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Key trends in the urban transport of goods - a data collection

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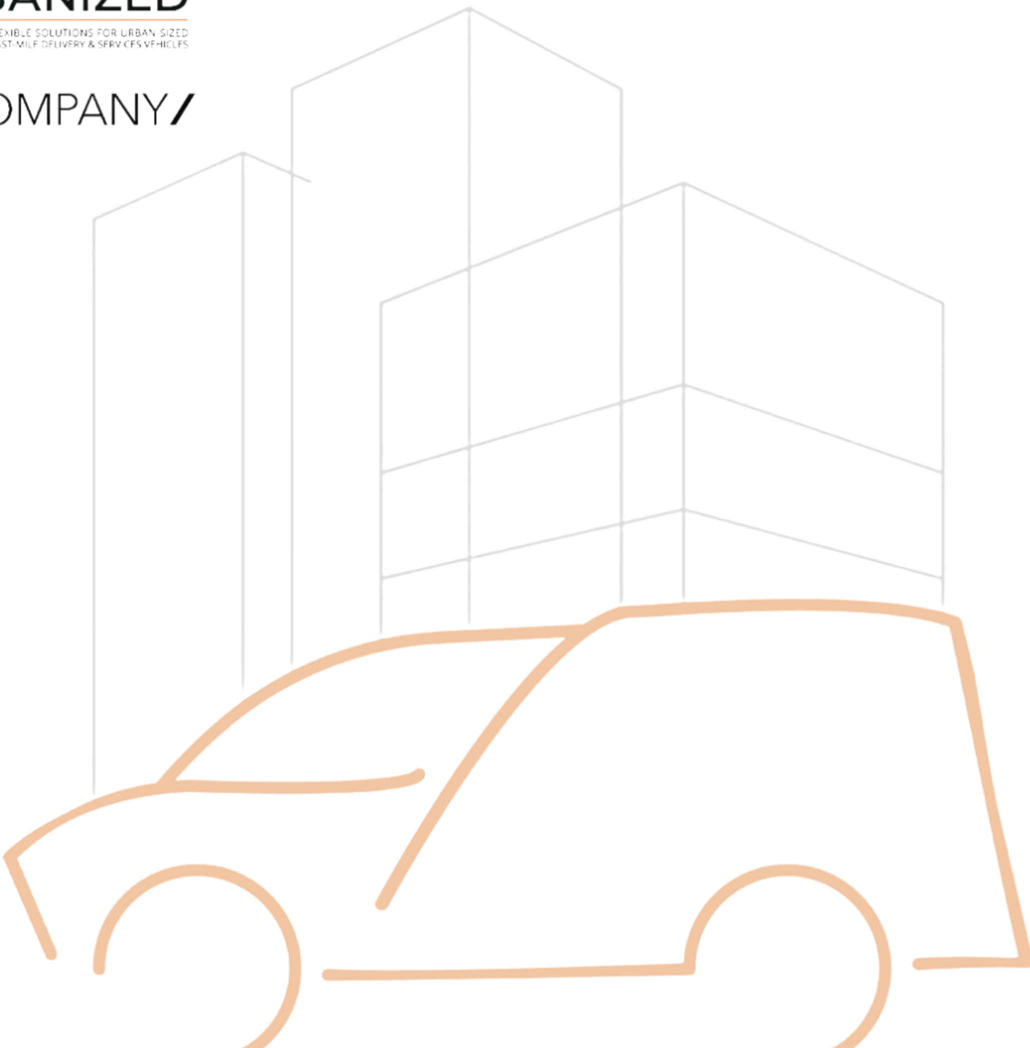
URBANIZED
MODULAR AND FLEXIBLE SOLUTIONS FOR URBAN SIZED ZERO EMISSIONS LAST-MILE DELIVERY & SERVICES VEHICLES

BAX & COMPANY



Keywords

Urban Freight; Electric-Light Commercial Vehicle; Alternative Fuels; Logistics

Executive summary

While only recently has the EU voted in favour of a permanent ban on ICE cars and vans from 2035, the visible transition already grasping the car sector is widely expected to spread to the freight transport sector, most notably in urban areas, where more than 75% of the EU's population is now living.[1]

In line with European Union's general objectives of climate neutrality by 2050 and a 55% reduction of CO_2 emissions by 2030[2], electrifying urban freight transport appears to be one of the key initiatives to help reach these targets, as it could reduce total road transport carbon emissions by at least 3%[3].

This is especially relevant considering the recent COVID-19 pandemic and the resulting change in consumer preferences. The need for same-day and fast deliveries has grown exponentially and is only expected to continue, as the share of urban population constantly increases. By 2050, we expect 83% of the European population to live in urban areas[1].

Therefore, the electrification of urban freight has a major role to play as it shows a high potential impact in all terms: environmental, economic and social, making its completion a critical condition of the EU's objectives fulfilment while bringing other promising benefits such as quieter cities, better working conditions and lower carbon emission levels.

To effectively address these challenges, OEMs and urban logistics operators have undertaken structural changes, taking into account new emission standards proposed by the EU along with the rise of urban vehicle access regulations that gradually reduces the right for polluting vehicles to enter cities. This has led to the development of smaller and cleaner light commercial vehicles, suitable for operating in an urban environment.

Typically, electric-Light commercial vehicles (e-LCVs) appear to be one of the most promising innovations to address these challenges. Through the development of efficient, clean and modulable solutions, they ought to tick all the boxes created by modern consumption patterns and the pressing need for emissions reduction.

However, barriers of various types subsist, thus creating necessary conditions for a full take-over of e-LCVs in the urban logistics market difficult: high technology costs prevent a sudden transition, and acquisition costs remain substantially higher than those of Internal Combustion Engine (ICE) counterparts. Adverse perceptions of range, loading capacity and charging

[1] United Nations, Department of Economic and Social Affairs, Population Division (2018).

[2] "Fit for 55": EU's plan for a green transition, part of the European Green Deal

[3] (Tsakalidis et al., 2020)

infrastructure still subsist in the purchase decision-making process, but they have not deterred fleet managers and logistics operators to adopt more than 45 000 e-LCVs[4]In 2021 alone.

These constraints can, to some extent, explain the modest breakthrough of e-LCVs into the market, but they tend to vanish as a result of policies set up by governments, regions, and cities as well as intensive innovative research undertaken by manufacturers.

Other externalities, such as urban vehicle access regulations (UVAR) are expected to strengthen the uptake of e-LCVs, which by their very nature, i.e., electric and zero-emission, comply with a vast majority of these proposals.

Thanks to a growing number of opportunities enabled by external factors and a rising involvement from governments and local entities, the future seems to be at hand for the e-LCV market**.** This will depend on several considerations mentioned in this report, leaning on academic evidence and market reviews, as well as insights from industrial partners.

[4] N1 BEV registrations in 2021, extracted from EAFO data

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1. Introduction

The logistics sector has been facing a transformation for decades now. Urban access restrictions aimed at improving air quality and safety have, to a large extent, motivated the downsizing of freight vehicles required to access such areas. Such a trend is only foreseen to increase, given the expansion of e-commerce throughout and following the COVID-19 pandemic, and the tightening of urban freight delivery by public authorities due to increased pressure on urban space. Moreover, after decades of dieselization spurred by favourable taxation schemes, the process is receding in favour of alternatively fuelled vehicles, partly due to the restrictions and incentives set in place to reduce air pollution and meet decarbonization goals.

The European Commission has implemented various strategies to increase the uptake and use of alternative fuel vehicles. One of them is fostering the creation of a comprehensive network of recharging and refuelling infrastructure, imposing a binding minimum deployment target for recharging stations across EU members.[5] Another strategy, specifically aimed at carbon reduction, is the setup and tightening of CO2 emission performance standards for new light commercial vehicles (and cars) within the 'Fit for 55' package.

This implicitly provides a strong push for the deployment of zero - and low-emission vehicles.[6] According to the new regulation standards, the average emissions target is set to 147 grams of CO2 per kilometre, with aims to reduce it by 31% by 2030 (compared to 2021). Along these lines, the Commission also imposed an excess emission premium of $112.15 per g/km in excess above the set target. EU member states also promote the adoption of e-LCVs by offering incentives that reduce the total cost of ownership (TCO) of such vehicles through different forms of tax benefits (registration, ownership, company, VAT), purchase subsidies or other financial benefits.

