E-Mobility NSR

Comparative Analysis of European Examples of Schemes for Freight Electric Vehicles

Compilation report

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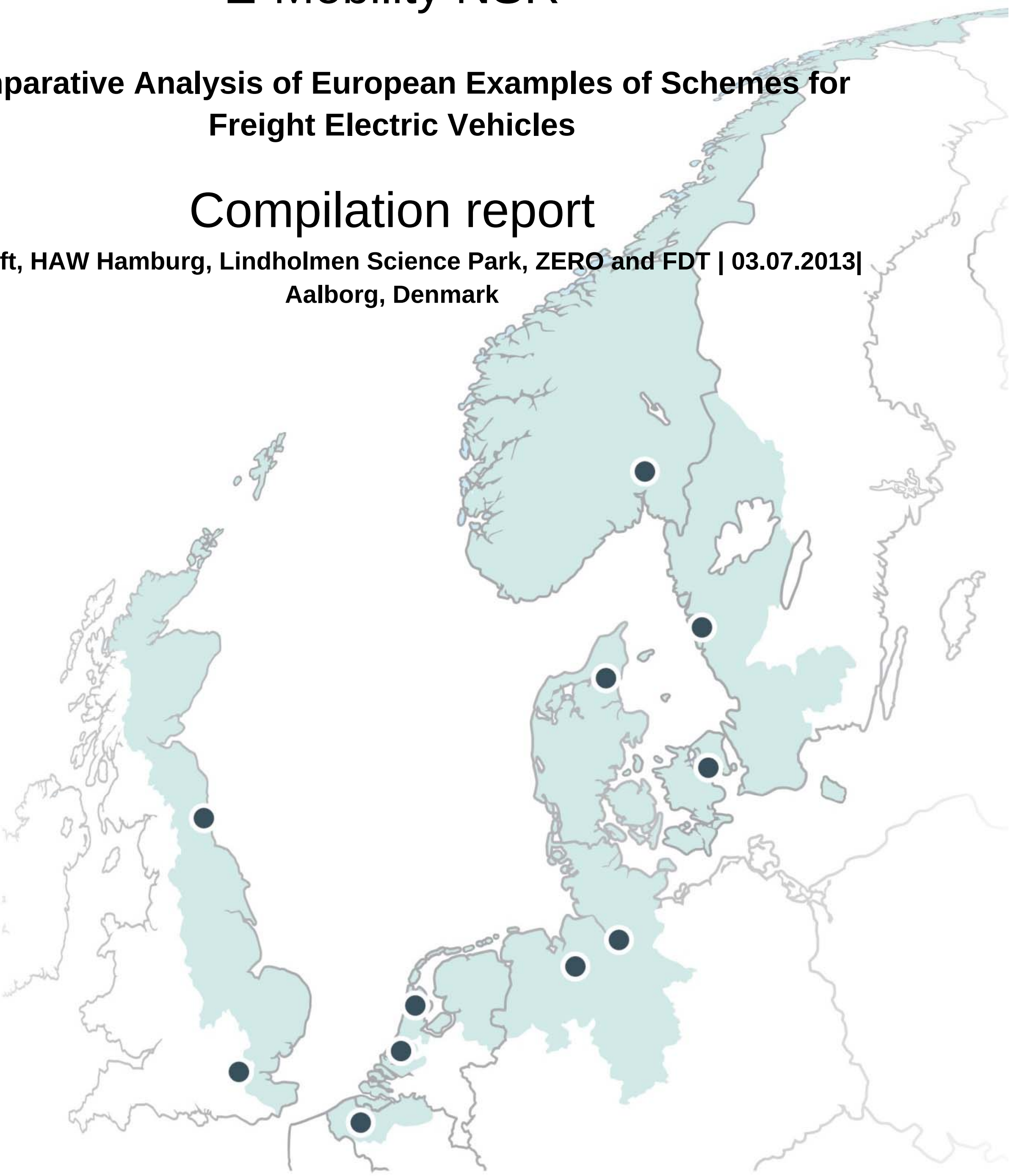

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Introduction

Electric vehicles (EV's) are currently being discussed intensively around the world, especially in European and North-American countries, but also in emerging economies such as China and India are EV's seen as a promising mean to increase the energy-efficiency and sustainability of today's transport systems. To effectively promote and successfully diffuse knowledge on EV's it is crucial to identify the initiatives containing the most likely early adopters and to target development, marketing and policy measures towards these segments.

Electric mobility itself is by no means a new concept: EV's first appeared in the late 19th century, where they seemed to prevail over petrol and steam cars for some time.

Figure 1: Thomas Alva Edison in 1916 with his Detroit Electric

The EV's leading position stopped in early 20th century when Henry Ford, with his model T created a gasoline driven car model, which in many fields was superior to the electric car.

However, the current global concerns about environmental problems such as air pollution and climate change have again given a boost to the development of EV's. The increased focus on EV's and E-mobility can mainly be attributed to the fact that EV's do not create local pollution and at the same time they are very silent. Though, in order to decouple the global pollution from their usage, EV's should be teamed up with a higher share of renewable energy in the future, hereby ensuring that the energy used to recharge the batteries come from renewable energy sources.

As a result of the opportunities to reduce the carbon footprint along with the deployment of EV's, numerous initiatives to stimulate electric mobility are being supported by governments, companies, universities, and private individuals especially in the fields of private and public transportation. However, the issue of e-mobility deployment for freight vehicles has this far not gained a substantial attention. The idea of electric freight fleet usage for the city distribution is most mature in North America and to some extent in Europe. A number of researches and pilot tests have been conducted in Europe, both based as private initiatives and within the European Union's framework programmes.

This contemporary report is created with an aim to gather and summarize a significant share of initiatives on deployment of freight electric vehicles for city distribution purposes in the North Sea Region countries: Belgium, Denmark, Germany, The Netherlands, Norway, Sweden and United Kingdom.

This report is one of the most comprehensive studies done on the usage of electric vehicles for urban freight distribution in the European countries. A total of 58 initiatives from 6 different countries are described. It is aimed at serving as a comprehensive information source for the transport related companies and public authorities, who might be interested in electric vehicles deployment for city distribution purposes. It presents initiatives with a division for specific countries, in order to draw out the country-specific legal, technical, financial and process factors for urban freight electric vehicles implementation. Through this, main drivers, opportunities and challenges were identified for each initiative and country. This information were used in the report's conclusion to draw out the common strengths, opportunities and challenges connected with urban freight electric vehicles implementation in the North Sea Region countries.

EU policies supporting e-mobility

With dwindling fossil resources and growing concerns for climate changes, the aspects of deployment of electric vehicles and electro-mobility have become more central to the European Union. Being the second largest consumer of oil and third largest of electricity (IA-HEVa, 2012), it is essential that the EU as a single unit focuses on decreasing its CO_2 emission and hereunder, on transport options which can support a decrease.

The European Commission has through different agencies and framework programmes provided support for initiatives which are directly aimed at supporting the adoption of electric vehicles and clean energy solutions. Hereby the union is addressing the possibilities of using renewable and non-polluting energy sources, thus reducing emissions, which again indirectly could encourage the adoption of electric vehicles.

The EU has announced an energy strategy which aims at reducing CO_2 emissions with 60% by the year 2050 (EUa, 2012) and the share of renewable energy sources in energy consumption has been mandated to 20% (IA-HEVb, 2012). In order to meet these goals, 'Clean Transport Systems' (CTS) have been implemented with the objectives of identifying policy areas where EU must try to stimulate the use of alternative fuels and provide industry, public sector and consumers with a vision for future market developments of alternative fuels and alternatively fuelled vehicles. The EU is the second largest importer of oil, but produces all of its electricity domestically. This means that a future with a higher share of electric vehicles will make EU less dependent on imported fossil fuels and instead become more self-sufficient.

Within the EU, road transport produce 20% of the total CO_2 emission and the transport sector is the only major sector where emissions are still rising. CO_2 emissions from the road transport increased by nearly 23%, between 1990 and 2010. Cars and vans contribute with approx. 15% of EU's emissions of CO_2 and have the highest share. Trucks and busses produce approximately 25% of the CO_2 emissions in the EU's road transport and 6% of the total EU emissions (European Commission b, 2012).

In order to reduce CO_2 emission in the transport sector, the EU has put in place legislation which obligates car manufactures to ensure that cars do not emit more than an average of 130 grams of CO_2 per kilometre (g CO_2/Km) by 2015 and 95g by 2020. The binding emission target for vans is 175 g CO_2/Km by 2017 and 147g by 2020. In regard to heavy vehicles, the European commission is developing strategies to reduce CO_2 emissions in both freight and passenger transport (European Commission b, 2012). This legislation is the most significant legislation with regard to the adoption of electric vehicles where it could become more feasible for manufactures to take electric vehicles into consideration as they with certainty will live up to the requirements.

Another way in which the European Union supports E-mobility spread across Europe is through researches on EV's and charging infrastructure technology. The biggest projects focusing on transport greening are concentrated under the European Green Cars Initiative, but also regional initiatives as the E-mobility NSR play an active role in promoting e-mobility solutions. A support for these programmes is also provided by the *White Paper*

Roadmap to a single European Transport Area-Towards a competitive and resource efficient transport system – containing an EU long term strategy for transport development. By 2050, goals connected with e-mobility include: *No more conventionally-fuelled cars in cities and all initiatives which will contribute to a 60% cut in transport emissions by the middle of the century* (European Commission c, 2011).

The European Green Cars Initiative contains three streams of action:

- *R&D, mainly through FP7 grants for research on greening road transport. Research is among others, conducted on electric and hybrid vehicles, notably research on: high density batteries; Electric engines; and smart electricity grids and their interfaces with vehicles. Budget: € 1 billion, of which € 500 million from the Commission, matched by € 500 million from industry and Member States.*
- *Support to industrial innovation through EIB* loans, e.g. EIB's €220 million support was provided to production of the 100% electric Nissan LEAF and advanced lithium-ion batteries. *Budget: € 4 billion (in addition to existing loans). Demand side measures & public procurement, such as reduction of circulation and registration taxes for low-CO2 cars* (European Commission d, 2012)

Interreg IVB programme: E-mobility NSR

- *The project North Sea Region Electric Mobility Network (E-Mobility NSR) provides state of the art information, which may help policy development in e-mobility in the NSR. It also provides insight into the gaps and needs in respect of infrastructure, logistics and preliminary standards for multi charging techniques. Ultimately, the project will deliver a long-term basis upon which regional and local governments as well as other relevant stakeholders in the NSR may engage on e-mobility. Budget: 6,658,732.00 €* (EU b, 2012)

The European Union also aim at the stimulation of the EV's market demand side, besides of ensuring that the supply side is well prepared and able to meet EV drivers' needs. EU is revising the energy tax directive 2003/96/EC to create standards for taxation that would link taxes to energy content and CO2 emission of fossil fuels.

The European Union also endeavours to provide potential EV drivers with an easily available charging infrastructure – through plugs standardization. Hereby accessibility will increase, as EV drivers will be able to charge at each operator's charging spot, potentially also across the countries' borders. Steps are undertaken to standardize the batteries and UNECE has established an informal working group (ELSA: Informal Group on Electric Safety) to develop requirements for batteries which finally are expected to be a part of a future regulation on batteries standardization. Three EU institutions: European Committee for Standardization (CEN), European Committee for Electrotechnical Standardization (CENELEC), and European Telecommunications Standards Institute (ETSI) were obligated to work out a common charging standard.

Methodology

The report is based on a transnational study with the contribution of multiple research partners. The partners are all situated in the North Sea Region; Denmark, Germany, the Netherlands and Norway. The report is developed in order to gain an overview of experiences in using electric freight vehicles in the North Sea Region and on basis of experiences, gaining an insight into the most important and commonly observed, barriers and opportunities.

The report is divided into country case studies with in-depth information from the following regions: Belgium, the City of London, Denmark, Germany, Netherlands, Norway and Sweden, meaning that all countries in the Interreg NSR program are covered. Each study has been conducted within an analytical framework, which has set requirements for which data that should be included in the study. The framework has ensured harmonization of the data gathered from each country and given comparative results to be analysed. Even though the data has been collected within a frame, researchers have been able to include addition aspects, which they found relevant to address and examine. This has meant that the national studies are not 100% identical; however, the nuances reflect that the countries examined are not identical either and have different approaches in adopting electric freight vehicles.

Data collection

The internet has served as a great source in the process of data collection, as most companies using electric freight vehicles have made information available online. Each researcher has therefore in the start-up process, conducted a thorough search on the internet to gather basic knowledge about electromobility (E-Mobility) in the respective country. After obtaining a large amount of information through the internet a sorting process began, where important and active actors in the adoption of electric vehicles were selected for further research. Information was gathered though interviews or mail correspondence in cases where it was not possible to obtain the fully needed data from the internet, or where actors have been particular active in the adoption of electric vehicles. Interviews have additionally been conducted with the purpose of validating the data found online. The interview was not structured by an interview guide; rather it was up to the individual researcher to ensure that the data collected consisted with the overall analytic framework. The interviews, which were mainly conducted by phone, were beneficial to the data collection, as the researcher gained further contribution from companies on issues, which initially were not thought of and in some cases it provided the researcher with a different approach. As the field of study is relatively new and narrow, it has been possible to conduct interviews with most companies, institutions or government agencies, who have adopted electric freight vehicles into their fleet of vehicles or who are somehow involved in supporting the adoption.

The information found in the report is a combination of data from online reports, websites and interviews. The references for data from websites and online reports are inserted in the text using the Harvard method and can additionally be found in the chapter of

references. References are not inserted in the text when data is obtained from interviews, instead the list of persons interviewed can be found in the chapter of references.
There has been close cooperation between research partners to ensure correlation between the national studies, where there has been regular phone meetings and mail correspondence.

Delimitation
'Electric freight vehicles' is the general topic of research and the aim has been to examine **Electric Vehicles, which are utilised for distributing freight in urban areas**.

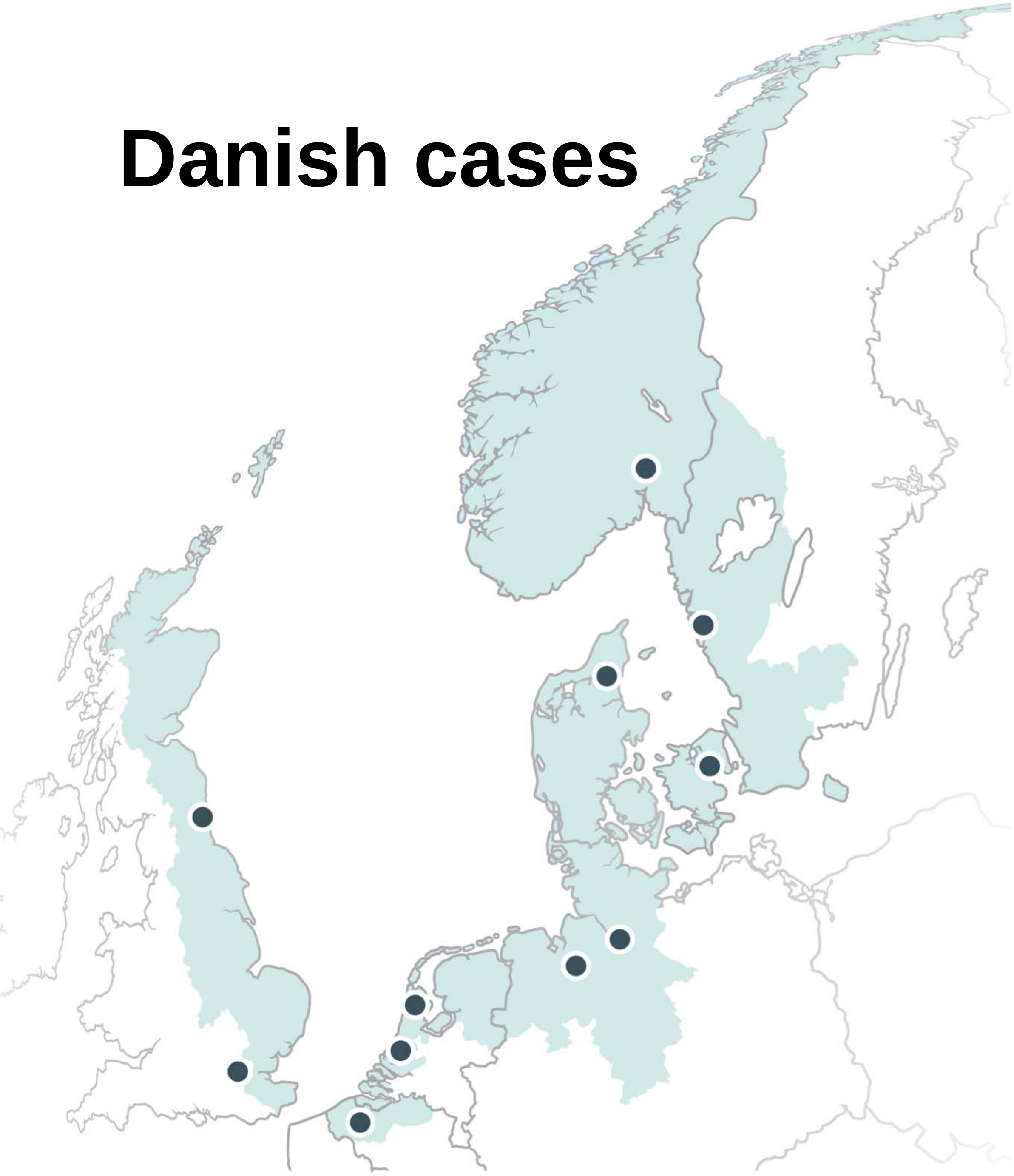
It has been up to the individual researcher to ascertain, which examples to include and the number of vehicles involved in each described case, may therefore vary from country to country.

Additionally it should be noted that in some country reports, the term "light commercial vehicles" was used, because the report describe different types of electric freight vehicles (vans, quadricycles etc.). However, for some cases it has not been relevant to use the term "light commercial vehicle" as they only entail the usage of vans. Smaller electric vehicles, like the Goupil, have in some national studies been included where it in other national studies has not. Additionally, some national studies have included distribution in smaller cities where others are mainly focusing on the largest cities.

The examples used for this report concern vans or trucks, and project partners have had to estimate the level of distribution of the vehicle. This means that cases have been deselected when it was found that an electric vehicle did not distribute any type of freight. The adoption of electric vehicles in the field of for instance domiciliary care or other types of passenger transport is therefore not been included in the report.

e-mobility NSR

Danish cases



1 Introduction

The aim of this report is to review how Denmark performs in the area of urban freight transport and distribution with electric vehicles. An account will be presented of companies that use electric vehicles for distribution and transport purposes. The aim is further to identify and discuss some of the initiatives, which have been made in Denmark and examine how electric vehicles have been incorporated into different work tasks. The report will in addition entail an account of the potential advantages and disadvantages that the various companies have experienced with the use of electric vehicles. In the final part of the country report, focus will be brought to the possible enablers and barriers of the application of electric vehicles into urban freight transportation and distribution.

2 Policies and legislation on freight electric mobility

In October 2011, The Danish government announced a new energy strategy aiming for a higher share of renewable energy in the Danish energy system. The main objective of the strategy is that Denmark is to be energy independent from fossil fuel by 2050, where all of Denmark's energy should come from renewable energy sources. Already in 2020, Denmark is to reduce its greenhouse gas emissions by 40 % compared to the 1990 level, and 50% of the electricity production ought to come from wind energy.

Wind energy is in Denmark one of the most important renewable and CO_2 neutral energy sources and the electricity produced by wind turbines account for a substantial portion of the total electricity produced in Denmark. In 2010, electricity produced by wind turbines amounted to nearly 22% of the total Danish electricity supply and in 2011, this number increased to impressive 26%, making Denmark the country in the world with the highest share of wind energy. Furthermore this also makes Denmark a suitable country to implement electric vehicles in, as the batteries can function as highly effective storage devices, which means that vehicle batteries are able to store excess energy to be utilised later by electric vehicles.

