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Morganti, E and Browne, M (2018) Technical and operational obstacles to the adoption of electric vans in France and the UK: An operator perspective. Transport Policy, 63. pp. 90-97. ISSN: 0967-070X

https://doi.org/10.1016/j.tranpol.2017.12.010

Technical and operational obstacles to the adoption of electric vans in France and the UK: An operator perspective

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Accepted version - Transport Policy 2018
Keywords: electric vans; urban freight transport; France; United Kingdom

Abstract

Since the mid-1990s European urban freight transport has undergone several major changes with direct impact on vehicle use patterns. These include (i) freight vehicle downsizing and (ii) the dieselisation of van fleets (formally referred to as light commercial vehicles or LCVs) More recently, a new possible trend has started to emerge, mainly related to alternative fuelled LCVs for reducing air pollution emissions in urban areas. Electric LCVs up to 3.5 tons are considered a suitable option for last mile operations, yet only a few last mile operators are replacing their diesel fleets with electric vans. In order to probe electric LCV acceptance in the freight transport sector, we conducted 15 experiment-oriented interviews with urban freight transport and service operators who tested and adopted electric vans, exploring technical and operational obstacles in daily operations in Paris and London. Additional interviews (8) have been conducted with policymakers, to update the initial survey. The results show that, in addition to range concerns issues, last mile operators' perception and acceptance of electric vans are affected by other concerns, such as queue, payload and grid anxieties. A number of financial and non-financial incentives for fostering the adoption of electric vans are identified and compared by considering the cities of Paris and London. The research also explored potential policy tools for mitigating the barriers to adoption that had been identified.

1. Introduction

Two major trends have profoundly changed the urban freight transport system across Europe over the last twenty years. The first trend concerns the downsizing of freight vehicles, conditioned by size-related vehicle restrictions adopted at the city level. The second trend refers to the dieselisation of light commercial vehicles (LCVs), such as vans up to 3.5 tons, as a result of taxation schemes and incentives applied to fuel types at the national level. Recently, under the European Parliament initiative (Directive 2014/94/EU), new low-emissions policies are further shaping the freight transport system, encouraging the use of alternative fuelled vehicles in densely populated areas. Indeed growing concerns about air quality have led to additional calls for restrictions on diesel vehicles in European cities, such as the progressive old diesel-vehicles ban in Paris established in July 2015 and the Ultra-Low Emission Zone (ULEZ) in London which will come into force in 2020. At national level, France defined areas with restricted traffic in major cities, together with the introduction of the Crit'Air Vignette to classified vehicles that are allow to enter. In the UK, the forthcoming Clean Air Zones Plan will be implemented in various large UK cities to fight the persistent air pollution crisis.

Electric LCVs have been identified as a clean alternative to diesel promoted by local and national governments through trials, grant schemes, investments in charging infrastructure and a range of complementary measures. Despite this increasing commitment to fostering electro-mobility, the uptake of electric LCVs is still limited and only few operators are replacing their diesel fleets. In 2015 just 0.5% of 1.7 million newly-registered vans in Europe were equipped with plug-in electric technology (EAFO 2016; ACEA 2016).

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Compared to five years ago, when the market offered no electric LCVs, automotive manufacturers now offer for sale numerous models of vehicles, such as the Nissan *e-NV200*, Renault *e-Kangoo*, StreetScooter *Work* and Peugeot *Partner Electric*. Moreover new formats for urban freight vehicles, such as electrically-assisted cargo tricycles and minivans, represent a new segment with high potential sales in heavily congested European cities (Morganti et al. 2015).

Although a larger selection of products stimulates sales, a wide variety of factors influence the transition from the testing stage of electric LCVs towards full-scale commercialization. On the economic side, the buyer is influenced by the upfront retail costs of electric vehicles (EVs) and the dramatic and sustained downturn in oil prices, dating back to the second half of 2014. Moreover the market is affected by regulatory factors, such as the European strategic plan attempt to reduce carbon dioxide (CO_2) emissions from transport, which set the enforcement of average emissions target at 175 g CO2/km from new LCVs by 2017 (European Parliament Regulation 2011/510/EU). Consumer awareness of emissions performance may also be on the rise due to recent events like the US trial against Volkswagen about diesel emissions violations in September 2015 and the consequent requirement for the manufacturer to invest in electric vehicle promotion (US EPA 2016).

In the last mile sector, fleet managers' preferences result from a combination of the above-mentioned factors and technical and operational obstacles associated to electric LCVs, such as limited range (Feng and Figliozzi 2013) and limited payload (Browne et al. 2014). Although recent studies have begun to clarify which EV features represent a concern for the operators, the topic is not yet fully explored. There is a consistent lack of knowledge on specific technical and organizational issues faced by early adopters of electric LCVs. Moreover considerable uncertainty exists regarding the nature of policy interventions that could mitigate these barriers.

