

Electric Commercial Vehicles in the Urban Freight Transport

The cars that we drive in our daily life normally are internal combustion engine (ICE) vehicles. They are a main type of transportation which is powered by burn-ing fossil fuels. However, with the growth of global population and demands of vehicles, air pollution and insufficient energy resources have become disadvantages for ICE vehicles. As a way to solve the problem, electric vehicles (EVs) are proposed and attracting increasing global attentions. On the other hand, the urban freight transport (UFT) as a platform, which requires a large number of vehicles and a sustainable development, is able to provide a chance to use EVs to improve our living conditions. However, since the adoption of EVs is low and the system of UFT is complex, this study investigates factors and sustainable scenarios to improve the adoption in the complex system.

Motivation

Fossil fuels as a primary fuel for ICE vehicles are non-renewable. It results in global reduction of energy resources and high energy imported dependency with high demands of vehicles. Based on forecasting and statistical data, there will be 63% global oil demands from transportation section in 2040. Moreover, the dependency of the European Union (EU) on energy imports was 53.3% in 2012. On the other hand, ICE vehicles release harmful emissions such as greenhouse gases (GHG) and particulate matter (PM). They lead to increasing global warming and deteriorating air qualities. Thus, electric vehicles which are powered by batteries have become an environmentally friendly solution. They release low or zero emissions, drive quietly and do not depend on fossil fuels. In addition, because of different engine sizes, commercial vehicles release higher average CO₂ emission, consume more fossil fuels and have worse working conditions than passenger cars. Therefore, electric commercial vehicles are the focus of this research.

Urban freight transport is the segment of freight transport which takes place in an urban environment. It plays an essential role in satisfying the needs of citizens, such as transporting food, beverage, clothes parcels and mails. According to statistical data in EU-28, there was 74.5% inland transport running on the road in 2012 and 99% of this road freight transport were ICE vehicles. In addition, until June 2014, 53.6% of the world population was living in urban areas. It means that the demands of urban freight transport is increasing and leading to a large number of ICE commercial vehicles running on the road. Therefore, in order to keep the living quality and improve the living conditions, electric commercial vehicles are recommended to be used in the urban area.

State of the Art

The electric vehicle is an interdisciplinary research field. It integrates automobile engineering and electrical engineering. There are three categories of electric vehicles. They are Battery Electric Vehicles (BEVs), Hybrid Electric Vehicles (HEVs), and Fuel Cell Vehicles (FCVs). For the HEV, depending on the type of refueling, there is another category called Plug-in Hybrid Electric Vehicles (PHEV) whose batteries are able to be charged by electricity grid. Battery technology, electric motor, power electronic converter and energy management systems are currently main research tasks for improving the performance of EVs.

Normally, there are three main stakeholders of the urban freight transport who undertake the activities in the supply chain directly. They are shippers, freight carriers and receivers. On the other hand, depending on the nature of goods, there are five markets covering primary freight movements in cities. They are retail markets, express/post markets, HoReCa (hotel, restaurant and catering) markets, construction markets and waste markets. Vehicle routing problem, congestions, safety, emissions and noise are research problems in the field of urban freight transport.



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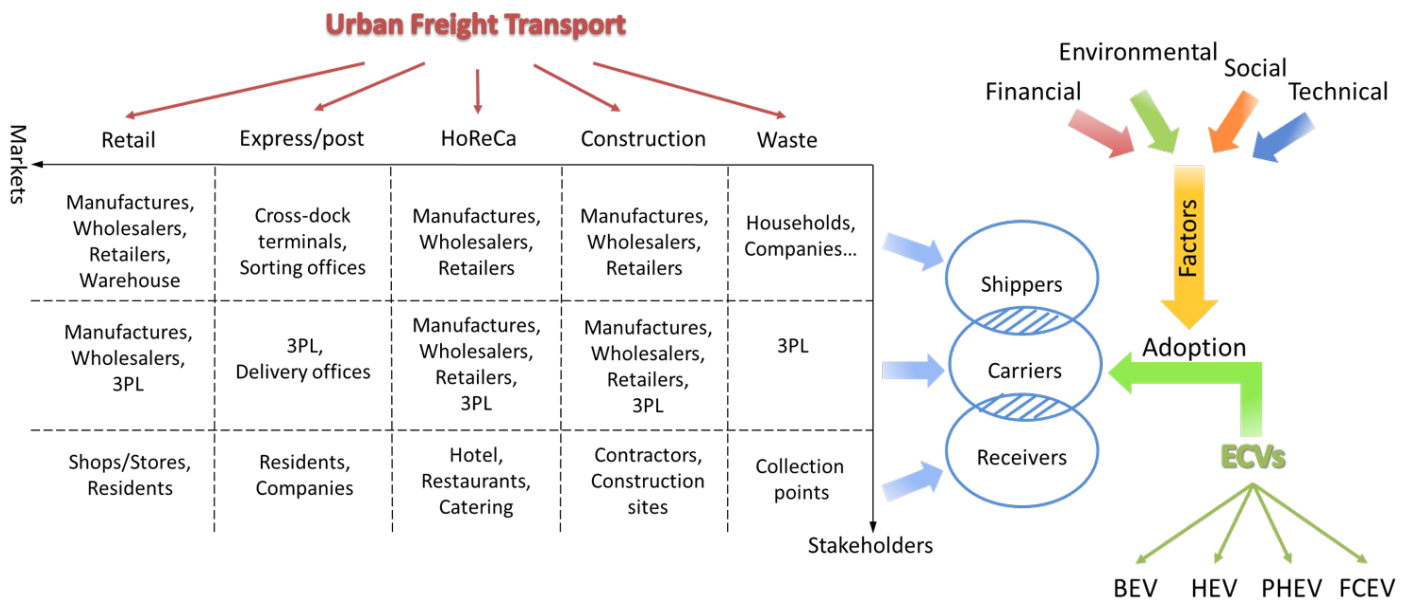
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Because a large number of researchers concentrate on electric passenger cars, the studies of the combination of electric commercial vehicles and the urban freight transport is still in an exploring and evaluating stage. Some papers investigated requirements and attitudes of customers, discussed and analyzed current key issues and factors, simulated optimal electric vehicle routings with considering charging stations and demonstrated trials to illustrate advantages of using ECVs in the UFT.

- What is affecting the employment of ECVs in the urban freight transport on a large scale?

There are two methods applied in this study: survey and simulation. In the method of surveys, the research designs a questionnaire with Analytic Hierarchy Process (AHP) to measure and collect data. The simulation is a method to develop a model to verify the results of the survey.

Research Questions and Methods

With the development of technology, EVs have matured gradually and been sold or leased by major automobile manufacturers in recent years. Toyota Prius PHV, Nissan Leaf, Tesla Model S and Chevrolet Volt are representatives of global popular retail EVs. Nevertheless, the percentage of adoption of EVs is still low. In 2013, alternative fuel vehicles, which include EVs, HEVs and natural gas vehicles, accounted for only 4% of total sales for passenger cars and only 1% for light commercial vehicles in EU-28. Thus, the study focuses on the following research questions:

- How to implement commercialization of ECVs in the UFT?
- Why is the adoption of ECVs low?

Research Objective and Expected Contribution

The study investigates the research problem from the perspective of companies who undertake goods delivery in the urban areas. The objective of the research is to provide a technical support to suggest these companies accepting and considering ECVs in their fleets through promoting and implementing the commercialization. The contribution of the research will illustrate advantages of employing ECVs to help companies evaluating the performance and make decisions. The figure below shows the framework of the research and describes relationships of the different research elements.