The ever-growing popularity of e-commerce and home delivery services has placed an unprecedented demand on last-mile delivery fleets. While shopping has become easier and more convenient, it is also producing various negative realities for citizens, especially in dense urban areas. To minimise the negative impacts, EU cities have accelerated the development, or revision, of their Sustainable Urban Mobility and Logistics Plans (SUMPs/SULPs). Many cities are also introducing circulation restrictions using urban vehicle access regulations (UVARs). Many times, UVARs specifically target LCVs through low emission zones (LEZs), zero-emission zones (ZEZs), access regulations (ARs) or congestion charges (CCs). To comply with these new

[5] COM (2021)-559 proposed to establish a minimum charging stations deployed power output of 1kW per each e-LCVs BEV registered that year in their territory, and 0.66 kW per PHEV. At the same time, to ensure minimum coverage of charging stations those should be located at most 60 km apart along the TEN-T network and have a power output of at least 300kW by the end of 2025 (and 600kW by the end of 2030)

[6] Such regulations are described in Regulation (EU) 2019/631 and COM (2021)-556

conditions in a timely and efficient manner, fleet managers are increasingly interested in shifting to alternative fuel sources and vehicle types[7].

The use of alternatively fuelled vehicles can help to improve last-mile delivery fleet efficiency in several ways. As an example, electric vehicles can substantially reduce fuel costs and emissions, while also providing a quieter and smoother ride for employees. This helps improve working conditions while reducing noise pollution, inside and outside the vehicle. Similarly, the use of alternative fuels such as compressed natural gas (CNG) or liquefied petroleum gas (LPG) can also help to reduce emissions and operating costs, despite being fossil fuels and still contributing to carbon emissions and pollution.

The EU's commitment to cut greenhouse gas emissions by at least 55% by 2030[8] is making the LCV fleet transition towards electrification crucial. LCVs make up roughly 13% of total road transport CO2 emissions, and their electrification could decrease CO2 emissions from LCVs by 30% by 2030. This CO2 emission cut is equivalent to around a 3% decrease in total road transport emissions.

In addition, total road transport emissions of air pollutants would also decline, including Nitrous Oxide (NOx) by nearly 5% and Particulate Matter (PM) by approximately 3% on an EU average. Local concentrations of PM2.5 could be reduced by almost 2% when distributed equivalently within EU countries[9]. The impact on city air quality could be stronger due to higher LCV activity across the years, an activity that has been boosted due to the Covid-19 crisis. As e-commerce and same-day delivery become more prevalent due to consumers' preferences shifting, a more efficient fleet of e-LCVs with zero tailpipe emissions is needed to turn these potential impacts into reality. Existing literature appears unanimous: e-LCVs can support a cleaner urban distribution of goods[10].

In order to do so, the car industry is currently undergoing a drastic transformation, increasing tremendously their investment in research and development of energy-efficient technologies. EU-funded projects can also take part in this revolution by setting up cross-stakeholder collaboration between OEMs, academics and logistics operators, as the URBANIZED project does. The vehicle being developed seeks to satisfy the new needs of the last-mile logistics sector: flexibility, energy efficiency, and carbon standards compliance. This implies a need to understand the challenges surrounding e-LCVs and their integration into the market, which this report intends to assess.

The report offers an overview of the available evidence on e-LCV uptake, providing quantitative statistics and research results regarding the barriers and opportunities for the adoption of such technology. We run a market analysis to provide insights on e-LCVs, purchase trends and tentative forecasts based on different approaches, giving a comprehensive

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[7] (Sierzchula, 2014)

[8] EC: 2030 Climate target plan

[9] (Tsakalidis et al., 2020)

[10] (Camilleri & Dablanc, 2017; de Mello Bandeira et al., 2019; Scorrano et al., 2021)

overview of what to expect moving forward. Linked to this, we also review government efforts and other trends that are likely to spur the transition towards electrified last-mile fleets. Policymakers and industrial and urban logistics stakeholders will therefore be able to find answers to the questions surrounding the e-LCVs market.

2. Evidence on the e-LCV uptake: an overview

The urban logistics sector is now highly dependent on light vans. In urban European areas, the number of tasks performed with LCVs has steadily increased, and last-mile operators are now using them not only to deliver goods, but also to supply a broad spectrum of essential services throughout cities.

Electric vehicles (M1-Passenger vehicles) have become increasingly common in urban and metropolitan areas. However, the same cannot be said for vans, which have so far been adopted by a proportionally lower share of logistic operators.

When assessing the ins and outs of the electric Light Commercial Vehicle (e-LCV) market, it is essential to determine its key drivers. Research[11] finds that in 2013, during the electrification's early stages, governments and private companies were responsible for the vast majority of global electric vehicle purchases. This claim is supported by a recent study[12] that has identified fleet managers as strong candidates for early e-LCV adoption, due to their intense vehicle utilisation and high purchase rates. Meanwhile, private individuals are not considered to be a significant portion of the target market for this type of vehicle due to its specific purposes, such as commercial and service delivery.

The uptake of e-LCVs in Europe has been hindered by several factors, including the high cost of vehicles, range anxiety, and a lack of charging infrastructure. However, multiple institutional and technical factors have contributed to the growth of the electric LCV market in Europe, including government incentives and the falling cost of batteries.

In this section, we will provide an overview of the main barriers and opportunities related to the e-LCV uptake, using academic evidence as well as business insights from industrial stakeholders.

2.1 Barriers to the e-LCV uptake

E-LCVs present a tremendous potential for urban delivery operators: silent, emission-free, and compliant with many forms of urban regulations. Besides, their beneficial aspects are not limited to urban delivery areas. Studies show that fleet managers express an intention to adopt

[11] (Sierzchula, 2014)

[12] (di Foggia, 2021)

e-LCVs. However, challenging obstacles subsist. Consumers and fleet managers are assumed to face a trade-off between higher upfront retail prices and lower operating and maintenance costs. In addition to the upfront costs, research has identified several barriers to the widespread adoption of electric light-duty vehicles:

On a technical level, these barriers include perceptions of lower performance in range and battery life[13], a lack of availability of charging infrastructure, and a limited loading capacity[14]. The number of charging stations, as well as the types of charging available (standard, semi-accelerated or fast), and their interoperability are issues that concern fleet managers when considering e-LCV adoption[15]. The number and location of stations also have implications on range anxiety and queueing perspectives. Nonetheless, the range of electric vehicles should not be a significant issue when thinking about substituting vans: most of the travel distance is within urban areas where recharging is much more feasible and fleet managers can, and tend to, plan their activities for overnight charging.

However, the availability of fast-charging stations is perceived as desirable for potential boost charging that enables increased vehicle usage and avoids wasting operational time due to queueing. From an interoperability perspective, the type of plug, registration procedures, and payment systems can impose operational constraints on fleet managers in need of boost charging.

Related to depot-based charging, infrastructure is an additional cost that e-LCV fleet managers must face. Moreover, the capacity of the electrical grid and its reliability is a concern for operators, especially with higher levels of electrification of both M1 and N1 fleets.

Furthermore, from a technical viewpoint, due to the size and weight of batteries, e-LCVs tend to be 100-200 kg heavier than their diesel counterparts, and therefore may face a reduction in loading space. In turn, this can lead to a reduction in the number of delivered goods and at a higher unitary price, an issue that could be compensated through changes in operational delivery strategy and central logistical locations (micro-platforms). The potential impact of this may require an adjustment of professional driving license certification requirements (level C1 instead of B) and, if such strategies are not adopted, a possible increase in labour costs may occur. However, ongoing trends are already pushing in the same direction anyway.

In parallel, researchers[17] detected a lack of efficient manufacturer support in case of repair needs, as well as a lack of ICT support for electric freight vehicles. The development of such manufacturer support is required in order to effectively integrate the use of e-LCVs into the daily practices of logistics operators.