Given the growing concern about the link between air quality and health and the dramatic rise in the use of LCVs in cities it is timely to present the results of a comparative study that assesses opportunities for change in two major cities (Paris and London). This paper looks at the last mile sector, covering product deliveries to businesses and end-customers as well as service activity, and it focuses on operators who tested electric vans, with a partially or totally renewed fleet. It provides an understanding of the technical and organizational issues observed and perceived by operators in their daily operations. The analysis was carried out in Paris and London, two metropolitan areas that set up specific measures on electro-mobility and where early adopters of EVs (including taxi, car-sharing projects and buses) represent a growing share of the existing fleet.

The remainder of the paper is organized as follows. The second section introduces the previous literature. Section Three presents the methodology. Section Four focuses on market trends and grant scheme programs in Paris and London. Section Five describes interview results. Section Six explores policy measures. Final remarks are presented in section Seven.

2. Barriers to the adoption of electric vans

The city logistics sector, also known as "last mile" logistics, is increasingly reliant on vans. In European urban areas, the number of tasks accomplished with vans has progressively expanded and last mile operators currently use vans to provide a wide range of essential services (e.g. repair and maintenance of road infrastructure) and to carry goods (e.g. parcel deliveries). Van usage has surged following the evolution of the retailing sector and consumer preferences, such as just-in-time deliveries and the rise of online shopping consequently increasing home deliveries (Browne et al. 2010). As a result LCVs are the fastest growing source of road traffic in the UK (4.2% growth in 2015 compared with 3.7% for trucks and 1.1% for cars) and van emissions represented 15% of total emissions in 2014, compared with 9% in 1990 (DfT 2016). Last mile operators 'perceptions and acceptance' of low-carbon vehicles and electric LCVs in particular are therefore crucial for researchers and practitioners to understand, in order to identify suitable measures to encourage increased adoption leading to higher sustainability.

In transport policy, the LCV segment has been overlooked as there are far fewer vans than cars, respectively 10% and 83% of the total licensed vehicles in the UK (DfT 2016). Referring to the freight sector, the limited amount of official data and statistics on vehicles up to 3.5 tonnes represents a limitation for in-depths studies in various European countries and in the UK (CfIT 2010). Despite growing interest in sustainable transport, issues related to electric LCVs have received limited attention (Pelletier et al. 2016). Available studies on urban freight transport and the corporate van fleet sector (Enclose 2014; Feng and Figliozzi 2013; Quack et al. 2016,) partly mirror some of the results about the adoption of EVs in the private car sector. Parameters such as relative price increases of new vehicles, the relative prices of oil and electricity developments in the availability of recharging infrastructure are all relevant both in the private car and professional LCV market segments (Rezvani et al. 2015).

Among the biggest barriers hindering the EVs deployment, literature identifies cost competitiveness (whether in terms of total cost of ownership or purchase price). However the EV industry evolves quickly and the price per kWh for lithium-ion batteries experienced a strong drop in 2015, having fallen by 60% since 2010 (Blomberg 2015). As a result, economic barriers are expected to decrease especially in countries where the remaining price gap is covered by incentives.

Range is widely identified as a major concern by potential EV buyers however significant recent improvements in battery technology and in charging infrastructure are expected to enhance EV performance and to mitigate concerns in the coming years (Morganti et al. 2015). The novelty perception is another barrier to EVs adoption, represented by the lack of knowledge about the vehicle's capability and performance (Thiel et al. 2012).

The literature identifies some barriers concerning electric LCVs and potential buyers operating in the last mile sector. Quack et al. (2016) argue that maintenance issues and reliable customer service from van manufacturers represent significant barriers. Uncertain resale values and long charging times contribute to the low penetration rate of electric vans as described by Noon (2015). He also identified major issues related to the British energy grid renovation and supply adequacy of local sub-stations, suggesting that mitigating the grid-related barriers can have a significant influence on EV adoption by large fleets. Browne et al. (2014) compared UK and France LCV growth patterns and CO_2 reduction opportunities and observed that payload limitations are a problem for 3.5 tons electric vans. Additional insights on the LCV segment in the UK are provided by the Commission for Integrated Transport (CfIT) report (2010), where the cycle of new van design and replacement by manufacturers is depicted as a long process. Moreover, on the buyer's side, preferences about model, size and fuel source depend on the long-term relationship between the manufacturer and the operator.