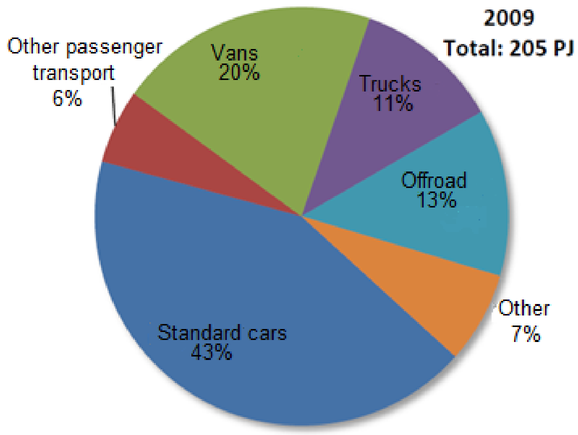


Figure 2: Distribution of energy consumption in the transport sector in 2009. 'Other passenger transport' includes energy consumption for motorcycles, buses and trains. 'Other' includes are personal transport by sea and air and freight transport by sea, air and rail.

In order to reach the goals announced by the government, it is crucial to take a look at the Danish transport sector. Denmark's energy consumption in the transport sector is mainly based on the use of fossil fuels. This can be applied to overland transport, air transport and sea transport. As road transportation in 2010 accounted for 75-80% of the total energy consumption in the transport sector, it is evident to examine initiatives concerning reducing the CO2 emission for road transport. Figure 2 shows the distribution of energy consumption in the transport sector in 2009. It appears that the major part consists of passenger cars, but vans (which are partly used for passenger transport) and trucks make up almost a third of the total energy consumption in 2009. This emphasizes that in order to reduce the CO2 emission in the transport sector it is a necessity to address vehicles, which operate in the freight, logistics and distribution field.

In Denmark the tax on passenger cars is quite high and can amount to up to 180%. In an effort to promote energy efficient vehicles, the Danish government has exempted electric vehicles from the registration tax and annual green tax until 2015 (Skattereform, 2012). The annual tax is based on the more petrol a car uses to run a kilometre, the higher the tax. When an electric car uses 0 litres of petrol to run a kilometre, the tax will inherently be 0 DKK.

A few Danish cities, here among Odense and Frederiksberg municipality, have introduced free parking to enable the use of electric vehicles. The city of Copenhagen had previously exempted electric cars from parking fees, though since December 1st 2011 electric cars are no longer exempted. The reason for the change is that there is no legal basis for exempting electric cars from payment in the parking payment area (København Kommune, 2012).

In larger Danish cities Low Emission Zones have been implemented to reduce pollution and improve the air quality in city centres. Low Emission Zones are restricted areas where it is required that diesel trucks and buses over 3½ tons are equipped with particle filters that live up to the EURO 4 norms or higher. Approved particle filters intercepts approx. 80% of the particles from a diesel engine (Miljøzone, 2009). In relation to electric vehicles, it means that it is beneficiary for companies to acquire electric vehicles to their fleet of vehicles as the electric vehicles automatically meets the requirements for driving in the zones.

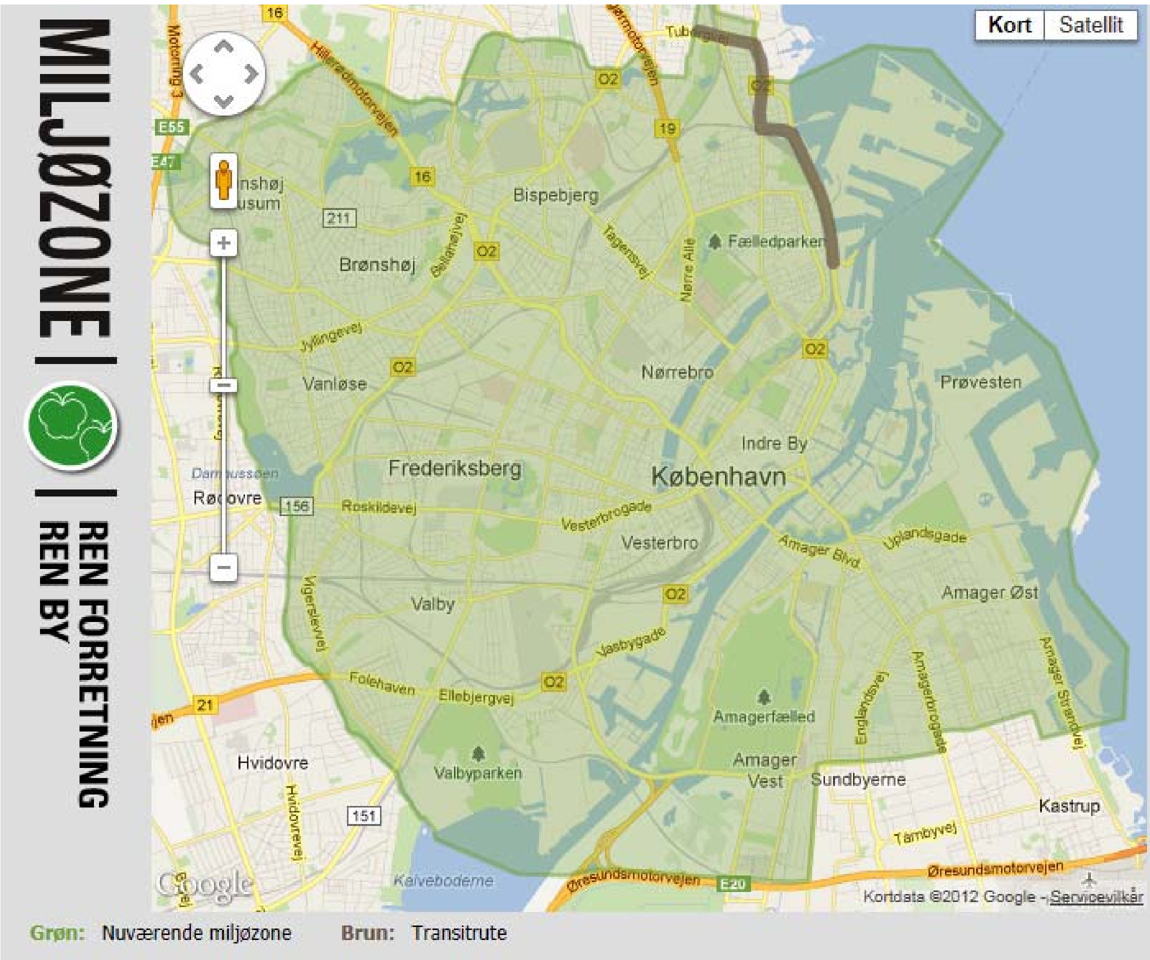


Figure 3: Environmental zone in Copenhagen and Frederiksberg

Danish EV promotion programs

In an effort to promote and test electric vehicles, 35 million DKK (€4.7 million) was allocated by the Danish Government to the Danish Energy Agency in February 2008 (Energi Styrelsen, 2009). The Danish Energy Agency should subsidize different projects in the period of 2008-2012. The main purposes of the projects are to test the usage of electric vehicles and to gather information on users' experiences with electric vehicles. Additionally, the aim is to obtain knowledge on storing excess electricity. Both, private and public companies can apply for subsidies, and it is possible to get support for the purchase of electric cars and charging points. Additionally 15 million DKK (€2 million) has been allocated for the period

Figure 4 Better Place battery switch station

2013-2015 to a continuation of the tests of electric vehicles (Energi Styrelsen, 2011). To establish charging points for electric vehicles, improve the infrastructure and the usage of gas in heavy transport additional 70 million DKK (€9.4 million) has been allocated for 2013-2015 (Klima- og Energi Ministeriet, 2011).

Another key figure in helping to reduce CO_2 emissions from the transportation sector is the Danish Transport Authority, who in 2009 April established the 'Centre for Green Transport' in a collaboration with stakeholders in the private and public sector. Both hybrid and electric cars are part of the program where the aim is to conduct demonstration projects about energy-efficient and environmentally friendly transport solutions. 200 million DKK (€26 million) has been allocated for implementation of the program, which is to run between 2010 and 2013 (Danish Transport Authority, 2012). Private EV test (ChoosEV), Hybrid busses, EV car sharing and fuel cell EV's are some of the demonstration projects included in the program.

In relation to deploying infrastructure for electric vehicles and acquisition of them, the companies Better Place and Clever are important. Better Place rents out batteries, delivers charging services and operates the infrastructure to enable adoption and use of EV's. The company offers their members access to battery swap stations, a network of charging spots and a battery guarantee (IA-HEV, 2011, 94-95). In cooperation with Dong Energy, Better Place has developed intelligent charging and smart grid solutions for future use (Dong Energy, 2012). Clever is owned by the utilities Syd Energi and SEAS-NVE, and is a Danish electric mobility operator. Clever are providers of electric vehicle services and offers charging stations, financing services, operation and advice. In contrast to Better Place, the Company is still in the process of developing intelligent charging and smart grid solutions.

As of 1st of June 2012, a total of 1,160 electric vehicles have been registered in Denmark, of these were 975 cars, 165 vans, 9 trucks and 11 buses (Dansk Elbil komite, 2012).

3 Initiatives on Urban Freight Distribution with Electric Vehicles

In the following section an account of individual Danish projects on electric vehicles for urban freight distribution will be presented. Each example will contain an examination of the current users of electric vehicles and the user's experiences in regard to their reliability and functionality.

The following initiatives will be examined:

The Municipality of Frederiksberg:	Four Modec trucks and one Fiat E-Scudo van.
The Municipality of Copenhagen:	Two Modec trucks, three Renault Kangoo Z.E. and 15 Fiat Fiorino vans.
KLS Grafisk Hus:	One Modec truck.
The Municipality of Rødovre:	One Modec truck.
TRE-FOR A/S:	One Modec truck
SEAS-NVE:	One Fiat Fiorino E van.
Loomis Danmark A/S:	Three Mercedes-Benz Vito E-cell vans.
Peter Skafte Aps.:	One MAN truck.
To Door:	Three Fluence Z.E. cars and nine Renault Kangoo Z.E. vans.
Post Danmark:	Three Mercedes-Benz Vito E-cell vans.

Technical specifications on all vehicles can be found in Appendix A

3.1 Gardening and Road service in Frederiksberg

Status: In operation

Participants: Frederiksberg Municipality & the Danish Energy Authority

Project description

The gardening and road service department of Frederiksberg municipality has since 2004 employed smaller electric vehicles into their work. In 2009, they entered a project with the Danish Energy Agency to test the usage of larger electric vehicles. The project was intended as an experimental scheme where Frederiksberg municipality was one out of five participants. The test of the electric vehicles included a Modec electric truck and a Fiat E-Scudo van. Due to the success of the project, Frederiksberg municipality has in addition, acquired three trucks in 2010.

The first truck that was introduced to Frederiksberg municipality was used to perform normal entrepreneur assignments and in public waste disposal. The Modec truck was in 2010 transformed to be able to transport haul asphalt. In the winter season the same truck is used to winter road maintenance. In order to prolong the driving time of the truck in the winter season, an extra battery has been acquired which can be changed in 30-45 minutes. The truck can in the winter season drive approximately four hours where after it need recharging or a battery switch.

The electric van of the brand Fiat E-Scudo has been modified from being a conventional fuel engined vehicle to an electric vehicle by the company EnerBLU. The Fiat E-Scudo van is employed in the gardening and road service department, where it transports items for electrical and plumbing work.

Of the three additional Modec trucks, two of them are equipped with electric waste compactor boxes and are being used in public waste disposal. The compactor box is connected to a separate battery pack, which means that the range of the vehicle is not affected. The Modec truck functions equal to a diesel truck. Due to the weight of the truck the driver has to have a driving licence C. The average driving distance per day of the Modec is approximately 40 km and annual drive is 5,000 km.

Goals:

- To collect data on the influence of frosty weather on lithium batteries
- To collect data on logistics concerning the charge, including battery range, charging time and reliability
- Broaden the experience with electric vehicles
- Promoting the use of electric vehicles
- A cleaner environment in the city

Figure 5, The Modec truck

- Minimising sound pollution in the city

Finance:
The Danish Energy Agency financed the first Modec truck and the Fiat E-Scudo. The subsidy was on 900,000 DKK and the project was within the budget. In addition, 500.000 DKK was invested by the municipality to establish the right charging facilities for the trucks. The purchase of the extra battery was self-financed and has a price on approx. 300.000 DKK. The Modec truck costs 800.000 DKK.

Due to the success of the project, Frederiksberg Municipality has purchased three additional Modec trucks, which they have financed themselves. In 2009 the municipality allocated 5.45 million DKK and in 2010 5.00 million DKK on their budget for the purchase of electric cars.


Figure 6, Fiat E-Scudo

Results
Customer attitude:
Frederiksberg municipality has in general been satisfied with the use of the Modec truck and it meets their requirement with regard to functionality and reliability. It is reported that the Modec has become the most preferable truck due to a larger carrying capacity compared to similar diesel trucks, which means limited trips for the user. Furthermore, it has good acceleration and it is comfortable to drive in. The two Modec trucks, which have compactor boxes mounted, are well functioning in accordance with their purpose and staffing of each vehicle has been reduced from two persons to one. The truck is fast and flexible in traffic and it has a good graphical overview of battery information and status. The backdoor of the truck has also been reported to function well in relation to its purpose. The sound of the trucks is relatively low, which contributed to a better sound environment in the city, but it has also been reported to surprise pedestrians. Due to the success of the Modec truck, Frederiksberg municipality has been contacted by several other municipalities and private companies who have an interest in their experiences on the Modec.

In regard to the research on the impact of cold weather on lithium batteries, there has not yet been analysed on the collected data.

Although the general attitude towards the Modec trucks is positive, a few negative remarks have been noticed. The municipality did experience computer charging difficulties in the start-up of the project, but it was quickly resolved by the truck supplier. Of minor critical issues can be mentioned that the truck bed is too high compared to other diesel trucks. This is a manufacture problem that cannot be changed because the space for the electric battery is needed. The rear view camera does not work and the windscreen wiper cannot reach the whole window. Furthermore, there have been problems with the heating of the driver's cab, but it has been resolved with the help of an oil-fired boiler.

In contrast to the success of the Modec truck, the Fiat E-Scudo has not met the expectations of Frederiksberg municipality. In the beginning of the project the driving of the van was satisfactory, but within a month of operation they faced problems with the lifespan of the battery. The battery could not last a whole working day. The battery would stop charging at the level of only 70% and the van would stop driving at approximately 34 %. After sending the van in for repair the error was still not corrected satisfactory. The error was software related. Furthermore, there have been problems with the heating of the driver's cab.

Frederiksberg municipality has decided to invest additionally in purchase of new electric vehicles. In the summer of 2012 they ordered a 26 tonnes electric garbage truck and a few electric cars, which were delivered ultimo 2012.

Impact

The Modec truck is relatively soundless which contribute to a better sound environment in the city. Frederiksberg Municipality will try to exchange a larger part of its municipal vehicle fleet to electric vehicles setting higher environmental standards and living up to the requirements for driving in the environmental zone that encompass the whole municipality.

3.2 Roadwork and distribution in Copenhagen

Status: In operation

Participants: The municipality of Copenhagen & the Danish Energy Authority

Project description

The municipality of Copenhagen is also part of the project financed by the Danish Energy Agency and received financial help to purchase their first electric truck. The municipality is in addition participant in three EU projects to promote awareness and the use of electric vehicles within Europe (Greening European transport infrastructure for electric vehicle, Green E-motion and E-mission in the Region of Oresund).

Figure 7: Renault Kangoo Z.E.

The municipality of Copenhagen started in 2009 to introduce electric vehicles into their daily work assignments. The municipality's vehicle fleet contains approx. 43 electric vehicles and six hydrogen electric cars and it grows continuously. Some of their larger vehicles are 15 Fiat Fiorino E, 3 Renault Kangoo Z.E.s and two Modec electric trucks (the smaller vehicles will not be elaborated further here). As participants of the project financed by Danish Energy Authority, the municipality of Copenhagen has, like the municipality of Frederiksberg, used public subsidies to purchase a Modec truck. Yet another Modec truck was acquired as a result of the first project. The tasks of the truck are in roadwork and distribution of books in between libraries. The 15 Fiat Fiorino E vehicles are part of the Technical and Environmental Administration and the Fire Brigade of Copenhagen. These vehicles are used for business visits, inspections, internal transportation and as a work car for craftsmen. The Fiat Fiorino E has been modified from a petrol-engined to an electric car by Micro-Vett. The Renault Kangoo Z.E's are employed for transportation of craftsmen and their tools.

Goals

- To reduce the CO_2 emission of the municipality by 20 % in the period of 2005 – 2015
- To insure that 84 % of the municipality's cars are electric or hydrogen powered by 2015
- To contribute to a cleaner environment
- To make their transport more efficient and reduce their fleet of cars by half
- To gain more information on the functionality and reliability of electric vehicles

- To collect data on logistics concerning the charge, including battery range, charging time and reliability

Financial Support

The Danish Energy Authority has given subsidies for the acquisition of a Modec truck, 6 Citroën C1 and 4 Fiat Fiorino E. The financial support amounts to approx. 1.4 mio. DKK and in own financial contribution 1.3 mio. DKK. The additional Modec truck, Renault Kangoo Z.E. and the 11 Fiat Fiorino E's are self-financed.

There have been some additional costs due to insufficiently reliability of the vehicles. The municipality needed to provide replacement cars for the Fiat Fiorino E.s when they were in for service or repair and the municipality found it necessary to hire two employees to maintain the electric vehicles. Many working hours has also been spent in connection with inquiries to suppliers for defects.

Policy

The municipality has removed the possibility for employees to receive travel reimbursement for transportation in own car for work purposes. This means that the employees more likely will make use of the electric vehicles of the municipality instead of a petrol-engined car.

Results

Customer Attitude

The users of the electric vehicles have in general a positive attitude towards the cars and have good experiences driving them. In the evaluation, an emphasis is put on the operational reliability of the vehicle and whether its functionality meets the needs of the employee. Most of the employees using the electric vehicles believe that it is important that the municipality sets a good example and demonstrate environmentally friendly behaviour. The functionality of the Fiat Fiornino is not considered to be adequate. It has received good reviews in regard to its driving, but there have been too many technical errors on the vehicle. 50 % of the Fiat Fiorninos have had technical errors. It has been difficult to procure the necessary spare parts to repair the vehicles and some have therefore not been used in a period of up to four months. The municipality of Copenhagen believes that the supplier has not given them vehicles in the promised quality and is very dissatisfied, that the vehicles did not function for such a long period of time. The municipality has experienced that the supplier of the electric vehicles does not have the requisite resources and expertise to repair the damage effectively. In addition, the repair shops are located outside the in inner city in Ballerup and Hillerød respectively, which has created a time waste in connection with the many repairs. It has shown to be difficult for some users to operate the Fiat, which has been a further contributor of errors on the vehicle. This issue has partially been solved by formulating a manual for the employees.

The Modec truck has been reported to be the most reliable electric vehicle compared to the Fiat. There have been some minor problems with the battery of the truck where it has been in service for a short period of time, but in overall the utilisation of the Modec truck has be satisfactory.

Evaluation of the municipality’s two Renault Kangoo’s could not be found.

Impact

The municipality has experienced cost savings on operating expenses on approx. 10-15 % per electric vehicle in comparison to their non-electric vehicles. The Municipality of Copenhagen had positive experiences with the use of electric vehicles which has derived larger interest in employing electric vehicles in other work areas. An example of their openness towards electric vehicles can be detected in their purchase of electric street sweepers and scooters. Moreover, the project has contributed to training of 2 employees in maintenance of the vehicles, which is highly useful for future purposes.

3.3 Environmentally friendly driving in KLS Grafisk Hus

Status: In operation

Participants: KLS Grafisk Hus & the Danish Energy Authority

Project description
KLS Grafisk Hus is a company consisting of 50 employees working with graphic solutions. The company is committed to reducing their CO_2 emission and has taken several steps to insure a cleaner environment for the future. By driving electric vehicles, KLS wants to reduce the company's emission of greenhouse gases for transporting passengers and products. The focus on electric vehicles is an integrated part of the company's overall strategy of reducing their CO_2 emission, and their climate initiatives are an essential element in the company's marketing.

