Electric Fleets in Urban Logistics

PUBLISHED AS PART OF THE ENCLOSE-PROJECT

Improving urban freight efficiency in small and medium-sized historic towns

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ENCLOSE

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Content

Introduction

Population growth combined with shifting consumption patterns – such as a rise in online commerce and flexible deliveries – have led to increasing inner and inter urban (freight) transport. Since the year 2000, the total number of global passenger and freight movements has increased by an average of 4%, with global energy usage up by 30%. This increased mobility has many positive effects, but also negative effects on our environment. Transport currently accounts for half of global oil consumption and nearly 20% of world energy usage, of which 40% is utilised in urban transport. Global transport emissions have risen annually by nearly two billion tonnes of CO_2 equivalent since 2000, with freight transport generating between 20% and 60% of local transport-based pollution (IEA 2013, p. 6ff.). Despite a substantial decrease in emissions of many air pollutants in Europe over the past decades, air pollutant concentrations are still too high, with around 90% of city dwellers exposed to damaging air pollutants at levels deemed harmful to health by the World Health Organisation (EEA 2013, online).

Due to their particular architecture, small and medium-sized historic towns are particularly affected by these developments. They suffer from the elevated noise and air pollution, congestion and health and safety issues which result from more urban freight transport entering historic city centres. It is imperative that feasible and sustainable urban logistics solutions are found that result in tangible reductions in energy consumption and environmental impacts. This is the focus of **ENCLOSE – Energy Efficiency in City Logistics for Small and Mid-Sized European Historic Towns**.

The International Energy Agency suggests an "Avoid, Shift and Improve" policy approach for cities, which – when applied to urban freight transport – implies:

- **Avoid** freight delivery kilometres
- **Shift** to more (energy-)efficient modes
- **Improve** the efficiency of vehicle and fuel technology

The use of electric vehicles instead of conventionally-fuelled vehicles in freight transport is one way to improve urban freight efficiency. This can yield positive long-term effects for cities by increasing air quality as well as reducing CO_2 emissions and noise. With the sector being particularly vulnerable to disruptions in energy supply and price volatility, the use of electric vehicles also offers an opportunity to break its dependence on oil.

This report focuses on electric urban freight mobility by taking into account technical, legal and social factors that are relevant for small and medium-sized cities. It offers an overview of current developments by providing examples of European cities that have successfully introduced electric vehicles into their logistics fleets. It also cites important regulations, incentives and options for facilitating the modification of infrastructure by cities and companies. The recommendations in chapter 7 provide a summary of possible subsequent steps in the process.

It is clear that improving the efficiency of vehicle and fuel technology is only part of the solution towards sustainable urban logistics. Equally apparent is the fact that there can be no standardised path leading to the successful introduction of electric freight transport. Each city must adapt the suggestions provided to match its own unique situation and put these on a legal footing. It is very important that the introduction of electric vehicles constitutes an integral part of a city's urban (mobility) planning. For this reason cities involved in the ENCLOSE project develop "Sustainable Urban Logistics Plans" (**SULP**), which focus on subsequent steps for implementation.

Challenges in urban logistics

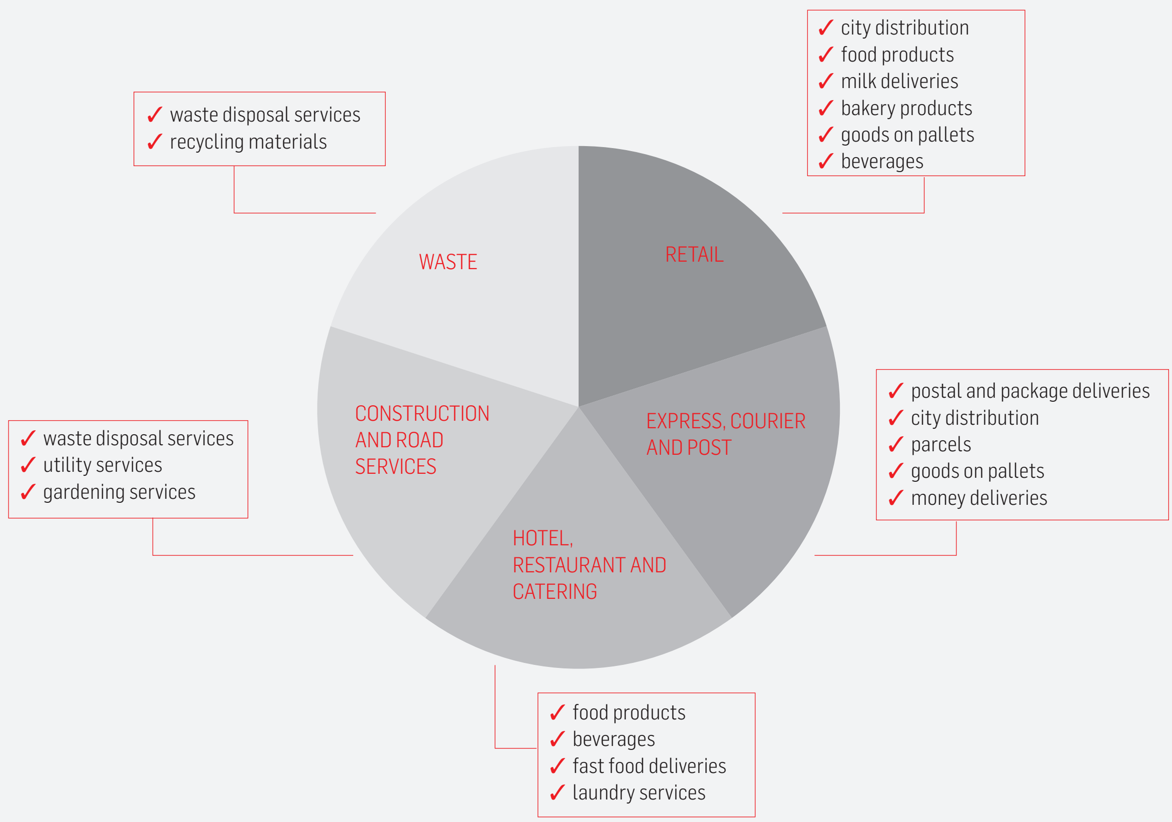
Urban freight logistics and the possibility of delivering and receiving goods and services whenever they are needed are important factors in various market sectors. At the same time, urban freight transport also causes economic, environmental and social problems that need to be addressed by offering alternative ways of transporting freight.

Customers not only want their goods delivered on time, but precisely when they want them and where they need them. Hardly anyone in a very competitive urban freight market gives any thought to the transport-related implications of increasingly flexible delivery schemes. Consequently, urban freight transport is on the rise. Countries in Eastern Europe in particular have shown a trend of increasing vehicle kilometres over the past 10 years; freight activity in Lithuania and Hungary increased by approximately 50% overall, while annual road-freight transport jumped 75% (Eurostat 2012, online). Urban freight transport within major market sectors covers the following areas (DG Move, p. 2):

The retail sector (30 to 40% of daily deliveries in cities) is highly fragmented with respect to the demand for and supply of freight transport. This results in a very high number of vehicle movements with low payloads. Studies predict even further declines in efficiency in future, due to anticipated trends in city centre redevelopment and increasing interest in smaller store formats.