Previous research on the EV market, mostly focused on the passenger car segment, has explored the intention and the willingness to adopt the innovation. In France various investigations on cost parameters, technological developments and vehicle acceptance were assessing the potential buyers (von Pechmann et al. 2015; MEEDDAT 2010). Windisch (2012) tested policy scenarios to derive a set of financial policy measures that encourage the adoption of electro-mobility by French households. Boutueil (2016) provided an outlook for large-scale uptake of EVs where French corporate fleets are identified as potential leading force, if supported with adequate policy support.

In the UK, perception and acceptance of EVs from private consumers has been documented through surveys on policies (Lane and Potter 2007). On perceived and actual barriers Skippon and Garwood (2011) assessed consumers' level of understanding of vehicle technologies, environmental impacts, car costs and economic incentives following a direct experience on driving a EV. Sierzchula (2014) explored fleet managers' behavior, and identified 'testing new technologies' as the most important driver on the adoption of EVs, followed by lowering environmental impacts, governmental grants, and improving the organization's public image.

Kaplan et al. (2016) carried out a study in Germany, Denmark and Austria to explain fleet managers purchase intentions for electric vehicles. Their model based on the theory of planned behavior describe the impacts of positive attitudes towards EVs, perceived familiarity and perceived operational ease on purchasing commercial EVs.

In more general terms, Mock et al. (2014) suggested that there is indeed some link between the incentives provided and the uptake of EVs in a market. Clear examples are Norway and the Netherlands, where high EV fiscal incentives result in a beneficial total cost of ownership for consumers, and this results in high EV market growth rate and market share. Moreover NRC report (2015) identifies a variety of incentives including subsidies for reducing production costs granted to manufacturers and non-financial measures, e.g. traffic incentives and special privileges granted to EV drivers. Nevertheless determining appropriate incentives is difficult because little is yet known about the effectiveness of past and ongoing policies, and about non-economic issues, such as technological and operational obstacles, currently faced by the operators of electric vans' fleet.

In sinthesis, the previous literature in this area analysed the private consumers' opinion and attitude toward electric cars, and a scarce literature examines limitations on the adoption of EVs by last mile operators. The findings showed that EVs range and price represent crucial obstacles in the transition. Furthermore, the previous studies also suggested that the adoption of EVs were influenced by public policies and financial incentives and non-financial elements. As stated by Rezvani et al. (2015) in their literature review paper, there is a gap in knowledge about the intention to adopt this new technology and the actual ("unforced") adoption of EV. The scope of the paper is thus to provide a better understanding of operators 'attitudes facing technical and operational barriers and potential mitigating policy measures (besides grant schemes), which can foster the transition towards electromobility by last mile operators. In order to gain greater insights and understanding it is necessary to understand decisions that are made in a corporate context. A research approach built around a series of in-depth interviews was adopted and this is explained in greater detail in the following section."

3. Method

Our investigation combined a literature review with survey activities. The fieldwork, started in November 2014 and was completed on October 2015, and comprised the following: (i) desktop research and analysis of publicly available information, and (ii) twenty three interviews with professional van users in the urban freight transport sector and with electro-mobility stakeholders in France and in the UK.

The desktop research set out to collect insights into the current state of the EV market from various sources, including the European Commission, national agencies, industry associations and consumers' communities. It consisted of an analysis of data from scientific literature and grey literature sources (e.g. official documents, reports by research institutions, consulting studies), and trade press articles.

Individual face-to-face (20) and phone (3) interviews were conducted with: last mile operators and industry associations; national and local policymakers, as reported in Table 1.

Table 1. Interviews by respondents' category and by country

Respondents	France	UK
Last mile operators and industry associations	9	6
Policymakers	2	6
Subtotal	11	12
TOTAL	23	

Interview topics were defined with the aim of detecting the operators' perception and acceptance of technical attributes of electric vans in their fleet, focusing in the behavior for last mile operators, instead of the intention or the willingness to adopt innovation (Rezvani et al. 2015). The semi-structured questions were derived from existing empirical literature, with a focus on exploring the attitude of car drivers who had a direct experience on driving EV (Skippon and Garwood 2011). The main questions are listed below:

- Referring to technical attributes of electric vans, what are the existing obstacles in their adoption for daily operations? How did you plan to overcome them?
- How did your operations change with the adoption of electric vans?
- Referring to electric van's technical features, what are the specific drivers fostering greater acceptance?
- What are the European, national and local policies and regulations that affect electric LCV deployment?
- How the adoption of electric LCVs is affected by grant schemes programs? Which are other potential measures to mitigate the technical obstacles?

