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Can battery electric light commercial vehicles work for craftsmen and service enterprises?

Erik Figenbaum

Institute of Transport Economics, Gaustadalléen 21, NO-0349 Oslo, Norway

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ABSTRACT

Battery Electric Light Commercial Vehicles (BE-LCVs) can reduce the environmental impacts of Craftsmen and Service (C&S) Enterprises transportation. These Enterprises produce vital services, using diesel vehicles for transportation of personnel, tools and materials to worksites, thus contributing to pollution and greenhouse gas emissions. Enterprises that have taken BE-LCVs into use report practical range challenges leading to a need to reorganize their transportation activities. The driving pattern of 7 C&S enterprises operating 115 vehicles, were logged over two weeks. The potential of using BE-LCVs can be evaluated by combining the real range of BE-LCVs in Norway, with these driving patterns. Although 42% of diesel LCVs (D-LCVs) could be replaceable by BE-LCVs with a range of 170 km. Many covered so short daily distances that the transport work would only be reduced by 13%. The replaceable vehicles and transport work can increase by redistributing vehicle assignments, daytime charging, or with longer range BE-LCVs. If all year range increases to 200 km, then almost all vehicles are potentially replaceable. Purchase incentives are required to unlock the potential, but may, not produce large effects until the range improves. BE-LCVs with 50% longer range enters the market in 2018, which should expand the market.

1. Introduction

The Norwegian fleet of vehicles contained 146006 battery electric vehicles at the end of 2017 (NPRA, 2018). Of these, 139474 where passenger vehicles (BEVs), which is 5.1% of the total passenger vehicle fleet. 3481 were Light Commercial Vehicles (BE-LCVs), which is 0.7% of the fleet of LCVs, i.e. small/medium sized vans.

This article focuses on the potential for replacing Diesel LCVs (D-LCVs) with BE-LCVs in Craftsman and Service Enterprises (C&S Enterprises). The Craftsman sector consist of small enterprises offering professional vehicle based services within geographic regions at customer sites. Examples are carpenters, electricians, and service technicians. Service enterprises such as facility servicing, janitors, security and cleaning, have much of the same transportation needs.

Little research has been conducted to map Craftsmen transport activities, despite their number and vehicle biased transportation, as pointed out by Hislop and Axtell (2011). There has also not been much research on means to mitigate the transport related environmental impacts of their activities. Mobility generated by economic activity has primarily been analyzed in terms of goods transportation (Pelletier et al., 2016), commuting trips (Aguilera, 2008) and electrification of commercial and municipal fleets (Wikström et al., 2014, 2016a).

Workers in C&S enterprises depend on vehicles to transport personnel, tools and materials to work sites, in order to carry out their work. Unlike “white collar” professionals who can use public transport or non-motorized modes when moving between clients (in urban areas), craftsmen and service workers hardly have alternatives to vehicle based transportation (Julsrud et al., 2016). The focus must therefore be on measures to improve the environmental characteristics of the vehicles they use, and efficient administration of these vehicles in daily activities.

This article uses an exploratory approach to identify the practical and economic potential for replacing diesel LCVs (D-LCVs) with BE-LCVs in Norwegian C&S Enterprises. Electronic travel logs are analyzed to reveal the travel patterns of their vehicles. These travel logs where obtained from GPS data loggers with GSM communication, to record and send vehicle movement information to a central database. The travel patterns generated from these data logs were used to assess the potential for replacing D-LCVs with BE-LCVs. The analyzes takes into account the real world range achievable for BE-LCVs under Norwegian traffic conditions. Measures to make the transition feasible and effective is also analyzed. Interviews with early users provide information on access to charging and how these vehicles function in practice. The economic implication is analyzed using a Total Cost of Ownership (TCO) perspective. The article thus addresses the “relative advantage” and “compatibility” of

Abbreviations: LCV, Light Commercial Vehicle; D-LCV, Diesel powered LCV; BE-LCV, Battery Electric LCV; C&S Enterprises, Craftsmen & Service Enterprises; BEV, Battery Electric Passenger Vehicle; TCO, Total Cost of Ownership; GPS, Global Positioning System; GSM, mobile phone communication system. VAT, Value Added Tax

E-mail address: efi@toi.no.

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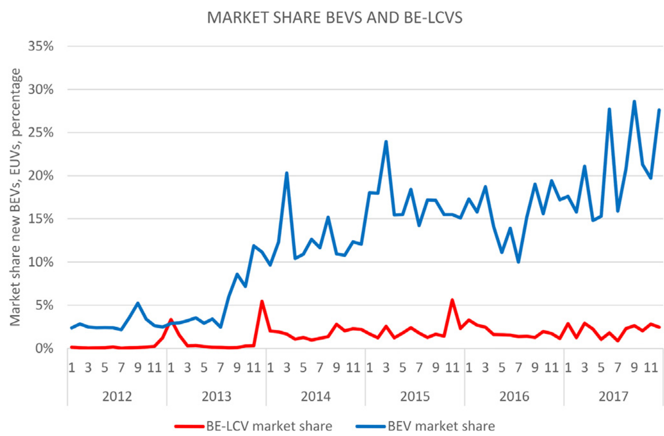

Fig. 1. BEV and BE-LCV market shares in Norway, 2012–2017. Source: Data from www.ofvas.no 2018.

innovations in Rogers' theory of diffusion of innovations (Rogers, 1995), by combining user practicality with economy of use, i.e. the techno-economic potential of BE-LCVs in these user groups.