The express, courier and postal sectors employ large vans or small to medium sized trucks, based on consolidated delivery and collection tours departing from cross dock terminals. The number of daily deliveries ranges from 20 deliveries (traditional parcel delivery) to around 90 deliveries (express courier delivery). The hotel, restaurant and catering sector is a rather homogeneous market sector.

FIGURE 1 : MARKET SECTORS FOR URBAN FREIGHT TRANSPORT



© AustriaTech, Based on DG Move, 2012

At the same time, its activities are subject to different logistics and organisational requirements. The sector is also defined by unpredictability as just-in-time deliveries are required frequently and in small quantities.

Construction deliveries involve a wide range of materials to building sites. These can be located in congested areas and sensitive locations such as heritage city centres with pedestrian zones. Another activity falling within this sector is the removal of waste materials for disposal; road work and gardening activities can also be included in this category. The challenge here lies in dealing with a high proportion of vehicles running with no or only a small payload.

Municipal waste management offers the collection and removal of household waste. The sustainability of this sector can be improved by optimizing fleet management and routing, by minimizing environmental impacts and by improving access to waste disposal facilities.

To summarize, developments in these sectors have economic, environmental and social impacts as cities are confronted with more traffic, more congestion, more noise and more pollution. Root causes for these problems range from inadequate road infrastructure and inefficient logistics processes resulting from a low load factor to unnecessarily long dwell times and/or a high amount of individual deliveries.

Small and medium-sized cities are particularly affected by these negative impacts of urban freight transport. Narrow roads and a lack of loading and unloading areas within city centres combine with inefficient logistics processes to produce negative effects that are attributable to the small scale of these cities as well as more pollution and noise (Figure 2). The smaller number of main roads leads to higher traffic levels and congestion. The space in small and medium-sized cities is also limited in terms of on-street parking and loading (BESTUFS II 2006, p. 8). In addition, delivery vehicles in historic city centres are perceived as a visual intrusion; urban heritage areas in particular must meet a number of obligations to maintain their status.

THE "AVOID, SHIFT AND IMPROVE" approach suggests different options for urban freight transport challenges of small and mid-sized cities.

It is clear that cities need to reduce pollution-intensive freight traffic by managing logistics processes more efficiently and switching to greener vehicles. An "Avoid, shift and improve" approach such as suggested by the International Energy Agency addresses this challenge by suggesting different policy options relating to specific objectives. Reducing trip lengths and the need for travel can help prevent freight traffic. This can be achieved by introducing subsidies or tax incentives for low-carbon transport or by implementing parking standards. Moving freight transport from road to rail and water or shifting to more efficient vehicle models can further alleviate the issues mentioned above. One last step is to improve the efficiency of vehicle and fuel technology and to reduce energy consumption and emissions. The introduction of electric vehicles into logistics fleets is one example for this "improve" strategy, since vehicle fleets and fuel systems can be transformed into zero emission technologies.

FIGURE 2 : IMPACTS OF URBAN FREIGHT TRANSPORT

ECONOMIC IMPACTS	ENVIRONMENTAL IMPACTS	SOCIAL IMPACTS	IMPACTS OF SCALE
road congestion	pollutant emissions	physical consequences of pollutant emmissions on public health	few resources
inefficiency	use of non-renewable fossil-fuel	traffic accidents	lack of co-operations
waste of resources	land and aggregates	noise	less policy considerations
	waste production	visual intrusion	few logistics providers based in cities
		other quality of life issues	little infrastructure

© AustriaTech

Electric vehicles in urban logistics Addressing current issues in urban freight transport

Electric vehicles are an energy-efficient alternative in inner-city traffic with frequent stops and can mitigate some of the problems caused by urban freight transport. Shifting inner-city distribution from conventionally-fuelled to electric vehicles helps to reduce emissions and noise. The advantages of electric vehicles are even more pronounced when switching to more efficient ways for the last-mile delivery of goods in city centres.

TABLE 1: KEY ACRONYMS

EV OR BEV	All-electric or battery electric vehicles are powered only by one or more electric motors. They receive electricity by plugging into the grid and storing it in batteries. They consume no petroleum-based fuel while driving and produce no tailpipe emissions.
PHEVS	Plug-in hybrid electric vehicles use batteries to power an electric motor, plug into the electric grid to charge, and use a petroleum-based or alternative fuel to power an ICE or other propulsion source.
HEVS	Hybrid electric vehicles combine an ICE or other propulsion source with batteries, regenerative braking, and an electric motor to provide high fuel economy. They rely on a petroleum-based or alternative fuel for power and are not plugged in to charge. HEV batteries are charged by the ICE or other propulsion source and during regenerative braking.
ICE	Internal combustion engines generate mechanical power by burning a liquid fuel (such as gasoline, diesel, or biofuels) or a gaseous fuel (such as compressed natural gas). They are the dominant power source used in on-road vehicles today.
EVSE	Electric vehicle supply equipment delivers electrical energy from an electricity source to charge an EV's or PHEV's batteries. It communicates with the EV/PHEV to ensure that an appropriate and safe flow of electricity is supplied.

© US Department of Energy 2012, Plug-In Electric Vehicle Handbook for Fleets

PUBLIC INSTITUTIONS play an important role by overcoming market barier of electric vehicles.

Electric vehicles, whether purely electric, plug-in or hybrid (see Table 1 for definitions), face a number of market barriers relating to aspects ranging from technology (range, charging time, insufficient charging network) to high investment costs, false expectations, lacking or inadequate incentives, lack of information, disinformation and misinformation (cf. EVUE).

Public institutions play an important role in replacing (a certain number of) conventionally-fuelled vehicles with electric cars, vans or two-wheelers. Municipal companies have already started this process in various European cities by procuring electric vehicles for their fleets and by installing charging infrastructure on company ground.

LOW EMISSION VEHICLES

Whilst the positive impact on air quality and noise of low emission vehicles is clear, there is a risk that the market take-up of electric vehicles in urban freight transport is very slow, because costs are high compared to conventional vehicles and companies are still uncertain about the maturity of the technology and about the availability of charging infrastructure. Finding a meaningful regulatory framework for the development and deployment of electric vehicles and infrastructure will remain a topic of concern for municipalities, governments and European institutions for the foreseeable future.

Nevertheless, electric freight vehicles are becoming more and more integrated into delivery fleets. There are several types of electric vehicles available that differ in vehicle type, weight or other criteria (see Annex for a listing of currently available vehicles):

Vehicles of categories N and L are often used for the transport of goods, while passenger cars (category M) are also used for other services in city logistics. Hardly any electric variants exist so far for heavy duty vehicles weighing over 3.5 tonnes (categories N2 and N3) due to the limited battery capacity and extra weight introduced by the battery.

In general, electric vehicles are suitable for duty cycles in (sub-)urban areas involving a low daily driving range and a relatively low load capacity. Also they work best when driving at low speed on flat terrain. Charging stations should be available at regular intervals and charging times of more than 30 minutes are required to utilise electric vehicles to their full potential (see Figure 3, p. 10).

Electric freight vehicles are best suited for last mile deliveries in compact cities involving short distances. If this is not the case, charging infrastructure must be available in order to recharge the vehicles during their duty cycle.