Vans used for professional purposes in France and in the UK are important to a wide range of business sectors, including infrastructure maintenance (e.g. gas and water maintenance), service providers (e.g. plumbers and builders) and goods collection and delivery (e.g. retail store deliveries and express couriers), as described by the "Enquête Véhicules Utilitaires Legers" for France (SOeS 2012) and by the report for the CfIT for the UK (2010). Our analysis focused on these professional users with specific interest on last mile operators including goods delivery and service providers. The panel included parcel services and home deliveries (five), food and perishable goods deliveries (two), retail store deliveries (three), services provision (four), organization representing transport operators (one). Of the operators interviewed, 11 had partially (just a few vehicles) or totally renewed their fleet with electric vehicles. Fleets size ranged between a dozen vehicles for some local operators to some thousands for big express delivery providers. Fleets were comprised mostly of vans up to 3.5 tons (registration category N1) and small trucks, however some operators also used cargo bikes and car-derived vans. It also includes sport utility vehicles (SUVs) and commercial variants of some 4x4 cars, in which the manufacturer blanks out the rear side windows and provides a load space in place of the rear seats (such as the Mitsubishi Cargo Outlander, one of the most popular plug-in hybrid electric vehicles in the UK).

Exploratory interviews (eight) have been carried out with city, regional and national policymakers to collect information on existing and planned measures on low-carbon policies and on the degree of understanding of last mile operators' attitude by institutional and government entities. Most of the respondents (six) were officers working within the transport planning or urban freight planning department for municipalities and boroughs.

Unless otherwise specified, the focus of this study is on full battery electric vans, operating solely on the electricity stored in their battery (no other power source) and relying on battery recharging infrastructure in private or public locations.

4. Overview of the French and UK contexts

4.1. Market overview

The market for LCVs in Europe is growing faster than car segments, with an average increase of 11.6% (compared with 9.3% for cars) in 2015 and more than 1,710,000 new registrations (ACEA 2016). The UK recorded one of the highest increases (16%) with 371,830 van registrations, surpassing previous the record set in 2007 (SMMT 2016). France is one of the largest European markets for new LCVs (309.620 registrations), and is one of the countries with the highest proportion of LCVs in new light-duty vehicle sales (around 15%-16%), just behind Norway and Portugal (Boutueil 2016). France and the UK together represent almost half of all new registered LCVs in Europe (EEA 2015).

France and the UK each have over 3 million registered vans used by businesses, representing respectively 8% of all light-duty vehicles in France (CCFA 2015) and 9% in the UK (Turner and Browne 2010). Moreover both countries witnessed a similar dieselisation process over the last twenty years. Up until the mid-1990s the majority of vans were powered by petrol. Later on, national policy favouring diesel over petrol – through higher taxes on gasoline than on diesel fuel and through the subsidization of new diesel vehicles purchases – led to a LCV segment currently dominated by diesel vans, which represent up to 97% of the fleet in France and in the UK.

Electric vans made their first appearance on the market in the late 2000's. Since that time the number of models offered as well as the size segment coverage (e.g. city-vans and car-derived vans) has increased significantly (Thiel et al. 2015). The total number of electric LCV registrations in the European Union from 2012 to 2014 constituted about 0.5% of total LCV registrations during the same period. This figure is higher than the new registrations share for EV passenger cars during the same period (Thiel et al. 2015).

France has firmly established itself as a European leader in zero-emission automotive transportation with more than 67,000 plug-in electric light-duty vehicles (including cars and LCVs up to 3.5t) currently registered (Morganti et al. 2015; AVERE France 2016). The electric LCV market was fostered by public bodies and publicly owned companies' procurement policies. In 2011, a consortium of large corporate fleets, including La Poste, Electricité de France and Air France, placed an initial order of 15,600 electric vans to promote low-carbon last-mile operations (La Poste 2011). In 2012 and 2013, electric van sales rose 42%, to 5,200 units, followed by a decline of 13% in 2014 (CCFA 2015). A positive trend was then registered in 2015 with 6.622 new registrations (EAFO 2016).

Until now France has been the biggest electric LCV market in Europe, but over the last two years the UK has steadily increased its EV sales (both cars and vans). New registrations of electric vans reached 4,500 units in 2015, increasing by 10% compared to 2014 (DfT 2016). Moreover large corporations are planning EV investments such as British Gas, who committed to converting 10% of their fleet to electric vans by 2020. In 2013 British Gas, in partnership with Nissan, set out on one of the UK's largest commercial trials of electric vehicle technology.

4.2. Incentives overview

Over the last several years, the European Union and most of member states have provided incentives to encourage the production, purchase, and use of electric vehicles. Since 2010, the French government has raised its commitment on enhancing the adoption of clean vehicles. Under the French environmental roadmap defined by the Energy and Sustainable Development Ministry, up to 750 million euros are available for initiatives aimed at the development and deployment of EVs. Indeed, France has set the ambitious target of having 2 million plug-in electric vehicles on its roads by 2020 (Borloo and Estrosi 2010) and about 7 million private and public charging stations by 2030 (MEDDE 2015).