Figure 8: Modec truck

KLS Grafisk Hus is also part of the project financed by the Danish Energy Authority and received financial help to purchase a Modec truck and a Fiat Qubo E. The Modec is used to distribute their products in Copenhagen capital region. The driver plans his route each day in accordance with the battery level. The truck drives between 100-130 km every day and has so far travelled 9.000 km.

Goals

- To reduce the emission of the company
- To promote the use of electric vehicles
- Examine the possibilities and the barriers of the use of electric vehicles
- To promote the company as environmentally friendly
- Replace five internal combustion engine (ICE) cars with electric cars by 2013
- Gain more information on the functionality and reliability of electric vehicles

Financial support:
The company has received a subsidy on 530.000 DKK from the Danish Energy Authority, while they themself have invested 900.000 DKK. In addition the company has spent 38.000 DKK on external counselling and 2.600 DKK on extra repair.

Results

Customer attitude

According to the company, the most important feature of the Modec truck is its environmentally friendly aspects. The truck meets the company's expectations and requirements in relation to functionality and operational range. KLS Grafisk Hus is overall pleased with the truck, but they have experienced technical errors and problems with receiving the right service for the truck. The truck was delivered with the wrong battery and they continued to have problems with the new battery. The truck's operational range was reduced to 100 km, instead of the promised 160 km. Due to the error the truck has been out of service for two out of the five first months. The supplier has repaired the errors and the truck is now working satisfactory. Furthermore, there is more noise in the cabin than expected and the steering wheel is not adjustable. Depending on how heavy the car is loaded and the driving behaviour, the truck's operational range is proved to be approx. 140-160 km.

The largest problem has, according to KLS Grafisk Hus been a lack of appropriate spare parts for the truck, and an uncertainty on who holds the responsibility for potential repairs. Company management believes that it is a serious barrier for the adoption of electric vehicles, that the underlying infrastructure and the skills to service and repair electric vehicles have not been present.

Impact

KLS Grafisk Hus has improved their carbon footprint, which they have used in marketing towards their clients

3.4 Electric Truck at the Recycling Centre

Status: In operation

Participants: Rødovre Municipality & the Danish Energy Agency

Project description

When Rødovre Municipality had to purchase a new truck in 2009 they decided to invest in an electric Modec truck. The truck is in operation at a recycling centre where it handles transportation of rubbish bins, recycle containers and other waste related tasks. The truck has a crane which has a separate battery. Like the above mentioned projects, Rødovre municipality is also a part of an experimental scheme financed by the Danish Energy Agency. The truck is in use two days a week and drives approx. 4,100 km a year and will in the future be employed in more tasks. The truck is being recharged at night and has a timer to start the process.

Figure 9: Rødovre municipality's Modec truck with a crane and truck bed

Goals

- To better the transportation of waste
- Broaden the experience and knowledge of electric trucks
- To gain experience on acquisition and maintenance of electric vehicles
- To gain knowledge on the implementation of electric vehicles.
- A comparative study on the operation of an electric truck and a conventional truck
- A user survey on the experiences with using an electric truck
- A study of environmental and work environment related issues concerning the operation of an electric truck.

Financial support:

Rødovre Municipality has self-financed the truck with app. 750.000 DKK and has received a subsidy on 250.000 DKK from the Danish Energy Agency.

Result

Customer attitude

The employees are very satisfied with employing the Modec truck in their work, and are content with its functionality and reliability. The truck meets their expectations and they have not considered an alternative vehicle. The municipality have experienced a good communication with the supplier. Training in using the vehicle was needed in the beginning, but after proper instructions from the supplier, users have no problems using the electric truck. It was delivered with a malfunctioning crane, but this was quickly repaired. The users are also satisfied with the operational range as it meets their needs.

Impact

The municipality is satisfied with the green image the usage of the trucks gives them

3.5 Electric Van for Internal Transportation of Goods

Status: In operation (since Sep. 2010)

Participants: TRE-FOR A/S & the Danish Energy Agency

Project description

Tre-For A/S is one of Denmark largest utility companies and is an important supplier of electricity, water and district heating. The company has adopted a green policy and is active in the development of environmentally friendly energy technologies. It is therefore natural for the company to employ electric vehicles into their fleet of cars. They have acquired a Modec truck, which is partly financed by the Danish Energy Agency. The truck is used in internal transportation of goods from the stock to construction site or other needed work assignments. The truck is also employed in marketing relations, as on fairs and exhibitions. The truck drives on average 50-60 km. a day which mostly consists of short distance trips, but it also has freight assignments of 70 km distance. The truck has overall driven 3,600 km. but it is expected to be more employed. The operational range of the truck has been extended by mounting a charger onto the truck. Tre-For has also been active in improving the infrastructure to accommodate electric vehicles by developing and establishing charging points,

Figure 10: TRE-For's Modec truck

Goals

- To examine the truck's practicability in a work relation
- To collect data on logistics concerning the charge, including battery range, charging time and reliability
- To contribute to a cleaner environment
- To spread knowledge and promote the use of electric vehicles
- A comparative study on the operation of an electric truck and a conventional truck
- To examine seasonal effects on the vehicle's performance

Financial Support

The project has exceeded its planed budged as there have been additional expenditures. This is partly due to a modification of the rear of the truck and because the first purchased crane did not have sufficient capacity. The company has received app. 340.000 DKK in subsidies from the Danish Energy Authority. Tre-For invested 410.000 DKK in the truck, excluding the modification and the purchase of the crane.

Results

Costumer Attitude

Tre-For is partly satisfied with their Modec truck, as the truck can be employed in diverse tasks, has a reasonable driveability, the acceleration is satisfactory and has a sufficient carrying capacity. Nevertheless, Tre-For experienced a few errors with regard to the functionality of the truck. The actual range was only 120 km compared to the 150 km, which was stated in the specifications. In the winter season the range was reduced to 100 km and the cabin of the truck was often too cold to sit in.

The charging of the truck was a further challenge, as the users of the truck found it difficult to go on long distances due to the lack of charging possibilities. The truck was out of operation for 2 ½ months in the autumn of 2011, where the Danish supplier did not respond to the inquiries of Tre-For and took far too long time to solve the problems. The carrying capacity of the truck was not sufficient for planned deliveries and Tre-For therefore detached the crane from the truck and mounted a closed truck bed instead.

Impact

The vehicle has enhanced the image of Tre-For of being environmentally friendly.

3.6 Electric Post Van

Status: In operation

Participants: SEAS-NVE & the Danish Energy Authority

Project Description
Seas-NVE is one of the largest utility companies in Denmark and delivers fibre-optic broadband and energy to more than 400.000 customers. The company has purchased a Fiat Fiorino E, which has been modified by Micro-Vett. The electric van is an integrated part of the company's daily work. The car has been acquired in connection to a project financed by the Danish Energy Agency and employ internal mail distribution. It is in operation three days a week, two trips a day. It drives between Haslev and Svinninge with a daily distance of 150 km. and has so far travelled 6,000 km. Only the regular driver operates the car as the other drivers do not have the possibility of charging the car for one hour on their route. A daily distance of 150 km per day is the longest test drive of electric vehicles in Denmark whereto the aim of the project is to examine if the car can operate on 150 km routes with only an hour of charging during the day and a full charging at night. The supplier is "Elbil Danmark".

Goals

- To collect data on the impact of the charging on the capacity of the vehicle
- To examine alternative charging opportunities
- To collect data on long range EV transport
- To collect data on logistics concerning the charge, including battery range, charging time and reliability
- To collect data on the opportunity to adjust charging to the market price on electricity

Finance
The car has partially been financed by the Danish Energy Authority with 166.000 DKK and self-financed with 500.000 DKK.

Results
Customer Attitude
The company has overall been satisfied with their vehicle. The main objective of the project was to measure if the vehicle could be employed on long distance routes. The results of the project have been positive as it has shown that the vehicle meets the expected range and is able to drive 150 km a day. The driver values that the car is environmentally friendly and that it is relatively soundless. It has fast acceleration and sufficient battery- and carrying capacity. The car has had a few errors, but the driver feels that these are not very essential as he has learned to manoeuvre the car better. The vehicle has had continuous problems with the gear and has needed more repairs than expected which mean that company is not fully content with its reliability and functionality. Elbil Danmark has in general ensured quick repairs and the car has been out of service for one week.

Impact:
The result of the project shows that fuel costs for operating the electric car is 12% lower than the operation of an equivalent diesel-powered car. The CO_2 emissions of the electric car are 36% lower compared to an equivalent diesel-powered car. The vehicle drives 4,84 km/kWh and with an electricity price on 2,03 DKK per kWh incl. VAT, the fuel cost for the electric vehicle is 0,42 DKK/km. Calculation on the CO_2 emissions is based on the CO_2 emissions of the average power in 2011 on 391 g CO_2/kWh where the energy loss on power plants and distribution are included. This means that a converted Fiat Fiorino has a CO_2 emission of 80,1 g CO_2/km. (Ens.dk, 2012)

In comparison, a diesel-engined Fiat Fiorino drives 26,3 km/l on highway and 22,7 km/l in mixed driving. With a diesel price of 10,8 DKK/L the fuel cost is in mixed driving 0,48 DKK/Km (Fiat, 2011). If loss on refinement and distribution of petroleum products on Danish soil is included is the CO_2 emissions 2,85 kg CO_2/l diesel (Energi Styrelsen, 2008). The CO_2 emissions for a diesel Fiat Fiorino is thus 125,6 g CO_2/km.

3.7 Cash Managing with Electric Vans

Status: In operation

Participants: Loomis Danmark A/S

Loomis is an international cash managing company, which has invested in the use of electric vans for their driving in the city centre of Aarhus and Copenhagen. They have acquired three electric vans of the brand Mercedes-Benz Vito E-cell to their fleet of cars. The company has departments in 15 countries and the management has an interest in employing electric vehicles in other departments. The vehicles are part of the company's daily work where they transport money from shops in the city centre. Due to the transport of valuables it is very important that the vehicles are secure. This means that the vehicles have a double power system, one for the car and one for the protection of money. It is not possible to purchase the vehicles yet and Loomis is therefore renting them from Mercedes for 11.300 DKK a month. Their previous diesel vehicles were 5-6.000 DKK, but the expense of electricity is half the expense of diesel. The vehicles drive approx. 80-90 km a day and are recharged in between trips. The charging points of the vehicles are located by the company and are set up by CleanCharge.

Goals

- To contribute to a cleaner environment in the city
- To contribute with a more quiet environment in the city
- To collect data on the use of electric cars for security purposes
- To employ more electric cars to their fleet of cars
- To promote Loomis as environmentally friendly

Figure 11: Mercedes-Benz Vito E-cell

Financial Support

The vehicles have been purchased without subsidy.

Result

Costumer Attitude

The biggest concern for Loomis was if the vehicles could live up to the company's high requirements in regards to security. The vehicles have met their expectations to both security and time and are therefore able to replace their diesel trucks for city transportation. The vehicles are perfect for city distribution, because the distance between their clients is short. The vehicles cannot be employed on their longer routes, which mean that they do not think they will purchase more. In addition the vehicles contribute to the company's environmentally friendly profile. The cars have a maximum speed of 80 km/h and a range of 100-130 which is enough for their purpose. The drivers of the cars are also very pleased, as the EV's drive and react as normal cars but make less noise. A challenge has been the heating of the cabin where it can become very cold in the winter. This issue has partially been resolved with a separate heating system. The company does not believe that they at the moment can employ more electric vans into their fleet of cars. Their other vehicles operate on long distances and the company has not yet found an electric vehicle, which is able to drive such a route without having to charge on its way.

Impact

The company's CO_2 emission has been reduced and their clients have received the new vehicles very well.

3.8 Electric Truck for Distribution of beverages

Status: Not in operation

Participants: Peter Skafte Aps. & the Danish Energy Authority

The project is one of the Danish Energy Agency's experimental schemes for electric cars. Peter Skafte Aps. has acquired an electric truck for freight distribution. The truck is a modified MAN truck, which was planned to be used for distribution of beer and soda in the Copenhagen area. Its daily distance should be approx. 80-100 km. and the expected annual drive 20.000 km. But, there have been major complications along the way in which the delivery of the engine was delayed, the battery system has failed and an electric motor has broken down. The truck has therefore not yet been tested. Damage to the truck was large due to superheating of the battery.

The truck has a chassis specially designed that can lower to the level of the pavements which means less strain on the employee.

Finance:
The project exceeded the budged with 30 %. The subsidy from the Danish Energy Authority is 1.000.000 DKK and self-financing is 1.750.000 DKK. The repair of the trucks battery amounted to 1.000.000 DKK but was covered by the battery manufacturer.

Figure 12: Custom made MAN EV truck

Results

Customer attitude
Peter Skafte Aps. has not been satisfied with the supplier of the engine and there is no longer co-operation between the two. The company is not working on the project and the truck will not be in operation in the future.

Impact
Due to the vehicle never being in operation, there has not been a measureable impact of the project.

3.9 ToDoor Grocery Delivery

Status: Cancelled due to financing problems

Participants: ToDoor & Better Place

Project description

ToDoor was an online supermarket, which services were structured around the delivery of groceries directly at the door of private households. The company was delivering to most of the Copenhagen Capital area. The company had three Renault Fluence Z.E cars with changeable battery as company cars and nine Renault Kangoo Z.E. vans, which were employed for delivery purposes of the groceries. ToDoor made agreements with BetterPlace about using their charging network in Denmark. The vans were not equipped with a cooling system therefore ToDoor had chosen to use cooler bricks to maintain the right temperature for the food. When the company still existed, they expected to expand on the market, and planned to purchase 18 additional electric vans in 2012 and 27 electric vans in 2013, but due to financial problems they had to stop their services ultimo 2012.

Figure 13: To Door's Renault Kangoo Z.E.

Goals

- To reduce ToDoor's CO_2 emission
- To contribute to a cleaner environment
- Make their transport more efficient
- To employ a business model only based on the use of electric vehicles

Financial support

The vehicles have been purchased without subsidy and are self-financed.

Results

Customer attitude

ToDoor has been very satisfied with the electric vans and will therefore in the future only make use of these. The vans are perfect for city distribution as the distance between the clients are short and the van's torque is high and constant. ToDoor reports that the vans are easy and comfortable to drive and that recharging of them are unproblematic. They have experienced challenges in regard to the vans' operating range, which was caused by unfavourable driving technique, but the company has solved the issue by formulating a driving manual for their employees. The van can now drive 120 km on a full battery. The company makes use of an economy function where the maximum speed is 90 km/h and do not have a need to drive faster. Another challenge has been the vans' air-condition system, which reduced the battery's lifespan with 50% when in use. This issue has partially been solved by adjusting the temperature of the vehicle an hour prior to driving, while it is still charging. Ejner Hessel is the supplier of the car and the company has been very satisfied with their service of the vans. The repair shop is located in Jutland, which has increased the time for repairs, but not significantly.

Impact:
ToDoor have experienced that their vans are positively met and they improve the image of the company. The business model which ToDoor tried to create has unfortunately proven to be unsuccessful, meaning that the largest self-financed EV project for commercial fleets in Denmark had to stop.

3.10 Mail Delivery in Electric Vans

Status: In operation (since Sep. 2011)

Participants: Post Danmark

Project description

Post Denmark Bornholm has received three electric vans as part of an experimental scheme. Post Danmark has launched the project on Bornholm to examine the functionality of the vans as delivery vehicles. The vans are of the brand Mercedes-Benz Vito E-cell and are used for mail delivery purposes. Two of the vans drive regular routes with a distance of 60-70 km a day and the third van are only used on occasion. The Island Bornholm has already been selected as a practical testing ground by the electric power industry, which is working on a mayor project called Edison to improve the infrastructure of the Island (Electric Vehicles in a Distributed and Integrated Market using Sustainable Energy and Open Networks). One of the objectives of the Edison project was to establish a network of charging points, which does not strain the grid.

Goals

- To reduce Post Danmark's CO_2 emission with 40 % by 2020
- To introduce 50 electric vehicles to their fleet of cars in 2013
- To collect data on the use of electric vehicles for delivery purposes
- To contribute to a cleaner environment
- To promote the company as environmentally friendly

Figure 14 Post Danmark's Mercedes-Benz Vito E-cell

Financial support

The vehicles are self-financed.

Results

Costumer attitude

Post Danmark has been very satisfied with the use of the electric vans. Especially the environmentally friendly aspect and the sound of the vehicles seem to be of great importance. The drivers are proud to be driving a vehicle which does not pollute. The vehicle is comfortable to drive in, where the seat and steer is adjustable and it has automatic transmission. Recharging of the battery takes 4-5 hours and when the battery is 50% full it is possible to charge to 80% in 45 min. A disadvantage of the vehicle is that when using it for delivery, the vehicle has to break and start a lot and it takes a lot of energy from the battery. Another disadvantage is the energy consumption of the heating system, which was too high. This has partly been solved by installing an oil-fired boiler in the cabin. On average it can drive 100 km on one charging.

Impact

The result of the project shows that CO_2 emissions of the electric car are 63% lower compared to an equivalent diesel-powered car.

4 Summary and Conclusions

The Danish government has aimed high for the transport sector in order to ensure a cleaner future environment. The ambitious goals set out by the government have meant that several projects concerning the use of electric vehicles have been launched. In many of them private and public companies could apply for subsidies to start test and trials. The subsidies, managed by the Danish Energy Agency, have shown to be very beneficial for the adoption of electric vehicles where most electric trucks in Denmark are partly financed through these subsidies. The study has shown that it is hard to get Danish companies to invest in electric vehicles, thus it has made a clear difference that they can be supported by either the Danish Energy Agency or a car manufacturer.

Most companies are very pleased with having adopted electric vehicles into their fleets. One of the biggest advantages reported by driving an electric vehicle is the fact that the vehicle does not pollute. Surprisingly the collected information shows that many are satisfied with the vehicles despite of sometimes poor functionality and reliability. This could indicate that the environmental aspect is valued high and can delimit some of the more negative experiences. Companies reported, that when the vehicles did not have errors, the operation range of the vehicles was sufficient for city distribution and the tasks intended.

Many companies have reported to encounter the same difficulties when adopting electric vehicles into their fleet of vehicles. It has been reported that the suppliers of the vehicles are not fully prepared to undertake potential technical errors. When the vehicles break down for various reasons, the repair time is often long. This can be due to limited spare parts to replace broken ones, lack of auto repair shops in the area, which has the right expertise or because there is a lack of agreement on who is responsible for making sure that the vehicles are repaired. These factors serve as serious barriers for the adoption of electric vehicles, especially that the skills and availability of personal to service and repair electric vehicles is not present. In relation to repair of the vehicles, many of the companies have had to invest additionally in the vehicles in order to make them work satisfactory and the repairs have been quite expensive.

Another frequent investment made has been in a better heating system where many have found, that the battery loss due to heating was too high during the Danish winter season. Moreover, the underlying infrastructure does also present a challenge for many of the companies, which have employed electric vehicles into their work. There are still too few charging points available across Denmark, which means that the companies cannot make use of the electric vehicles on long distances and therefore does not want to purchase more. With the new EU initiative on Clean Power for Transport national goals for the number of public and private financed charging points have been determined.

Main functions of freight EV's within city distribution

- Mail delivery
- Grocery delivery
- Cash managing

- Transportation of goods
- Waste disposal
- Roadwork and winter road maintenance
- Gardening and road service

Impacts

- An openness towards expanding the fleet of vehicles with more electric vehicles have been created for most companies using electric vehicle
- Electric vehicles are relatively soundless which contribute to a better environment in the city
- Cleaner environment, especially cleaner air in urban areas.
- Electric vehicles help create a company image of being environmental friendly, which to most industries and commercial operators are beneficial in marketing relations.