TABLE 2: VEHICLE CATEGORIES

POWER-DRIVEN VEHICLES HAVING AT LEAST FOUR WHEELS AND USED FOR CARRYING GOODS

CATEGORY	WEIGHT
N1	< 3,5 tonnes
N2	3,5 - 12 tonnes
N3	> 12 tonnes

MOTOR VEHICLES HAVING AT LEAST FOUR WHEELS AND USED FOR CARRYING PASSENGERS

CATEGORY	WEIGHT	SEATS
M1	n.a.	< 8
M2	< 5 tonnes	> 8
M3	> 5 tonnes	> 8

TRICYCLES

CATEGORY	WEIGHT	MAX. SPEED
L5e	3 (symmetricaly arranged)	45km/h

QUADRICYCLES

CATEGORY	WEIGHT	MAX. CONTINUOUS RATED POWER (EV)
L6e	> 350 kg (excl. Battery)	< 4kW
L7e	> 550 kg for vehicles intended for carrying good (excl. Batery)	< 15kW

© European Commission 2010, online

FIGURE 3: DUTY CYCLE COMPATIBILITY OF ELECTRIC VEHICLES

PROVIDING CHARGING INFRASTRUCTURE

The availability of charging infrastructure is an important factor for the success of electric vehicle fleets in urban freight transport. Yet, as recent studies show, there is little or no demand from current commercial electric vehicle users for public charging points. This was the outcome of a study for London (CLFQP 2012, p. 1f.), so this lack of interest in shared on-street charging stations might be even more pronounced in smaller cities where daily routes are even shorter or where a company's charging infrastructure can be accessed during the duty cycle. However, there may be a demand in future when the number of freight companies using electric vehicles increases.

EFFICIENT DELIVERIES

Electric freight vehicles only produce the desired environmental effects when they are introduced in combination with other measures in order to utilise the specific characteristics of this propulsion system and make electric vehicles competitive in comparison with conventional vehicles.

CONSOLIDATION OF SUPPLY

A widely adopted practice to tackle the "last mile" distribution problem is the establishment of Urban Consolidation Centres (UCC). A UCC is a logistics facility for the last mile collection and distribution of goods which is situated close to the urban area that it serves. UCCs are used by large freight transport service providers for operational purposes near cities, functioning as a junction between urban and interurban parts of the transport chain. The main freight operations carried out in UCCs are:

- handling of cargo
- loading and unloading
- warehousing
- added value services

Shipments with the same origin and destination are consolidated into a single vehicle to reduce the number of vehicles employed. Electric vehicles provide an option for this last mile inner-city distribution as the distances are relatively short thanks to the combined deliveries. All the same, cities find combining the installation of UCCs with the use of electric vehicles challenging. While consolidating several deliveries has a beneficial impact on the environment, high initial investments and monopolistic trends amongst freight companies provide a challenge.

Small or medium-sized cities also have to take into account the dimensions of a UCC as studies show that UCCs are more applicable in larger cities with bigger freight transport markets. Nevertheless, there are also successful examples of smaller towns adapting the idea of distribution centres in combination with alternatively fuelled vehicles (see Case Study).

CASE STUDY: ELECTRIC POSTAL SERVICE

© http://www.postennorge.com

In order to reduce CO_2 emission by 30% by 2015, Posten Norge in Trondheim (Norway) has been replacing diesel vehicles with electric (and hybrid) vehicles for deliveries in the city centre. Mail is delivered by electric trolleys, while parcel and pallet distribution relies on vans and trucks with different load capacities.

According to the "Action plan for efficient goods transport in Trondheim", the city plans to further enhance the use of electric vehicles in logistics operations, integrating them in town logistics schemes (ENCLOSE 3.1, p. 10f)

TABLE 3 : POSITIVE AND NEGATIVE EFFECTS OF URBAN CONSOLIDATION CENTRES

	ADVANTAGES	DISADVANTAGES
ENVIRONMENT	reduction of vehicle numbers	
	possible use of low- or zero-emission vehicles	
	reduction of emissions	
	reduction of congestion	
FINANCE	savings in supply chain and staffing costs for retailers	public subsidies needed (up to 50%)
	efficiency gains in historic city centres	high (initial) investment costs
		calculation of costs between retail partners difficult
		transport cost savings resulting from consolidation are less than additional handling costs
		viable only with subsidies
LOGISTICS	charging stations for electric vehicles in UCC	low load capacity
	increased level of security	
	reduced number of deliveries	limited action range
	better coordination of delivery times	lack of bundled goods
	use as storage facility	trans-shipment necessary (tricycle use)
	special parking areas	
	allow easier time-windowed operations	
COOPERATION	staff can concentrate on core activities	necessary only for small retailers
		cooperation between (larger) retail partners not always easy (distance, competition ...)
		decreasing interest in cooperation when no visible cost reduction occurs

© European Commission 2013c, p. 21ff.

CASE STUDY: DISTRIBUTION CENTRES

© Binnenstadservice Netherlands

In 's-Hertogenbosch and nine other Dutch cities, distribution centres were established as part of the "Binnenstadservice" to reduce emissions and traffic in smaller sized cities. These distribution centres are located just outside the city centre and offer combined services like collective stock management and collection of package materials (ENCLOSE 3.1, p. 13).

A similar approach was taken in several French cities within the "Petite Reine" initiative, where electrically assisted bicycles and tricycles were used for deliveries. Based on the concept of cargo cycles, these are used for last mile deliveries for carriers and retailers. (DG Move, 2012, p. 114)

CONSOLIDATION OF DEMAND

Another option to reduce logistics traffic within city centres is to combine deliveries to one area (e.g. shopping street or district) from multiple suppliers. Collaborative orders lead to an increase in average load factors and a reduction in the numbers of deliveries. This concept is applicable for electric vehicle fleets in areas with a pronounced residential character because even though more clients can be reached, the distances are shorter.

In the case of bundled deliveries, all the goods being picked and forwarded to the city centre in one tour must be homogeneous. This type of delivery is not generally suitable for frozen products. Nevertheless, Amsterdam adapted a model to transport temperature-controlled products to a distribution centre and deliver bundled goods by electric vehicles to the city centre. The main target group are retailers.

In London a Delivery Service Plan (DSP) was implemented in order to reduce the number of deliveries and gain cost benefits for organisations by consolidating goods in bundles. As part of the implementation of the DSP Transport for London, the procurement and storage of smaller goods (stationary) was centralised and delivery times reduced from twice a day to three times a week. In addition, catering supply deliveries were reduced by 40%. The development of the measures promoted in the DSP was based on data collected on deliveries of small goods or catering activities. (DG Move, p. 102) 's-Hertogenbosch arranged partnership agreements between shopkeepers, transport companies and other stakeholders in order to improve the efficiency of municipal deliveries.

Changing the behaviour of shippers, receivers and transport operators, who are used to ordering goods whenever they want and receiving rapid deliveries within narrow time windows, is of course a challenge. Organisations often order small volumes of goods and want to receive them just in time. Consequently, a key issue is to encourage greater consolidation of orders by individual large organisations and foster collaboration in the procurement of transport services (DG Move, p. 102).

An alternative approach to reducing transport kilometres and congestion is the co-operative use of electric vans for urban freight transport as for example implemented in the Italian "Ariamia" project, where electric vehicles are offered for rent to ensure sustainable logistics for pick-up and delivery of goods in the urban centre of Reggio Emilia. The basic idea of "Ariamia" is transferable to other cities, but involves many players and funding for start-ups (SUGAR 2011, p. 106f.).

