



40th

Indian Engineering Congress

December 19-21, 2025
Durgapur

Theme:

**Innovative Engineering Solutions
for Viksit Bharat @ 2047**



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40th Indian Engineering Congress

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**Innovative Engineering Solutions
for Viksit Bharat @ 2047**



The Institution of Engineers (India)

8 Gokhale Road, Kolkata 700020

Conference Proceedings
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Innovative Engineering Solutions for Viksit Bharat @ 2047

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A Comprehensive Review on Sustainable End of Life Management for Electric Vehicle Batteries

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ABSTRACT

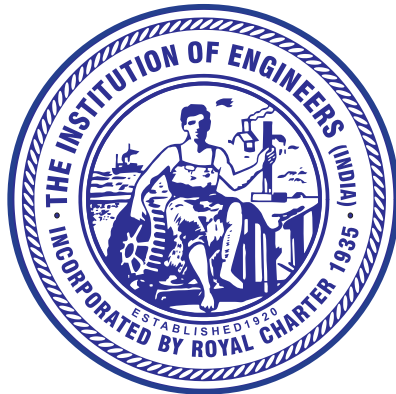
Electric Vehicle (EV) adoption is increasing rapidly, impelled by the growing concern over climate change and the finite nature of fossil fuels. However, the growing number of EVs on the road is expected to lead to a significant increase in battery waste in the coming years. Sustainable end of life management for EV batteries is essential to minimize environmental impacts, conserve valuable resources and promote a circular economy. The challenges associated with EV battery waste management are complex and multifaceted. They involve developing efficient recycling technologies, repurposing batteries for energy storage and ensuring safe disposal. Moreover, the lack of standardization in battery design and chemistry poses significant hurdles for recycling and reuse. To address these challenges, a comprehensive approach is needed, considering the entire battery lifecycle. Extended producer responsibility, design for recyclability and closed loop recycling are critical components of a sustainable end of life management strategy. The benefits of sustainable EV battery waste management are numerous. They include reducing the environmental footprint of EVs, conserving valuable materials such as lithium and cobalt, and promoting a more circular economy. However, achieving these benefits will require significant investment in research and development, infrastructure and education. Ultimately, the development of sustainable end of life management practices for EV batteries is critical for ensuring that the growth of the EV industry does not come at the expense of the environment. By prioritizing sustainability and circularity, waste can be minimized, reducing environmental impacts and promoting a more sustainable transportation sector. This comprehensive review in the present research examines the multifaceted landscape of sustainable end of life management for electric vehicle batteries, synthesizing current practices, emerging technologies, regulatory frameworks and policy interventions. The analysis reveals that while significant progress has been made in battery recycling technologies and circular economy principles, substantial challenges remain in standardization, infrastructure development and effective implementation across different regions. A holistic approach combining extended producer responsibility, design for recyclability, investment in advanced recycling technologies and international policy harmonization is essential to realize the substantial environmental, economic and social benefits of sustainable battery management. This review provides a critical assessment of the current state of knowledge and identifies key recommendations for stakeholders including policymakers, manufacturers, recyclers and researchers to advance the transition toward truly circular and sustainable EV battery systems.

KEYWORDS

Electric Vehicles, Battery Waste, Sustainable Management, Recycling, Circular Economy

INTRODUCTION

Electric vehicle adoption is accelerating globally, with battery retirement volumes projected to reach 1,483 GWh annually by 2030. However, the increasing battery waste poses critical environmental and resource challenges. Sustainable end-of-life management is essential to conserve valuable materials, minimize environmental impacts, and establish circular economy models.



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