These factors lead to a negative perception of the costs and usability associated with e-LCVs, thus hindering their mass adoption. On a financial level, the total cost of ownership seems to

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[13] (di Foggia, 2021)

[14] (Quak et al., 2016)

[15] (Morganti & Browne, 2018)

be the main driver of apprehension for fleet managers, along with high uncertainty on the vehicle's residual value, followed by consumption and infrastructure costs[16].

Still, surveys carried out show that most fleet managers are willing to maintain and expand the volume of activities performed with e-LCVs. This suggests that these technical and financial barriers are surmountable and, as the paragraphs below show, can be tackled by multiple means.

2.2 Opportunities for the e-LCV uptake

Both at the institutional and technical levels, governments and companies have been undertaking a wide range of efforts to enhance the adoption of e-LCVs, thus generating various positive externalities. These external factors, which open the door to numerous opportunities, can be observed from the perspective of a fleet manager (micro). Their effects can be first felt before the purchase decision is made, as they facilitate preconditions for adoption: tax and mobility benefits, as well as subsidies, can substantially abate a perceived total cost of ownership. These financial benefits are available in a vast majority of EU countries.

Still, there is a demonstrated need for wider charging infrastructure, which ought to be developed through governmental incentives. As an example, Germany created a €2.5bn fund to ramp up the implementation of charging infrastructure. Belgium is also offering significant tax reductions on charging costs, whilst other European countries are following these trends. As a result, the perceived performance risk associated with charging e-LCV tends to fade over the years.

In relation to the technical aspects, years of extensive research have made it possible to reduce the major barriers of costs, range limitation and limited payloads. Rigorous estimations[17] found that since 1991, the real price of lithium-ion cells has declined by about 97%. Innovative production methods, new formulations, and economies of scale have enabled this cost reduction, opening the way to substantial improvement in range capacity as well as a decrease in purchase prices, as the battery represents a major share of e-LCVs' manufacturing costs. Between 2011 and 2019, the annual growth rate of the range of battery-electric vehicles (BEV) was 13%,[18] and was expected to continue in this way until recent uncertainty surrounding the price stability of raw materials[19]. Nevertheless, promising technologies such as solid-state batteries are expected to bring cutting-edge improvements both in range capacity and charging efficiency.

[16] (Camilleri & Dablanc, 2017)

[17] (Ziegler & Trancik, 2021)

[18] (BNEF, 2021)

[19] (Forbes, 2022)

From a strategic point of view, managers seek to create and maintain a competitive fleet. Given that e-LCVs are still an innovation with very few adopters, they consider the "first mover" benefit as one of the strongest advantages of adopting e-LCVs. Improving their organization's public image was also observed as one of the most influential factors for managers to adopt electric vehicles, as well as the opportunity to test new technologies[20].

To reach a widespread adoption of e-LCVs, the purchase decision is a necessary, but not sufficient condition. While investigating key motives for the adoption of electric vans[21], researchers identified both push and pull factors amplifying this adoption, led by policy measures such as the use of green certificate systems and the restriction on the use of ICE vans in urban regions. An overview of public policies' effects is further assessed in this report (see sections 3.4.3 to 3.4.5).

In recent years, the electric LCV sector has been able to overcome several technological and financial barriers through support from public policies, intensive innovation research, and external factors such as urban access regulations. It is also important to consider recent externalities, such as soaring oil prices. This surge tends to benefit the adoption of e-LCV, bringing down their total cost of ownership (TCO) relative to their ICE counterparts.

However, the road ahead is still long, as e-LCVs have made only partial breakthroughs in the market. In the subsequent section, we will provide a general analysis of the e-LCV market at a European level. This analysis allows us to determine which countries are ahead and which are lagging behind, while identifying key factors for the widespread adoption of e-LCVs.

3. European e-LCV's market analysis

This section offers an overview of the e-LCV market trends in Europe. We review the evolution of alternative fuel drivetrain adoption in Europe, highlighting front-running countries in terms of volume and penetration rates, laying down market potential scenarios for the upcoming years.

3.1 Evolution of alternative fuel drivetrains

A comparison of EV (M1) and e-LCV (N1) figures for the whole of Europe since 2010 shows that the market share of new registrations of the former has surpassed the latter, despite e-LCV

[20] (Sierzchula, 2014)

[21] (Taefi et al., 2016)

uptake starting slightly earlier. [22] Since 2018, the expansion of EVs market share in new registrations has grown significantly, increasing from 1.9% of newly registered vehicles to around 9% in 2021, with equal figures for PHEV. The uptake of e-LCVs has shown a much more moderate increase, growing from 1.2% BEV in 2019 to 2.9% in 2021. In terms of the total fleet, BEVs currently represent about 0.9% of M1 vehicles (just over 2M vehicles) and e-LCVs below 0.6% (about 166k vehicles).

Within the BEV segment, most new registrations occur in Germany, United Kingdom and France, with volumes that account for 24.8%, 19.8% and 17.6% of all new registrations in Europe during last year, respectively. This means that these three countries alone concentrate more than 60% of the new N1 BEV registrations. The closest follower is Norway (8.8%), far head of Italy (4.8%), Netherlands (4.7%), Sweden (4.1%), Spain (3.7%), Austria (3.4%) and Denmark (2.25%). According to EAFO data shown in Figure 3-1, France is the market where e-LCV uptake started earliest, followed by Germany, where 5,000 BEV N1 vehicle registrations per year were surpassed in 2013 and 2018, respectively. This uptake resembles an exponential trend, with signs of acceleration increasing for later adopters like UK and Norway, who surpassed the 5,000-vehicle barrier in 2020 and 2021, respectively.

Even though Germany, the United Kingdom and France are the European markets with the largest number of registered e-LCVs, the penetration rate among freight vehicles is lower than in other countries with smaller N1 vehicles registration figures, as shown in Figure 3-2. When measuring penetration rate in terms of the share of BEVs over N1 vehicles fleet, we see that Norway is by far the country where the largest share of light commercial vehicles uses a BEV drivetrain (16.7%). Sweden is the closest runner-up with a 7.4% share of e-LCVs over N1 vehicles, followed at a distance by Switzerland (4.5%), Netherlands (4.4%), UK (3.6%), Luxembourg (2.7%), Italy (1.7%) and Spain (1.5%). Germany and France lay far behind with BEV shares below 0.1%. Again, the penetration rate among light commercial vehicles seems to follow an exponential trend.

[22] Market share of new registrations is measured in terms of percentage of newly registered vehicles relative to the total number of vehicles registered in any given category (namely M1 and N1)

Figure 3-1. Evolution of newly registered e-LCVs across several European countries since 2010