Drivers

Technical factors

- Few spare parts to repair
- Suitable for city distribution
- Good carrying capacity
- Fast acceleration

Financial factors

- Some companies have experienced cost savings on operating expenses

Energy supply and infrastructure factors

- Several charging points available in larger cities

Environmental factors

- No pollution of the environment
- Almost soundless

Regulatory factors

- Tax exemption when purchasing an EV
- Free parking in Odense and Frederiksberg municipality
- Can drive in Low Emission Zones

Human factors

- Drivers are proud to be driving a vehicle which does not pollute
- Gives companies an environmental friendly image which is good for marketing
- low functionality does not always equals low satisfaction as the environmental aspects is valued high and therefore compensates

Challenges

Technical factors
- Limited spare parts available on the Danish Market
- Lack of auto repair shops that has the right expertise
- The battery often don't last as long as expected
- Companies cannot make use of the electric vehicles on long distances
- Long repair time
- High battery consumptions in the winter season due to the heating system
- Needs more repairs than companies expected
- High number of errors with EV's which have been modified

Financial factors
- Companies have had to invest additionally in the vehicles in order to make them work satisfactory and the repairs have been quite expensive
- To prolong the driving time of the truck in the winter season, companies often have to invest in improving the heating system
- The total costs of ownership for EV's are higher than other comparable diesel trucks
- The manufacturer of Modec trucks has recently gone bankruptcy.

Energy supply and infrastructure factors
- Too few charging points available across Denmark (outside major cities)

Process and logistic factors
- EV's need to recharge for a certain time period which has to be considered in the work schedule

Human factors
- Lack of agreement about who is responsible for ensuring that the vehicles are repaired

Opportunities

Technical factors
- Longer lasting batteries
- Most companies have installed a separate heating system to solve the heating problem

Financial Factors
- Continue with subsidizing different projects where support is possible for the purchase of EV's and charging points
- Continue to test the usage of electric vehicles and to gather information on users' experiences with EV's

Energy supply and infrastructure factors
- More charging points

Environmental factors

- Living up to the requirements for driving in the environmental zone that encompass larger cities

Regulatory factors

- Tax exemption when purchasing an EV
- Implementation of Low Emission Zones means that it is beneficial for companies to acquire electric vehicles to their fleet of vehicles, as the EV's automatically meets the requirements for driving in the zones

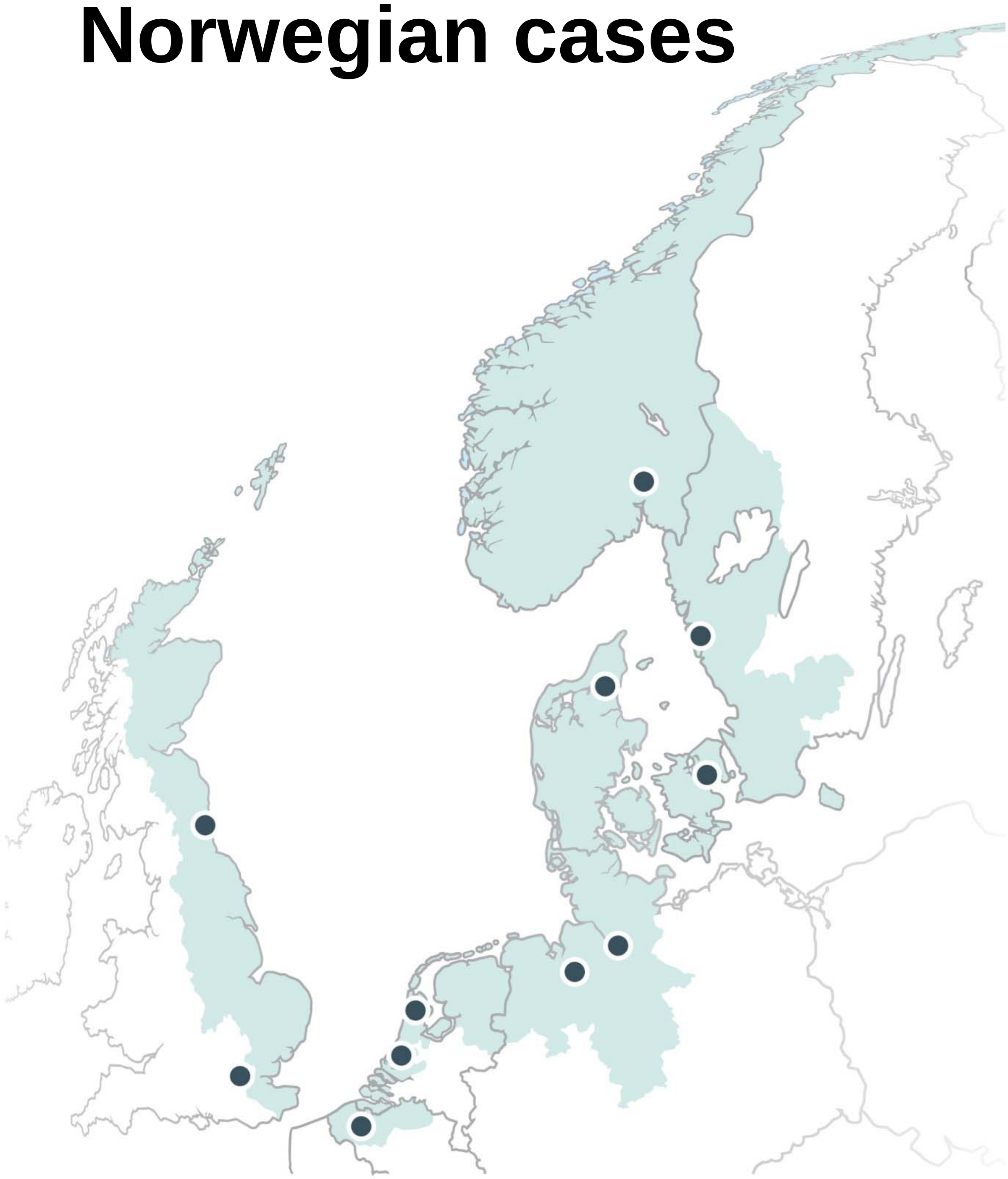
Human Factors

- Formulate a driving manual for employees to improve driving technique
- Setting higher environmental standards by changing a larger part of the vehicle fleet into electric vehicles

NORTH SEA REGION ELECTRIC MOBILITY NETWORK
e-mobility NSR

e-mobility NSR

Norwegian cases



The North Sea Region Programme
Investing in the future by working together for a sustainable and competitive region

European Union

The European Regional Development Fund

1. Introduction

Norway currently experiences a great deal of enthusiasm and focus on electric vehicles. They are proposed as a means to reduce greenhouse gas emissions, increase energy security, and producing new green jobs. However, electric vehicles do not enter the market by themselves. Predictions have been made about EV's developing a sales curve like iPods, or battery capacities developing according to Moore's law that has been describing processor capabilities in the IT world. Neither of these comparisons is likely to be true, and they could pose a threat, in creating an impression the EV technology will diffuse in society by itself. It is more likely that a successful introduction of low emission, highly renewable transportation system will be a result of long term efforts across many sectors and technologies, to gear society towards the best available technology. The purpose of the work described in this Norwegian part report is to collect and create knowledge about how and where electric vans could be used to reduce CO_2 emissions.

2 Method

This paper is about assessing the potential for electric vans in Norway, partly based on experiences with available technology. At the core of this assessment lies the case of Norway Post introduction of electric Ford Transit Connects in their fleet. ZEROs cooperation with Norway Post, the Ford retailer Røhne Selmer, and leasing company Leaseplan, has been important for information about on-going experiences with electric vans in Norway. This paper will form a part of an aggregated report on urban electric freight in the North Sea Region. The information in this report is based on statistical data and qualitative data from interviews with vehicle fleet owners Norway Post, Bravida, Nokas and Allkopi. These vehicle users operate mostly in distribution, service and security. Experiences and perspectives from them should be applicable for several other similar businesses, except Norway Post which is somewhat in a special position.

Most of the statistical data is from Statistics Norway and Leaseplan. Statistics Norway (SSB) keeps a lot of data on age and types of vehicles in Norway. However, they do not distinguish well between different types of vans, based on payload, etc.

If a more thorough report were to be undertaken, it would be interesting to more quantitatively investigate a larger number of businesses, as to which specific vehicles could be electric. This could possibly be part of a larger effort, such as an informational campaign, to inform about the possibility of electric utility vehicles in the future.

3 An overview of the freight transport sector

To reduce greenhouse gas emissions, it is necessary to address multiple issues at the same time. Transportation accounts for about 32% of Norwegian emissions. Emissions from transportation make up almost 44%, if emissions from offshore oil industry are disregarded. To address these emissions, all types of vehicles must be investigated.

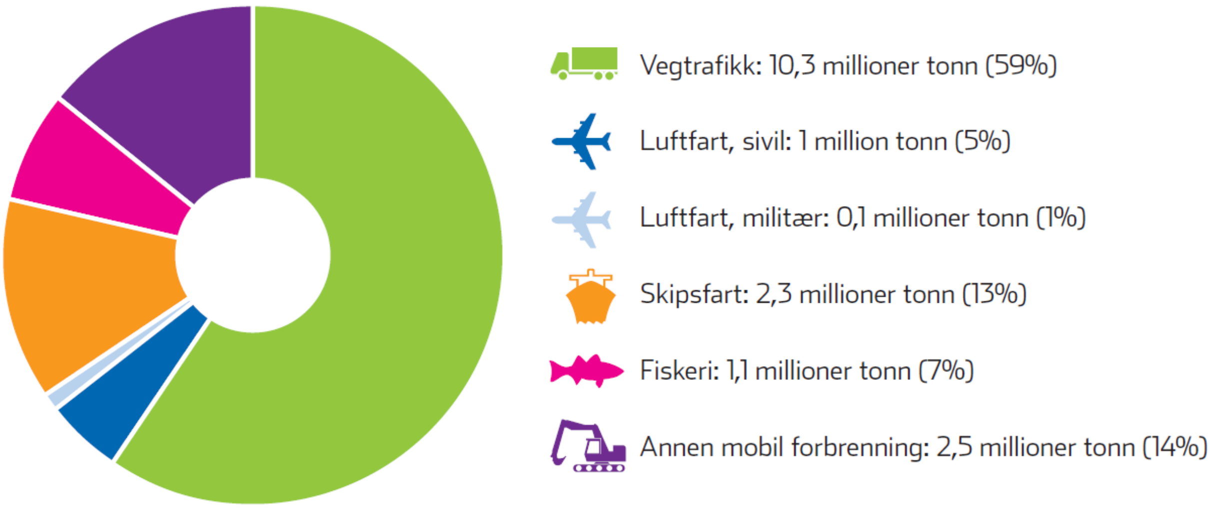


Figure 15 Emissions from road transport are about 10 million tonnes, or about one fifth of all Norwegian emissions.

In 2010 ZERO released a report on “Norway’s effort to introduce electric vehicles, hydrogen vehicles and plug-in hybrids”. In it, ZERO describes the situation and recommends a number of actions to promote and support zero emission vehicles so that they can be properly introduced in the market, and achieve real emission reductions. The recommendations were meant as an input to the much awaited *White Paper on Norwegian Climate Policy* (presented on April 25, 2012) and the announced *Action Plan for the Phasing in of Zero and Low Emission Vehicles*. Some of the recommendations were:

- Maintaining current incentives for zero emission vehicles, at least until there are 100.000 zero emission vehicles on the roads
- Strengthening the government agency Transnova, that supports transportation projects that reduce greenhouse gas emissions
- Removing VAT on leasing and battery leasing of EV’s
- Establish new incentives to promote electric vans

The 2010 report from ZERO did not focus on electric vans, as they were available only to a very little degree. This report on electric vans could thus be seen as late additional chapter in the previous report.

There is reason to believe that electric vans and the incentives for their introduction should be treated somewhat separately from private passenger cars. Several pioneers have used EV’s at an early stage in Norway, but public and private fleet owners have generally not been among them. There have been electric vans available, such as the discontinued Peugeot Partner, and various refitted Fiat vans from Micro-Vett in Italy. Some early users have already got some experience with electric vans, such as Posten (early experiences with the Peugeot Partner, now some electric Ford Connect) and Trondheim Municipality and NTE (power utility company) with Micro-Vett Fiat vans. There are probably several reasons why these haven't caught on in a larger scale. Though this has not been studied further, the reasons for the relative lack of success of using EV's for commercial operations in Norway can only be estimated. Reasons may include that the vehicles have only been available in moderate numbers and at a high price, and not through established sales systems. Also the quality has been perceived as unstable.

It can be assumed that some of these issues can be alleviated. Firstly, the electric Connect, though expensive, and based on a modification on a standard Connect, is sold through the normal retailers of Ford vehicles in Norway. Following this model, we will see more moderately priced vans that are also in full produced as electric vehicles from the manufacturers, namely the Renault Kangoo, Nissan NV200 and the Volkswagen Caddy. There's reason to think that these vehicles technically will fit the business market better than private cars, as the EV's range limitations will be less of a compromise for many users who operate with fixed routes, or limited areas to cover. The challenge is to make the transition happen: creating the necessary drive to make sure electric vans.

EV's are taking off

At the end of 2010, before Mitsubishi launched their i-MiEV on the Norwegian market, Buddy and Think possessed about one third each of the Norwegian EV fleet of about 3000. EV owners were mostly private enthusiasts, accompanied by small scale municipal and company fleets. The i-MiEV, with its appeal as a more "normal" car, with room for four, decent safety and with more reliable delivery from a renowned carmaker, spurred more people to take advantage of the good incentives for EV's in Norway. Within the first year of sales, Mitsubishi hit the 1000 mark with their i-MiEV, making it not only the best-selling EV, but the best-selling A-segment car in parts of 2011 (Elbil.no, 2011).

At the beginning of 2012, several hundred Nissan Leaf were hitting Norwegian roads and the total EV numbers hit 6000. Though still most buyers are private individuals, an increasing share of buyers are companies.

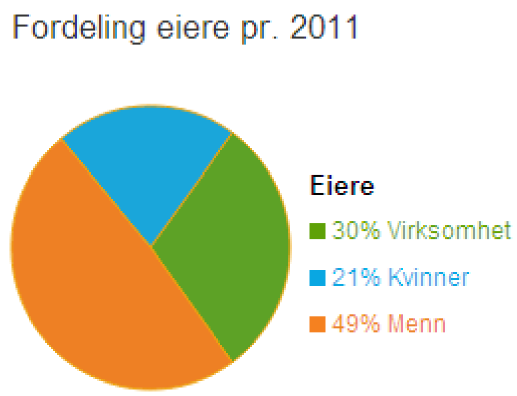


Figure 16 Companies comprise about 30 % of the owners. Previously, this figure was at about 25 %. Gronnbil.no 2012.

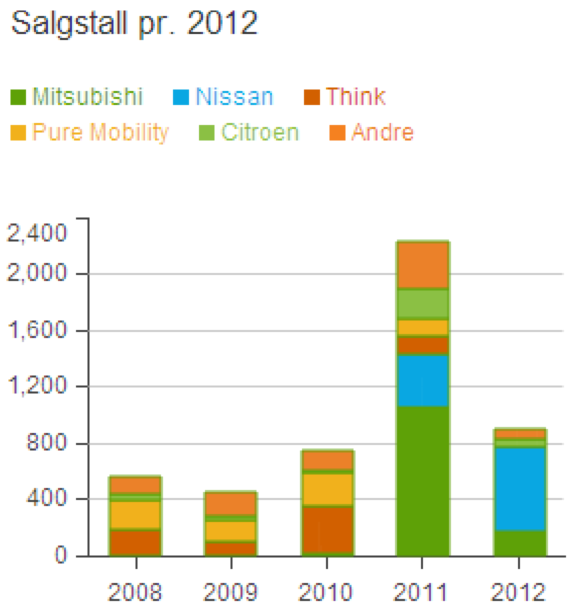


Figure 17 EV sales as of March 2012. 2011 was a big year for the i-MiEV, while 2012 so far seems to be associated with Nissan's Leaf. Gronnbil.no 2012

Even though total numbers are still low, EV's are a relative success in Norway. Many companies find use for EV's, both to profile themselves as environmentally friendly, but also because EV's suit many of their needs, and increasingly the EV's can replace fossil fuelled cars with a positive impact on the bottom line.

Transport with vans in Norway

In Norway there are about 400 000 vans (app. 330 000 with a payload less than 1000 kg), compared to 2.3 million passenger cars. Vans are used for service vehicles and for cargo, but compared to large trucks, the total amount of cargo transport produced by vans is very small. Even though vans in total drive much more kilometres than large trucks per year, the transportation (in tonne-kilometre) done by large trucks is about 20 times higher, as seen in the figure below.

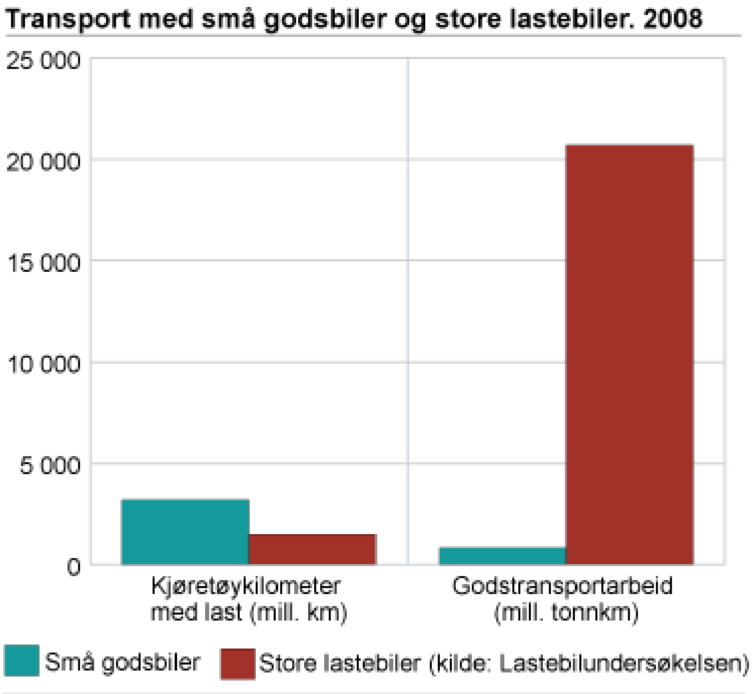


Figure 18 Transport with vans and large trucks. Blue is small scale goods vehicles, and red is large trucks. In million km, and in million tonne-kilometre, for 2008 (SSB, 2009)

The amount of transport has been steadily increasing over the last decades.

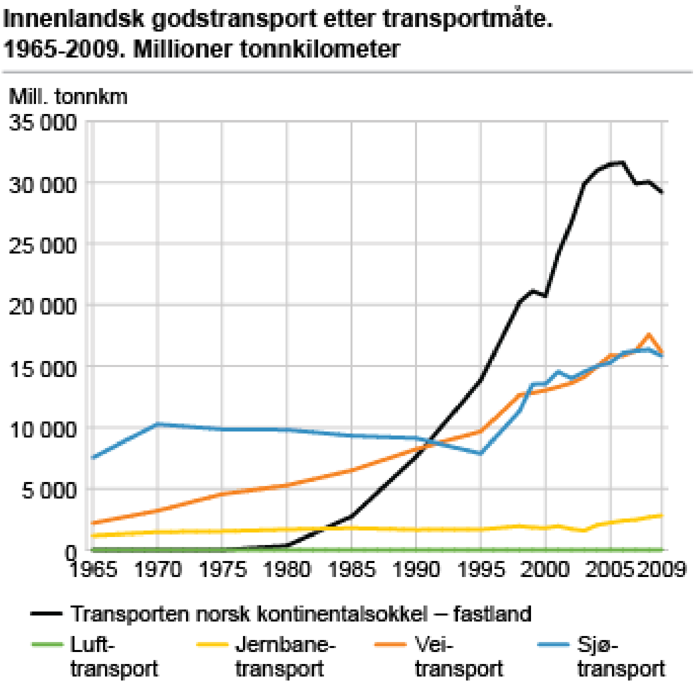


Figure 19: Source SSB.no. Orange is road transport.

Van use

45 % of the users of small goods vehicles report that the vehicles are used as service vehicles, or by craftsmen, while this figure is at 60 % for large vans. For small vans operating for public administrations this figure is at 47 %, while for vehicles in private use it is at 40 %. This use indicates that many of the vans do not carry heavy goods. This can turn out as a benefit for small scale electric vehicles, as their range is negatively affected if

they carry very heavy goods. In general, if the goal is to replace fossil fuelled vans with electric vans, it makes the transition easier, knowing that vans in general are not used for a lot of heavy cargo.

