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A METHODOLOGY TO INVESTIGATE COST COMPARISON BETWEEN THE EXCLUSIVITY OF END-OF-LIFE (EOL) BATTERIES FOR ELECTRIC VEHICLES (EVs) IN MALAYSIA

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ABSTRACT

The usage of electric vehicles (EVs) is currently experiencing an upward trend in most countries around the world. A similar demand for EVs was also detected in Malaysia, as shown by the surge in the number of EV sales over the past few years. However, the growing number of EVs raises a new environmental concern since it can lead to a potential risk of pollution in the country. This problem is caused by a lack of proper management for the main component in the EV, such as the battery, which has not been properly addressed yet, especially when it reaches the end-of-life phase. This study is prepared with the objective to present a methodology proposed for the study to investigate the cost comparison between the exclusivity of end-of-life (EOL) batteries and management strategies for electric vehicles (EVs) in Malaysia. The methodology of the study is designed with a qualitative research method that encompasses a semi-structured interview approach to interview respondents with established experience, knowledge or skills in electric vehicles (EVs). The study will identify suitable strategies that can be recommended to overcome the issues of end-of-life (EOL) batteries of electric vehicles (EVs), which could be served as bases for decision-makers to ensure the strategies chosen are relatively low-cost and, at the same time, promote broader usage and ownership cost optimisation of electric vehicles in the future.

Keywords: *Methodology, Electric vehicles, Batteries, Cost*

INTRODUCTION

Electric vehicles (EVs) are alternative vehicles aimed at replacing traditional internal combustion engine vehicles in the future, as they promote a sustainable environment and the use of clean energy. According to Ritchie (2024), there are more than 40 million electric cars in use globally, and the number continues to grow rapidly each year. In response to the latest market trends and technological developments, Malaysia is also seizing the opportunity by adopting electric vehicles. To support this shift, Malaysia has introduced several initiatives to promote EV implementation, including the

installation of numerous charging stations, tax incentives, full exemptions of import and excise duties for imported Completely Built-Up (CBU) vehicles, and a six-year full exemption of excise and sales taxes for locally manufactured Battery Electric Vehicles (BEVs).However, there is growing concern over the environmental risks associated with battery pollution due to the increasing number of EVs. According to Ashaari (2025), Malaysia may face a major crisis in managing battery waste from EVs by 2040 if appropriate strategies are not implemented. Therefore, this paper and accompanying video aim to present a structured methodology to evaluate the life cycle cost (LCC) comparison among selected end-of-life (EOL) BEV strategies in Malaysia. The objectives of this study are to review the latest approaches to EOL battery management strategies for BEVs and to identify strategies that can be recommended to optimise the life cycle cost of EOL battery management. The significance of this study to improve sustainable financial planning for EV ownership, as some EV components involve higher costs. It also aims to acknowledge people about the importance of choosing suitable strategies for managing the end-of-life phase of EV's batteries and raise awareness of the potential for pollution risk caused by unmanageable battery waste.

METHODS

To accomplish the study purposes, the suitable methodology chosen is qualitative research strategy because it would help to uncover insights into the preferred strategies to manage the EOL of batteries in EVs according to the Malaysian environment. Other than that, it also can uncover detailed personal insight and any barriers when applying those strategies in the real world, helping to provide more flexibility and deeper understanding needed to solve the problem since some of the approaches might be new. This method also can be more flexible in terms of questions and also respondents, as they can freely open up their opinion and follow the research requirements compared to quantitative methods that are more fixed and structured. The literature review is used to gather secondary data from existing or past academic sources, reports, and journal articles related to end-of-life (EOL) battery management strategies for electric vehicles (EVs). By doing this, it helps to identify existing practices, challenges, and frameworks from both international and Malaysian perspectives. For primary data collection, the appropriate approach is by using semi-structured interviews. Semi-structured interviews are widely used in qualitative research, as they allow for flexibility for participants' responses while maintaining a structured format aligned with the research objectives (Kallio et al., 2016). This approach was used to find more information about battery management practices, challenges in end-of-life (EOL) handling, and expert opinions on strategies for improvement in Malaysia. Next, the literature review is used to gather secondary data from existing or past academic sources, reports, and journal articles related to end-of-life (EOL) battery management strategies for electric vehicles (EVs). By doing this, it helps to identify existing practices, challenges, and frameworks from both international and Malaysian perspectives. The expected findings from this research are to know the most EOL battery management strategies implemented by other countries and to analyse the total life cycle cost for different EOL battery management approaches for the selected EVs.

CONCLUSION

In this study, an appropriate methodology is designed and proposed to evaluate the total life cycle cost comparison between the end-of-life (EOL) BEV strategies among the selected BEVs. Based on the literature review, it has been found that there are limited studies reported on the methodology to evaluate the total life cycle cost comparison between the end-of-life (EOL) BEV strategies among the selected BEVs. Therefore, the qualitative research strategy is adopted to gather more information for suitable strategies, subjective data for LCC and limitations to implement the strategies in Malaysia to overcome the issues based on the expert insight. Semi-structured interviews are used as an instrument to retrieve information about battery management practices, challenges in end-of-life (EOL) handling, and expert opinions on strategies for improvement in Malaysia. Hence, the expected findings, including identifying widely adopted global EOL battery management strategies and comparing the total life cycle costs of different EOL approaches for the selected EVs in Malaysia, can be achieved through the application of this method.

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