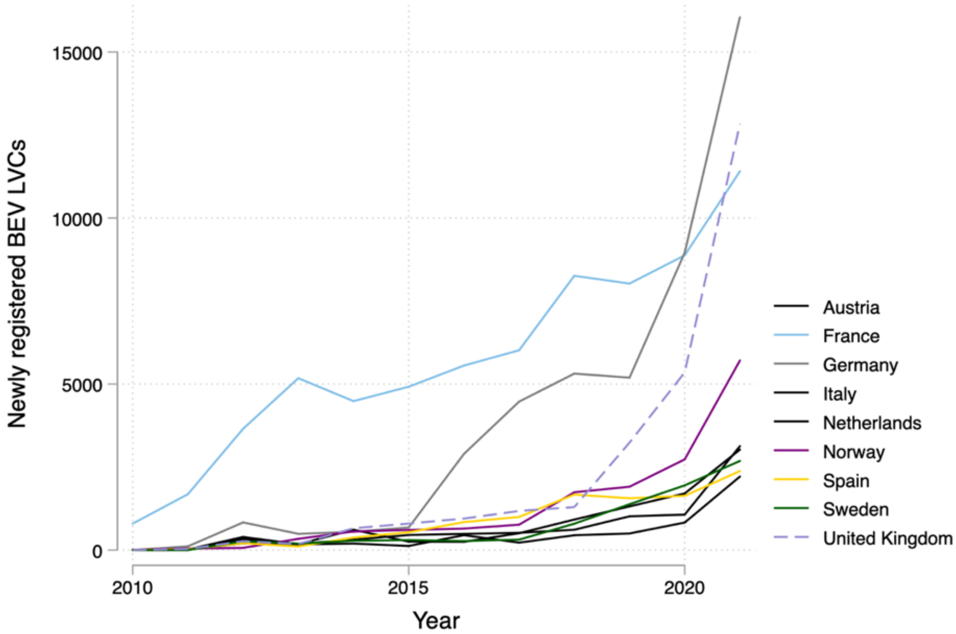
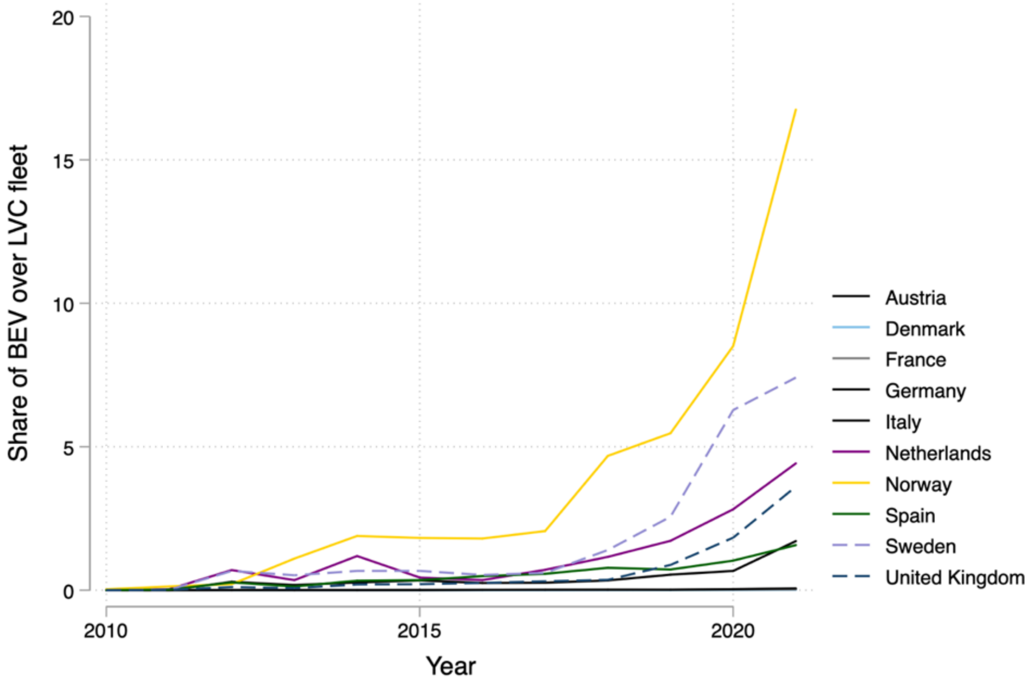


Figure 3-2. Evolution of the share of e-LCVs over the LCV fleet across several European countries since 2010



3.2 Market potential – evidence and tentative forecast

The market potential for e-LCVs in the coming years is not yet clear, and there is a wide variation in forecasted figures across studies and reports.

A pre-pandemic study based on statistical distributions of the driven distances, range constraints, and the TCO for alternative vehicle options assessed an upper bound of the potential market share of e-LCVs in France in 2016 as somewhere around 6% when the actual figure was just 1.36%. This shows the relevance of barriers to adoption in order to realize the true market potential of e-LCVs, where they suggest that uncertainty surrounding the residual value of the vehicle, consumption, and infrastructure costs are the prime factors leading to lower-than-expected uptake. This same study also forecasted a market potential of around 13% in 2021, assuming an increase in battery size and reduction of its prices.[23]

This, and other studies consistently point out that the TCO of e-LCVs is already lower than their ICE counterparts, yet such cost advantage is not fully grasped, thus not translated into e-LCV uptake. Examples include vehicles such as; Peugeot Partner Full Electric L1, Nissan eNV-200, Renault Kangoo Z.E. Maxi, and Peugeot Partner Full Electric L2, with a greater cost advantage when petrol and diesel prices are higher.[24] Evidence also suggests that TCO for e-LCVs will become the lowest on average across European countries in the upcoming years, which is already the case in several, even without incentives. With respect to the pace of uptake, a Bloomberg NEF forecast predicts that in Europe, e-LCVs' market shares will reach 17% in 2025, 36% in 2027 and 73% in 2030.

This forecast is based on a bottom-up approach that takes into consideration the evolution of indicators such as GDP, EV range, upcoming model launches and price parity with ICE, in combination with the demand curve describing the mass of customers willing to purchase at certain price ranges. This allows for the assessment of the portion of the market addressable by e-LCVs and a generalized Bass diffusion model[25] to forecast long-term trends.

Some market research reports suggest that the e-LCV market will grow at a compound annual growth rate of 4.5% from 2021 to 2026, which at such a rate implies a 55% increase in the number of vehicles by 2030 (Mordor Intelligence, 2021). Other, less optimistic studies point towards penetration levels peaking around 40% by 2030 under current technological incentive schemes by simply projecting uptake trends, meaning e-LCVs would settle around 1.3M vehicles in Europe[26].

An even more conservative approach to evaluate e-LCV market potential would be to use EAFO data and expand past trends (over the last decade). The estimation of a simple log-linear model

[23] (Camilleri & Dablanc, 2016)

[24] (BNEF, 2021; Scorrano et al., 2021)

[25] Forecasting model consisting of a simple differential equation, describing the adoption process of new products in a population following an s-shaped curve for the cumulative number of adopters.

[26] (Frost & Sullivan, 2021)

suggests an average BEV drivetrain vehicle fleet increase of 28.4% per year based on historical data at a European level, which, when projected to 2030 implies that the actual e-LCV fleet is expected to double current figures (around 6% penetration rate), increasing up to 378,000 vehicles across Europe. Obviously, this figure is a continent-wide estimate that does not consider the uptake acceleration in the last few years (especially experienced by frontrunner countries), nor the cumulative effect of incentives and regulations set in place in recent years.

When taking a long-term view, previous figures could be adapted to lower- and upper-bound estimates based on actual data. On the one hand, based on the actual alternative-fuel drivetrain fleet within Europe, we estimate that by 2040, the lower bound market potential for e-LCVs will be roughly 620,000 vehicles (equivalent to an 11% penetration rate) with a realized market worth of around €15,500M. This is a bare minimum, long-run estimate solely taking into consideration the actual uptake of alternative fuel vehicles (already purchased) that are progressively renovated to BEV. Such estimates implicitly assume that all customers moving away from ICE will not go back to it. These figures are expected to be higher, as adoption will increase significantly in the following years as fleet managers switch to e-LCVs due to their associated environmental and economic benefits, spurred by public policies supporting such transition. On the other hand, considering that several governments, cities, and OEMs have committed to phase out fossil fuelled vehicles by 2040 (as announced at COP26), we can assess the upper bound market potential based on the actual figures of LCV fleets across Europe. This means that the full conversion of N1 fleet to e-LCVs would imply an upper cap of 5.5M vehicles (100% penetration rate) and €138,000M market worth, a scenario only feasible when all barriers to adoption are completely removed and ICE vehicles are completely phased out.

The European e-LCV market is generally concentrated around the main OEMs, with two models dominating the scene: Renault Kangoo Z.E. and Nissan E-NV200. All major players are bringing in new models to cover part of the rapidly increasing demand for electric motorizations, with technological innovation in powertrain performance and safety features. Examples of this include: Nissan unveiling the upgraded NV300 Combi, Ford setting out for production the new E-Transit delivery van, and General Motors announcing BV1 as an all-electric van. Despite the existence of sunk costs (investments which cannot be recovered) involved in vehicle development and manufacturing, the market is contestable, allowing for the entrance of new players. This can keep prices in check, despite the increase in demand driven by e-commerce expansion and the incentives introduced by the public sector.

3.3 URBANIZED vehicle market fit

URBANIZED commercial e-vehicle is designed to introduce a high-performance e-powertrain, a modular/interchangeable cargo body fit for different urban freight transport use cases, and an integrated energy and fleet management strategy (using data, connectivity and learning algorithms).

