Transportation Research Part A 91 (2016) 61–79

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Supporting the adoption of electric vehicles in urban road freight transport – A multi-criteria analysis of policy measures in Germany

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ARTICLE INFO

Article history:
Received 23 June 2015
Received in revised form 23 May 2016
Accepted 11 June 2016

Keywords:
Electric vehicles
Urban freight transport
Transport policy evaluation
Multi-criteria analysis

ABSTRACT

Policies in Germany to support electric vehicles, which are free of exhaust emissions, mostly focus on urban road passenger transport. However, road freight vehicles are a main source of the traffic air pollutants and noise emissions in cities. Available vehicle types, tour planning and purchase decisions in urban road freight transport differ from the passenger transport segment. The political and scientific literature lacks a comprehensive discussion of specific policy measures to support electric urban road freight vehicles. This article contributes to the existing body of knowledge, by undertaking a multi-criteria analysis of policy measures to support battery electric freight vehicles based on the rating by two stakeholder groups, "policymakers" and "freight electric vehicle users". These stakeholders rate 23 policy measures as suggested in the literature or which are implemented in European countries. In comparing and ranking the rating results of the groups, we find that the discordance between the groups can be large and offers noticeable insight and room for future research and practice. Although financial support of electric vehicles is often named in the literature as the primary measure to overcome the total cost of ownership gap of freight electric vehicles, the current study shows that the effect of special legal measures and supporting the setup of company-charging infrastructure are underestimated by the policymakers. Recommendable policy options – beyond several fiscal measures – are to request emission-free vehicles in municipal tenders, to allow drivers with a class B license to drive freight EVs over 3.5 tons, or to implement a city toll on the long-term. The practicability of other policy measures depends on the local implementation goals of the municipality. Hence, a transparent debate on the aim of supporting electric freight mobility is as necessary as choosing measures targeted at the freight transportation segment.

1. Introduction

In order to achieving an emission-free urban transportation the European Commission (2011) suggests to take action in two segments of the urban road traffic: in passenger and freight transportation. While the European Commission's framework aims to achieve emission-free urban passenger transportation by 2050, they suggest accomplishing an essentially

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http://dx.doi.org/10.1016/j.tra.2016.06.003
0965-8564/

emission-free urban freight transportation already by 2030. In conjunction with the so-called "Energiewende", the German federal government recognizes the necessity for emission-free transportation systems. At the same time the federal government stresses the importance of the transformation process for its automotive industry; here, 25% of the industry's turnover and 20% of the country's exports are generated; the large cars segment is a particular strength of the German car manufacturing industry (Merkel, 2013). As a logical consequence, the German federal government aims to become a lead supplier and lead market of electric mobility with one million electric vehicles on the streets by 2020 (NPE, 2014).

The focus on the technical and economical chances and challenges of electric mobility for Germany lead to large investments in research, development and pilot projects. As a result, the car manufacturers will have launched 29 battery electric passenger car series models by the end of 2015 (NPE, 2014). International electric mobility benchmarks acknowledge Germany to be in a leading position, when ranking the suppliers of electric vehicles (EVs) (McKinsey, 2014; NPE, 2014). However, the same benchmarks conclude that Germany currently lags behind its self-set goal of becoming a lead market for electric mobility. By January 1st, 2015, only one out of 2434 registered passenger vehicles was an EV (Kraftfahrt-Bundesamt, 2015). Since the German government aims to achieve electric mobility without permanent financial subsidies, an electric mobility law was adopted in Germany in March 2015 (EmoG, 2014) in order to strengthen the demand for EVs. The law foresees a labeling of electric vehicles on the vehicle registration plate, providing a legal basis for municipalities to grant privileges to electric passenger vehicles and light commercial vehicles.

At the same time and while receiving a considerably lower attention and financial stimulus, the freight transportation market has outperformed the passenger car market. As an example, one out of 923 registered trucks between two and five tons had an electric drive-train by January 1st 2015 (Kraftfahrt-Bundesamt, 2015). Due to the unavailability of battery electric series freight vehicles, certain logistics companies interested in electric mobility became involved in importing, retrofitting, or producing freight EVs themselves (Taefi et al., 2015).

Furthermore, freight EVs offer particular benefits in urban applications, since the vehicles are free of exhaust emissions such as nitrogen oxide and particulate matter and are more silent compared to conventional diesel trucks (Umweltbundesamt, 2013). Although only about five percent of the registered vehicles are trucks (Kraftfahrt-Bundesamt, 2015), they are responsible for more than ten percent of the driven kilometers in German cities (Wermuth, 2012) and are a main source of noise and air pollutants, such as particulate matter or nitrogen dioxide (Menge, 2013). As an example, trucks over 3.5 tons cause over 45% of the traffic's NO_x-emissions in Germany's second largest city Hamburg (Böhm and Wahler, 2012). On a drive-cycle with frequent stops and low average speeds, medium duty delivery trucks emit 42–61% less greenhouse gas emissions compared to diesel vehicles (Lee et al., 2013). Duarte et al. (2016) found in a real-world case study that small electric urban delivery vehicles reduce the vehicle usage energy consumption by 76% (57% when considering the energy production stage). Despite the local environmental advantages of freight EVs, despite the interest of logistics companies in electric freight vehicles, and despite the results of research projects, which underline the potential of electric mobility in freight transportation (Tenkhoff et al., 2012), the German federal government excluded freight EVs over 4.25 tons from the electric mobility law.

The public and scientific debates on policy options to support EVs so far misses to clearly differentiate between the two transport segments passenger and freight transportation, which have a fairly different structure and thus different requirements for support. Hence, this paper explores the question: Which policy measures are recommendable to support electric vehicles in urban road freight transport in Germany?

Transport logistics companies indicate that policy measures are an important driver for the design of their logistics networks: 75% of the companies indicate that the political framework is an important or very important influencing factor (Fraunhofer IML, 2010). Thus, supporting electric freight vehicles through policy measures could increase the number of electric freight vehicles and abate freight transport-related emissions.

In the next Section 2 we review the related literature, explicate the research questions and the contributions of this paper. In Section 3 the research methods used are described. This involves an exploration of the available literature and surveys considering two groups (policymakers and freight EV users). The results are presented in Section 4 and the differences between the ratings of the groups are discussed in detail in Section 5. This is followed by a conclusion and a discussion on the limitations of our work in Section 6.

2. Background and investigative questions

Evaluations of urban freight transport policy measures often generally name electric or low emission vehicles as options to reduce freight transport emissions (Bozzoa et al., 2014; Lützenberger et al., 2014; Zanni and Bristow, 2010). Despite this, the literature does not yet provide an ample discussion of specific policy measures to support electric urban road freight vehicles.

The high investment to purchase an EV is one of the main obstacles for commercial users (Amburg and Pitkanen, 2012; Ball and Wietschel, 2009; Kley et al., 2011; Taefi et al., 2015). Hence, some authors analyze fiscal policy options to bridge the gap between the total cost of ownership (TCO) between an EV and a vehicle with an internal combustion engine. Wietschel et al. (2013) discuss the efficiency of fiscal measures, such as a purchase price subsidy, tax abatement or depreciation model for the passenger vehicle market. They conclude that the segment of commercial passenger fleets offers a high replacement potential with electric vehicles and is sensitive to financial subsidies. Other authors who discuss fiscal tools in order to