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The Constraints of Vehicle Range and Congestion for the Use of Electric Vehicles for Urban Freight in France

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Abstract

Electric vehicle is a solution to reduce pollutant emissions from road urban freight. This paper assesses the potential CO_2 reduction by transferring urban freight from diesel to electric vehicles while simultaneously looking at the two main technical constraints: electric vehicle range and the impact on congestion linked to change diesel heavy duty vehicles (with a load up to 25 tons) to much smaller electric vehicles. The data used has been computed from a survey (ECHO) that describes in details a very large sample of French shipments. Two scenarios were set up, which differ mainly by the type of available electric vehicle: In scenario E1, the electric vehicle has a payload of 2 tons, versus 6 tons in scenario E2.
The vehicle range is not very binding for urban deliveries in our scenario, except in the Paris Urban area. The CO_2 reduction is nearly the same in the two scenarios, but the congestion is much higher in scenario E1, showing that the payload is an important issue for the generalisation of electric vehicles in urban freight.

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Keywords: Urban freight; CO_2 emissions; Electric vehicle; Simulation

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1. Introduction

Road transport is the main mode in cities. It generates negatives impacts especially congestion and pollution, so it is necessary to consider other less pollutant solutions. Indeed, the last EU White Paper on transports (2011) points out the necessity to find a transport less pollutant and to save energy resources using transport.

Considering urban mobility of people, electric private car cannot be the general solution, because private cars, electric or not, are generating congestion. In cities, the requirements for vehicle range are lower and the population density higher, what makes public transport more adapted, as well as the option of walking and cycling. According to Agenda 21 (UNCED 1992) "Transportation strategies should reduce the need for motor vehicles by favouring high-occupancy public transport and providing safe bicycle and foot paths". But, for urban freight, electric road vehicles are probably part of the solution considering the necessity to spread the deliveries all over the town. The main benefits of electric vehicles are the reductions of local pollutants and noises, which are important items in town while the reduction of greenhouse gases emissions, is generally considered only as a co-benefit, because transport CO_2 could be reduced as well in the countryside as in town. In France, electricity mainly produced from nuclear power (73.3 % in 2013), is relatively few carbonised and electric vehicles have a high potential of decarbonising the transport.

This paper assesses the potential of electric vehicle to mitigate freight transport GHG emissions in France, using scenarios of electrification or urban freight. Our objective is to estimate the maximum CO_2 mitigation that could be obtained by the electrification of urban freight and to assess in parallel two important technical problems of electric vehicles for freight: vehicle range and urban congestion.

The paper is structured as follows: The section 2 provides a review about the use of electric vehicle for urban freight. The section 3 details the data and the methodology. Finally, the section 4 defines the electric scenarios and assesses the benefits of using this type of vehicle instead of heat engine.

2. Experimentations of electric vehicle in urban freight

Cities are the places of concentration of people and activities. Among these activities, urban freight transport is an important contributor of pollutants and greenhouse gases emissions. But urban freight is necessary to provide goods to population. Public authorities can't forbid the freight, because it allows the city live. As Van Duin et al. (2013) mentioned, "urban freight transport is a necessary daily activity in and around urban areas".

Several European projects (BESTUFS 2006; SUGAR 2011, and BESTFACT ongoing) make an inventory of best practices in freight especially in urban freight. Some of these best practices are linked with electric vehicles like electrically assisted cargo-cycles or urban consolidation centres from which the deliveries are made by electric vans. These inventories show a growing interest for the electric deliveries that become more and more popular in several cities.

Several experimentations conducted in European cities are described and assessed in these EU research projects: Elcidis Urban Distribution Center with electric vehicles in La Rochelle (France), Ikone project in Stuttgart-Ludwigsburg (Germany), Distripolis in Paris (France), Cargohopper, a dedicated inner city delivery service using clean freight vehicles in Utrecht, Netherlands, Citylog EMF is a new type of electric freight vehicle developed in Austria by a consortium led by HET, Citylogistik-kbh in the historical centre of Copenhagen (Denmark), using an Urban Consolidation Centre and electric vehicles for the last mile, Txita in San Sebastián (Spain), Eco-Logis a distribution service operational in the urban area of Brescia (Italy). FREVUE (2013), an ongoing EU project, is directly on the experimentation of electric vehicles for urban deliveries and their assessment.

The results of these experimentations are much contrasted according to the situations. For example in London, a company, Office Depot, decided in 2009 to reorganise their transport plan with an urban consolidation centre and electric vehicles (vans and cargo-cycles). The assessment by the university of Westminster points out a reduction of the quantity of CO_2 emitted by parcel (-62%) and a reduction of total miles covered to deliver (-54%) (Leonardi et al., 2012); this experimentation seems to be a success, both environmentally and economically.

Why don't freight operators use more electric vehicle? Vehicle range is often mentioned as a technical constraint of electric vehicles for freight today (Morganti and Dablanc, 2013; Van Duin et al., 2013). The range allowed by the battery wouldn't be enough, for example when there is more than one round trip per day in a big city. The literature