IMPLICATIONS OF THE INCREASING SIZE OF BATTERY ELECTRIC VEHICLES

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Introduction

The electrification of road transport is widely promoted as a cornerstone for achieving climate targets, particularly in Europe. The number of battery electric vehicle (BEV) models available on the market has steadily increased, covering all size segments from small city cars to large sport utility vehicles (SUVs). However, alongside the growing market penetration of BEVs, a significant structural shift toward larger and heavier vehicle types, mostly SUVs, can be observed. According to the International Energy Agency, SUVs accounted for more than 50% of global BEV sales in 2023, with similar patterns emerging across major European markets [1]. This trend raises important questions regarding the long-term sustainability, affordability, and resource implications of passenger car electrification. Larger BEVs typically require more energy, more battery capacity, and higher quantities of critical raw materials such as lithium, nickel, and cobalt. These factors may undermine some of the anticipated environmental and economic benefits of vehicle electrification. The main objective of this paper is to analyze and discuss the implications of the increasing size of BEVs, focusing on their impacts on energy consumption, total cost of ownership (TCO), and the demand for critical raw materials.

Method of approach

The study combines market data analysis with energy consumption modelling and a simplified total cost of ownership framework that incorporates purchase prices, battery costs, electricity use, and maintenance expenditures, complemented by a material-flow assessment. In addition, a scenario analysis is conducted to compare size-dependent BEV uptake pathways toward 2050.

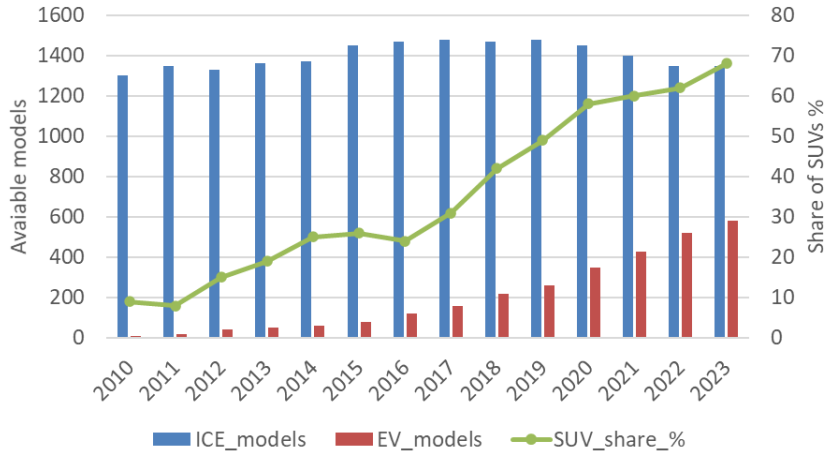

Figure 1: Car model availability

Results

The growing size of BEVs directly affects their energy consumption and battery capacity. Larger vehicles have higher electricity use, typically 15–30% higher compared with compact BEVs of the A/B segments. To achieve market-acceptable driving ranges, manufacturers compensate with larger batteries. While small BEVs commonly use 40–55 kWh battery packs, electric SUVs frequently require 70–100 kWh.

This battery size inflation drives both production costs and life-cycle environmental impacts. Several studies estimate that each additional 10 kWh of battery capacity increases production emissions by 0.5–1 t CO_2-eq [2]. These trends also have significant implications for critical raw materials. A 90 kWh SUV battery needs nearly double amount of lithium, nickel and cobalt as a 50 kWh battery. This leads to additional supply-chain risks, as lithium, nickel and cobalt extraction is geographically concentrated and associated with environmental and social challenges. Moreover, the higher purchase prices of electric SUVs, combined with high energy consumption, reduce their economic competitiveness, particularly in countries where purchase subsidies are declining or being phased out.

Conclusions

Overall, the increasing size of BEVs introduces several challenges, including growing electricity demand, higher consumption of critical raw materials, rising production-related emissions, and reduced affordability. While BEVs remain essential for achieving climate-mitigation targets, the current market trajectory, dominated by larger and heavier SUV models, risks making the transition more resource-intensive, less energy-efficient, and economically more demanding. To address these issues, policy frameworks should actively incentivize the adoption of smaller and more efficient BEV segments through targeted fiscal measure and efficiency-based vehicle standards.

References

[1] IEA (2024). Global EV Outlook 2024. https://www.iea.org/reports/global-ev-outlook-2024
[2] ICCT (2018). Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions, https://theicct.org/wp-content/uploads/2021/06/EV-life-cycle-GHG_ICCT-Briefing_09022018_vF.pdf