As part of this roadmap, an incentive (€6,300 bonus) directly reducing the purchase price of an electric car has been offered to private customers and businesses since 2008. Since May 2015, the government granted an additional bonus, called "prime à la conversion": when trading-in a diesel car registered before January 1st 2001, EV customers receive €3,700 on top of the existing grant (reaching €10,000 discount). It is worth noting that only cars are eligible for the additional incentive, whereas LCVs are not included. The differentiation of incentives among the two segments of light-duty vehicles might influence professional user preferences and eventually encourage the use of cars for urban freight operations.

Grants to purchase EVs have also been available in the UK since 2011 for cars, 2012 for LCVs and 2016 for heavy goods vehicles. The UK government's strategy to support ultra-low emission vehicles (ULEVs) identifies nine models of eligible vehicles within category N1 with a gross weight of 3.5 tonnes or less. The scheme provides 20% off an eligible van purchase price, up to £8,000, while electric cars are granted up to £4,500 (Office for Low Emission Vehicles 2015). Participation in the program was slow during the first two years, when only 3,200 grants were offered to both cars and vans; since then participation has surged over the last three years. In February 2015, the UK Ministry of Transport announced the renewal of the subsidy scheme, providing an additional 50,000 grants during the period 2015-2017 and a budget of £43 million for infrastructure and research and development related to plug-in electric vehicles (Office for Low Emission Vehicles 2015). More than 47,700 claims have been made through the Plug-in Car Grant scheme as of December 2015 for new battery electric and hybrid vehicles (Lane 2016). Outside London, the Clean Air Zones program aims at introducing targeted local measures to tackle the most polluting vehicles, such as old trucks and vans.

Financial and non-financial measures influencing EVs potential buyers have been adopted in France and in the UK, as reported in Table 2. Referring to ownership incentives, both countries offer national schemes funding purchase grants and exemptions on vehicle excise duty and motor fuel taxes (since electricity is not yet identified as fuel). Referring to use incentives, free charging and free parking fostering the use and the penetration of EVs are increasingly available in many French and British cities. In the UK, the EVs are also exempt from the vehicle safety and exhaust emissions test. London also promoted the exemption from the congestion charge (€14 a day) for EVs. Moreover ongoing infrastructure developments are financed to increase the number of publicly accessible charging stations. French and British public policymakers see the deployment of conventional, semi-fast and fast-charging points as a major priority in overcoming obstacles related to the limited range of EVs and they set up grant schemes to help cover the installation cost for charging points on private premises. Additional incentives are offered at the city and local level in both countries. Like Norway, Paris has promoted access permits on high-pollution days, although neither Paris nor London offer access to restricted lanes (e.g. bus only lanes).

The national strategy to improve urban air quality and foster the adoption of clean vehicles includes city-level initiatives in both countries. More precisely the cities of Paris and London have recently adopted showcase projects to cut urban emissions from road transport. In Paris, the anti-smog plan sets a progressive phase-out of old diesel-powered vehicles, banning diesel cars, two-wheeled vehicles and vans registered before the end of 1997 by July 2016 (Mairie de Paris, 10 February 2015). Next steps include the progressive ban of old diesel vehicles by 2020.

Table 2. Comparing existing incentives in France and UK

Macro-category	Type of incentive	Specific measure	France	UK
Financial	Ownership incentives	Purchase grant	x	x
		Exemption/Reduction in registration taxes	x	x
		TVA		
		Reduced company tax		x
	Use incentives	Exemptions from motor fuel taxes	x	x
		Reduced roadway taxes or tolls		x
		Free charging and/or parking	x	x

		Exemption from vehicle safety test (e.g. MOT)		x
	Infrastructure upgrade incentives	Installing publicly accessible charging stations	x	x
		Contribute to installing in-house charging points	x	x
Non-financial	Traffic incentives	Wider time windows	x	
		Access to city center in case of high pollution days restriction	x	
		Reserved parking	x	x

Source: own elaboration adapted from NRC 2015

In February 2016, Transport for London launched a new programme to reduce the emissions of freight and fleet operators and to increase the uptake of low carbon commercial vehicles, called LoCITY. The five-year programme aims to demonstrate the potential use of low emission vans and lorries through trials and research, bringing together freight and fleet operators, vehicle manufacturers, fuel providers and the public sector. The initiatives focus on three main areas: (i) increasing the availability and affordability of low emission vans and lorries; (ii) improving the alternative fuel infrastructure, such as electric charging points; and (iii) improving policies, procurement and land use planning to foster the adoption of clean commercial vehicles (LoCity 2016). This programme precedes the introduction of London's Ultra Low Emission Zone (ULEZ), which is currently expected to operate similarly to the current congestion charge zone. In September 2020, special standards, including Euro-VI for trucks and Euro 6 for diesel engine cars and vans, will take effect across the zone including a daily charge, varying with vehicle type.