DELIVERY SERVICE PLAN

The EU recommends the establishment of Delivery Service Plans as a way to consolidate demand for urban freight transport. They reduce the number of deliveries required and can also lead to cost savings for businesses. So far, these initiatives have been voluntary, but it is possible for city authorities to make them a planning requirement for new office and retail developments (DG Move, p. 106).

CASE STUDY: ELECTRIC B2B SERVICES

Luccaport FEV fleet in the consolidation centre © www.luccaport.it

Lucca started business-to-business services with electric vehicles for freight operators providing palletized goods transport. The city also offers freight operations integrated with leisure mobility as a service for tourists and for luggage transport, hence combining freight and passenger transport.

Regulations to support electric mobility

The European Commission aims to decrease CO_2 emissions as well as tackle air and noise pollution by encouraging the use of alternative fuels. In order to limit air pollution the European Community has policies in place limiting individual sources but also national totals of atmospheric emissions of a number of pollutants. Many cities and member states are aligning with the Commission's strategic guidelines by granting electric delivery vans and trucks access to environmental zones or by exempting them from certain fees or taxes. The regulations governing public vehicle procurement were also changed in order to promote the use of electric vehicles.

CASE STUDY: LOW EMISSION ZONE

© www.truckenmillieu.nl

In July 2007 Utrecht introduced a Low Emission Zone ("milieuzone") in the inner city as part of a national covenant which all Dutch cities can join. The partners of the covenant agreed on a common standard for environmental zones throughout the country, applying to heavy goods vehicles over 3.5 tonnes. The aim is to support the use of clean vehicles for transporting goods in the city as well as to reduce emissions from road freight traffic. The city of Utrecht is planning to expand the Low Emission Zone to the EURO 5 norm and to widen the zones.

In 2007 and 2008 nine Dutch cities joined the network with another two cities only recently implementing Low Emission Zones. Originally, these zones applied solely to lorries; since July 2013 vans also have to meet the EURO 4 standard (ENCLOSE 2.1, p. 67ff).

Following the European policy on urban freight transport that was published in the European Commission's 2011 Transport White Paper (see Info Box p. 15), the EU encourages the establishment of "Sustainable Urban Mobility Plans" (SUMPs). To emphasise the special issues and conditions in the field of urban logistics so called "Sustainable Urban Logistics Plans" (SULPs) are developed as part of the ENCLOSE project.

Following the concept of the EU's proposed mobility plans, SULPs focus on energy efficiency and sustainability objectives in the field of logistics. They are developed for each city individually, covering a definition of visions, objectives and targets in relation to the current sustainable mobility approach and a selection of policies and measures for city logistics.

Linking these objectives and goals on a city level to EU guidelines and integrating them into an overall Sustainable Urban Mobility Plan is essential in order to gain acceptance and EU support. Electro mobility plays an important role in the context of SULPs and SUMPs since the use of electric vehicles implies a reduction of CO_2 emissions which is the key issue of European Union transport policy.

Cities can define a number of regulatory measures in order to manage urban freight transport and support the use of electric vehicles. By granting companies regulative exemptions and financial incentives for the use of electric freight vehicles, cities can help compensate higher purchasing prices and consequently make clean freight vehicles more appealing to potential users.

ACCESS INCENTIVES

PERMITTING ACCESS TO LOW EMISSION ZONES

Low Emission Zones (LEZ) or Zero Emission Zones are implemented by cities in order to improve air quality and to reduce the noise level in city centres by excluding vehicles like heavy diesel trucks during working hours. Electric trucks can be exempted from these restrictions.

Low Emission Zones are often introduced in larger cities where air quality is a particular concern. Yet, smaller or medium-sized cities like Utrecht (Netherlands) or Bologna (Italy) have also installed these zones in order to reduce CO_2 and pollutant emission in the city centre and to promote and stimulate the usage of electric vehicles as an alternative for conventional vans.

EXEMPTION FROM TIME RESTRICTIONS

Historic city centres in particular often have zones with time restrictions in order to reduce the amount of traffic. In limited Traffic Zones, for example, vehicles are only allowed access at certain times when other cars are prohibited from entering. Non-authorized trucks, which do not fulfil certain requirements concerning CO_2 emissions or noise, are not permitted to access the city centre for loading or unloading operations.

CASE STUDY: ACCESS SCHEMES

© 's-Hertogenbosch (NL)

The Dutch city of 's-Hertogenbosch has implemented specific by-laws for clean logistics vehicles that regulates inner city access. Only green and silent trucks with an optimized delivery scheme are allowed to enter the city centre after 12:00 a.m., whereas other commercial freight vehicles are only admitted in the time slots 7:00 to 12:00 a.m. and 6:00 to 8:00 p.m.

This regulation applies not only to retail freight deliveries, but also to public services in relation to the transportation of heavy or large purchases by small electric buses within the inner city.

Consequently, exemptions from time restrictions are beneficial for companies that acquire electric trucks for their fleet, since they meet the requirements for driving in the zone (E-Mobility NSR 2013, 148).

EU POLICY AND REGULATIONS

In 2011 the European Commission published its Transport White Paper announcing a switch to the use of renewable energy sources and alternative fuels in the transportation sector complementing its 2010 Communication on a Strategy on Clean and Energy Efficient Vehicles. An important White Paper goal is to achieve virtually CO_2-free city logistics by 2030 and phasing out conventionally-fuelled cars in urban transport by 2050.

Directive 20078/50/EC on ambient air quality and cleaner air for Europe sets air quality objectives for fine particles and other pollutants.

Regulation 443/2009/EC limits average fleet emission to 130 grams of CO_2 per kilometre by 2015 and 95 grams by 2020. The emission target for vans is 175 grams of CO_2 per kilometre by 2017 and 147 grams by 2020 according to Regulation 510/2011/EC.

Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles aims at the market introduction of low-emission vehicles.

The Commission's latest policy initiative is the Clean Power for Transport Package (2013) which includes Directive 2013/18 on the build-up of charging infrastructure.

As electric vehicles operate quietly, it is possible to expand usage into morning and late evening hours. Also, multi-shifts are possible and can be coordinated with recharging shifts of the vehicles. This temporal shift to off-peak hours can therefore relieve the city in rush-hours and prevent congestion (E-Mobility NSR 2013, p. 148).

NIGHT TIME DELIVERIES

Another incentive for the electric delivery vehicles installed by several cities are the night time deliveries that are made possible by their low level of noise. Optimizing delivery schedules can prevent morning road congestion and increase efficiency. Projects testing night time delivery have commenced in Dublin and Barcelona as part of the NICHES project, where low-noise delivery vehicles are typically allowed to access the city centre from 10:00 p.m. to 7:00 a.m. The main benefits of this regulation are

(i) a reduction in delays for the logistics service providers by using the free night-time road capacities,
(ii) a reduction in emissions and energy consumption due to less congestion and direct access to the shops, and
(iii) increased logistics efficiency.

In addition, road safety is enhanced thanks to fewer other road users or pedestrians at this time of the day (NICHES 2007, p. 2).

According to the outcomes of the NICHES programme, special zones with night time delivery options for "green" freight vehicles can be implemented in every city, regardless of its size. In terms of costs, the faster and more efficient delivery process lowers logistics expenses, something which can compensate for possible higher investments for quiet (electric) vehicles and equipment (NICHES 2007, p. 3).

