

IMPLEMENTING SUSTAINABLE BATTERY CIRCULARITY FOR BENGALURU'S ELECTRIC VEHICLE FLEETS: AN ESG APPROACH

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Introduction:

The use of electric vehicles (EVs) is growing very fast across the world, especially in cities like Bengaluru. This growth is mainly because people want to reduce pollution and depend less on fossil fuels. EVs are seen as a better and cleaner option for transportation. However, along with this growth, the issue of managing EV batteries is also becoming important. If batteries are not handled properly, they can harm the environment. To solve this problem, the concept of battery circularity is gaining attention. It focuses on reusing, recycling, and redesigning batteries to increase their life and reduce waste. This not only helps the environment but also saves costs and resources. Many studies support this idea. Sahivirta et al. (2025) explain that circular battery design can improve battery life but still lacks proper recycling systems. Tian (2025) and Chen et al. (2025) show that ESG practices can improve sustainability, but there is less research in EVs. Leong (2024) says that circular economy practices improve efficiency but do not cover the full battery lifecycle. Berg et al. (2019) highlight differences in ESG ratings, and Geiss Doerfer et al. (2017) describe the circular economy as an important model for sustainability. In Bengaluru, EV usage is increasing quickly, especially in public and commercial transport. Some companies are trying recycling and reuse methods, and second-life battery use is also growing. But there are still challenges like lack of awareness, limited infrastructure, and weak systems. This study collects primary data using a Google Form questionnaire from EV stakeholders like fleet operators, battery suppliers, and recyclers. The main aim is to understand current practices, analyse ESG impact, and find gaps in the system. It also provides practical suggestions to improve battery management.

Objectives:

The main aim of this project is to understand how EV batteries are used and managed in Bengaluru, especially in commercial and public transport sectors. It focuses on studying the

complete lifecycle of EV batteries and identifying gaps and opportunities for improving battery circularity. The study also evaluates recycling, reuse, and second-life solutions for lithium-ion batteries in the local context. It further analyses the environmental, social, and governance (ESG) impacts of adopting these practices. The project also aims to suggest practical strategies, suitable business models, and policy recommendations to improve battery circularity and support a more sustainable and efficient EV ecosystem in Bengaluru.

Methodology:

This study follows a clear and structured approach to understand battery circularity in the EV ecosystem of Bengaluru. It begins by studying the full lifecycle of EV batteries. This includes procurement, usage, maintenance, replacement, and end-of-life stages. Each stage is analysed carefully. This helps to understand current practices. It also helps to identify gaps in battery management. The study uses both primary and secondary data. Secondary data is collected from government reports, research papers, and industry publications. This helps to understand current technologies and market trends. Special focus is given to battery recycling, reuse, and second-life applications. The study also develops an ESG-based framework. It includes environmental, social, and governance factors. These indicators help to measure sustainability performance. They also help to evaluate existing practices. Primary data is collected using a structured questionnaire. The questionnaire is prepared using Google Forms. Data is collected from EV stakeholders. These include fleet operators, battery manufacturers, suppliers, recyclers, and industry experts. Their responses provide real insights into current practices and challenges. The collected data is analysed using simple statistical tools. Methods like percentage analysis and comparison are used. This helps to identify patterns and trends. Comparative analysis and benchmarking are also applied. This helps to check the readiness of Bengaluru for battery circularity. Finally, the study identifies key gaps and issues. Based on the results, practical suggestions are given.

Result and Conclusion:

The project is still in progress and data collection is going on. The study mainly focuses on how EV companies in Bengaluru manage battery reuse, recycling, and circular practices. It also looks at how ESG factors influence sustainability in the EV ecosystem. Based on the initial understanding some gaps have been identified which are low awareness, limited recycling, infrastructure and weak implementation systems. At the same time the study also finds opportunities for improvement which include better reuse of batteries, second-life applications, and advanced recycling methods. The results are expected to show how companies can reduce costs and improve environmental performance. The study highlights the importance of ESG in business decisions and helps companies plan for long-term sustainability. The findings are likely to give useful insights to stakeholders. These include EV companies, recyclers, and policymakers. Based on the results, the study will suggest practical recommendations. These include strategies, business models, and policy improvements. In the long run, the study is expected to support a more sustainable EV ecosystem. It can help in better resource use and reduced environmental impact.

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Future Scope:

The future scope of this study is wide and can be expanded in many ways. This research can be extended to other cities in India. This will help to compare battery recycling and reuse practices across regions. Future studies can look deeper into the full lifecycle of EV batteries. This includes usage, maintenance, and final disposal. More stakeholders can be included in future research. These include government officials, manufacturers, policymakers, and experts. This will provide more accurate and diverse insights. Advanced technologies can also be used. Tools like artificial intelligence and smart systems can improve battery tracking and recycling. Future research can also focus on cost and benefit analysis. This will help to understand financial feasibility. The study can support the development of better ESG guidelines for the EV sector. It can help companies follow more sustainable practices. The findings also help the government in making better policies and rules. Future studies can explore public awareness and consumer behaviour. This will help to understand people's role in sustainability. Collecting more data over time can improve accuracy. It can also make results more reliable. This study can create opportunities for new business ideas. Startups can focus on battery reuse, recycling, and second-life applications.