also considers the innovation pipeline, examining patent activity, research publication trends, and investment flows to gauge

the maturity and momentum of various technologies. Additionally, the study models the potential impact of future batteries on EV adoption, market expansion, and environmental outcomes using diffusion of innovation theory and S-curve analysis. Risks and uncertainties, such as supply chain dependencies, regulatory hurdles, and scalability challenges, are explicitly addressed in the forecasting process. By systematically evaluating future battery technologies, the methodology provides stakeholders with actionable insights into long-term opportunities and strategic risks in the evolving EV landscape.

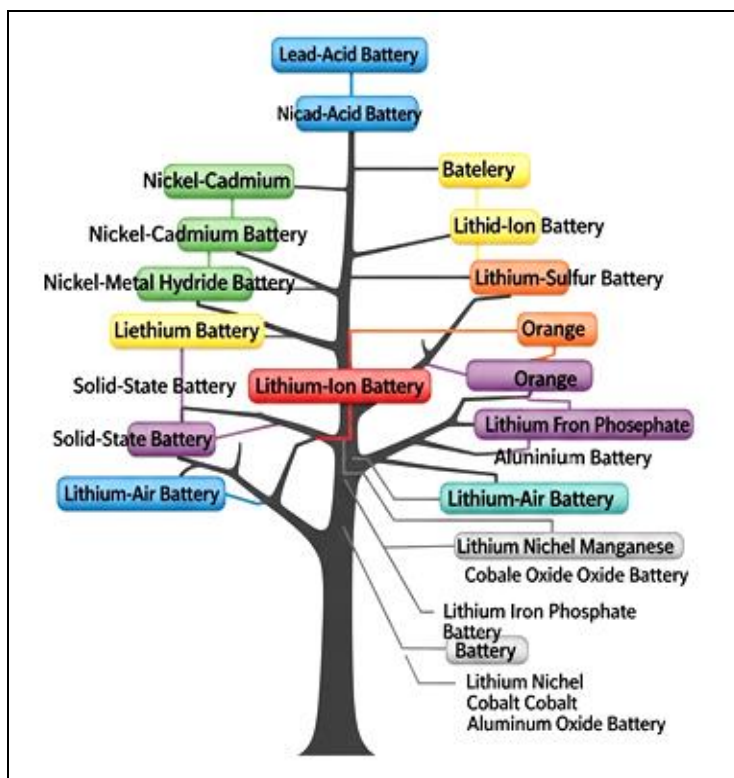


Fig 5 Types of Batteries

The final methodological step involves a critical evaluation of the overall approach to ensure rigor, transparency, and validity of findings. This includes triangulation of results from multiple data sources—literature, empirical data, and expert input—to confirm consistency and identify any discrepancies. The robustness of comparative analyses and forecasting models is tested through sensitivity analyses and scenario stress-testing, evaluating how results vary under different assumptions and parameter ranges. Limitations of the methodology, such as potential biases in source data or uncertainties in long-term projections, are explicitly acknowledged and discussed. Ethical considerations, including the responsible use of proprietary information and the treatment of sensitive issues such as labor practices in battery supply chains, are systematically addressed. The approach also incorporates mechanisms for peer review and external validation, inviting feedback from academic and industry stakeholders. Through this comprehensive evaluation, the methodology ensures that the study’s conclusions are well-founded, replicable,

and relevant to a diverse audience of researchers, practitioners, and policymakers. Ultimately, this reflective process enhances the credibility and utility of the research, supporting informed decision-making in the fast-evolving field of EV battery technology.

III. CONCLUSION

The evolution of battery technologies has been fundamental to the progress and proliferation of electric vehicles, serving as both the primary enabler and the central challenge in the journey toward sustainable transportation. This study has provided a comprehensive evaluation of battery chemistries, tracing their historical development from early lead-acid and nickel-based systems to the current dominance of advanced lithium-ion technologies and the promising horizon of solid-state and next-generation batteries. Through rigorous classification, performance benchmarking, and comparative analysis, it is clear that each generation of battery technology has contributed unique

advances while also presenting distinct limitations in terms of energy density, safety, cost, lifecycle, and environmental impact. The integration of batteries within the electric vehicle powertrain has also evolved, with innovations in management systems and thermal controls enhancing reliability and consumer acceptance. Looking forward, the field continues to be shaped by rapid advancements in materials science, engineering, and manufacturing, as well as by economic and policy dynamics that influence the pace of adoption and the direction of research investment. While lithium-ion batteries are likely to remain the standard in the near term, emerging chemistries such as solid-state, lithium-sulfur, and lithium-air batteries hold significant potential for breakthroughs in energy storage, vehicle range, and safety. However, the realization of these technologies on a commercial scale will depend on overcoming critical challenges related to raw material sourcing, production scalability, cost reduction, and sustainable end-of-life management. To ensure a truly sustainable transition to electrified mobility, it is imperative that future research and industry practices prioritize not only performance and cost, but also environmental stewardship and ethical supply chains. Ultimately, the continued collaboration among scientists, engineers, policymakers, and industry stakeholders will be essential in navigating these complexities and driving the successful evolution of battery technologies, thereby securing the future of electric vehicles as a cornerstone of global efforts to reduce emissions, improve air quality, and build a more sustainable transportation system.