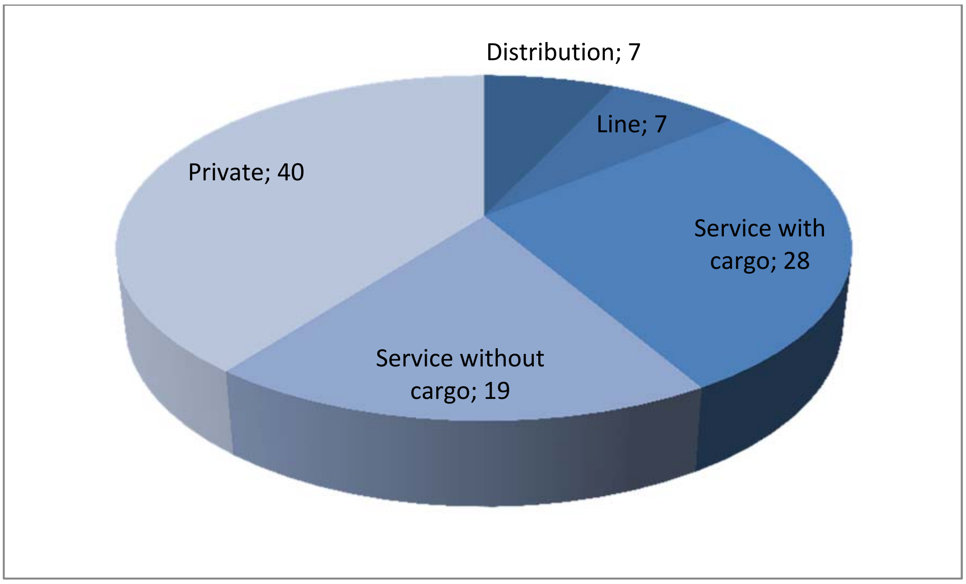


Figure 20 Percentage of small van fleet in different uses (SSB, 2009). Note: Due to rounding, the listed percentages add up to 101 %.

In general small goods vehicles are used for local transport. Distributors drive the longest, on average 40 km per trip with cargo. That is about 10 km longer than both vehicles in line transport and service transport (SSB, 2009). Even distributors, who drive the longest trips, are well within the range of an EV for each trip. Of course, the vehicle may be used for several trips per day, but this could indicate that a lot of issues related to the electric vans' range could be alleviated with faster charging.

Popular vehicles

The same brands are popular within vans, as with passenger cars in Norway. Volkswagen and Toyota dominate. In passenger cars, Volkswagen and Toyota make up about one fourth of Norway's cars, while almost 40 % of all vans are either one or the other of the two brands. Behind them follow 8-10 brands of similar popularity.

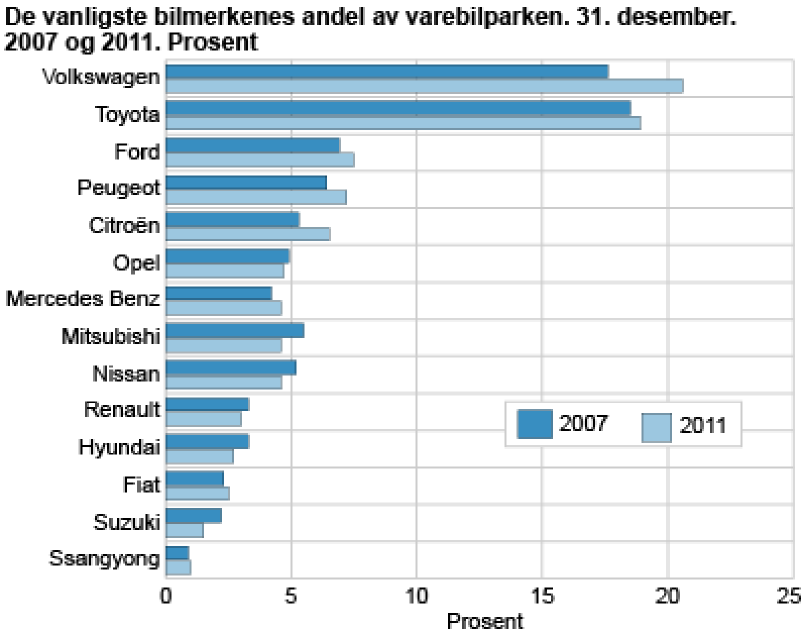


Figure 21: The most common van brands in Norway (SSB, 2011)

To the extent that previous market shares will affect the possibilities for electric versions to succeed, it can be assumed that the models from Ford, Renault, Nissan, Peugeot, Citroën and Volkswagen will have a broad potential customer base. Other brands may find their way through less well-known sales channels, such as the *Mia Electric*, or options from *Smith Electric Vehicles*.

Average lifespan

Of further interesting areas regarding vans for distribution purposes, can be identified the fact that they stay in operation for a shorter time than passenger cars.

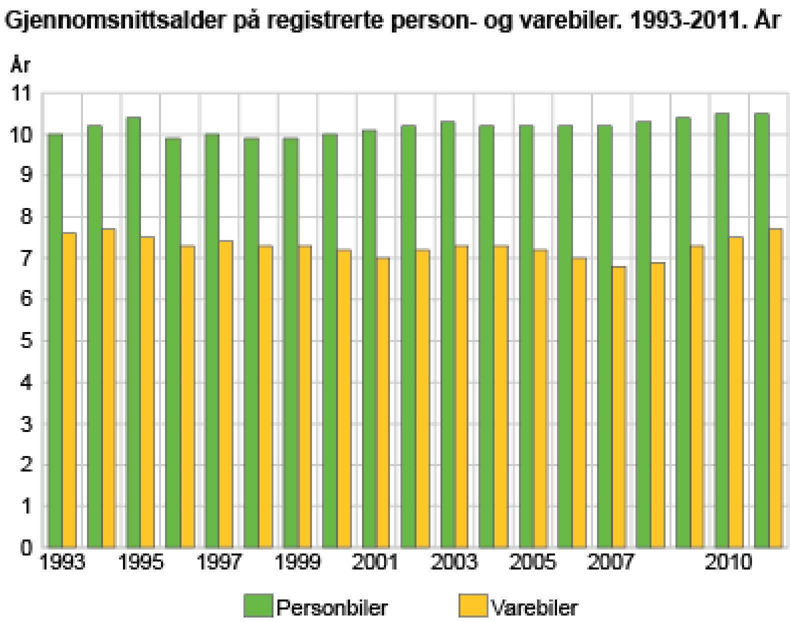


Figure 22 Average age of passenger cars (green) and vans (yellow)

As the figure above shows, the average age of registered passenger cars has stayed between 10 and 11 years since the early nineties, while vans' average age is 7 to 8 years. When new vehicle technologies are available, vans could therefore more quickly adapt to these technologies, due to their shorter average life span. The composition of brands, quality, and taxation policy may cause the average age, and average end-of-life age to change over time. However, it can roughly be estimated that half of all vans in Norway are to be replaced in the 7 years until 2020. The challenge is to get as many of them to run on renewable fuels.

4 Policies and legislation on electric freight mobility

Norway's history of promoting EV's stretches back to the late eighties, with several organizations such as Bellona, the Norwegian EV Association (Elbilforeningen) and ZERO paving the way for the relative EV sales success that is seen today. In 1991 EV's were exempted from excise tax; in 1996 EV's got free parking; in 2001 EV's were exempted from VAT; and access to the bus lanes was given from 2003 (Bellona, 2003, 2004, Dagbladet 2012). Other current incentives are free access to public ferries, free charging at most public charging stations, reduced road tax, and reduced company car tax, which currently make Norway one of the frontrunners in Europe when it comes to EV deployment. In combination these incentives have created a unique package that has made Norway special in two ways: Norway has the highest per capita EV ownership in the world; and at the same time the EV owners are mostly private individuals.

Vans are in turn divided into sub-categories. *Statistics Norway* uses these definitions in describing transport with smaller vehicles (SSB, 2009):

- Small scale vans (or just small vans): Vans with payload capacity of less than one metric tonne. Also known as panel vans. Most of the focus of this report is on the coming availability of these as electric vans.
- Large vans: Vans with payload between 1 and 3.5 tonnes.
- Small trucks: Trucks with less than 3.5 tonne payload.
- Small goods vehicle: Any cargo vehicle with payload of less than 3.5 tonnes.
- Distribution: Transportation of goods with several stops for loading and unloading
- Line transport: Transportation of goods from one destination to another

Also, of importance is the fact that there has been local production of EV's in Norway, namely the Think, and the Buddy vehicles. Think started up in 1991 and, though having a series of up's and down's, the company has contributed with a large portion of the Norwegian EV fleet, before finally filing for bankruptcy in 2011. Similarly, the Danish EV Kewet was produced in Denmark, and later acquired by Norwegian *Kollega Bil*, who rebranded the *urban electric vehicle* to *Buddy*, which is still produced in Oslo.

Barriers to business

The Norwegian EV incentives do come short at targeting businesses, and especially electric vans. Norway's EV incentives have been great for private commuters, in offering a daily life with shorter travel time, and less hassle when finding parking. Some of the incentives cater less to businesses. But there are two main issues that negatively affect EV and electric van adoption in businesses and public service: Leasing practices, and excise tax on vans.

Issues with leasing EV's in Norway

The purchase price of a Nissan Leaf and a Volkswagen Golf are, with the Norwegian tax system, comparable. When leasing a vehicle, the leasing company will not have to pay VAT for the vehicle, given that it is leased for a period of 36 months. Even though EV's are exempt from VAT at the moment of sale, the VAT on the monthly fee to the leasing company will still have to be paid. When leasing a fossil vehicle, you need to pay VAT on the leasing cost, but that cost is based on the vehicle cost without VAT. When leasing an EV you will also have to pay VAT on the leasing cost, thus increasing the taxation on the vehicle. That means that the *Nissan Leaf*, that compares with the *VW Golf*, in sales prices, will have to compete with a vehicle that costs 25 % more when leased.

An example: *A Nissan Leaf is sold for about NOK 263,900. A Golf Edition 1,2 105 hp TSI costs NOK 264,900. However, the price of that Golf without VAT would be about NOK 225 000.*

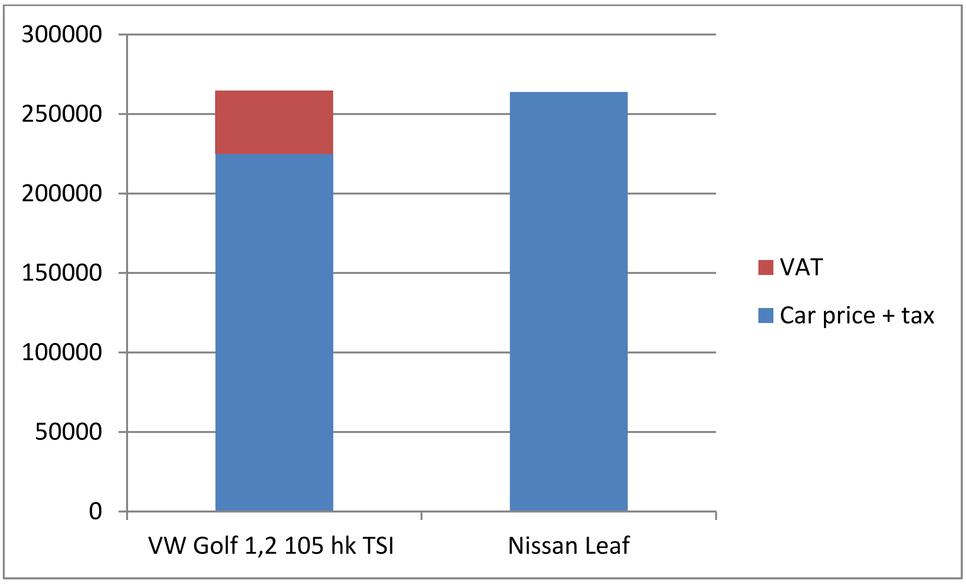


Figure 23 The ICE Golf and the EV Leaf have the same sales price, but for leasing, the VAT is deducted. The Leaf is comparably more expensive when leased.

The Norwegian taxation system has two aspects that affect electric vans differently than passenger cars. The negative aspect is that the taxation on fossil vans is lighter than on passenger cars, that is, less in favour of electric vans. On the other hand, vans that can fit a hypothetical box with measures 1.4 m × 1.1 m × 0.9 m, can use green plates, which entails that VAT can be deducted from leasing costs, and thus annulling the previously mentioned leasing problem. This hypothetical box that vans need to be able to carry leave the van with a reduced excise tax, and pay less, about 25 % than a normal (fossil) car. See the table of Norwegian taxation rules below for details. This means, that an MPV, like the Opel Zafira (designed to be a family car with five seats) with two seats can be registered as a van, while the small Peugeot van, the *Bipper* cannot (DN, 2009). In addition to this, companies will be able to deduct at least parts of the VAT paid for the vehicle, and thus render both the VAT and the excise tax exemption less valuable for electric vans than for passenger cars.

Figure 24: Due to Norwegian tax regulations, this Opel Zafira Tourer (with only 2 seats) is a van, because it can fit a box of 1.4×1.1×0.9 meters, while the Peugeot Bipper cannot, and thus cannot be registered as a van.

Excise tax on vehicles in Norway			
Passenger cars			
Weight NOK/kg	2011	2012	Change %
First 1 150 kg	36,31	36,89	1,6
Next 250 kg	79,14	80,41	1,6
Next 100 kg	158,31	160,84	1,6
The rest	184,11	187,06	1,6
Motor power, NOK/kW			
First 65 kW	0	0	-
Next 25 kW	466	315	-32,4
Next 40 kW	1 320,68	895	-32,2
The rest	2 751,42	2 220,00	-19,3
NO_X-emissions, NOK per mg/km	-	22	-
CO_2-emissions, NOK per g/km			
First 110 g/km (115 g/km in 2011)	0	0	-
Next20 g/km	738	750	1,6
Next 40 g/km	744	756	1,6
Next 70 g/km	1 735,00	1 763,00	1,6
The rest	2 784,00	2 829,00	1,6
Deduction per gram below 50 g/km, valid for vehicles with less than 50 g/km emissions only.	738	850	15,2
Deduction per gram for emissions less than 110 g/km, valid down to 50 g/km, valid for vehicles with emissions less than 110 g/km (115 g/km in 2011)	620	750	21
Vans (class 2. Tax group b)			
Weight, % of passenger car tax	22	22	-
Motor power, % of passenger car tax	22	22	-
NO_X-emissions, % of passenger car tax	-	25	-
CO_2-utslipp, % of passenger car tax	22	25	3

Table 1: Exercise tax on vehicles in Norway

5 Initiatives on Urban Freight Transport with Electric Vehicles

5.1 Posten

Norway Post is a state owned company, and holds a monopoly in mail delivery of shipments under 50 g. In recent years they have encountered heavy competition on larger packages, and are also noticing a general decline in mail delivery due to increased use of electronic communication. Nevertheless, Norway Post is represented all over the country, with 20.000 employees and a wide array of transportation needs. A lot of their line transport is done by contracted transporters, and the types of vehicles are therefore only indirectly influenced by Norway Post. Further, according to their own web pages, 80 % of the mail is transported by train where possible (Posten, 2011a). Still Norway Post has a stated goal of reducing their CO_2 emissions by 30 % by 2015.

Vehicles at Norway Post

Posten Norge AS

	2008	2009	2010	2011
Varebil < 7.5 t	**4 755**	**4 601**	**4 876**	**4 554**
Antall lastebiler ≤ Euro 2	55	14	2	1
Antall lastebiler Euro 3	263	272	124	94
Antall lastebiler Euro 4	249	141	249	232
Antall lastebiler Euro 5	51	105	83	164
Mopeder	120	123	234	391
El-mopeder	3	47	100	231
El-jeep			10	40
El-traller			80	80
Biogass biler			1	
El-biler	2	2	1	21
Biodiesel			58	58
Sum	**5 576**	**5 351**	**5 818**	**5 866**

Table 2: List of vehicles owned by Norway Post

All in all Norway Post is a large owner of vehicles, owning almost 6000 vehicles (Posten, 2011b). As can be seen from the table above, there are a few examples of alternative vehicles, such as electric mopeds, so called electric jeeps (small, low speed, four wheeled vehicles) and electric trolleys.


Figure 25 One of the so-called jeeps, from Spanish company Comarth in service for Posten (DittOslo, 2011)

Part of the package in reducing CO_2 emissions is to replace 1.300 fossil vehicles with zero emission alternatives. In one example 6 fossil fuelled vans in a distribution area were replaced with only 5 electric mopeds. In 2012 Norway Post acquired 31 biogas vans (VW Caddy), and the plan is to get about 30 more.


Figure 26 Electric three-wheeled moped in service for Posten (Photo: Posten)

Norway Post's strategy demonstrates how a diversity of different more climate-friendly technologies can help reduce greenhouse gas emissions. However, the topic of this paper is electric vans. In 2011 they purchased 20 electric Ford Transit Connect. These were a result of cooperation between Ford, the EV technology firm Azure Dynamics (AZD) and Norway Post and supported by a Norwegian Ford retailer, Røhne Selmer. Initially ten vehicles were used in Bergen and ten in Oslo.

Mail is delivered all over the country, from city centres to rural areas. Small electric trolleys and light electric vehicles can replace vans in city centres where distances are short, and vans would be troublesome to get in and out of. In more rural areas, it's less likely that EV's can provide sufficient range, and biogas and bioethanol can be good substitutes. In Norway Post's perspective, the electric van can fill a gap in between, where distances are relatively short, in fairly dense residential areas.

Figure 27 A mail distributor in Bergen, using the electric Ford Transit Connect.

Lessons learnt from Norway Post

Vans in the postal service are used differently. The electric Ford Transit Connect in the photo above is used in Bergen for short distances. The driver fills the van up with sorted mail and stops in Bergen and continues by foot with a trolley. When the mail is distributed, he returns to the vehicle, drives a little further and does another route by foot. This mode of operation is not uncommon, and the vehicle drives very little per day, about 15 km. This is of course well below the estimated 130 km range of the Ford Transit Connect. In replacing conventional vehicles on such a delivery route, only very small reduction in local and global emissions will occur and unfortunately often at a high price, due to the high purchase price of the vehicles. That is why most electric vans in service operate differently. Many delivery routes will require the driver to often get in and out of the car, maybe up to several hundred times per day. Generally it can therefore be assumed that by using an electric vehicle instead of a fossil one is better the longer the route. However, some additional issues need to be considered when choosing suitable routes.

Range

First of all, the vehicles come with an electric heating system. Though many postal vans drive short distances every day, they tend to spend a relatively long time doing it, and the driver frequently lets heat out when opening doors. Normally, driving 30 km could take 30 minutes, but in postal service, this could take several hours. This means that the vehicle needs to produce a reasonably high temperature over much longer periods of time than normal, and this will affect the driving range negatively. In addition, different driving conditions will affect the possible range, such as snow and rain.

During a test on a longer route, a driver of the electric Ford Transit Connect followed a conventional diesel van while in operation. On a day with snow and a temperature of -1 °C, the route involved dozens of stops and the total time, where the vehicle was standing still was above 3-4 hours. During this period the vehicle should maintain a reasonable indoor temperature around 20 degrees Celsius. In these conditions the EV driver was able to follow the fossil vehicle for about 70 km, which in some cases is sufficient, while it in other might offer a too limited range.

To overcome this issue, Posten Norway now plans to install diesel heaters in the vehicles. This should make them able to use the vehicles more predictably on longer routes (The diesel heaters will consume about 0.5 L per day). Typically, vans are used on routes that are 15-70 km per day. Most routes are between 20 and 30 km. With diesel heaters, electric vans could be used more on longer routes, but presently they are used well within their comfort zone. However, most EV producers do not design cars with liquid fuel heaters built in, for two reasons: First of all, heaters run on e.g. diesel could affect the climate benefits of EV's. Secondly, diesel heaters could hurt the public perception of the cleanliness of EV's.