The article contributes to the ongoing research agenda on measures to make professional users transportation more sustainable, and to the more general literature on diffusion of innovations (Rogers, 1995; Geels, 2012; Figenbaum, 2017).

The analysis starts off in Section 2 with an overview of the Norwegian electromobility context, i.e. incentives, policies and market developments for battery electric vehicles. Section 3 describes the theoretical framework used in the analysis. Section 4 presents the material, methods and calculations used. The results of the analysis are presented in Section 5 followed by the discussion in Section 6 and the conclusion and policy recommendations in Section 7.

2. Norwegian context

Incentives have resulted in an unprecedented breakthrough for BEVs in the Norwegian private consumer market (Bjerkan et al. 2016; Figenbaum, 2017; Figenbaum et al., 2015a, 2015b). Although most of these incentives also apply to BE-LCVs, a breakthrough has yet to materialize.

2.1. Clean electricity

The Norwegian electricity mix is clean, with 96% hydroelectric power (Figenbaum et al., 2015b). Norway is moving towards a larger surplus in the national electricity production (NVE, 2016). Electric vehicles can take up some of that surplus. Norway has no vehicle production and therefor need not take vehicle production emissions or employment into account when developing policies for greenhouse gas (GHG) emission reductions. Replacing Internal Combustion Engine Vehicles (ICEVs) running on fossil fuel with vehicles using electricity, will therefore be an effective policy to combat national GHG emissions from the transportation sector. Fossil fuel emission are eliminated, the energy efficiency is improved, and the electricity is clean. The same situation would also apply for Europe as a whole when the EU emission trading system (EU ETS) for greenhouse gases is taken into account (Figenbaum, 2017). For vehicle production the picture will be more complex. The individual parts making up a vehicle and the vehicle itself may be produced inside or outside the EU ETS.

2.2. Cheap electricity, expensive diesel

The annual energy cost saving of using BE-LCVs will be much lower than that of D-LCVs due to differences in energy cost and energy efficiency. Figenbaum and Kolbenstvedt (2015) found that when BEVs replace ICEVs the cost savings is larger in Norway than in other European countries. These results are valid also for vans, but the net cost difference could be smaller as C&S Enterprises do not pay value added tax (VAT), but the energy consumption of LCVs is higher, pulling in the other direction.

2.3. BEV and BE-LCV markets

The BEV market share of the passenger vehicle market reached 18% in 2016 and 20.5% in 2017 (OFVAS, 2018), as seen in Fig. 1. The BE-LCV market share has been stagnant around 2% since 2014.

These differences can partly be explained by differences in incentives, as discussed in Section 2.4, and in the technological limitations of BE-LCVs relative to the transportation needs of owners of D-LCVs. The limited availability of BE-LCV models could also have had an effect, as only four small electric vans were available in the Norwegian market in 2016, as seen in Fig. 2. Their main characteristics are presented in Table 1 and compared with the diesel versions. They were sold in various seating, cargo and size configurations. Two of these vehicles were upgraded with a 50% range increase in 2018.

2.4. Incentives and policies

The battery electric vehicle market in Norway is heavily incentivized (Figenbaum, 2017; Figenbaum et al., 2015a), with the most important incentives in place over a period of 20–25 years, as seen in Table 2. In the 1990s incentives were introduced to allow market experimentation, and in a period around 2000 to support an EV industry in Norway (Figenbaum, 2017). From 2010 the focus shifted to climate policy goals (Figenbaum et al., 2015b). The incentives are thus anchored in policies supporting climate policy targets (NTP, 2016, 2017; Stortinget, 2017), such as becoming a carbon neutral society by 2050.

The large market shares for BEVs has thus been the result of a long term stable national framework. The incentives have been available long enough to allow actors to take advantage of windows of opportunities that arose over the years (Figenbaum, 2017). The most important incentives have been the exemptions from the value added (2001) and registration (1990) taxes, toll road charges (1997) and the access to bus lanes (2003).

The National Transportation Plan for 2018–2027 states that only zero emission passenger vehicles, LCVs and distribution trucks shall be sold from 2025, essentially targeting a phase out of diesel and gasoline passenger vehicles and diesel vans, from the sales mix (NTP, 2016). The

Fig. 2. BE-LCVs in the Norwegian market, left to right: Renault Kangoo, Nissan E-NV200, Peugeot Partner, Citroën Berlingo, Source: Importers/manufacturers web pages.