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# Vehicle electrification in a developing country: Status and issue, from a well-to-wheel perspective



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### ABSTRACT

The increase of public attention, scientific research and political interest in environmental problems associated with transportation has provided the motivation for re-invention of electric vehicles. However the usage of grid-dependent EVs with a high-carbon electricity grid might produce more damage to the environment. This study aims to provide an environmental impact comparison of ICEVs, HEVs and EVs during their usage cycle, by modeling their energy consumption (electricity or fuel) and the supply chains of the supplied energy, (well-to-wheel) based on a life cycle assessment. The results show that running EVs with the existing mixed sources of electrical energy produce larger impacts on the environment 60% of the time; when compared to HEVs. When compared to ICEVs, EVs produce a larger environmental impact on 7 out of 15 environmental impact categories. Overall the environmental impacts of EVs are substantial based on the well-to-wheel analysis. It will continue to be so if no change is made to the methods of electricity generation in the near future. Given that the environmental profile of EVs is linked with the existing national electricity generation mix, the national electricity supply must be made cleaner before the electrification of the urban transport system.

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## 1. Introduction

Civilization through industrialization, agriculture, energy generation and transportation has released enormous amounts of anthropogenic greenhouse gases (GHG) into the atmosphere which are contributing to global warming and climate change concerns (Beniston, 2002). Demand for transport has led to the blossoming of energy harvesting activities around the world, as the transportation sector used almost one quarter of the world's energy (Ma et al., 2012). Based on the National Energy Balance report, in 2010 a total of 41,477 kilotons of oil-equivalent energy was used in Malaysia. The transport sector used up 40.6% of the entire amount and followed by the industrial sector at 31.1% (Energy Commission, 2010). It could be a formidable task ahead for Malaysia to reduce energy usage in the transportation sector, as almost 98% of the energy came from fuel consumption (Mustapa et al., 2011). An endless increase in fossil fuel consumption makes the transportation sector the second highest contributor in carbon dioxide emissions and emitted 26% of the global carbon emission after the energy sector (Chapman, 2007; International Transport Forum, 2010). Unless mitigating measures are implemented soon, carbon emissions from the transport sector will continue to rise (International Transport Forum, 2010). Fuel usage alone contributed 76% of the total carbon emissions from an average vehicle life cycle, 15% are from losses in the fuel supply system and a further 9% was from the manufacturing of the vehicle (Potter, 2003).

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