IV. FUTURE SCOPE

The future scope of battery technologies in electric vehicles is defined by a dynamic interplay of scientific innovation, industrial scaling, and regulatory evolution, all converging toward the goal of enabling mass adoption and sustainable mobility. As global demand for electric vehicles accelerates, there is a growing imperative to surmount the existing limitations of current lithium-ion batteries, particularly in terms of energy density, charging speed, safety, lifecycle, and resource sustainability. Emerging technologies such as solid-state batteries, lithium-sulfur, and lithium-air chemistries offer the promise of transformative gains, with the potential to significantly extend vehicle range, reduce costs, and enhance safety profiles by eliminating flammable liquid electrolytes and harnessing novel electrode materials. Advances in nanotechnology, artificial intelligence-driven battery management systems, and modular pack design are expected to further optimize performance, durability, and recyclability. On the manufacturing front, scaling up production while minimizing environmental impact will require the adoption of greener processes, closed-loop recycling systems, and the use of ethically sourced raw materials, addressing both ecological and social concerns. Additionally, the development of ultra-fast charging infrastructure, wireless charging solutions, and vehicle-to-grid integration will redefine the relationship between electric vehicles and the broader energy ecosystem, enabling new business models and supporting the stability of renewable-powered grids.




Policy interventions, international standardization, and robust investment in research and talent development will remain crucial in fostering innovation and mitigating supply chain vulnerabilities. While significant technical and economic challenges persist, the convergence of interdisciplinary research, supportive policy frameworks, and an increasingly engaged marketplace positions the field for revolutionary breakthroughs in the coming decades. Ultimately, the future scope of battery technologies in electric vehicles extends well beyond the vehicles themselves, promising to reshape transportation, energy storage, and environmental stewardship on a global scale as we move toward a cleaner, smarter, and more sustainable future.





REFERENCES


- [1]. N. Nireekshana, A. Archana, and K. Pullareddy, "A Classical H6 Topology for Modern PV Inverter Design," in *Power Energy and Secure Smart Technologies*, CRC Press, 2025, pp. 1–7. Accessed: Nov. 12, 2025. [Online]. Available: <https://www.taylorfrancis.com/chapters/edit/10.1201/9781003661917-1/classical-h6-topology-modern-pv-inverter-design-namburi-nireekshana-archana-pullareddy-kanth-rajini>
- [2]. C. P. Prasad and N. Nireekshan, "A Higher Voltage Multilevel Inverter with Reduced Switches for Industrial Drive," *Int. J. Sci. Eng. Technol. Res. IJSETR*, vol. 5, no. 1, 2016, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_24_22pm%2092.pdf
- [3]. N. Namburi Nireekshana and K. R. Kumar, "A Modern Distribution Power Flow Controller With A PID-Fuzzy Approach: Improves The Power Quality", Accessed: Nov. 12, 2025. [Online]. Available: https://www.academia.edu/download/112956747/ijeer_120124.pdf
- [4]. N. Nireekshana, N. Ravi, and K. R. Kumar, "A Modern Distribution Power Flow Controller With A PID-Fuzzy Approach: Improves The Power Quality," *Int. J. Electr. Electron. Res.*, vol. 12, no. 1, pp. 167–171, 2024.
- [5]. N. Nireekshana, R. Ramachandran, and G. V. Narayana, "A New Soft Computing Fuzzy Logic Frequency Regulation Scheme for Two Area Hybrid Power Systems," *Int. J. Electr. Electron. Res.*, vol. 11, no. 3, pp. 705–710, 2023.
- [6]. N. Nireekshana, R. Ramachandran, and G. Narayana, "A Novel Swarm Approach for Regulating Load Frequency in Two-Area Energy Systems," *Int J Electr Electron Res*, vol. 11, pp. 371–377, 2023.
- [7]. N. Nireekshana, R. Ramachandran, and G. V. Narayana, "A Peer Survey on Load Frequency Control in Isolated Power System with Novel Topologies," *Int J Eng Adv Technol IJEAT*, vol. 11, no. 1, pp. 82–88, 2021.
- [8]. N. Nireekshana, "A POD Modulation Technique Based Transformer less HERIC Topology for PV Grid Tied-Inverter," in *E3S Web of Conferences*, EDP Sciences,