USE OF ALTERNATIVE DRIVING LANES

In order to address congestion, cities also have the option of opening bus lanes for electric freight vehicles. Journey time benefits that may result from this regulation can motivate companies to change their fleet to electric vehicles. However, as tests in Oslo and London show, the effects are not only positive. Electric vehicles are confronted with a range of obstacles that may prevent them from using bus lanes:

- start and stop conditions
- conflicts with buses and vehicles in other lanes
- bus lanes only cover a small percentage of the road network (5% in London)
- safety concerns for vulnerable users, particularly cyclists and pedestrians

CASE STUDY: BUS LANE PRIORITY ACCESS

© park and ride, CIVITAS Project

As part of the CIVITAS initiative, Norwich (UK) tested priority access regulations for clean goods vehicles. The measure only applied to heavy goods vehicles and they were only permitted to use some bus lanes that were considered most appropriate. This allowed greater control over the number and behaviour of freight vehicles and made the measure easier to enforce. The vehicle drivers received specific training in advance on how and when to use the bus lane.

The results of this project showed that:

- the width of the existing bus lanes was a barrier
- only a few vehicles used the bus lane
- the benefit from using the bus lane at off-peak times was limited
- some stakeholders did not approve of the measure

© http://www.civitas.eu

Due to these problems most cities have so far decided against the use of bus lanes for electric vehicles, as the benefits do not outweigh the disadvantages.

DEVELOPING SPECIAL PARKING SLOTS

Another incentive for companies using electric delivery vehicles is the allocation of free or specifically designed parking spaces and (un)loading docks for electric vehicles. The Danish cities Odense and Frederiksberg, for instance, offer free parking to enable the use of electric trucks in the city. Copenhagen previously exempted electric cars from paying parking fees, yet this regulation had to be changed again, as there was no legal basis for this incentive (E-Mobility NSR 2013, p. 21), exemplifying the need to align municipal level regulations with federal and supranational policies. A similar practice is also applied in Barcelona, where parking is free during the charging process. Free parking for electric delivery vehicles is also available in Norway and Germany.

FINANCIAL INCENTIVES AND REGULATION

SUBSIDIES AND FUNDING FOR VEHICLES AND INFRASTRUCTURE

The most common form of subsidies in the field of electric mobility is financial support for electric vehicle purchases, usually granted by the government or individual cities as part of a program to reduce emissions. One example of this kind of incentive just started in New York, where a "Truck Voucher Incentive Program" was implemented (Hybridcars.com 2013, online). This program focuses on private and public companies that add electric trucks to their fleet; the goal is to replace 1.000 conventional trucks and transporters in the region to reduce CO_2 emissions.

Other subsidies for electric freight vehicles include:

- subsidies for a certain percentage of the acquisition costs of an electric vehicle (e.g. Barcelona|Spain)
- grant or cash incentives given to the first companies (or individuals) who buy an electric vehicle (e.g. Sweden)
- subsidies to municipalities and companies for the acquisition of electric vehicles (e.g. Denmark)

Funding or subsidies are not only an option for vehicles but also for installing the necessary charging infrastructure for electric vehicles. In Europe, Norway, the Netherlands, the UK and France offer sizeable programs to support the electrical installation and use of charging infrastructure for electric vehicle fleets. The E-mobility NSR program recommends a targeted support program to stimulate the adoption of electric vehicles. Several cities offer free charging

CASE STUDY: PRIORITY PARKING

© Christioph Bellin, bildarchiv-hamburg.de

In Germany special parking areas for e-trucks were installed in some city centres, offering loading and unloading zones with charging infrastructure. This measure was introduced to reduce double parking (perceived as a hindrance) and accelerate the use of electric vehicles by logistics companies. As the outcomes of the "E-mobility NSR" project show, the reserved parking slots were blocked by conventional cars nevertheless, until towing signs were established.

The introduction of these parking and loading areas is subject to regional law and policy, which is why a labelling system for electric vehicles needs to be adopted first in order to unify this approach and to facilitate its implementation. In September and October 2013 the city of Hamburg and the state of Baden-Württemberg tabled a common framework in the German Bundesrat for labelling and encouraging EVs. It is expected that a nationwide standard will be adopted in 2014.

FUNDING, TAX INCENTIVES or exemption from fees can make e-vehicles highly attractive.

for electric trucks at most public charging stations. Other European countries such as Germany or Austria only fund research and development projects concentrating on so-called model regions. In the US commercial applicants receive tax credits if they install recharging stations (RAEL 2010, p. 21f.).

TAX INCENTIVES

Another widely adapted method for fostering the use of electric vehicles in logistics is the adoption of tax incentives. In order to stimulate the electric vehicle market's demand side the EU revised the energy tax directive 2003/96/EC to create standards for taxation that would link taxes to energy content and CO_2 emission, leading to lower taxes for electric vehicles as a consequence (E-Mobility NSR 2013, p. 16).

Options for tax incentives include:

- exemption from vehicle registration taxes
- exemption from fuel consumption taxes
- exemption from taxation for company cars
- VAT exemptions

These exemptions are usually based on CO_2 emission limits. However, some countries only grant tax incentives for a limited number of years in order to support the initial sale of electric vehicles.

EXEMPTION FROM FEES

Apart from tax exemptions, electric vehicles are also eligible for further reductions on various traffic-related fees. Examples include:

- reduced fares for accessing environmental zones
- exemption from congestion charges
- free use of toll roads
- free parking

PUBLIC PROCUREMENT

Public procurement of electric vehicles for municipal vehicle fleets can serve as a role model for private companies, functioning as a method to promote the use of clean energy trucks for logistics purposes as a consequence.

Public authorities need vehicles for a broad range of applications: delivery vans, transportation of gardening equipment, emergency services vehicles (ambulance, fire engines, police vans), and special vehicles (sweeping trucks, garbage trucks, buses …). Each of these types has a specific function and different requirements, so purchasing criteria vary accordingly (EVUE 2012, p. 5). Municipal fleets usually cover large distances in cities, making them a specific source of air pollution as they constitute a large proportion of heavy

CASE STUDY: FUNDING FOR GREEN VEHICLES

© Renault, Brossard Yannik

In February 2012 the British Government created a funding grant – called "Plug-In Van Grant" – to support not only private but also business buyers purchasing an ultra-low emission van. Buyers receive a grant of 20 per cent towards the cost of the vehicle.

So far, only vans with a maximum weight of 3.5 tons or less and carbon dioxide exhaust emissions of less than 75 grams per kilometre are eligible for this grant (Gov.uk 2013, online). This is one of few financial incentives directly addressing electric vehicles for logistics purposes.

However, experiences differ across cities and countries. Vienna (Austria) offers one of the most generous purchase subsidies for light duty vehicles (€10.000 per vehicle as of 2013) but this has so far met with little interest.

vehicles and diesel engines. Therefore, investing in alternative energy resources within public fleets is a first step towards increasing the use of electric vehicles.

The initiatives listed below show different approaches towards sustainable public procurement in EU countries, based on the "Clean Vehicle Europe" initiative (see http://www.cleanvehicle.eu).

ENVIRONMENTAL SCORE SCHEMES

Sustainable public procurement takes into account not only the purchase price, but also the environmental impact of the procured goods or services. Countries such as Belgium and Denmark have developed schemes to evaluate vehicles before the procurement process starts. In Belgium the evaluation is based on an "ecoscore scheme", which sets the minimum target value for the purchase of vehicles. A similar approach is used in Denmark, where awards of procurement contracts are based on environmental requirements relating to CO_2 emissions. Possible parameters can be:

- energy efficiency
- compliance with EURO standards
- eco-driving
- alternative fuels
- monitoring requirements for energy consumption

PUBLIC PROCUREMENT ADVISORY UNIT

In Finland a Public Procurement Advisory Unit was founded that serves both municipal and state authorities and other public procurement units. Its function is to provide authorities with free advice on public procurement law, the application of the law or good practice in procurement. The aim of this measure is to encourage joint procurement and to create expertise on sustainable public procurement.