It aims to achieve future-proofed urban-readiness by integrating flexibility and adaptability through modularity in the design of e-LCVs, making vehicles more adaptable to a larger range of on-demand UFT services, while reducing the number of necessary vehicles and substantially improving last-mile delivery operations' efficiency. The new vehicle, based on the Alkè proprietary ATX electric N1 platform, will be able to optimally perform under different UFT use cases with modular cargo solutions, to be demonstrated in two specific pilots: last-mile parcel delivery operations (with BPost in Belgium); and HoReCa and on-demand (time-sensitive) service with auxiliary tooling power needs (with Coffee Island in Greece).

This allows it to cover a wide range of needs for fleet managers in different logistic sectors: Retail, HoReCa, Postal services, Construction and road services, Waste are expected to benefit from the URBANIZED vehicle's modularity and high energy-efficiency. An optimistic scenario would suggest that by 2030, more than 15,000 URBANIZED vehicles will be adopted by fleet managers, mainly in the retail, HoReCa and construction sectors.

3.4 Moving forward: ongoing trends and limiting conditions for a general e-LCV take-off

The e-LCV market is still in its nascent stage, with a large section of the total light commercial vehicle market still being dominated by the conventional internal combustion engine (ICE) LCVs.

However, this market is gradually picking up the pace, with market share reaching double digits in some countries, following a seemingly exponential trend. Identifying and focusing on the most appropriate sectors is essential to ensure a successful market take-off.

3.4.1 Most suitable sectors and market segments

The most favourable sectors for e-LCV market penetration have a relatively higher proportion of journeys that are both predictable and within the range of the vehicle's battery capacity. This would ensure that range anxiety, which is one of the primary concerns for fleet managers, is addressed to a certain extent. Additionally, the sector should have a lower average speed, which would help maximize the vehicle's range. These are typical features of urban areas.

Previous research[27] revealed that the commercial sectors most favourable to a shift to electric mobility are those with larger sizes of vehicle stock, higher overall mileage, and longer average daily travel distances. Typically, light vans in construction and health services, as well as in administrative and support services appear to dispose of these features, alongside parcel and post deliveries.

[27] (Christensen et al., 2017)

3.4.2 Vehicle and battery manufacturing

As e-LCVs are a relatively new technology, their cost-competitiveness has been debated. While investigating the cost-competitiveness of e-LCVs with respect to their diesel and petrol counterparts, researchers[28] find that a short majority of e-LCVs have, on average, a higher total cost of ownership. Even so, the existing fleet of e-LCVs is diverse, and some e-LCV models operating in urban areas are already more cost-efficient than their diesel equivalents. The same research documented that "urban driving strengthens the e-LCV competitiveness[28], certainly because the energy required for fossil-fuelled vehicles is higher at lower speeds, which substantially reinforce the competitiveness of e-LCVs.

However, to ensure a general take-off of the fleet, several conditions have been identified to achieve price competitiveness of the entire e-LCV line. Some must be seriously considered, as results suggest that *"major fuel price inflation rates will be needed over the next 15 years to ensure the competitiveness of electric commercial vehicles"*[29]. As of 2022, this condition seems to have been met, as a result of the brutal surge in oil prices and the level of competitiveness achieved by certain segments of the e-LCV market.

Additionally, the significant role that subsidies and tax benefits play in reducing the total cost of ownership should not be taken for granted. Most of the incentive schemes are voted for short periods, making the continuity of these incentives a critical condition in the price-competitiveness of e-LCVs over the long term.

According to recent studies[30], the transition to zero-emission vehicles in the car fleet is also expected to impact the uptake of e-LCVs through TCO reductions, due to economies of scale in components manufacturing as has been observed in the manufacturing of batteries. In fact, the price per kilowatt-hour (KwH) of lithium-ion batteries has dropped drastically in recent years due to increased production and capital investment, owing to the uptake in passenger EVs[31]. To illustrate: the average EV battery price dropped from $1,200 per KwH to $132 per KwH between 2010 and 2021[32] . However, the price drop of the most common EV battery has slowed, and prices appear to be stabilising.

There remains much uncertainty surrounding EV battery prices, as the supply of lithium, cobalt and nickel is stressed by their price hike and EV uptake, currently intensified by the supply chain disruptions caused by the COVID-19 pandemic. Another price development is occurring for solid-state batteries, proclaimed by many as one of the next generation batteries. Their

[28] (Scorrano et al., 2021)

[29] (Feng & Figliozzi, 2012)

[30] (Witkamp et al., 2017)

[31] Statista, 2022

[32] BNEF, 2021

respective prices have been forecasted to drop from $800 to $400 per KwH between 2022 and 2026[33]. Car manufacturers will have to wait longer to reap their benefits, it seems.

Nonetheless, conditions are ripe for widespread adoption of e-LCVS in the coming years. With many countries focusing on high-potential sectors and intensively investing in battery development, it is highly likely that e-LCVs will become more affordable and therefore, more widely purchased. Additionally, the growing pessimism towards fossil fuels, alongside the pressing need to reduce CO_2 emissions in order to comply with the objective of carbon neutrality provides even more incentives for widespread adoption of e-LCVs. However, the crucial role played by public policies should not be neglected as it is one of the main factors lowering the financial barrier posed by the acquisition cost.

The consumers' perception on product novelty and long-term relationship between manufacturer and operator also introduce some challenges for e-LCV adoption. Efficient OEM support in case of repair, limited production and availability of models, the development of ICT support tools to optimize vehicle and battery usage under daily practice in combination with available infrastructure[34] are still to be considered as key conditions and factors to the e-LCV uptake.

As mentioned in section 2.1, e-LCVs could face a reduction on payload, imposing higher unitary prices and labour costs due to higher weight of batteries and the need for driver's license certification. Dispensations allowing operators to go above 3.5 tons with the same licensing permissions are expected to expand the possibilities of e-LCVs through increased opportunities for a more efficient vehicle use in a scenario where drop density increases for home deliveries. It is true that certain exemptions already exist, yet the lack of clarity about whether they will continue introduces too much uncertainty amongst fleet management decision-makers.

The cycle of new e-LCV design, certification and commercialization is long, reducing the opportunities of fast entrance for new, smaller OEMs and the rapid coverage of emerging needs. This advocates for vehicle modularity.

3.4.3 Governmental incentives

We have seen a rise in regulatory measures towards decarbonization and the promotion of vehicle fleet electrification at both city and national levels. There is a variety of policy measures to stimulate the shift from fossil-fuelled to alternatively-fuelled and clean vehicles. The most observable financial measures include the following: Exemption or reduction in registration tax, value-added tax reduction, company tax benefits, discounts on urban road tolls or free parking.

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[33] Research and Markets, 2019

[34] (Quak et al., 2016)

When studying the incentives at a European level, it is difficult to see a common pattern. Indeed, each country perceives its situation and needs differently, even if there is a common base of measures, such as subsidies and tax reduction. These discrepancies are not visible in the type of incentives, which are similar from one country to another when offered, but rather in their magnitude: each country does not incentivize its citizens and companies to acquire clean vehicles in the same way.

According to the ACEA[35], only 17 EU member states are offering incentives for the purchase of electric vehicles. Among these incentives, tax benefits seem to be one of the standard options used by governments to push their citizens' and companies' decisions to shift towards electric vehicles. These tax benefits can vary both in type and scale, but we observe a common core of measures involving registration tax, ownership tax and VAT benefits. When overviewing the registration tax benefits offered, we can find some consistent schemes across countries. When offered, the registration tax benefit brings on average a rebate of 94,5% on the registration tax[36], as most of the countries offer a full registration tax exemption, thus reducing this first barrier.

In terms of ownership tax reduction, most EU countries provide an average reduction of about 75%. Some consistency among countries is also observable even if slightly more disperse than registration tax, with a standard deviation of 19% in the registration tax reduction and 35% in the ownership tax reduction. Conversely, the availability of VAT benefits appears to be patchy across countries, as only 6 schemes are available in Europe - a sign that the focus is not on business vehicles but rather on individual use.