User acceptance

Norway Post is currently replacing conventional vans with several different types of electric and other low emission vehicles. These alternatives are very different, as they have introduced vehicles from small mopeds to vans the same size as conventional one. The user acceptance is different from vehicle to vehicle. Many drivers need to get in and out of the vehicles very often during one working day, and the benefits from easy entry vehicles can have positive health effects. Additionally, electric trolleys can enable users to walk more without having to push too heavily.

All in all, the feedback from users when it comes to small electric vehicles is mixed. Some don't find the light electric vehicles, such as the so-called jeep, comfortable or safe. The maximum speed is low, so the aim is to avoid roads with high speed or high traffic. Users also see the vehicles as a tool to do their work, and as such, they may be less cared for than electric vehicles that are bought by private individuals. Most light electric vehicles

provide less shelter against the weather than a conventional van, but the experience so far has been positive enough for Norway Post to continue to phase such vehicles in.
For the electric Ford Transit Connect vans, the story is a bit different. Many drivers have used the same type of van before, just with a fossil fuelled engine. The transition from a conventional van to an electric van is mainly about the differences in drive train, thus these drivers have not had to change their working conditions significantly. So far the user experiences have been relatively positive: the vehicles have not had significant problems in running out of power. Further, at least some users experience the electric cars as better: They are quiet and comfortable, and in addition, the electric Connect has about twice the power of the diesel equivalents that Norway Post has been using (approximately 100 kW electric motors, vs. approximately 50 kW for the diesel versions).

5.2 Allkopi

Allkopi is one of Norway's largest players in graphical layout: prints, roll-up, posters, etc. With 15.000 customers from 19 regions in Norway, they also do a lot of distribution. Allkopi is a so-called *Miljøfyrtårn* (Environmental lighthouse) since 2009. This is a certification system, supported by the Ministry of the Environment, which seeks to improve the environmental focus in small and medium sized businesses by steps that should be profitable, concrete, relevant and simple for the customer (Miljøfyrtårn.no, 2012).

Allkopi was actually the first to use the Ford Transit Connect (e-Connect) in Norway, before Posten. Though holding a smaller fleet of electric vans than Posten, Allkopi has the largest EV share. About one fourth of their fleet or five out of 19 vans are electric. Of these five, two are in Oslo, one in Bergen, one in Stavanger and one in Kristiansand.

Lessons learned from Allkopi

As a distributor of printed materials, Allkopi uses the smaller panel vans, such as the electric Ford Connect, to transport small amounts of goods. The e-Connects are used when the weight of the goods is almost negligible, usually less than 30 kg. Usually, when larger amounts of printed materials are transported, larger vehicles are used. For a driver in Oslo, this has meant that he has been able to drive close to the listed range of about 130 km. At Allkopi they have also had experiences in the opposite direction. When another vehicle systematically performed only 60 km per day, a technical problem was suspected, and it was sent to service for a check-up. After investigation, it was determined that the low performance was due to driving habits, as an aggressive driving pattern could be very inefficient. This underlines the need for thorough training and information for users of electrical vehicles, but at the same time it indicates that driving patterns and eco-driving can have positive both environmental and economic impacts.

Today Allkopi has 5 electric vans, which have been fitted into their transportation system without much change in the planning and administration of routes. Today it is common for a vehicle in service to travel a distance up to 150 to 200 km per day. An estimation from Allkopi is that with the current available range and technology a few more electric vehicles could be integrated in Allkopis fleet, while with a range of about 250 km, all of their vehicles could be electric.

5.3 Potential users of electric vans

Nokas

Nokas is a Norwegian company with about 4.000 employees in Norway, Sweden and Denmark. They specialize in handling cash money, and security, as summed up in the two divisions *Nokas Cash Handling* and *Nokas Security & Safety.* The cash handling division uses several armoured vehicles, and there are not currently any potential zero emission alternatives to those vehicles. The armoured vehicles are necessarily relatively heavy and the annual driving distance is about 50 000 km per year.

The focus is therefore on the vehicles of the security and safety division, where about 230 panel vans among other vehicles are used. To systematize their environmental efforts, Nokas has decided to pursue an ISO 14001 certification. According to Nokas' own web pages, they wanted to emphasize an environmental approach even though their normal activity is not particularly hazardous to the environment (Nokas, 2012).

A good start for electric vehicles

Even so, most of their activity is relying on transportation of goods (money) or personnel, Nokas wants to investigate the possibilities in using electric vans. So far they have no electric vans in their fleet of vehicles, but a number of steps have been taken to make an introduction simpler:

Nokas relocated to new premises in 2011. In creating the new parking space, charging for electric vehicles was prepared for. This is likely to make the introduction simpler and smoother. Similarly, Nokas has invested in a transport management tool that can optimize routes for security guards. This could help reduce unnecessary driving, but also make the integration of vehicles with limited range easier. Also, learning from past experiences, Nokas will focus on encouraging users to be part an EV test fleet, to make it rewarding, and to provide good training.

Half could be electric

Of the about 230 panel vans available, Nokas' own estimation is that half of those could be electric, given what is expected of electric vans today. If maximum range were as much as 150 to 200 km, almost all vans could be electric. Nokas uses mostly vans, even though passenger cars could be sufficient in many cases. Vans have lower tax than a normal passenger car, and even though the security personnel rarely needs that much cargo space, Nokas has opted for a widespread use of vans. This is because it saves on purchase cost, but also that a van makes them more flexible, as they more often need extra cargo space, than more passenger seats. However, since Norway's taxation does not distinguish between vans and passenger cars in the electric segment, there is less of an incentive to opt for vans once a company chooses to go electric. This may potentially change the fleet setup of Nokas and others.

Nokas is in dialog with the local dealer of Renault Kangoo in Norway, to start testing a small fleet when they become available. The price of the Renault Kangoo is not set in Norway yet, but it is expected that it could be more competitive in a total cost perspective, than the electric vans that have been on the market so far.

Bravida

Bravida is one of Scandinavia's largest companies within electrical installations, piping and ventilation. In Norway they operate at 30 locations, and they have 2.300 employees and a fleet of vans of about 800 vehicles.

Bravida's technicians work at different types of sites, from service operations of a few hours, to larger projects lasting several weeks. As a user of vans, Bravida, like many other users, mainly transport tools and small amounts of construction materials to service sites. When technicians work for longer periods of time at a construction site, the materials needed for construction (electrical components, water and ventilation pipes etc.) are usually delivered to the construction site.

The vans are assigned to individual users, so that each technician will use the same car every day, and no other technicians will use the same car. This is probably true for many similar businesses. The van is not intended for freight and delivery of goods, it's rather a mobile office, or workshop. The technicians will have their own set of tools, systems, paperwork and so on, making swift swapping of vehicles challenging. This makes each technician more tied to the vehicle, and it makes it more challenging to manage a fleet based on range.

In 2010 Bravida signed a large contract with a dealer of conventional Volkswagen Caddy, and also with a Citroën dealer (BilNorge 2010). For the most part the Caddy will replace the larger Toyota HiAce vans, in an effort to reduce costs in purchase and operation, as well as reducing environmental impacts. Currently, 35-40 % of Bravida's fleet consists of panel vans the size of a Caddy, but the ambition is to increase that percentage.

Like many other businesses, Bravida leases most of their vehicles. The economic perspective on electric vs. fossil is then on the costs of leasing and the second hand value of the vehicles, compared with operational costs. Presently, the purchase cost and insecurity of second hand value of EV's are considered a barrier to electrification, even though running costs would be lower.

If a typical yearly driving distance is 20.000 km, a rough estimation is that the average daily driving distance will be manageable for electric vans. In operation for a business we could assume the vehicles are used every working day, which adds up to about 230 days per year in Norway. 20 000 km spread evenly over 230 days is about 87 km.

Driving distances are more than the average, and even though business users are more predictable users than private car owners are, there is some uncertainty associated with simply dividing yearly driving distances with working days in the year. A more comprehensive study is needed to correctly assess, which vehicles could be electric, for individual businesses. Based on statistical data from Bravida's fleet, assumptions can nevertheless be made. According to the Leaseplan for Bravida, the average yearly driving distance of a small van (Caddy, Connect, etc.) is 14,000 km, while for large vans (HiAce, Transporter etc.) is 16,500 km. We can further break these numbers down. The figure below shows the number of vans for each yearly driving distance interval for small vans and big vans.

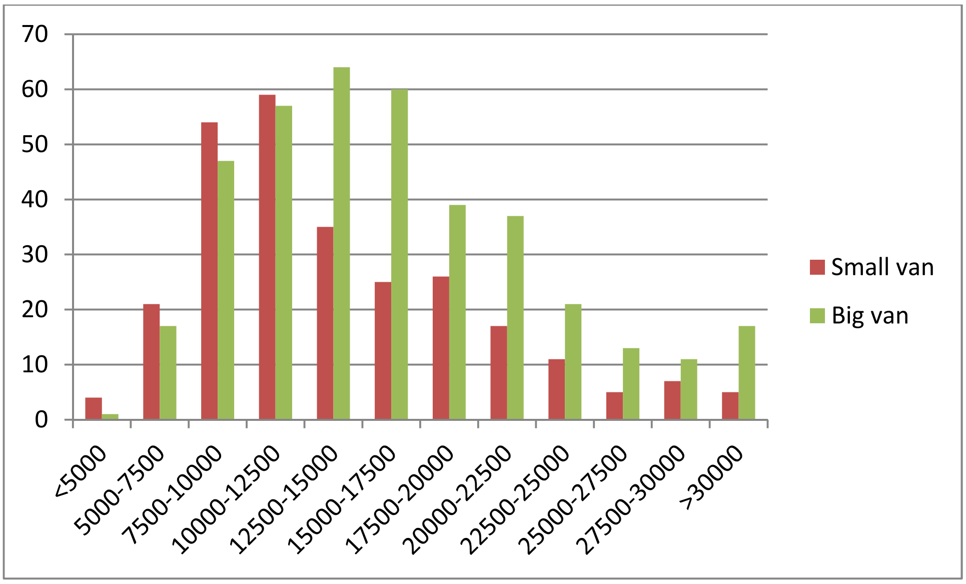


Figure 28: The number of vehicles (small and big vans) in each interval.

This shows that for small vans, about 64 % of the vehicles drive less than 15,000 km per year. This number is smaller for big vans, as in this group 48 % drive less than 15,000 km per year. The total figure for all their vans is 55 %. If yearly driving distances is divided with 230 working days per year that would indicate that these vehicles drive less than 65 km per day, which should be well within the driving range of today's electric vans, even in adverse driving conditions.

If it is assumed that there is room for improvements, such as optimized driving, improved vehicle range, and the possibility for charging during the work day, it can be estimated that vehicles driving less than 100 km per day could be replaced by electric vehicles. If that's the case, then 90 % of the small vans could be electric, and 86 % of all Bravidas vans combined.

With short daily driving distances, it could be imagined that the vehicles could simply be replaced by electric vans without much logistic change. However, technicians can legally drive the van at their disposal to their home, when their work is taking place outside fixed working locations. This means that, unless changing during the working day, Bravida or their employees will have to install chargers at the employee's homes. The question is then, who should pay for such installations and who should pay for the charging? Not all employees may have the possibility to install an EV charger, depending of their housing situation. Although these barriers can be overcome, these issues are probably common to several similar users, and complicate the situation.

6 Summary and Conclusions

Norway performs well phasing in EV's in the car fleet. The EV share in sales is the highest in the world. However, there has been little focus on electric cargo, freight, and utility vehicles. In 2012 new electric vans will hit the market, which may improve the competitiveness of electric vans. In this paper existing and potential users of electric vans have been investigated and it is based on the analyses estimated that about half of the small van fleet in Norway in terms of range, could be electric with today's technology.

Norwegian van owners use them for line transport, distribution, service tasks, and private use. Thus, van users have different operational modes. Many trips made with vans are relatively short, across the board, however. This could indicate that challenges are connected as much with charging as with range, for electric vans.

To address the possibilities and challenges of electric vans, some possible measures should be further investigated:

1. Financial support for charging infrastructure should be considered
2. Local zero emission zones in the largest cities, to promote and stimulate the switch to zero emission vehicles on renewable energy.
3. Leasing of EV's should be exempted from VAT to avoid punishing users for leasing instead of buying EV's.
4. Vans have significant tax breaks, making the tax free EV's less competitive as vans than as passenger cars. An assessment of the effects of van taxation should be made.

The focus of this report is that new electric vans will hit the market and create new possibilities for EV's to reach new markets. It is believed prices are about to drop to levels that are comparable with fossil versions, though some measures may need to be taken to get the market moving.

Available options

Several types of electric vans have been available for years. As mentioned, there are several French vans: Peugeot Partner, Citroën Berlingo, and the Renault Kangoo. There has also been some retail sale of retrofitted EV vans from Italian Micro-Vett, and others. There have, however, not been any notable examples of projects involving larger freight vehicles, such as could be provided from Smith Electric Vehicles. Neither has Norway yet seen any moves towards EV-only zones to promote EV's or improve local noise levels or air quality.

In addition to the electric vans that are available now (Ford, Micro-Vett), there will soon be available vans from Renault, and later from Nissan (expected 2013) and others. It is also likely that these vans will come at lower price, and that the introduction of these will come as a result of early market adoption, rather than merely in subsidized projects, but the market may need a stronger push.

The web page klimabiler.no, operated by ZERO, aims to inform the public about which vehicles are available now and in the near future. Here users can sort by vans, but also larger freight vehicles when they come to market.

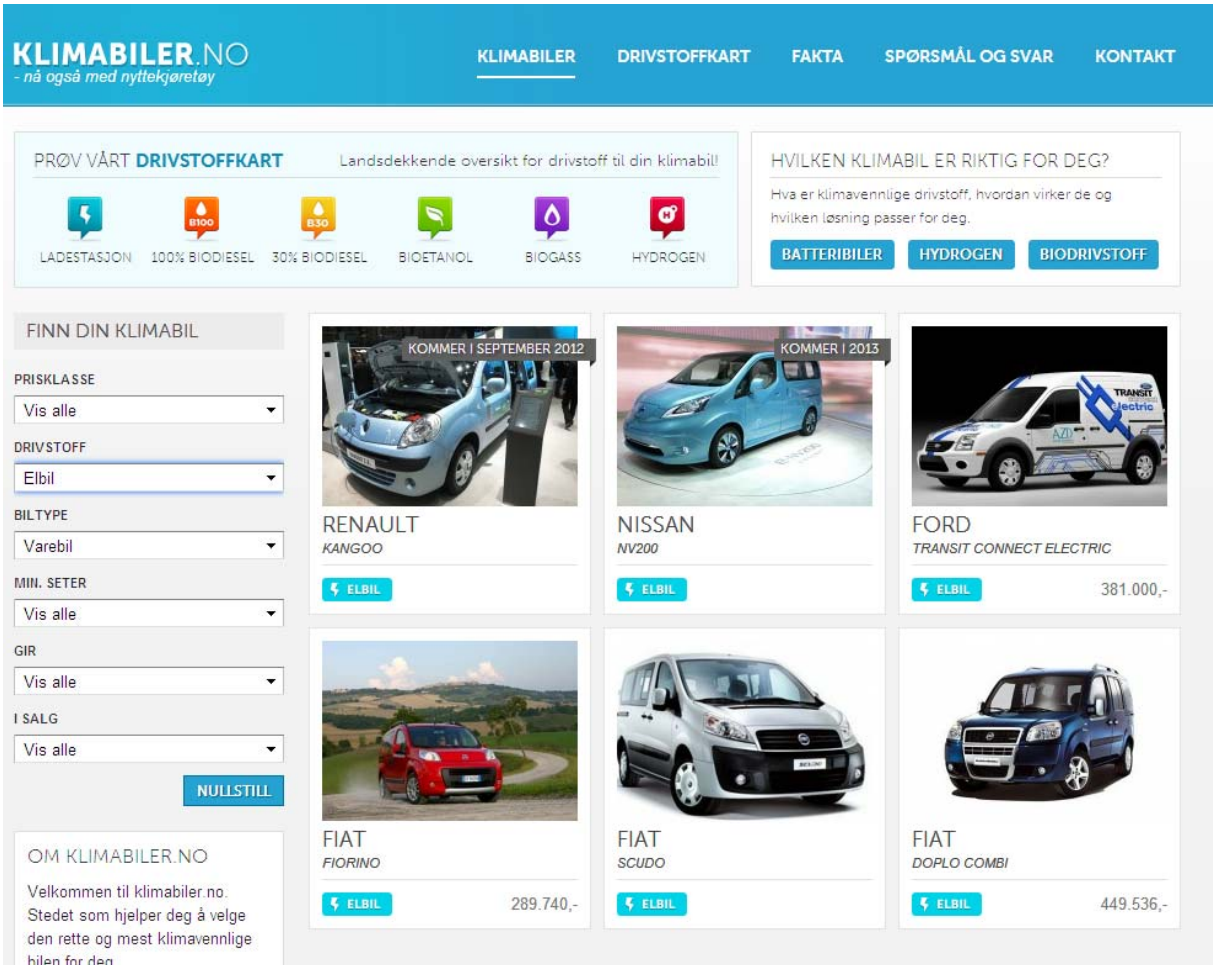


Figure 29 Screen shot of the web page klimabiler.no. The prices can be seen on available cars, as well as the expected release date on vehicles not yet for sale. Clicking on the vehicles will lead to more technical and sales information.

The project Grønn Bil (Green Car, 2012) promotes EV's to different users in Norway, and has a calculator to show how different driving schemes and car uses will affect the total cost of ownership of an EV in comparison with a fossil alternative. The numbers are not flattering for an electric Ford Transit Connect, given its high price. However, there are realistic scenarios that will make it comparable to a fossil alternative, such as driving 20 000 km per year, and passing the Oslo toll road twice per day. To such users, driving in the public transport lane and potential public relations benefits will come as a bonus on top of that.

What can be done?

As have been described earlier in this paper, the general terms for EV's are quite beneficial in Norway. In June 2012, an agreement across political borders was made, to ensure that current incentives will last until 2017, unless there are more than 50 000 cars on the road. This does not mean that the incentives will end in 2017, but that they shall not be up for debate until then.

This means there is a time frame of about five years of stability, which could be enough in the first phase to let business users better estimate total cost of ownership (TCO), not least based on a more predictable second hand value.

Leasing

As many business users lease their vehicles, VAT exemption on EV leasing could lower the TCO of an electric van. It would not be the single measure that would make electric vans more competitive, though it would help to some extent. Also, it is somewhat inconsequent that EV's should be exempt from VAT when purchasing, but not when leasing.

Charging

Financial support for charging has so far been focusing on passenger cars, in line with most other incentives for EV's. Most EV charging spots supported by the 2009 program by Transnova has helped fund charging at shopping centres, visitor parking at work places etc. Installing charging infrastructure for one vehicle is relatively easy, but for a fleet of cars, a business may have to do further improvements to their electrical installation. This could be what stops a transition to electric vans for some users. A targeted support program could be a good way to stimulate EV adoption both in a financial perspective, but also in terms of awareness.

Information

Awareness and knowledge of the electric options for businesses and municipalities should not be underestimated. Even if electric vans become economically competitive within a short period of time, many users will need more information to see if electric vans could be a feasible option for them. The first step is to get potential users to actually try the cars. ZERO and Grønn Bil (Green Car) have several times arranged events where people new to EV's could get first-hand experience with electric cars and vans. This is important to break down the first barrier towards EV's. More information about the benefits, and incentives, and user experiences will also help break down further barriers to electric van adoption.

Zero Emission Zones

Electric vans can reduce noise and particle emissions in cities, in addition to reduced greenhouse gas emissions. In city centres the ambition to reduce emissions could help stimulate EV usage. Zero Emissions Zones are areas where certain vehicles are excluded, to help improve air quality, or to reduce noise level. It could potentially be a tool to promote electric vans over fossil vans, in a city like Oslo. Other vehicles could also fit the bill, such as plug-in hybrid, hydrogen vehicles, and clean renewable biofuels, like biogas.