SUSTAINABLE PUBLIC PROCUREMENT COACH

Another initiative developed in the Netherlands is a web-based instrument that offers authorities the opportunity to track their performance in sustainable public procurement. Public organisations must answer questions to obtain customized advice on how to improve the organisation and implementation of sustainable public procurement within their company.

CASE STUDY: CHARGING SCHEMES

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In Rome vehicles are charged fees based on a charging schedule for permission to enter a Low Emission or Limited Traffic Zone within the historic city centre. Whereas conventional diesel-fuelled cargo vehicles must pay an annual fee of EUR 570, hybrid and electric vehicles are offered a discount, granting them access for EUR 430 (hybrid) or EUR 300 (electric vehicle).

A similar charging scheme exists for the inner city of Milan, where hybrid or electric vehicles receive an ECOPASS, which exempts them from being charged fees entirely (Comi et al. 2008, p. 7f).

EV PROCUREMENT DIRECTIVE

In 2009 the Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles, also called the "Clean vehicles Directive", was enacted. It requires public authorities to take into account lifetime energy and environmental impacts when purchasing road vehicles. Important factors of this directive for governments to concentrate on are energy consumption, emissions of carbon dioxide (CO_2) and emissions of oxides of nitrogen (NOx), non-methane hydro-carbons (NMHC) and particulate matter (DG Environment 2011, p. 2).

User acceptance

An important factor for greening fleets in urban freight transport is the acceptance of electric vehicles by companies and drivers. Most early adopters report very good suitability of electric vehicles for their needs and considerably lower operational as well as maintenance costs compared to conventional vehicles. Drivers' enthusiasm about their vehicle is crucial in order to reach high user acceptance.

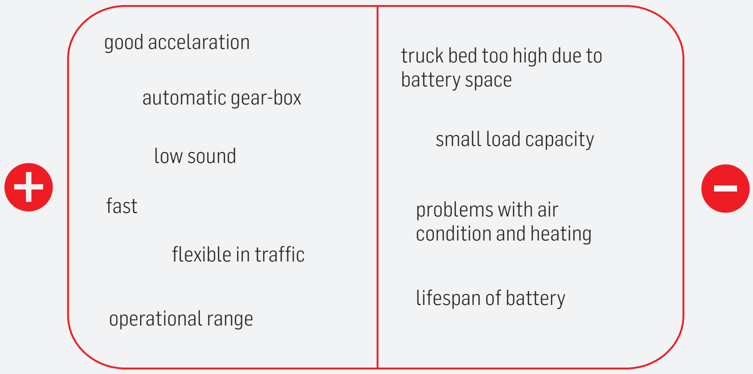
BEFORE CHOOSING a vehicle, requirements as battery performance or load capacity should be taken into consideration.

The choice of vehicle is one indicator for avoiding initial rejection of electric vehicles; drivers see features such as clean, silent technology and comfortable operation as incentives. Public acceptance of electric delivery vans will also be affected by a positive image of the delivery sector based on the new low emission and low noise vehicles.

DRIVING COMFORT

The driving comfort of electric vehicles is influenced by the technical performance of the vehicle (including its applicability for freight transport) and by the working environment of the drivers. In recent studies truck drivers mention the fear of getting stranded in the electric van or the lack of public charging infrastructure as negative factors causing rejection. Yet, they also appreciate the advantages compared to conventional vehicles in handling the car.

FIGURE 4: POSITIVE AND NEGATIVE ASPECTS – VEHICLE PERFORMANCE



VEHICLE PERFORMANCE

Issues mentioned by test drivers in several European cities (E-Mobility NSR 2013) cover the vehicles' driving behaviour, the possible load capacity and the vehicle's battery. While most vehicles are perceived as silent, fast and easy to drive, drivers complain about the battery's performance and the reduced load capacity (caused by the size of the battery) compared to diesel trucks. These evaluations are strongly influenced by the vehicle model, as some models are better suited for logistics purposes than others.

WORKING ENVIRONMENT

The working environment is influenced by driving behaviour and the need to adapt it to conditions met in electric vehicles. In general, electric vans and trucks are perceived as comfortable and many drivers like the fact that the vehicles are zero-emission. Many employees who participated in pilot projects also believe that it is important for the municipality to set a good example and demonstrate sustainable behaviour.

Challenges are still related to the available charging infrastructure and, notwithstanding lower total cost of ownership, the high initial purchasing price. A number of companies offer tailored advice for fleet managers on whether or not an electric, plug-in hybrid or range extender electric vehicle would be suitable for the needs of a driver based on their specific profile.

COST

Even with higher procurement costs and additional investments in loading infrastructure, the replacement of conventional vehicles with electric ones still offers an opportunity to save costs by reducing operational costs, leading to increased profitability for businesses:

- electricity prices are approximately 20% lower than diesel prices
- no requirement for a tachograph
- electric vehicles are exempt from certain fees
- average maintenance costs are generally lower

Looking at the overall operational costs, electric vehicles have the potential to become competitive compared to conventional diesel-fuelled trucks. Indeed some studies claim that total cost of ownership (TCO) is already at similar levels for electric vehicles and conventionally fuelled vehicles. Existing cost differentials (especially the higher initial purchase price) are expected to diminish over the next years (assuming increased production figures and advances in battery technologies) and there are a number of initiatives looking into business models in various European cities (SMARTSET project 2013). The US Electrification Coalition published case studies on the cities of Houston and Loveland which show that these cities are actually saving money by using electric vehicles in their vehicle fleets. City officials in Houston estimate that the city's 27 Nissan Leaf electric vehicles will save the city $110.000 per year compared to internal combustion engine vehicles (Electrification Coalition 2013, online).

In addition to vehicle costs, another cost factor is the required recharging infrastructure, with the amount of investment depending on the type of infrastructure. The use of plug-in charging infrastructure requires one charging spot for each distribution vehicle as they are fully recharged overnight. At the moment one charging point costs around EUR 6,200 for an electric vehicle with a battery capacity of 120 kWh (Boer et al. 2013, p. 88), with the cost varying considerably depending on installation, the available network and location.

FIGURE 5 : POSITIVE AND NEGATIVE ASPECTS – WORKING ENVIRONMENT

+	−
comfortable to drive in	training for drivers required
operational reliability	many technical errors
low emission	lack of driver´s knowledge
good graphical overview of battery information and status	heating problem
	difficult to procure space parts
	uncertainty on who holds responsibility for repairs

CASE STUDY: USER ACCEPTANCE

© www.postennorge.com

The importance of driver enthusiasm is shown by the initial reaction of some Posten Norge employees to the introduction of new electric vehicles. Drivers who are used to conventional delivery vans in particular did not appreciate the change to simpler vehicles such as electric mopeds and trolleys. Truck drivers also complained about the smaller size of electric vans, which are able to access the city's narrow streets more easily and can therefore replace larger vans or trucks.