Purchase subsidies present the same characteristics as the other financial incentives: when available, they differ in their amount, which cannot be explained by the differences in purchase car prices among countries but rather on the governments' willingness and resources allocated. A summary of the different incentives applied in countries with the largest uptake figures is provided in Table 3-1.

As we stated in section 1, TCO advantage in favour of e-LCVs is further enlarged by government incentives, and it is safe to assume that this has a positive impact on the purchase of this type of vehicle (holding everything else equal). However, to the best of our knowledge, there are no studies assessing the specific impact of the different incentives on e-LCV adoption.

Studies have been carried out to assess the impact for electric vehicles. However, these are not directly transferable to the information needed to analyse the e-LCV market, and therefore do not provide direct reference points. Those studies point towards a positive relationship, but the magnitude of the effect is quite heterogeneous. For example, a Norwegian study[37] estimates that a 10% increase in tax incentive correlates with an increase in BEV purchases of around 3% on average, smaller than the effect they seem to have on PHEV or HEV, arguably

[35] ACEA, 2021

[36] Bax&Co calculations based on a compilation of data from ACEA & the European Alternative Fuels Observatory

[37] (Yan, 2018)

due to consumers comparative unfamiliarity with such solutions (in terms of future costs, benefits, reliability, convenience, etc.) that makes demand less responsive. Taking Canada as a case-study[38], researchers find that $1000 in tax rebates does increase market share for HEV by 30%. While one of the earliest papers[39] on this topic found a non-significant impact of monetary incentives on the increase of market share for HEV in the US during the early 2000s, more recent studies[40] find a positive and significant impact of financial incentives and charging infrastructure on EV adoption. It is worth noting that a vast majority of the studies on the effect of incentives focus on single consumer adoption and rarely on the adoption of electric vehicles from fleet managers (most common scenario for e-LCVs opposite to EVs), where a different set of issues might be more salient.

[38] (Chandra et al., 2010)

[39] (Diamond, 2009)

[40] (Sierzchula et al., 2014)

Table 3-1. Overview of nation-level incentives on battery-electric vehicles, 2022

Countries	Registration Tax Reduction	Ownership Tax Reduction	Company Tax Reduction	Purchase Subsidy
Austria (1)	100%	100%	100%	12.500 €
Denmark(2)	60%	78%		
France(3)	100%		100%	7.000 €
Germany(4)		100%		9.000 €
Italy(5)		100%		8.000 €
Netherlands(6)	100%	100%	30%	
Norway(7)	100%	15%		50.000 NOK
Spain(8)	100%	75%		5.000 €
Sweden(9)		100%		70.000 SEK
United Kingdom(10)	100%	100%	100%	8,000£

Notes: reductions are expressed in percentages of the tax value; a reduction of 100% is a tax exemption. Purchase subsidy values are expressed as the maximum subsidy available. Incentives aiming directly at N1 vehicles are featured in bold.

Prerequisites to benefit from these incentives are country-specific, and stand as follows: (1) all cars below 141g Co_2/km are registration tax-free. BEVs are 100% tax-exempt from all relevant federal taxes, except VAT. Zero-emissions cars such as BEVs are entirely exempt from the benefit-in-kind tax. Businesses and municipalities can receive up to 12.500€ for the purchase of an electric light commercial vehicle (e-LCV) with a weight of over 2.5 tons, and 7.500€ for an e-LCV with a weight under 2.5 tons. Conditions: purchase price not over 60.000€ including VAT; (2) Zero-emission cars pay 40% of the registration tax. Ownership taxes are based on CO_2 emissions, BEVs pay the minimal tax of DKK 340, equivalent to a 60% reduction. No purchase subsidies are available; (3). Region councils provide registration tax exemption, either 50% or full exemption for alternative-fuelled vehicles (BEV, PHEV, FCEV, HEV, CNG, LPG, E85). For company tax reduction, vehicles emitting less than 20g of CO_2/km are exempted from emission-based tax (TVS). A subsidy of 5.000€ is provided for businesses for the purchase of a car or van emitting ≤ 20g of CO_2/km; (4) Until 2030, full ownership tax exemption for BEVs. A subsidy of 9000€ is granted for the purchase of a BEV with a net list price under 40.000€; (5) BEVs are exempted from the annual ownership tax for a period of five years from the date of their first registration. A special fund provides up to 8000€ for the purchase of a fully electric light commercial vehicle; (6) zero-emissions car are exempted from the registration tax. Exemption of road tax is granted for full-electric cars; (7) BEV have been exempted from the registration tax since 1990. VAT and registration tax exemption are only granted to BEVs. They are also exempted from the re-registration fee as of 2021. BEVs are granted a reduction on ownership tax and only pay a scrapping fee of NOK 455, equivalent to a 15% reduction. Companies that purchase electric vans can receive between 15.000 and 50.000 NOK; (8) Exemption from "special tax" (equivalent of registration tax) for vehicles emitting up to 12g of CO_2/km. main cities (Madrid, Barcelona, Valencia etc) offer a reduction of 75% for BEVs in main cities. For BEVs with a net list price < 40.000€ ae granted a 30% reduction on the benefit-in-kind tax. Electric vans can receive from 7.000€ to 9.000€, depending on scrapping; (9) BEVs are exempted from annual circulation tax for the first five years after registration. As of 2021, the maximum bonus available for the purchase of an electric car is 70.000 SEK (approx. 6.560€); (10) Since 2017, registration tax exemption is granted to zero-emission vehicles with value under 40.000£. Same conditions are applied for ownership tax. From April 2021, zero-emissions vans are exempted from company tax.

Source: European Alternative Fuels Observatory; ACEA

Based on the incentives review conducted previously, we can see that policymakers are likely to set up incentives in a "neutral" way, aiming to promote different alternative fuel technologies. However, substitutive powertrain options imply that incentives can interact by stealing demand from each other (think about a fleet manager facing the decision to substitute ICEs for any of the available AF options, what they consider are relative prices and savings). Such situations can, to some extent, undermine the transition of ICE fleet toward e-LCVs.

Moreover, we have observed strong discrepancies among countries in the way they subsidize alternatively fuelled vehicles. A lack of clarity in the aim of incentives has also been noted, creating a blur on the targeted segments, as some countries design incentives aimed at consumers while allowing companies to benefit from them. This has also been observed in the treatment differences across drivetrains. Countries such as Hungary and Czech Republic provide certain tax benefits without differentiating for drivetrains. Such impreciseness may result in inefficient outcomes as only battery-electric (BEV) and fuel-cell electric vehicles (FCEV) are able to function without generating emissions.

In any case, further research on the appropriateness of incentives is much needed. Little is yet known about the effectiveness of past and ongoing interventions, and the causal effects of those on operators' decision-making about e-LCVs adoption. This missing gap can be explained by the absence of exploitable data compiling incentives in a timely manner, and by the lack of a comprehensive framework to assess the causal effects of incentives on e-LCVs adoption.

3.4.4 Regulation

Additional measures taken by governments that could impact the uptake of e-LCVs must also be considered. Rather than the 'carrots' described in the previous section, we must now study the 'sticks' in order to understand the full implication of governmental involvement in these markets**.**

The regulatory framework affecting competing alternatives can imply an incentive to purchase readily available electric models that satisfy CO_2 regulatory thresholds, as a growing number of cities are already restricting access for certain polluting vehicles.

Moreover, within the European Union, vehicle access regulations are becoming increasingly common in capital cities, as well as other, large cities. These regulations typically restrict the use of internal combustion engine (ICE) vehicles, while gradually incentivizing the adoption of electric vehicles for both individuals and businesses. In some cases, these regulations may take the form of low-emissions zones (LEZ), in which only vehicles that meet certain standards are allowed to enter. In other cases, such as in London, a zero-emissions zone has been planned, in which only zero-emissions freight vehicles will be allowed to circulate. Low-traffic zones are another measure adopted in cities, such as Milan, where only certain types of vehicles are allowed to enter depending on the time of the day (not necessarily tied to vehicle efficiency levels).