5. Results

Interviews provided insights about perceptions and attitudes of last mile operators towards existing technical and operational barriers, which have been classified into four concerns: limited range; risk of queuing; payload restrictions; and unreliable grid. Nevertheless operators that adopted electric vans and reorganised their operations accordingly were satisfied with the vehicles performance, and used them as 'working tool' in their daily routine. As complementary information, opinions related to economic obstacles have been gathered. Respondents referred to the importance of cost and the high retail price as a major obstacle. In particular, purchase subsidies (e.g. bonus and "prime à la conversion") and ownership incentives are considered crucial in fostering this transition phase from full dieselisation to alternative fuel vehicles. Some respondents suggested that use incentives such as tax reductions and fiscal incentives directly impacted vehicle-purchase decisions.

The four main concerns expressed by the last mile operators are explained in the following paragraphs, followed by the results from policymakers' interviews.

5.1. Limited range

Charging infrastructure is expanding quickly but coverage is not yet consistent throughout the main areas where operators use and anticipate using electric LCVs. Varied initiatives are developed at the local and regional levels, thus areas are covered by different service levels in terms of number of available stations, type of charging stations (standard, semi-accelerated or fast) and type of plug (e.g. Combo 2, CHAdeMo, Type 2, etc.). Respondents are in general aware of the increasing availability of publicly accessible chargers and this contributes to reducing *range anxiety* concerns. This provides confidence to operators in metropolitan areas like Paris and London where initiatives for improving charging coverage are strongly supported by local governments.

Operators tend to plan charging activities at their facilities, nevertheless fast-charging stations, which allow up to 80% battery recharge in about 30 minutes, are perceived as desirable for eventual boost charging, also referred to *biberonage*, eventually enabling the use of the electric vehicle throughout the day. Two respondents mentioned the potential for charging the delivery vehicle during the driver's lunch break as a way to extend their catchment areas. Current regulations covering drivers break times is an administrative issue which needs clarification.

5.2. Risk of queueing

Five operators were concerned with socket availability when needed and the consequent risk of wasting time waiting at the charging station. Defined as *queue anxiety* among operators and drivers of EVs, this unease rises with the popularity of EVs among private and professional users. It includes the loss of time while in line, but also the risk that the previous EV driver stays plugged in longer than needed. Being informed about available sockets and being able to book the charging time appear to be a major concern for last mile operators.

Although charging infrastructure coverage is improving, a common key theme across respondents relates to the reliability and interoperability of charging stations. The dependence of early-stage deployment of charging infrastructure on several relatively local initiatives is perceived as a lack of reliability. Electric van users express the desire for interoperability among the different charging networks at local, national and international scales. Respondents are also concerned not only by charging modes and plug types, but also identification procedures and billing systems for registered customers, which can increase delivery times in the case of boost charging.

5.3. Payload restrictions

The size and weight of batteries required in EVs lead to reduced payload. Consequently, an electric van is typically one to two hundred kilos heavier than its diesel equivalent and its load space is reduced on some models (Enclose 2014). Goods delivery providers identified two main strategies to avoid exceeding 3.5 tons of the authorised gross vehicle mass (GMV), and both have an impact on the organisational structure and on operating costs of the freight delivery firm.

The first option deals with reducing the total amount of goods transported resulting in new criteria to plan deliveries and journeys. Because electric vans have reduced load capacity / payload compared to their thermic counterparts, the amount of parcels delivered per journey is lower and thus each unit has a higher cost. This led three operators to partially re-design delivery operations and re-think logistics platform location. The most successful initiatives included the adoption of micro-platforms near the high-density delivery areas (within a 20-30 kilometres range) to reduce the distance travelled by electric vans and to allow multiple journeys.

The second option centers on recruiting professional drivers with at least a driving license for light trucks (category C1). Since loaded vans exceeding the GMV are subject to the same legal scrutiny as heavy goods vehicles (HGVs), and they are classified as N2 or N3 vehicles, a driving license for regular cars (category B) is not sufficient. Currently a large majority of drivers recruited by last mile operators are license B holders, and the sector could face a shortage of professional drivers. Moreover Directive 2002/15/EC adopted by the European Commission applies to professional driver's categories and it defines specific requirements related to working time in order to preserve the health and safety of drivers. As a result, increased labor costs for recruiting professional drivers would expand company budgets. Unsurprisingly, six respondents stated that the risk of increased costs of new recruitments represents an obstacle.