Technical background

The development of electric vehicles for the greening of freight transport depends mostly on the availability of suitable, energy efficient batteries and appropriate charging infrastructure. There are still several challenges which currently limit the use of electric vehicles to urban areas.

THE DEVELOPMENT OF NEW BATTERIES PROMIS to bring more stability and a wider driving range, which will make E-Logistics even more attractive within the next years.

Even with the technological improvements expected over the coming years in terms of the durability and cost of batteries, limited power density and life cycle considerations will continue to pose challenges in using electric freight vehicles for long haul transport applications, as will the large volume and weight of batteries. Similarly, the high cost (often mainly administrative) of installing charging infrastructure can be an issue. Nevertheless, vehicle availability continues to increase and electric vehicles are about twice as efficient as conventional vehicles, even after battery charging/discharging and transmission losses. Energy density is anticipated to improve by up to a factor of 10 by 2030.

CASE STUDY: DRIVING RANGE

© www.mp-ecodrive.com

In the UK electric transport vehicles with lithium ion batteries are used by grocery companies and for parcel and post distribution operations in cities. The procured vehicles require a range of approximately 200 kilometres.

VEHICLE TECHNOLOGY

Electric vehicles are increasingly viewed as a good option for inner city freight transport due to their low emission rates and good performance on trips with frequent stops over shorter distances. Lower daily driving ranges and the possibility of recharging vehicles at scheduled times (e.g. overnight) allow daily usage without interruptions to vehicle operation. Nevertheless, the introduction of electric trucks into urban logistics also provides cities and transport companies with a number of challenges concerning these new types of vehicles. The major challenges include the battery weight, the limited driving range and sometimes a lack of maintenance skills.

BATTERY STABILITY AND DRIVING RANGE

Battery performance determines the range and weight of the vehicle and therefore influences possible fields of application. At present, lithium ion batteries are most often used in electric freight vehicles with a current battery lifetime of 1000 to 2000 cycles (approximately 6 years). In order to achieve higher battery energy density, researchers are working on lithium-air batteries, which are not commercially available yet.

As projects over recent years have shown, electric vehicles usually offer a lower driving range compared to conventional trucks, since the battery's energy density is comparatively low. Existing technologies offer a driving range of approximately 150 to 200 kilometres, depending on the battery used. Driving range is influenced by various factors including

- weather conditions (shorter battery range in hot or cold seasons
- use of heating or air conditioning
- driving style

Also, the kilometer range declines over time, which may reduce peak power capacity and energy density. For these reasons electric vehicles are currently most suitable for daily urban distribution activities as the battery energy density is too low for regular long haul applications. According to recent studies (Boer et al. 2013, p. 25), 20% of the battery capacity is generally left unused, so it would be possible to dispense with a portion of the battery weight.

At the moment, lithium ion batteries last for four years; however, practical experience has shown that the average period of use is only two years. Improvements in battery powered trucks are expected within five years in terms of the cost and durability of batteries.

AVAILABLE SPACE FOR PAYLOAD

The in-vehicle space available for transporting goods is determined by battery size and weight, which reduce the payload and volume:

- Electric vans: 500 kg – 2 t payload
- Electric trucks: 2 – 3.5 t payload
- Electric tricycles: 150 – 200 kg payload

In comparison with diesel vans, the heavy batteries can reduce the payload of electric vehicles by 200 kilograms and by 200-700 kilograms for converted vans. Consequently, there are very few electric vehicles with a payload of more than 1.500 kilograms on the market. Higher payloads lead to restrictions due to the weight regulations for logistics trucks:

- Vehicles over 2.8 tons need to be tracked by a tachograph
- Vehicles over 3.5 tons: the driver needs a truck driver's license and a professional driver qualification, which results in greater costs for drivers than comparable conventional vehicles

In order to compensate for battery weights, the EU has increased gross weights for original electric vans, which means that the payload loss can be reduced to between 5 and 10%. An increase of one tonne is required to adapt the weight limits for trucks to the extra battery weight.

CHARGING INFRASTRUCTURE

There are several options for recharging the batteries of electric vehicles:

- in-house charging
- public charging points
- inductive charging
- battery changing

IN-HOUSE CHARGING

Charging the electric vehicle overnight with a (slow) plug-in charging system on company premises is the easiest option, since the battery usually lasts long enough for one duty cycle and can typically regenerate within 8 hours. Installation costs are relatively low compared to battery costs and the charging station can be installed using the existing electric grid.

PUBLIC CHARGING POINTS

In a freight context and especially in an urban context, public charging points in public spaces or en route are generally viewed as less important. Such charging points can be used during dwell times (of more than 10 minutes) on charging lots that are reserved parking spaces for electric vehicles. This option might gain in importance with the introduction of fast charging as a way of charging freight vehicles en route at strategic locations – next to big loading and unloading facilities such as stores. At the moment, fast charging takes 20 to 45 minutes for smaller freight vehicles and can be undertaken during loading and unloading. Over the coming years charging stations are expected to be scaled up from 50 to 200 kW, so even larger distribution trucks (over 7.5t) can be recharged within 15 to 30 minutes. However, this will require a significant improvement in the current batteries, with the installation of public charging infrastructure only being amortised when electric vehicles are operated in multi-shifts.

The challenge of this model lies in the lack of compatibility between the existing infrastructure and electric freight vehicles. The European Commission is currently planning the standardisation of charging infrastructure as part of its Clean Power for Transport Package (2013) in order to avoid incompatible plugs and charging equipment in future.

A VARIETY OF CHARGING OPTIONS ARE AVAILABLE TODAY: in-house, public or inductive - other options are battery changing stations.

INDUCTIVE CHARGING

Inductive charging conducts power between two systems without the use of a wire, with the transmission device being installed beneath parking lots. This system reduces the on-board battery capacity required and represents one option for enabling the use of electric trucks for long haul applications.

Vehicles can be recharged while they are parked or stopped (stationary inductive charging). Drivers can position their vehicles over the embedded energy sources to charge them. This works either via magnetic induction coupling, which requires precise alignment of the vehicle, or via magnetic resonance coupling that can transmit power over larger distances and can adapt to misalignment. Another method for charging vehicles via an inductive energy flow works via dynamic in-road charging. This allows the battery of an electric vehicle to be charged while driving over specific electrified sections of road, thus reducing battery weight (and costs). However, this method is more suitable for highways and therefore not of relevance for small or medium-sized cities.

BATTERY CHANGING

At battery switching stations depleted batteries from electric vehicles can be exchanged for fully charged ones while the batteries are recharged at the station. According to an ICCT study on zero emission trucks, this method is especially useful for electric trucks that are used in urban distribution with daily driving cycles (Boer et al. 2013, p. 41). The benefits lie in reduced switching times compared to charging times and in reduced upfront costs for logistics companies as the batteries are leased (not owned). At the same time, the investment in changing stations and battery stocks is high and it is difficult to achieve standardisation of battery and vehicle design for different types of vehicles and different manufacturers. All in all this option is not yet implementable as demonstrated by the recent bankruptcy case of Better Place, the Danish-Israeli company based on battery-swaps.

CASE STUDY: INDUCTIVE CHARGING

© http://www.pluglesspower.com/

So far, inductive charging systems for electric freight vehicles are mostly available in the United States, where several car companies and infrastructure providers are developing pilot projects to establish this recharging method. Different technologies are tested to optimize wireless power transmission.

