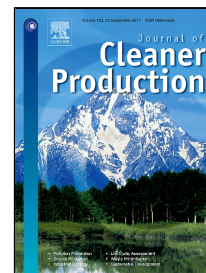


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Vehicle's Lightweight Design vs. Electrification from Life Cycle Assessment Perspective

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Abstract

Lightweight materials and vehicles' electrification are among the most viable and economic solutions to improve fuel economy of vehicles and reduce environmental impacts in the operational phase of typical vehicle's life cycle span. This study aims to shed more light on the combined effect of lightweighting and electrification by assessing different lightweight designs and electric powertrains from the environmental perspective using a life cycle analysis coupled with an emphasis on energy expenditures and carbon dioxide emissions. This paper discusses the life cycle assessment for several advanced powertrains namely; plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV) and hybrid electric vehicles (HEV) relative to the conventional gasoline operated internal combustion engine based power train vehicles. The main focus will be on the energy greenhouse gas emissions (GHG) in the material extraction and resources phase, manufacturing phase and use phase (operation and maintenance). While most of the current studies focus on the use phase that does not reflect the correct environmental impacts associated with advanced powertrains, thus the presented text applies a holistic LCA approach that covers pre-manufacturing, manufacturing, operational and end-of-life phases, plus another indirect phase to account for fuel extraction, refining and transportation to the end-users or customers. Based on the LCA emissions results, one may infer that environmental policies that reduce emissions rates from the electricity sector can mitigate this effect without completely eliminating it. Interestingly, the analysis shows that lightweight vehicles with internal combustion engines have less impacts on the environment as a direct result of upstream emissions associated with electricity generation in United States. This scenario can differ in other countries with higher renewable and sustainable energy generated electric powers.

Keyword: Auto-bodies; Automotive, Electric Vehicles, Life cycle analysis, Lightweight, Sustainability

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