Three respondents were aware of existing electric vans weight dispensations at the local/national level, where public authorities decided to exempt certain road transport operators from the GMV requirements of the regulation due to the nature of the goods carried or for short distances travelled. At the European level, exemptions from the maximum authorised weights and dimensions of alternatively fuelled vehicles are granted for trucks (Categories M2 and M3 and their trailers) by the Directive 2015/719/EU.

5.4. Unreliable grid

Six respondents referred to the need for additional charging infrastructure at the warehouses or where the EVs are based. Depot-based charging is a common solution adopted by managers interested in electric fleets. Indeed, being equipped with charging stations improves autonomy on charging management but it also means that: potential users have to assume the costs of charging equipment; fleet managers need to develop skills in planning charging times and depots have to be sufficiently large (and safe) to accommodate such stations.

Depending on the city-level initiatives, the cost of charging equipment is partially or totally eligible for public incentives. However, beyond these costs, the capacity of the grid and the local electrical circuits remains a concern for operators. In the short-term future, the increasing demand of power to service multiple vehicles simultaneously represents a critical need as well as investments in renovating and improving local circuits.

In terms of charging management, complex charge scheduling is seen as a new skill for fleet managers, who seek to optimize the process of battery charging as to how much charge is required, the urgency in charging and the price.

Moreover two operators in France identify additional concerns related to the high safety standards required at the charging stations within private facilities. In Paris, they mentioned the critical requirements to keep the power usage within safety standards, defined by the city fire officers who are responsible for emergency services, as particularly cumbersome.

5.5. Policymakers' contribution

Interviews with policymakers contributed to the understanding of existing and future scenarios in metropolitan areas and were useful in determining whether existing and planned measures dealt with technical obstacles for last mile operations. Local policymakers recognised the importance of creating favourable conditions for the transition towards alternative-fuelled vehicles. Many believed that electric LCVs contributed to the reduction of local CO2 emissions and that local policy was effective or highly effective in fostering innovation in urban areas. Urban transport planning officers were aware of main challenges for last mile operators, nevertheless they were not necessarily aware of technical and operational obstacles experienced by electric vans operators in the urban areas of Paris and London.

With regards to improving air quality, British policymakers referred to the concept of "technological neutrality", aimed at equally promoting different alternative fuel technologies and eventually prioritising measures that expand options for alternative fuelled vehicles. Stakeholders' opinions also suggest that traffic regulations and restrictions may have a positive impact on EVs uptake. This is confirmed by the introduction of low-emissions zones in both Paris and London, where access for selected polluting vehicles is restricted or deterred with the aim of improving the air quality.

6. Discussion and potential policy instruments

The results suggest that last mile operators are clear that electric vans imply a modification of their operations and possibly new skills about EVs technology and the planning required for charging. However, a majority is willing to continue to use electric vans and eventually increase the volume of activities performed with the new vans. Participants appeared to understand that technologies evolve fast and forthcoming models would have better performance. Nevertheless respondents did seem concerned by the need to better inform policymakers, manufacturers and players involved in the energy supply and local power distribution about the existing obstacles.

The finding that national and European regulations about interoperability, payload restrictions and professional drivers' contracts were perceived as unclear, inconsistent or non-existent by respondents highlights the complexity of the transition towards a full deployment of EV, entailing a broader perspective than reducing upfront price and range limitation issues.

Our findings suggest that government (at all levels) and the manufacturers are expected to develop further relations with charging network providers, energy distribution networks and real estate companies to better coordinate the EV uptake policy interventions. In Table 3, we present a set of potential financial and non-financial measures, including the relevant stakeholders to be involved. The table has shaded cells in order to show the most relevant points for potential actions.

Table 3. Potential policy interventions to overcome technical and operational obstacles

	Policy instruments	**Technical and operational obstacles**	**Stakeholders**

Macro-category		Limited range	Risk of queuing	Payload restrictions	Unreliable grid	Government – all levels	Manufacturers	Energy distribution networks	Charging network provider	Real estate companies
Financial	Enhancing fast charging infrastructure in cities									
	Dedicated charging options									
	Charging planning tools and training									
	Increased total vehicle weight									
	Upgrade grid capacity local sub-stations									
Non financial	Access to restricted lanes									
	Wider time windows									
	Interoperability guidelines for charging and billing									

Several of the interventions noted in Table 3 are discussed in more detail below.