All in all, we have counted nearly 700 urban vehicle access regulations implemented across Europe. As explained above, they vary in size, type and standard, but all serve the same purpose: to reduce congestion and other negative externalities associated to vehicles (air pollution and carbon emissions) while incentivizing the use of cleaner and smaller vehicles. Of these 700 urban access regulations, only about forty regions have officially planned a full ban on diesel and petrol fuelled vehicles. Even though this number seems small, it is important to consider that these regions are facing high pollution peaks and also have higher leverage in both institutional and financial means, allowing them faster and stricter implementations of UVARs.

While conducting a generic review of the urban access regulations, we observed roughly the same pattern of financial incentives. We provide below an overview of the evolution of emissions standards required to circulate, in the regions assessed. We observe that the required standards are gradually becoming stricter, trending towards a total ban on internal combustion engines by 2030 that is very likely to spread to many other European cities.

By 2030, the EU will have implemented even stricter emissions standards (Euro 7), which will further increase the pressure on ICE vehicles, especially in the commercial sector whose competitivity will be tremendously affected by sanctions in case of non-compliance.

Table 3-2. Overview of urban vehicle access regulations currently implemented and planned across several European cities/regions

Region/City	Zone type	Restriction detailed	2022		2022-2025		2025-2030		2030	
			Petrol	**Diesel**	**Petrol**	**Diesel**	**Petrol**	**Diesel**	**Petrol**	**Diesel**
Vienna	LEZ	Min. standards	3	3						
Greater Paris Metropolitan Area	LEZ	Min. standards	4	4	4	5	6	Banned	Banned	Banned
Brussels & Wallonia Region	LEZ	Min. standards + permit needed	2	4	3	6	4	Banned	Banned	Banned
Milano	LEZ & LTZ	Min. standards	3	6	4	6	5	6	Banned	Banned
Amsterdam[1]	ZEZ Logistics	Min. standards	4	4	5	5	Euro 6 until ban in 2028	Euro 6 until ban in 2028	Banned	Banned
Oslo[2]	URT	Charging Scheme	Zero-emission vehicles benefit from advantageous discounts (amount depend on city charging scheme)							
Madrid Barcelona	LEZ	Min. standards	3	4						
Stockholm	LEZ	Min. standards	6	6						
London	URT	Charging Scheme	BEVs can benefit from a full exemption of the charge							

Note: This table is intended to provide an overview of the urban access regulations of the cities covered in this report and is not meant to be exhaustive.

Numbers expressed under "Petrol" and "Diesel" represent the minimal Euro standard required to circulate.

(1) Around 35 cities in the Netherlands have adopted this scheme, including Delft, Den Haag, Eindhoven, Groningen, Maastricht, Rotterdam, Utrecht.
(2) 7 cities have adopted this urban road toll scheme, including Bergen, Oslo, Haugesund, Kristiansand, Stavangern, Tonsberg, Trondheim

Key: LEZ = Low Emission Zone; LTZ = Low Traffic Zone; ZEZ = Zero-Emission zone; URT = Urban Road Toll; BEV = Battery-Electric Vehicle

3.4.5 Infrastructure

Number of stations, types of charging available (standard, semi-accelerated or fast), and their interoperability are issues that worry fleet managers when considering e-LCV adoption[45]. The number and location of stations has implications from range anxiety and queueing perspectives. A limited range for electric vehicles should not be considered such an issue when analysing the substitution of vans instead of HGVs, as most of e-LCVs' travelled distance is within urban areas, where recharging is more feasible and fleet managers tend to plan their activities for overnight charging.

However, the availability of fast charging stations is perceived as desirable for potential boost charging that enables increased vehicle usage and avoids wasting operational time due to queueing. From an interoperability perspective, the type of plug, identification, and registration procedures and payment systems can impose operational constraints to fleet managers in need of boost charging.

Related to depot-based charging, infrastructure is an additional cost that e-LCV fleet managers need to face. Moreover, the capacity of the electrical grid and its reliability is a concern for operators, especially with higher levels of electrification of both M1 and N1 fleets.

When considering the goals set by the EU[46], most of the countries assessed in this report comply with the objective of 1kw per registered e-LCV. It should be noted that this sample is not intended to be representative as we have considered the countries where data was processable, i.e., the most "advanced" countries in this current transition.

On the qualitative side, the development of fast-charging stations is a necessity. Classic charging stations (<22kW) allow vehicles to be fully charged within a night, while fast-charging stations allow a much quicker charge, within an hour or less. For urban logistics operators, access to fast-charging stations is a key enabler to fully switch their fleet to electric, as it allows them to recharge during the daytime, in between delivery rounds. From a logistics perspective, an easier access to fast-charging stations would result in a major advantage as it reduces the need for large fleets and allows for a more flexible and nimble operation.

Recent studies[47] found that the slight increase in the sales of N1 battery-electric vehicles may be due to a lack of infrastructure, where charging infrastructure is strongly correlated with country's GDP. Similarly, a Dutch study[48] finds a positive and significant correlation between EV adoption and charging availability. Regression results suggest that an additional charging station could have more impact on EV adoption than a 1000$ increase in financial incentives,

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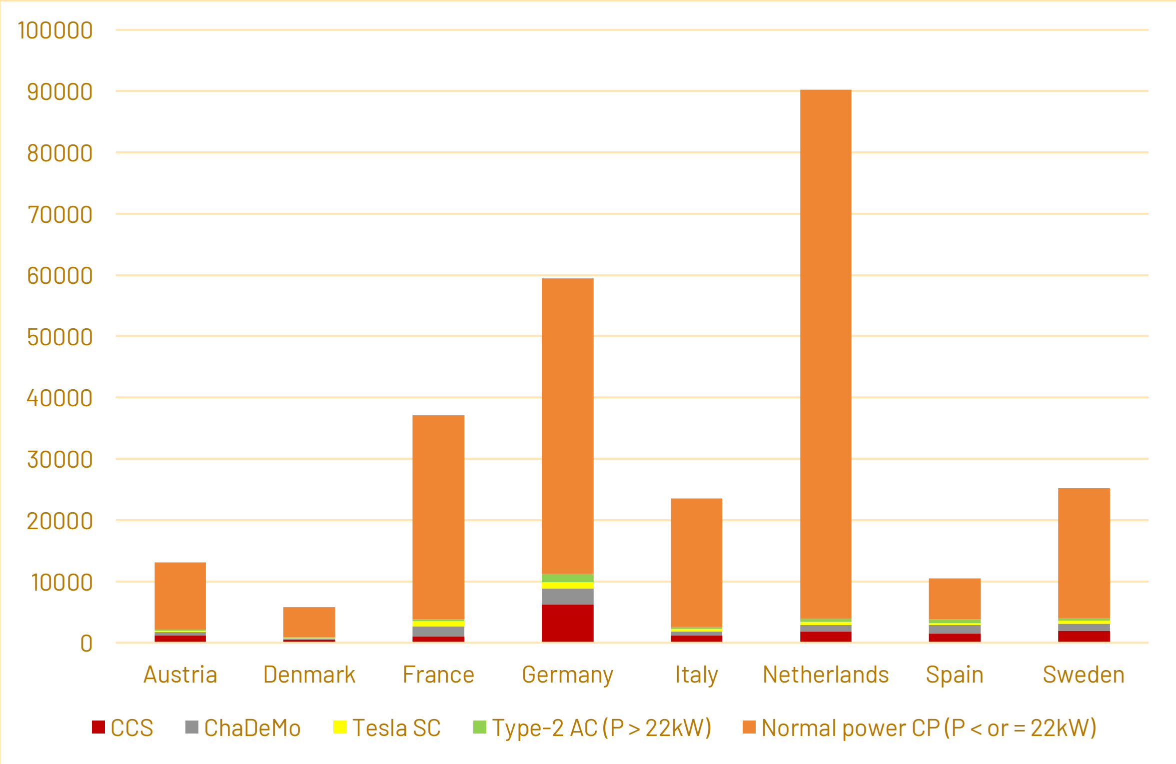
[45] (Morganti & Browne, 2018).

