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THE IMPACT OF HYBRID ELECTRIC VEHICLES IN URBAN CENTRES

ABSTRACT

Electric Vehicles (EV) without external energy source have been commercially available since the late 1880s. The weight of batteries, their short-range and reduced load capacity, were and still are, the principal reasons for their non-acceptance by the market. The market sees them on lower performance compared to Internal-Combustion Engine Vehicles (ICEV).

A new concept of vehicles, however, has been researched and slowly introduced into the world market specially designed for private and public transport to achieve more recently introduced vehicle emission standards. These vehicles, called Hybrid Electric Vehicles (HEV), have the advantage of being less environmentally damaging compared to ICEV. HEV, on the other hand, do not have the costs and inconveniences of EV, which require a large battery pack or overhead wires, for example as for a tram or trolleybus. Combining a low powered diesel engine and a battery pack, for example, can replace a high-powered diesel engine keeping the same vehicle performance with less pollution and fuel consumption.

An objective of this thesis has been to develop a computer simulation model to compare HEV to conventional ICEV and EV. An analysis of the impact of HEV in urban centres has been simulated in order to calculate emissions and fuel consumption in a real operating environment. Different characteristics of HEV in several scenarios and transport strategies have been simulated over route options in Bristol, UK, and in São Paulo, Brazil where a case study was carried out.

The case study was carried out in São Paulo city, Brazil to predict Hybrid Electric Bus (HEB) performance, emissions reduction and fuel consumption savings compared to conventional diesel buses in tow real drive cycles. The simulations predicted an average of fuel savings around 25% and 12% for standard and articulated buses, respectively. The results for emissions have predicted reductions around 85% of CO, 35% of HC, 30% of NO_x and 80% of PM.

The case study results have been compared with real measures ordered by Eletra Industria Ltda, Brazilian HEB manufacturer, to validate the model. The case study results have presented accuracy of about 80% compared to measures of fuel consumption carried out by the Federal University of Rio de Janeiro (UFRJ).

The model results have given evidence to São Paulo Transportes (SPTtrans) authorities and public transport operators of the advantages of operating HEB. After analysing results from the HEV Model, SPTtrans ordered 15 HEB to run on the new elevated and segregated route in that city. Results from them HEV Model can produce evidence on which rational choices can be taken regarding public transport systems.

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