Recommendations

This last chapter offers a shortlist of recommendations for implementing electric vehicles in urban freight traffic. This should help cities to create their own roadmap towards sustainable urban freight transport and support them in developing a Sustainable Urban Logistics Plan (SULP).

Many European cities, including small and medium-sized towns, have started greening freight transport over the past couple of years as part of an impressive number of projects under the CIVITAS initiative, which aims at improving transport in cities (for an overview see http://www.civitas.eu/thematic-categories/clean-fuels-and-vehicles). The introduction of cleaner fuels and vehicles leads to a reduction in greenhouse gas emissions and local air pollution. However, it is clear that any such initiative needs to be part of a municipality's overall mobility strategies.

Especially in the case of smaller cities, regional approaches and partnerships with local associations and stakeholders are extremely important. When it comes to electric vehicles, specific technology choices should not be the sole focus of greening urban freight. Rather, a green vehicle strategy should be part of a broader initiative towards sustainable urban freight transport. It is especially important to develop a fleet planning initiative, consider available financing and the purchase of tools, and reallocate resources. Lastly, the total cost of ownership, including the resale value of vehicles, and the lower maintenance costs need to be taken into consideration.

DEVELOP A SULP FRAMEWORK

Identify Challenges and needs in urban logistics system
In a first step the current situation has to be assessed by identifying issues concerning the city's logistics system (e.g. CO_2 emissions, noise, congestion in rush hours), in order to find suitable measures to address the problems.

Engage possible stakeholders
Different types of stakeholders can provide critical support and feedback and their previous experience can facilitate the implementation of measures. Possible stakeholders for the development of a SULP are city authorities and different departments, logistics companies, electric vehicle providers, freight suppliers and all sorts of retailers.

Establish policy framework and action plan
After identifying issues and possible needs of the urban logistics system, a policy framework and an action plan for the implementation of the measures has to be developed, covering key steps, milestones, the time framework and the responsibilities of the stakeholders.

ESTABLISH ELECTRIC VEHICLES AND INFRASTRUCTURE

Choose the right vehicle type
When choosing an electric vehicle to replace a diesel-fuelled truck the extra space needed for the battery and the resulting extra weight have to be taken into account. The extra weight or volume might result in the choice of a vehicle from a category with higher weight limits and therefore lead to stricter regulations for the driver.

Adapt the infrastructure to the new energy needs
The implementation of smart grids and load management for large electric fleets is necessary to avoid an overload of the infrastructure by the high capacity need of electric trucks. Also charging in case of power outage has to be ensured.

Identify the need for charging stations
In-house charging infrastructure on company ground is necessary for the electric vehicles to be recharged overnight, whereas publically accessible on-street charging points or charging infrastructure in off-street car parks are not recommended in the near future, since the installation of the infrastructure is rather expensive. This is especially true for fast charging infrastructure, which will be needed in the future for recharging heavy freight vehicles. Though, if the need for (fast) charging infrastructure is large enough once, it will be useful to install charging stations (at least 22 kW) in dedicated loading bays that are located in areas with a clear demand for on-street charging options.

Develop a system to combine deliveries
In order to avoid unnecessary freight traffic in the city centre, the combination of several deliveries in one vehicle is recommended. Yet, urban consolidation centres are an expensive solution that may not be suitable for small or medium-sized towns. Therefore the consolidation of demand – combining the deliveries of multiple suppliers within an area – might be a better option as transshipment can be kept to a minimum.

ADAPT REGULATIONS TO PROMOTE ELECTRIC FREIGHT TRAFFIC

Exempt electric delivery vehicles from access restrictions to environmental zones
Less tighter access regulations for electric freight vehicles can work as a measure to make them more attractive for companies compared to conventional trucks. Due to the lack of CO_2 emissions of electric vehicles these exemptions are legitimate.

Widen delivery times
The noise emission of electric vehicles is relatively low compared to diesel trucks, so deliveries outside normal working hours (like night time deliveries) are an option to reduce congestion during business hours.

Provide subsidies and tax incentives for electric logistics vehicles
Subsidies for the purchase of electric vehicles as well as the exemption of certain environment-related taxes or fees are one of the easiest ways to support the purchase of these vehicles.

FOSTER PUBLIC PROCUREMENT OF ELECTRIC VEHICLES

- **Integrate electric vehicles into the communal fleet**
  As public procurement covers all sorts of distribution and service activities that require passenger cars or trucks, the use of electric vehicles for these purposes will work as a role model for companies.

- **Set environmental guidelines for public procurement of vehicles**
  To avoid the procurement of older vehicles with a higher amount of greenhouse gas emission, cities can develop environmental scoring schemes that makes it easier to assess the environmental impact of vehicles.

- **Offer advice for green public procurement**
  The establishment of advisory units or „coaches" for sustainable public procurement can support the decision making process before purchasing new vehicles for the communal fleet.

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ENCLOSE

ENCLOSE, **EN**ergy efficiency in **C**ity **LO**gistics **S**ervices for small and mid-sized European Historic Towns, is a pilot project under the **Intelligent Energy– Europe** (IEE) programme. The IEE programme is run by the Executive Agency for Small and Medium-Sized Enterprises (EASME) on behalf of the European Commission and supports EU energy efficiency and renewable energy policies, with a view to reaching the EU 2020 targets (20% cut in greenhouse gas emissions, 20% improvement in energy efficiency and 20% of renewables in EU energy consumption).

ENCLOSE supports the development of **Sustainable Urban Logistic Plans** in 9 small and mid-sized historic towns involving 16 partners from 13 European countries – Austria, Bulgaria, Greece, Ireland, Italy, Norway, Poland, Romania, Portugal, Spain, Sweden, The Netherlands and the UK. ENCLOSE is based on the cooperation of a number of stakeholders and solution providers including:

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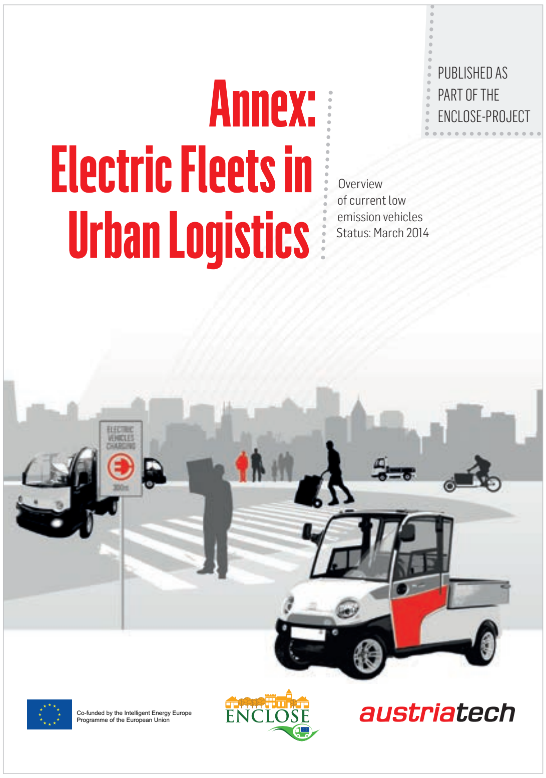
Annex

Also available as part of this Brochure is an Annex, which provides an overview of currently available electric-, hybrid and fuel cell freight vehicles. It contains vehicles of the light freight sector and the heavy goods-freight transport sector.

Both the report and the annex are also available at: www.austriatech.at/news/downloads



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