– *Enhancing fast charging infrastructure in urban areas*

In order to overcome concerns of last mile operators related to the limited range and the risk of failing to fulfill their trip, the implementation of fast charging infrastructure in urban areas should be encouraged. Mainly located along the motorways to allow quick re-filling on long journeys, fast charging stations are rare in urban areas (Morganti et al 2015). Nevertheless our results show an interest by last mile operators on urban fast charging stations. If located along the main gateways and the most travelled corridors to access metropolitan areas, these stations may benefit not only last mile operators but also private drivers. Local governments should engage with and encourage charging networks providers in installing fast charging infrastructure serving urban freight traffic flows.

Complementary measures deals with granting access to restricted lanes and allowing circulation during wider time windows. This enables shorter and faster trips, thus consuming less energy.

– *Dedicated charging options and interoperability*

In order to avoid long queues for operators during their professional activities, it is essential that fast charging services include special options for last mile operators (and professional users), e.g. advance booking for charging, dedicated sockets and customized subscriptions. Policymakers should encourage charging networks providers in providing *ad hoc* services.

Moreover it is the responsibility of public policymakers to provide an adequate legal framework under which the deployment of safe and harmonized charging systems for electric mobility at public and private premises can take place. All levels of jurisdiction, including European, national, regional and local governments, are involved in enabling, supporting and facilitating the electrification of road transport. Interoperability among the different charging networks, at both national and international scales, is thus requested and assured by a common standardization process. Also procedures of identification and billing systems for electric vehicle drivers should comply with interoperability schemes. As a result, all EV drivers should be able to charge their vehicles and pay at all public charging stations using a universally accepted payment method just as any thermic vehicle can be fueled at any gasoline station.

– *Increased total vehicle weight*

The opportunity to introduce a different payload for electric vans, for example to allow these vehicles to operate at 4.5 tonnes could be evaluate by the European Commission in conjunction with national authorities. For example, in Germany the driving licence regulation already allows persons with a driving licence class B to drive electric vans with gross vehicle weight up to 4.25 tonnes. Broader initiatives in this field need to be developed in accordance with the EU road safety regulations, since LCVs are vehicles designed and constructed for the carriage of goods and having a maximum mass not exceeding 3,5 tonnes.

– *Reliable grid*

In order to improve the grid performance, the main issue relates to who has to make the payment and take the risk that as a result of changes the business may have to move for example. This is perhaps especially problematical for last mile operators because (i) many of them work on rather short term contracts for their clients (ii) there has been a tendency for market prices for land to lead to operating centres and depots being pushed out of the city and into the suburbs or beyond the suburbs (Dablanc and Rakotonarivo, 2010). The question may need to be addressed at a more strategic level i.e. a grid that supports urban freight operations is important in the uptake of these vehicles. Many will continue to be charged at the depot because that it the operators normal pattern of activity.

7. Conclusion

This was a small exploratory study, so its findings should be considered as insights into the issues that need to be addressed in further research in the field of "actual adoption", not limited to the intention to adopt of electric vehicles. The barriers discussed in Section 2 are a complicated mix of technology issues and business behaviour. While some of these will be overcome with more technology developments the main concern is with the speed of change and the limited uptake of EVs in the commercial vehicle sector in the short and medium-term. The approaches that have been sued to promote the uptake of EVs in the case of cars bought by private consumers are not sufficient to result in changes for commercial vehicles. Attitudes of last mile operators, after the adoption of electric vans, changed and transport operations were redesigned. Results show that anxieties related to range, queue, payload and grid affect operators' acceptance. From their perspective, these technical and operational issues related to the use of electric LCVs represent obstacles which can be overcome only partially without the help of policy interventions.

The analysis of financial and non-financial incentives adopted by Paris and London describes substantially similar approaches, targeting mainly car drivers, without adequate focus on other consumers' groups i.e. last mile operators using electric vans. Existing grant schemes, charging infrastructure subsidies and complementary measures might improve the acceptance of electric vans among last mile operators on alleviating the economic barriers such as the upfront retail price. Nevertheless technical and operational issues identified by this study were not fully addressed by existing policy measures and policymakers shown limited knowledge about them.

The research from this study provides insights into the policy changes and incentives that would be most relevant to increasing the uptake of EVs in the field in commercial vehicles. Successful policy interventions to promote electric vans will require well-designed combinations of incentives, regulatory standards, information and guidelines for stakeholders involved in the process. Effective policy-intervention strategy must be designed to reduce the key barriers involving manufacturers, energy distribution networks, charging network providers and real estate actors.

Acknowledgements

We would like to thank the Volvo Research and Education Foundations (VREF) and the TEN-T Corri-Door project for support for this study. We also would like to thank the companies, organisations and individuals that have provided input or contributions.

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