Such a zone in Oslo, for instance as showed below, could be open only to zero emission vehicles. Alternatively, there could be time restraints for other types of vehicles, or it could only apply to goods delivery. Several options are possible, and it would also be possible to make requirements successively stricter, as more vehicle options become available over time. A similar approach is done with *low emissions zones*, like in Gothenburg (Sweden) where emissions, as described in EUR-categories, will ban certain types of vehicles in a zone, with stricter requirements over time.

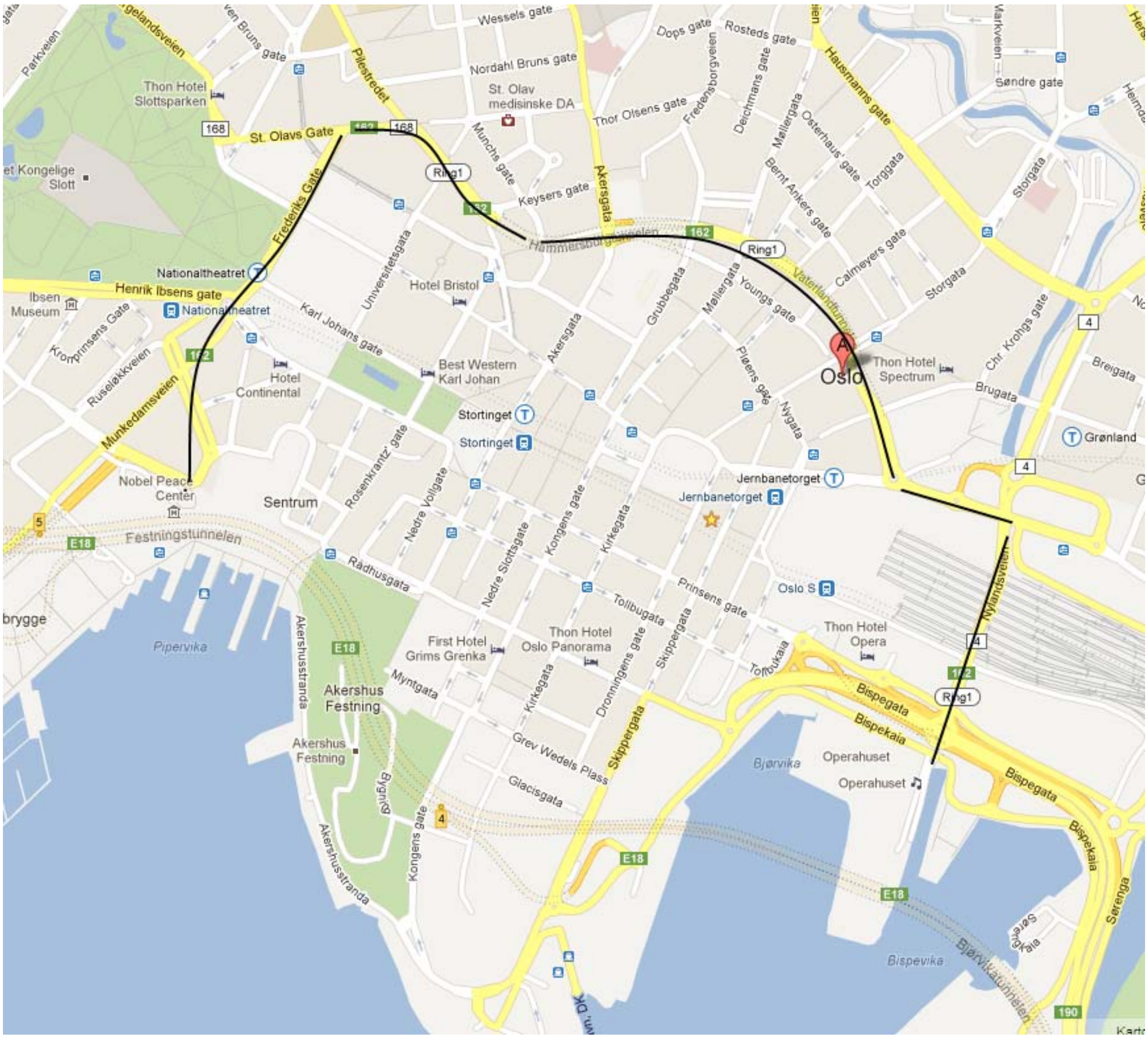


Figure 30: Possible Zero Emission Zone within Ring 1 in central Oslo.

The town of Vicenza in Italy has prohibited goods delivery within the historical city centre limits. A local logistics centre has taken over all deliveries to the centre, which is done by electric vans and trucks only. This is a public-private cooperation, and has so far been relatively successful. Vicenza (pop. 116 000) is of course not directly comparable with Oslo, since the population is smaller, and the reasons for enforcing a zero emission zone is mostly because of its status as UNESCO World Heritage. However, it is not unlikely that Oslo too, can benefit from enforcing such measures, and developing better cooperation on logistical hubs.

Van taxation

Vans are given significant (excise) tax breaks, paying only about a quarter of passenger car taxes. This tax break is to stimulate businesses. However, it is seen that many businesses that do not need five seats in a car, will choose a van for the tax break, even if they do not need the additional cargo space of a van. A change in the taxation system, so that conventional vans pay about 50 % of the tax instead of only 23-25 % as today, could effectively support electric van adoption, and at the same time help keep total taxation income from vans at the same level, if electric vans could make up 50 % of the sale.

Drivers

- Many vans have a more fixed route than passenger cars. For these vans, electric versions could be feasible without a lot of adjustments.
- Electricity prices are relatively low in Norway, and fuel prices high. Together with other incentives, this could lead to an increased profitability for businesses.
- Incentives for EV's, such as being able to drive in the bus lane, and free parking, can be calculated as an economic good, and as such help improve the business case for electric vans.

Challenges

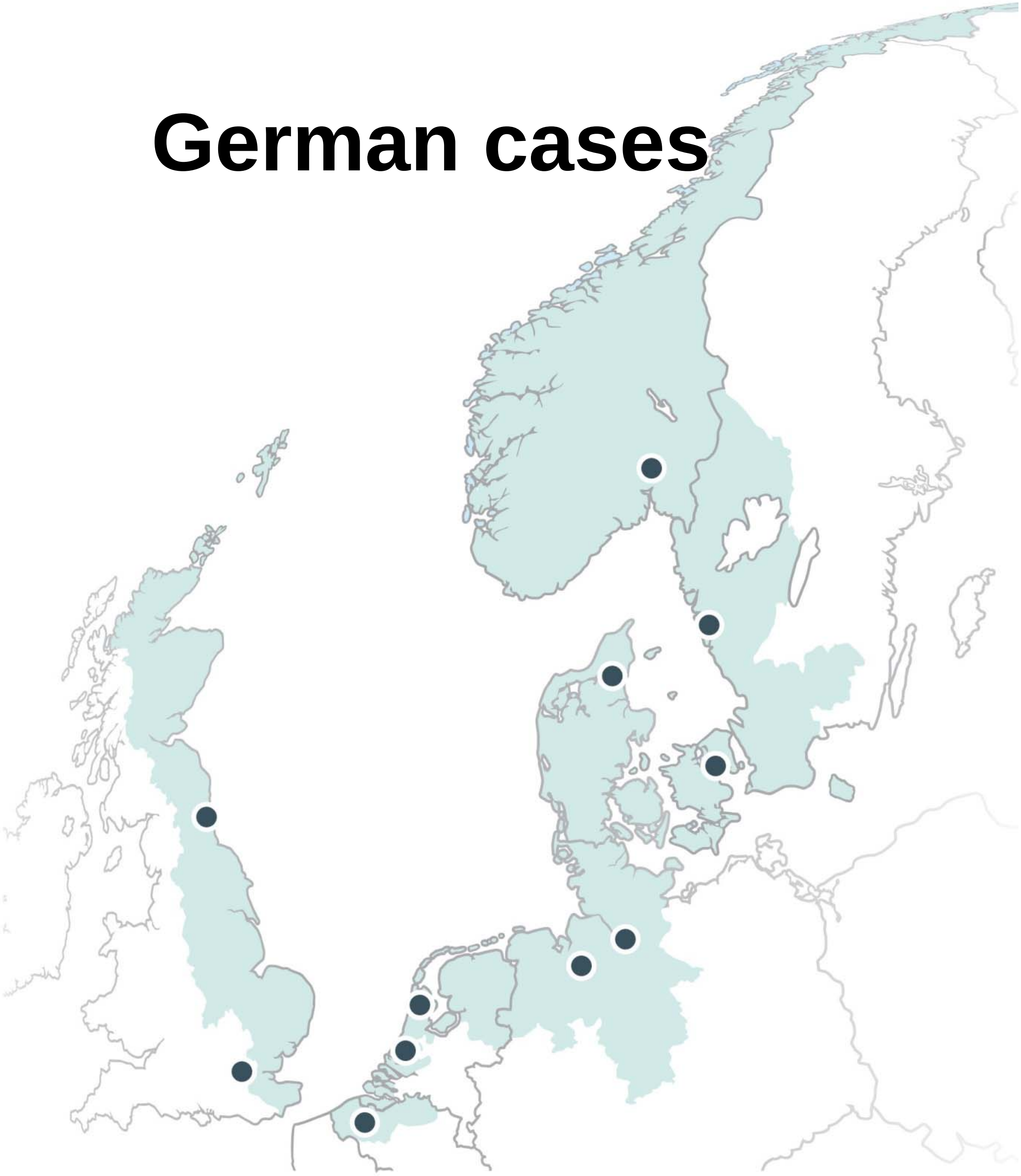
- Up until now, electric vans have been much more expensive than fossil fuel equivalents. This has limited market uptake significantly.
- Total cost of ownership, and uncertainties associated with residual value of vehicles can prevent some potential users from buying electric vans.
- Limited range will make electric vans suitable for only parts of the users, even though it has been estimated the about half of users in Norway could manage with the current range.
- Winter conditions reduce the EV's range. Some users that drive short distances, but start and stop frequently, as in delivery vehicles, can experience that heating the vehicle will use a significant share of the energy.
- Private owners of EV's are very engaged in using electric vehicles. Users of fleet vehicles do not usually have the same "care" for the vehicle.

Risks

- Norwegian EV incentives are ensured until 2017 by a settlement across party lines. If insecurity arises around the credibility of this settlement, this could reduce investments in electric vans.
- With new mass production of electric vans, prices will drop and electric vans will be more competitive with fossil equivalents for users with suitable driving patters. Any fiscal changes what will make fossil vans cheaper, or electric vans more expensive will negatively affect electric van uptake.

e-mobility NSR

German cases



1 Introduction

The development and application of electric vehicles (EV's) is of significant interest to Germany. Apart from the environmental advantages of CO_2-efficient transportation, the independence from mineral oil supplies, the possibility to buffer energy in EV's batteries and stabilize energy grids, as well as securing jobs in the car-manufacturing industry by developing innovative EV technology are discussed as being major advantages of electric mobility. Electric mobility also plays a significant role in the German plans of the so-called "Energiewende".

This report examines the proposition that EV's are especially useful in urban freight transportation, as the kilometrage in urban delivery is rather low and matching the technical capabilities of EV's, and because improving air quality is an important issue in urban areas.

The application of electric vehicles has to be investigated in the frame of the current development in traffic and traffic policies, which again are based on EU-wide CO_2-reduction goals and their adaption in Germany. For this reason, a summary of statistical data from German commercial traffic and CO_2-emission of the road transport sector is given in chapter 3, as well as an overview on the aims of the "Energiewende". In chapter 4, policies and legislation on electric vehicles are summarised, before reporting nine different freight transportation initiatives that are utilising electrical vehicles in chapter 5. The German report concludes with an evaluation and summary of the findings in chapter 6.

2 Methodology

The results and prognoses presented in chapter 3 are mainly based on the statistical data of the German Federal Motor Transport Authority (Kraftfahrzeugbundesamt KBA) and two major reports, which are briefly explained here

I) TREMOD calculations and report for 2012.
TREMOD stands for Transport Emission Model and is a major tool for reporting and forecasting the transport sector and its emissions in Germany. The model is developed and updated by the institute for energy and environmental research (IFEU) on behalf of the German Federal Environmental Agency since January 1993. The latter and other federal agencies are using the results for monitoring reductions targets (e.g. international commitments: NEC-Directive, Kyoto-Protocol) and the preparation of political decisions (e. g. emission standards, supportive measures).

TREMOD is using different sources as input for its calculations, like traffic prognoses of other federal projects and it is harmonized with the Handbook Emission Factors for Road Transport (Ifeu, 2011a).

II) Prognosis on the German Traffic 2025.
The prognosis of the German Traffic 2025 sets the frame for the traffic infrastructure planning of the German Federal Ministry of Transport, Building and Urban Development (BMVBS). The ministry has assigned Intraplan Consult (Munich) with the compilation of the report (ITP, 2007).

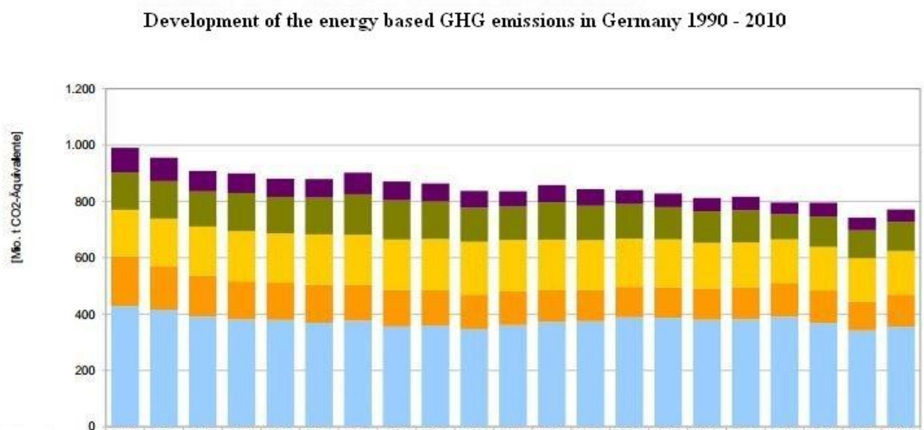
The data on initiatives utilising electric vehicles for urban freight transport presented in chapter 5 was collected in personal interviews and the review of written sources, such as research reports, journal articles and information gathered from the companies' websites.

3 An overview of the freight transport sector

Commercial vehicles are divided into the classes light commercial vehicles < 3,5t (LCV) and heavy commercial vehicles > 3,5t (HCV). This separation allows a more detailed analysis of the area in which electric vehicles are operating in.

Overview on CO_2-emissions in Germany

Figure 31 shows that transport is responsible for 20% of the energy based GHG emissions in Germany (Bundesumweltamt, 2011). Emissions from transport have reached a peak in 1999 and are slightly decreasing since then. In difference to others, like the commercial sector where GHG reductions up to 50% where realised, emissions from traffic have remained relatively constant, with only -6% between 1990 and 2010, (Bundesumweltamt, 2011, p. 4)



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commercial Sector	89	84	73	70	65	66	77	66	64	60	55	62	59	50	48	48	49	41	49	45	44
Househoolds	131	133	125	135	130	130	144	139	133	121	119	132	122	123	114	112	114	89	108	99	103
Traffic	165	168	173	178	174	178	178	179	182	187	183	179	177	170	170	162	158	155	155	154	155
Industry	177	156	145	135	133	136	126	130	126	123	119	112	111	108	109	111	114	120	115	102	115
Energy Sector	428	415	392	381	379	370	377	356	359	347	361	373	375	389	387	380	382	390	369	342	355

Figure 31: Overview about the energy based GHG emission in Germany 1990 – 2020.
Source Bundesumweltamt (2011, p 4)

CO_2-emissions by traffic segments

Electric mobility is a measure to reduce emissions from road traffic. The relevance of road traffic emissions within the traffic segment is described in the following chapter:

Figure 32 shows that even with increasing emissions from aircrafts, road traffic has accounted for 82 % in 2010 and still is the major source of traffic related CO_2-emissions in Germany. NO_x emissions peaked in 1990 and are declining since then, mainly due to the tightened laws on exhaust emissions. In 2010, 53% of the total German NO_x emissions came from traffic, 76% of this from road traffic (Bundesumweltamt, 2011, p.11).

Road traffic is also responsible for over 90% of other air pollutants, like fine particles or carbon monoxide, but there has been a significant reduction in the past decade. Also emissions of sulphur dioxide could be reduced significantly in the past years (Ifeu, 2011a).

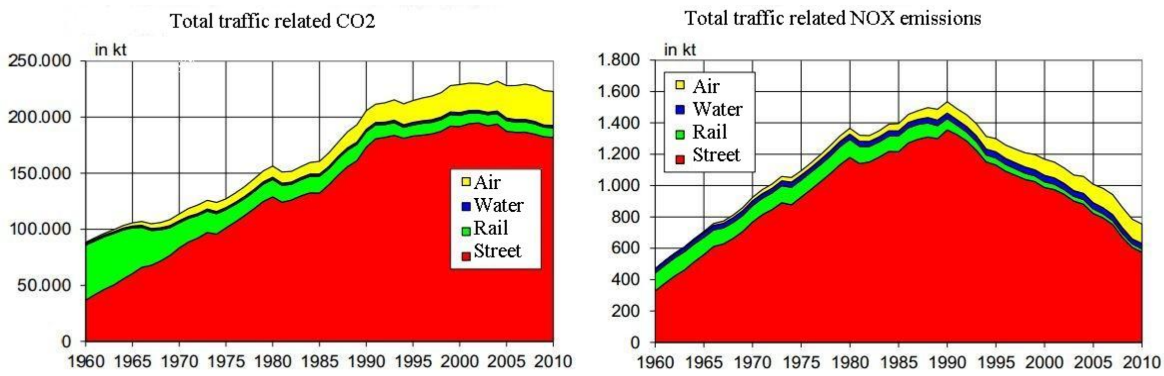


Figure 32: CO_2 - and NO_x -emissions of German traffic (1960 - 2020). Source: Ifeu (2011a, p. 40).

In future, direct CO_2 -emissions of road traffic are expected to decrease, see Figure 33 (Ifeu, 2011a). Positive effects will be realized due to emission reductions from stronger exhaust emission standards and the increasing the portion of bio-fuels. NOx-emissions are forecasted to be reduced by 36%, compared to 2010, based on the introduction of the new Euro-6 vehicles. Interestingly, savings from the exchange of conventional cars with electrical vehicles do not play role in the Tremod calculations - although with projected numbers between 500.000 and one million EV's by 2020 (charged by green energy), between one and two percent of the road traffic would be electric and no longer contributing to the CO_2-emissions.

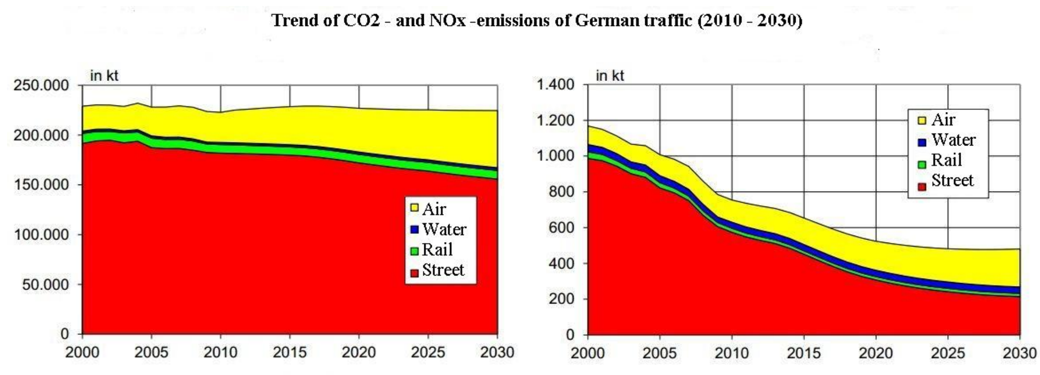


Figure 33: Trend of CO_2 - and NO_X -emissions of German traffic (2010 - 2030)
Source: Ifeu (2011a, p. 40)

Summary of CO_2 –emissions in Germany

The most important findings from current and forecasted CO_2 emissions in Germany are summarised as follows:

- About 20% of the German GHG emissions are emitted by traffic.
- Traffic is the only sector in which, CO_2 emissions have remained relatively constant, with a reduction of only -6% between 1990 and 2010.

