CERIS : Civil Engineering Research and Innovation for Sustainability

Toward sustainable urban transportation: developing optimization models in urban transportation fleet

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Summary

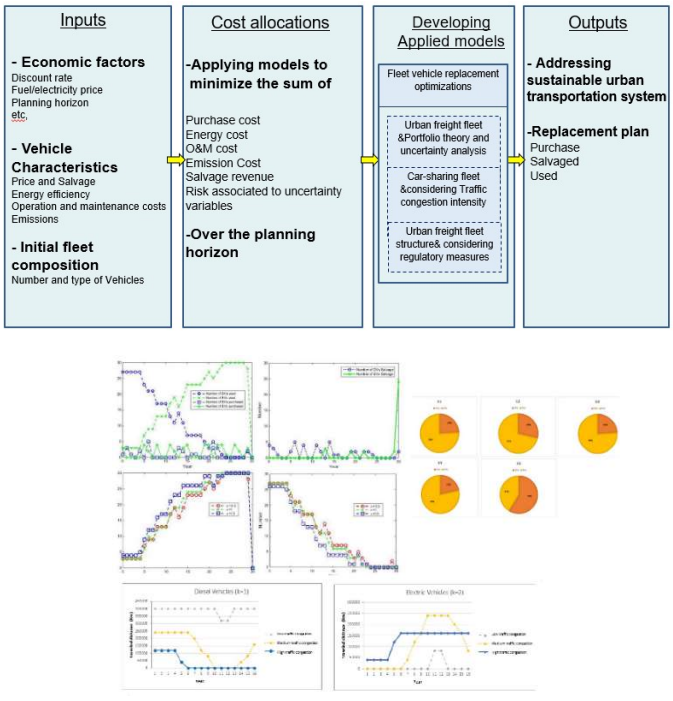
Recently, the use of more sustainable forms of transportation such as electric vehicles (EVs) for delivering goods and parcels to customers in urban areas have received more attention from urban planners and private stakeholders. The urban freight transportation sector is examining such a shift toward using electric vehicles, besides current combustion engine vehicles, to deliver goods and services to customers.

This study is to contribute toward sustainable transportation in urban logistics by considering the important factor of decision replacement management and studying how to shift toward sustainable modes of transportation, specifically EVs, in an urban area. In this regard, this research study has developed different optimization models to find the best combination of vehicles in a fleet and optimize the fleet structure to achieve a sustainable transportation system. In this thesis, the fleet replacement problem is studied across three fundamental lines of research, each corresponding to a paper: (i) – Fleet replacement towards sustainable urban freight transportation; (ii) – Car-sharing fleet considering traffic congestion intensity; and, (iii) – Vehicle replacement in sustainable urban freight transportation subject to the presence of regulatory measures. These three lines of research, which correspond to Paper 1, Paper 2, and Paper 3, stem from the five presented research questions.

To answer the presented research questions, we proposed various optimization frameworks for a vehicle replacement decision plan that can be used by the operators (private and public stakeholders) for a combination of various types of vehicles in their fleet in order to achieve an optimal fleet structure.´All results of the approaches highlighted the positive and significant effect of EVs' contribution to sustainable urban transportation, and it shows how we can effectively contribute green modes like EVs in the urban transportation system through optimization models and methods.

Keywords

Sustainable transportation system, fleet optimization, vehicle replacement and composition, electric vehicles competitiveness, uncertainty analysis.



Structure of process for developing different optimization models for vehicle replacement and composition problem.