[46] COM(2021)559 proposed to establish a minimum charging stations deployed power output of 1kW per each e-LCVs BEV registered that year in their territory, and 0.66 kW per PHEV. At the same time, to ensure minimum coverage of charging stations those should be located at most 60 km apart along the TEN-T network and have a power output of at least 300kW by the end of 2025 (and 600kW by the end of 2030)

[47] (Osieczko et al., 2021)

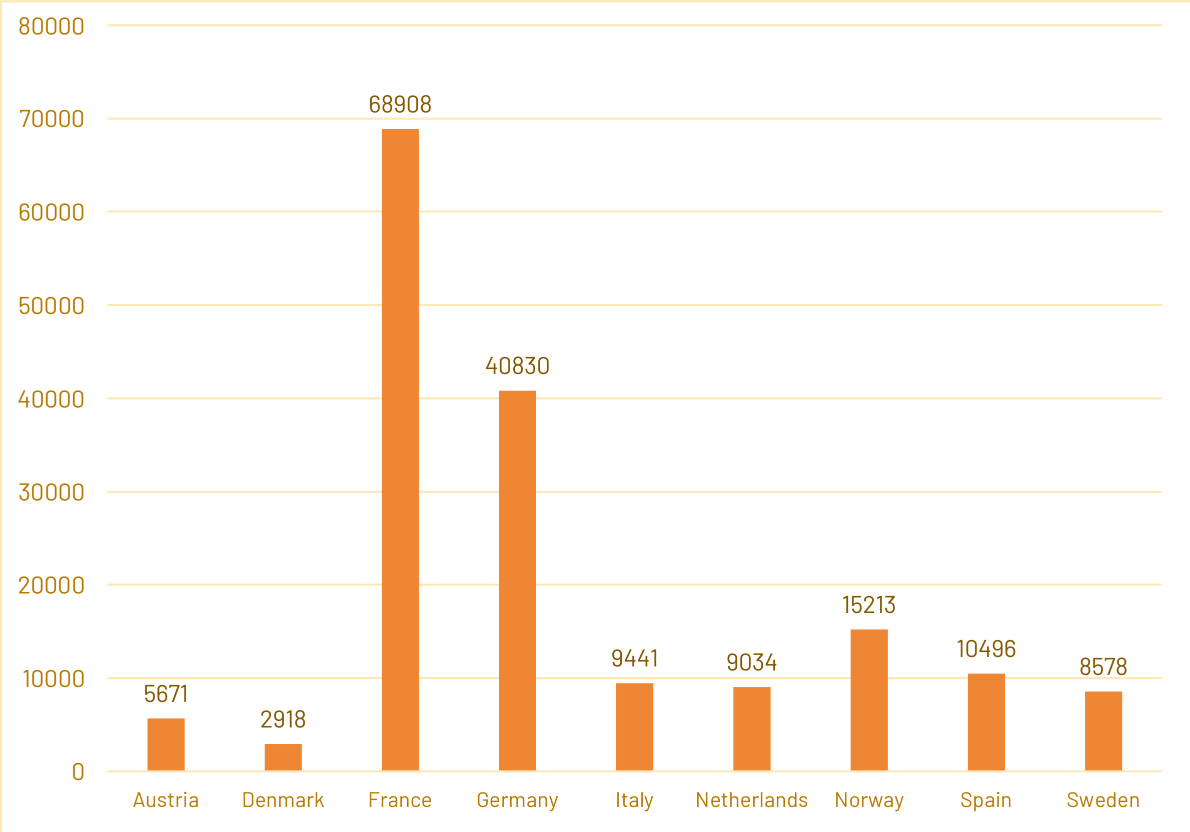
an important assumption to consider when designing policies. In all instances, adapting and extending the existing infrastructure is crucial to the upcoming takeover of electric vehicles and, therefore, those of e-LCVs.

Figure 3-3. Number of charging stations across several European countries



Source: European Alternative Fuels Observatory

Figure 3-4. Number of N1 Battery-electric vehicle across several European countries



Source: European Alternative Fuels Observatory

4.Conclusions

The logistics sector is facing simultaneous transitions. Changes in consumer purchase preferences, with the expansion of e-commerce and instant deliveries, is putting pressure on urban environments and spurring the downsizing of city logistics fleets. Tied to this, cities have introduced UVAR to tackle carbon emissions and other negative impact of ICE vehicles in urban areas (mainly congestion and air quality), spurring the transition towards alternatively fuelled vehicles. Moreover, carbon emission standards and charging stations binding minimums set up by the EC, jointly with EU member states' incentives schemes, further promote vehicle electrification to achieve the EC commitment to emission-free freight transport by 2030.

When analysing opportunities for e-LCV uptake, evidence consistently points towards the following:

- In many cases TCO is already favourable for e-LCVs when compared to their ICE counterparts.
- E-LCVs show a high potential for urban delivery operators, especially for segments with large number of short-range journeys, low average speed and high vehicle stock. Fleet managers are better able to exploit e-LCV advantages through intense vehicle utilization and high purchase rates.
- Technological developments on batteries and their usage have already improved range capacity and payload issues. Further improvements are expected in upcoming years, potentially lowering its cost (conditional on materials scarcity).
- Prospective future scenarios with high fossil fuel costs increase e-LCV attractiveness.
- Subsidies and tax benefits seem to play a crucial role in tilting TCO in favour of e-LCVs, until economies of scale in components manufacturing allow for further cost reduction.
- UVARs are expanding across Europe and further tightening vehicle efficiency thresholds imposed to allow circulation within urban areas. In many cases, plans are to completely ban ICE vehicles by 2030, which, it is expected, should lead to an acceleration of the e-LCV adoption rate.

Through a market analysis, we can assess the evolution of e-LCV uptake. Three countries (GR, UK, FR) concentrate more than 60% of the volume of registrations in Europe (where adoption also started earlier). Later adopters show a much faster paced increase in registration figures, although total numbers are still low, and penetration rates follow an exponentially increasing trend, with countries such as NO and SE the front-runners (16.7% and 7.4%, share of BEV within N1 vehicles, respectively).

Current figures are still far from the estimated market potential, suggesting that adoption barriers are still in place. Current penetration rates of e-LCVs at EU level are around 2.9%, while its potential has been estimated at around 13% with current incentives and policies in place. Through market analysis we estimate that a 6% penetration rate is to be expected by 2030 if evolutions follow historical data trends, with quite some certainty that the uptake will be faster as shown by the most recent data. More optimistic estimates suggest penetration rates could surpass 17% by 2025 and end up somewhere between 40% and 73% by 2030 (depending in how optimistic the market analysis is).

The main challenging obstacles that still subsist are:

- E-LCV adopters still face a trade-off between higher upfront purchasing price and saving in maintenance that will arise during the vehicle lifespan, while consumers tend to give more consideration to present factors, than those in the future. Financial benefits and subsidies help to relieve such perception burden.
- Uncertainty about vehicle residual value and efficient manufacturer support also enter the TCO calculation, increasing the risk of e-LCV adoption and hindering its uptake.
- Lack of evidence on how much each type of financial incentive contributes to e-LCV uptake might hinder long-term political support for them, generating uncertainty about TCO. Moreover, technology-neutral incentives (how it is set up) can be somewhat detrimental to the speed of the transition, as drivetrain options are substitutes to a large extent.
- Availability of charging infrastructure and interoperability (range anxiety and queuing) are still an issue for operational flexibility, and positively correlate with BEV adoption. Depot-based charging implies that some investment and grid reliability is also a concern.
- Higher weight of e-LCVs imposed by batteries can imply a reduction in loading space and labour costs through driving license certification, where dispensations for e-LCVs can play a role (at least reducing uncertainty) until further technology developments can fully overcome that.

5. Acronyms

Acronym	Meaning
BEV	Battery Electric Vehicle
HoReCa	Hotel/Restaurant/Catering
ICE	Internal Combustion Engine
KPI	Key Performance Indicator
LCV	Light Commercial Vehicle
LV	Low Voltage
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
SUMP	Sustainable Urban Mobility Plan
SULP	Sustainable Urban Logistics Plan
TRL	Technology Readiness Level
TCO	Total Cost of Ownership
UFT	Urban Freight Transport
URBANIZED	modUlaR and flexible solutions for urBAN-sIzed Zero-Emissions last-mile Delivery and services vehicles
UVAR	Urban Vehicle Access Regulation
ZE(V)	Zero Emission (Vehicle)

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