- 2025, p. 01001. Accessed: Nov. 12, 2025. [Online]. Available: https://www.e3s-conferences.org/articles/e3sconf/abs/2025/16/e3sconf_icregcsd2025_01001/e3sconf_icregcsd2025_01001.htm
- [9]. N. Nireekshana, K. P. Reddy, A. Archana, and P. R. Kanth, “Solar-Assisted Smart Driving System for Sustainable Transportation,” *Int. J. Innov. Sci. Res. Technol.*, vol. 10, no. 8, pp. 168–173, 2025.
- [10]. N. Nireekshana, M. A. Goud, R. B. Shankar, and G. N. S. Chandra, “Solar Powered Multipurpose Agriculture Robot,” *Int. J. Innov. Sci. Res. Technol.*, vol. 8, no. 5, p. 299, 2023.
- [11]. N. NIREEKSHANA, A. SHIVA, A. FURKHAN, M. SRIDHAR, A. OMPRAKASH, and K. K. SHIVA, “SIX PULSE TYPE SEGMENTED THYRISTOR CONTROLLED REACTOR WITH FIXED CAPACITOR FOR REACTIVE POWER COMPENSATION,” *Int. J.*, pp. 3153–3159, 2024.
- [12]. N. Nireekshana, “Reactive Power Compensation in High Power Applications by Bidirectional Cascaded H-Bridge Based Statcom”, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_45_47pm%20152.pdf
- [13]. N. Nireekshana, G. M. Krishna, A. George Muller, K. Sai Manideep, and M. Abdul Mukheem, “Power Quality Improving using FCL and DVR,” *Int. J. Innov. Sci. Res. Technol. IJISRT*, pp. 624–632, May 2024, doi: 10.38124/ijisrt/IJISRT24MAY025.
- [14]. N. Nireekshana, R. Ramachandran, and G. V. Narayana, “Novel Intelligence ANFIS Technique for Two-Area Hybrid Power System’s Load Frequency Regulation,” in *E3S Web of Conferences, EDP Sciences*, 2024, p. 02005. Accessed: Nov. 12, 2025. [Online]. Available: https://www.e3s-conferences.org/articles/e3sconf/abs/2024/02/e3sconf_icregcsd2023_02005/e3sconf_icregcsd2023_02005.htm
- [15]. B. Jula and N. Nireekshan, “Improving the Voltage Profile at Load End using DVR,” *Grenze Int. J. Eng. Technol. GIJET*, vol. 4, no. 3, 2018, Accessed: Nov. 12, 2025. [Online]. Available: <https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=23955287&AN=134178998&h=YQk2OkwoPFcVuqJX%2B1rKA0Mbu%2B3%2FNRIInXZhf6Wu1MJR4MoiWNdCgc7k4H5aV7e79V%2BdpemgvHWYJbJToV64CuQ%3D%3D&crl=c>
- [16]. N. Nireekshana, R. R. Chandran, and G. V. Narayana, “Frequency Regulation in Two Area System with PSO Driven PID Technique,” *J Power Electron Power Syst*, vol. 12, no. 2, pp. 8–20, 2022.
- [17]. R. Jatoth and N. Nireekshana, “Improvement of Power Quality in Grid Connected Non Conventional Energy Sources at Distribution Loads,” *Grenze Int J Eng Technol GIJET*, vol. 4, no. 3, 2018, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_58_06pm%20201.pdf
- [18]. Namburi Nireekshana, M. Anil Goud, R. Bhavani Shankar, and G. Nitin Sai Chandra, “Solar Powered Multipurpose Agriculture Robot,” May 2023, doi: 10.5281/ZENODO.7940166.
- [19]. Namburi Nireekshana, Onteru Divya, Mohammed Abdul Saquib Adil, Rathod Rahul, and Mohammed Shoaib Mohiuddin, “An Innovative SSSC Device for Power Quality Enhancement,” Feb. 2024, doi: 10.5281/ZENODO.10670526.
- [20]. Namburi Nireekshana, A. Archana, Setla Manvitha, Mohammed Saad Ahmed, Nisar Ahmed Khan, and Akellu George Muller, “Unique Facts Device for Power Quality Mitigation,” Feb. 2024, doi: 10.5281/ZENODO.10652911.

AUTHOR’S PROFILE

	<p>G. Sai Kumar is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Narayana Junior College and his Secondary School Certificate (SSC) at Master Talent School.</p>
	<p>N. Akhil is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Sri Chaitanya Junior College and his Secondary School Certificate (SSC) at Brilliant Grammar High School.</p>
	<p>B. Pawan is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Tejas Junior College and his Secondary School Certificate (SSC) at Aditya School.</p>

	<p>D. Karthikeya is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Sri Chaitanya Junior Kalasala College and his Secondary School Certificate (SSC) at Adarsh Convent High School.</p>
	<p>R. Vardhan is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Vizag Difference Academy and his Secondary School Certificate (SSC) at Telangana State Model School.</p>
	<p>M. Narendar is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Kavitha Junior College and his Secondary School Certificate (SSC) at MDR High School.</p>
	<p>P. Ramesh is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Alphores Junior College and his Secondary School Certificate (SSC) at Zilla Parishad High School.</p>

	<p>T. Akhilesh is currently pursuing a Bachelor of Engineering (B.E.) degree in Electronics and Communication Engineering at Methodist College of Engineering and Technology, Hyderabad, India, and is presently in his third year of study. He completed his Intermediate education at Narayana College and his Secondary School Certificate (SSC) at Sri Sai Grammer School.</p>
--	--