- Road traffic is the most important contributor to the emissions and accounted for 82% of the traffic related CO_2- and over 90% of the NO_x - emissions in 2010.
- By 2020 CO_2-emissions from road traffic are estimated to decrease by roughly 8% compared to the year 2000 - which nearly equals the level of 1990. This means relative to the base year 1990 no CO_2-savings from road transport will be made to help reaching the climate goals (while emissions from air transport are even increasing) until 2020.
- Additional CO_2 -saving efforts are necessary in road traffic to reach climate goals.

3.1 Freight vehicle fleet characteristics in Germany

In order to find enablers and barriers for electric mobility in urban freight transports it is of interest to analyse the traffic development and emissions depending on vehicle types, kilometrage and main area of operation:

Kilometrage is an essential factor that determines greenhouse gas emissions. In the past 50 years, the kilometrage of heavy trucks grew 4,50 times, including light trucks even five times, see Figure 34 .

Development of kilometrage in road freight transport

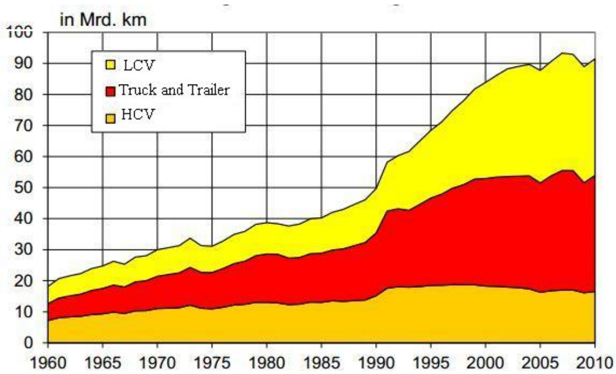


Figure 34: Kilometrage in road freight transport
Source: Ifeu (2011a)

Besides kilometrage, the age and emission class relevant when discussing commercial vehicle stock. The average of the current fleet of commercial vehicles on the road is about six to seven years old and falling under the EURO3 exhaust emissions class in case of LCV. For HCV the exhaust emission classes increase with the vehicle weight (KBA, 2012). This can be explained by the higher savings in vehicle tax and fuel consumption for vehicles with better emission, which become more relevant for heavier vehicles. The EURO3 exhaust norm was valid in Germany for vehicles firstly registered between January 2001 and December 2005. For this reason most of the in average six to seven year old LVCs fall under this class. Many of those vehicles can be expected to be replaced by newer models with the EURO5 exhaust emission class soon - or potentially in urban centres by an electric vehicle.

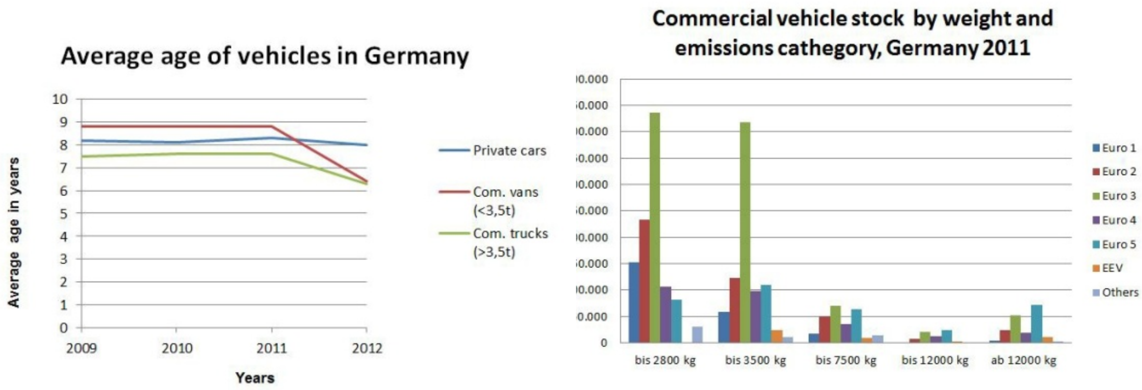


Figure 35: Age and exhaust emission standard of LCV and HCV in Germany (Jan 2012)

The future development of the traffic in Germany will be continuing with a strong increase in road traffic, especially in commercial traffic.

Table 3 shows that with 112.5 million tons in 2004, CO_2 -emissions from passenger cars contributed a dominant 2/3 of the total emissions. Although road traffic mileage of passenger cars will increase by 13%, due to the tightening exhaust emissions standards, their CO_2 -emissions is projected to be reduced by 20% until 2025. In contrast to the GHG emissions decrease in the passenger car sector, CO_2-emissions of light and heavy commercial vehicles are projected to increase by 16%, due to a strong increase in kilometrage: +55% for HCV and +29,3% for LCV by 2025.

	Bln. km		Change (2004/25)	CO_2 mio. t		Change (2004/25)
	2004	2025		2004	2025	
Passenger cars	590,4	671,4	13,7%	112,5	89,7	-20,2 %
Motorbikes	17,0	19,7	16,1%	1,6	1,5	-6,1%
Busses	3,6	3,4	-4,2%	2,7	2,3	-16,2 %
Trucks	72,8	101, 7	39,6%	42,1	48,9	16,0 %
> 3,5t	28,8	44,8	55,5%	-	-	-
< 3,5t	44,0	56,9	29,3%	-	-	-
Other vehicles	12,6	16,8	32,9%	8,1	8,7	7,1 %
Total	**696,4**	**813,0**	**16,7%**	**167,1**	**151,1**	**-9,6%**

Table 3: Forecast of road traffic mileage and CO_2-emissions by 2025
Source ITP (2007).

The transported volume in road transport is expected to increase even more; in the period between 2010 - 2030 by 234% (Ifeu, 2011b), see Figure 36.

Freight transport performance (1960 – 2010) Freight transport performance (2000 – 2030)

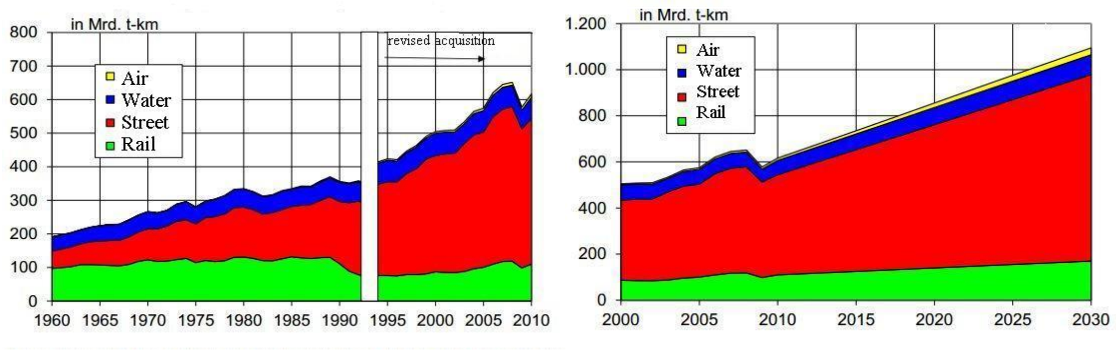


Figure 36: Past and projected freight transport performance by traffic carriers
Source: (Ifeu (2011a, p. 7)

The major driver for growth in traffic volume and performance are long distance transports, see table 4:

Distance	Traffic Volume increase	Traffic performance increase
Short distance	3%	11%
Long distance	55%	84%

Table 4: Road traffic forecast in freight transport 2004 to 2025
Source: (ITP, 2007)

To determine what vehicle class has the highest share in which area, the German roads where categorized into three classes: “Inside built-up areas” (urban areas), “outside built-up areas” (rural areas) and “highways”. It was concluded that passenger cars have the highest share on roads outside built-up areas (rural areas), light commercial vehicles are in majority inside build-up areas (urban areas) and heavy trucks do have the highest percentage on highways (Ifeu, 2011a).

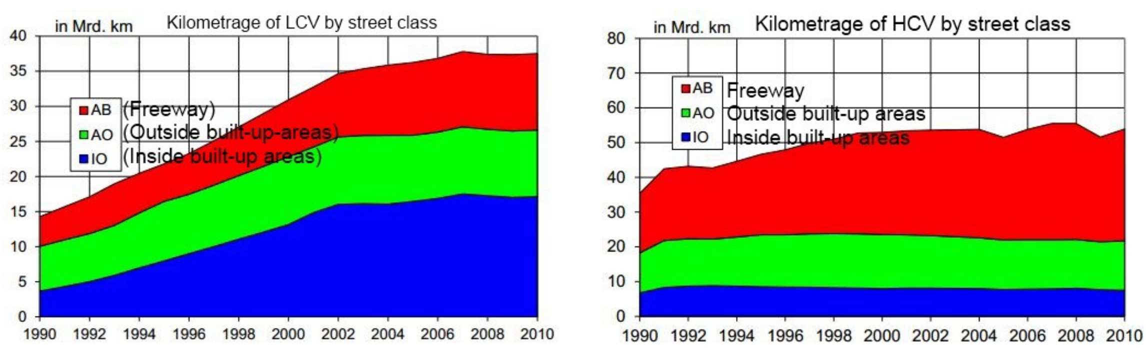


Figure 37: Kilometrage of light and heavy commercial vehicles by street class
Source: Ifeu (2011a)

Freight transports can be categorized in two classes: Freight traffic “on-own-account” and commercial traffic. When transporting goods on-own-account, the companies use their own staff to drive the vehicles and the freight transport is an auxiliary activity to achieve the main business tasks. Commercial freight transport is defined by the business of transporting freight for other entities, usually against payment.

Figure 38 is split in an overview on how the number of trips, distance travelled and cargo carried distributes between the two classes. In the range up to 150 km, relevant for electric commercial vehicles, about twice as many trips are made, cargo is carried and kilometres are travelled by commercial freight transport compared to transport on-own-account.

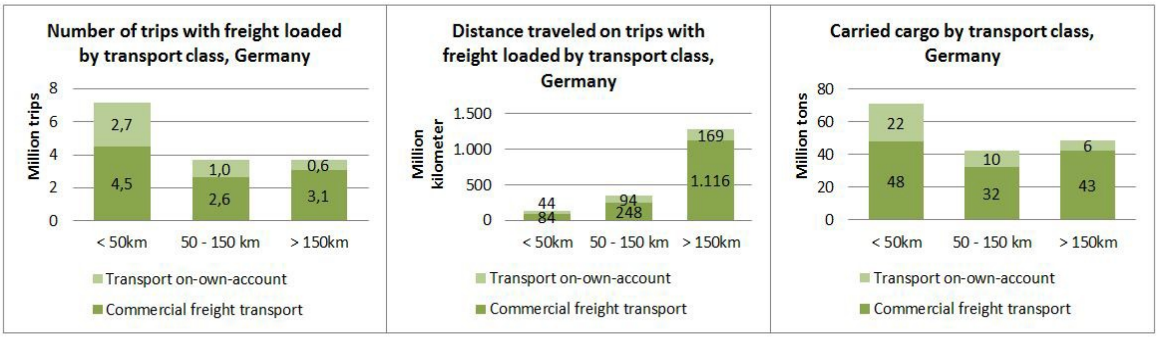


Figure 38: Comparison of commercial freight transport and transport on-own-account
Source: own graphic based on KBA (2011).

Another aspect of commercial freight transport is the degree of capacity utilization. In the close distance range below 50 kilometres most relevant for electrical urban transport, the capacity utilization on tours with cargo lies at 53 %. 43% of all driven kilometres are carried out even without cargo. For the middle distance range up to 150 km, which is also potentially interesting for EV's, the degree of capacity utilization on tours with cargo lies at 52 % and 34% of all driven kilometres are made without cargo, compare table 6 and 7.

WITH CARGO	Drives	Distance	Carried weight	Capacity	Utilization
	in 1.000	1.000 km	1.000 t	1.000 t	%
< 50 km	4.497	84.368	48.078	90.356.	53%
50 - 150 km	2.647	248.001	32.295	61.713	52%
> 150 km	3.106	1.116.042	42.556	80.919	52 %

Table 5: German commercial freight transport statistical data with cargo
Source: KBA (2011)

NO CARGO	Drives	Distance	Capacity	Share empty drives
	in 1.000	1.000 km	1.000 t	%
< 50 km	3.474	63.867	70.531	43%
50 - 150 km	1.428	125.762	35.936	34 %
> 150 km	417	106.644	10.713	9%

Table 6: German commercial freight transport statistical data without cargo
Source: KBA (2011).

Summary of the freight transport sector development

The following is an overview of the most important findings from traffic and transport statistics for electric mobility in urban freight transport:

- The group of commercial vehicles will come closer into focus in being a relevant segment for CO_2-reductions: commercial vehicles kilometrage will grow from 1/4th to 1/3rd of the overall traffic. CO_2 emissions from commercial transport will increase by 16% until 2025, in contrast to the passenger car sector with declining CO_2 -emissions.
- The majority of vehicles on urban roads are light commercial vehicles. This group will grow by 29,3% mainly due to the increasing delivery traffic.
- The most relevant area of substitution of conventional commercial freight vehicles with EV's in urban transport is in the category below 150 km. Furthermore substituting a certain percentage of conventional vehicles with EV's in commercial freight transport would have a higher impact on energy, noise and CO_2-savings than if the same percentage in the transport-on-own account would be substituted. The commercial freight transport vehicle fleet driving up to 150 km, makes about twice as many trips, carries twice as much cargo and travels the double amount of kilometres as compared to vehicles that transport freight on-own-account in Germany. Nevertheless, also the transport on own account has a considerable share that should not be neglected.

3.2 Electric freight fleet characteristics

Electric vehicles number

By 1st of January 2012, 4,541 electric vehicles where registered in Germany. This is about 0.01% of the total of 51.7 million registered vehicles, see Figure 39 (KBA, 2012).

Analysing the numbers of the EV's over the past 7 years reveals, that from 2006 to 2010 the stock of EV's on German roads was declining, with a change of trend in January 2011, where numbers of EV's started to increase. By beginning of 2012 the population of EV's has nearly doubled compared to the year before. Recent registration numbers of electric vehicle from 1st of January to 31st of June 2012 count 1,419 newly registered vehicles, so that in July 2012 nearly 6,000 EV's were driving on German roads (KBA, 2012).

In the period since 2006, numbers of hybrid electrical vehicles were increasing steadily. By January 2012 there were about ten times more hybrid electric vehicles on the read as full electric vehicles in Germany (KBA, 2012).

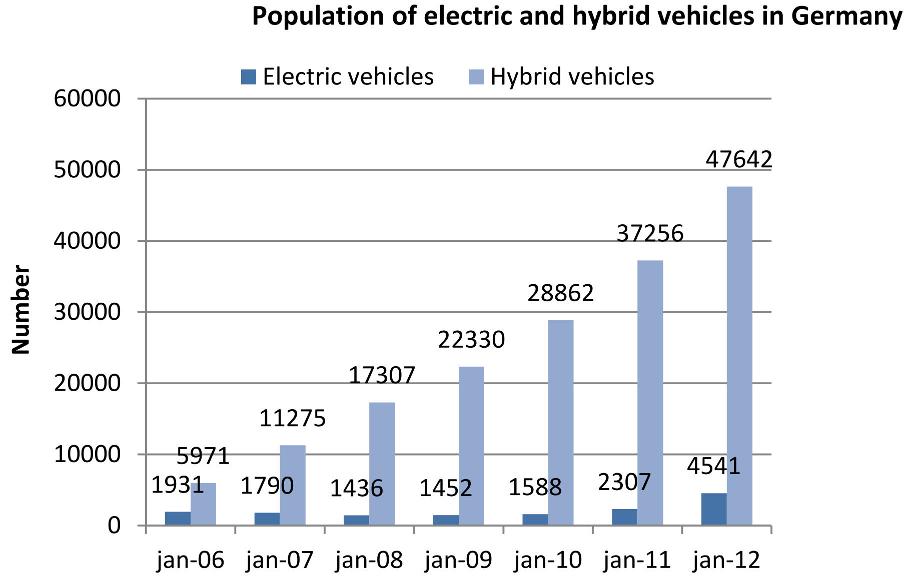


Figure 39: Population of electric and hybrid vehicles in Germany Jan. 2006 – Jan. 2012
Source KBA (2012)

Commercial electrical vehicle numbers

In January 2012, the share of freight electric vehicles accounted with 1,457 pieces for about 1/3rd of the total EV stock of 4,541 pieces. The electrical freight vehicles share reached a total of 0.06% of the freight vehicles stock in Germany, which is significantly higher than the share of EV's in the overall vehicle stock (only 0.01%).

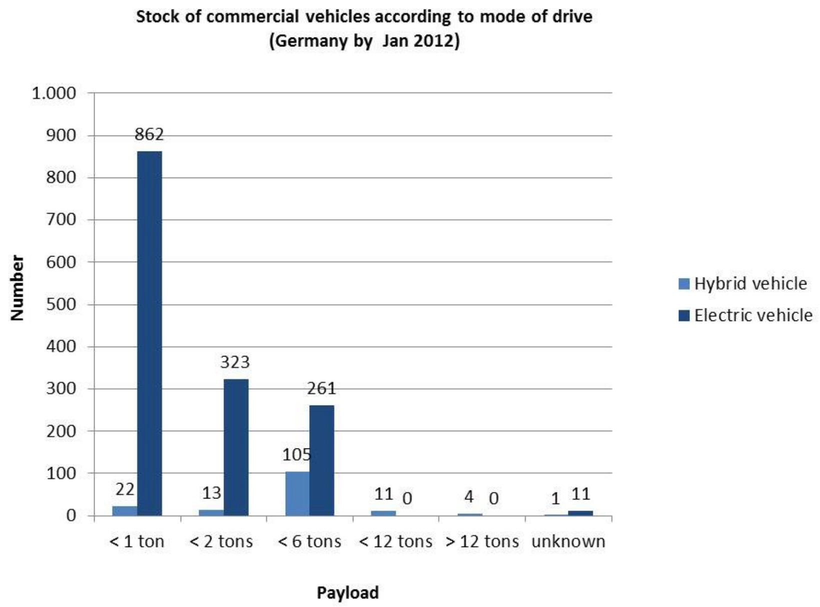


Figure 40: Stock of commercial electrical vehicles in Germany (Jan 2012)
Source KBA (2012)

The most relevant classes for commercial EV's can be identified by analysing Table 7:

a. In the class 'vans below one ton', 59% of all commercial EV's were registered, summing up to 0.08% of overall vehicles numbers in this class.

b. In the class 'less than six tons' are presumably mainly electric trucks up to 3.5t registered. They have with 0.09% the highest share of overall numbers in this payload class. Within the group of commercial electric vehicles this class reaches 18%. Hybrid vehicles played a minor role in commercial vehicles segment by January 2012, see figure 40.

	<1 ton	**<2 tons**	**<6 tons**	**<12 tons**	**>12 tons**	**not known**	**Overall (of fuel)**
Electric vehicles	862	323	261	0	0	11	1,457
Overall (by pay-load)	1,120,551	915,107	294,138	94,493	103,234	1,133	2,528,656
Percentage of EV (of payload)	0.08%	0.04%	0.09%	0.00%	0.00%	0.97%	0.06%
Percentage of EV (of total commercial EV)	59.16%	22.17%	17.91%	0.00%	0.00%	0.75%	100%

Table 7: Stock of commercial vehicles (Jan 2012)
Source: (KBA, 2012):

3.3 Summary of electrical vehicles on German roads

The following is an overview of the most important findings from the current electric vehicle stock for electric mobility in urban freight transport:

- In 2010 the downward trend of electrical vehicle numbers turned. This implies that the German policies on electric mobility started to bear fruits.
- Within the electrical vehicle population, electrical freight vehicles play an important role, making up 1/3 of the total EV stock in Germany by 1st of January 2012.
- The percentage of electrical freight vehicles is with 0.06% of the total commercial vehicles stock six times higher than the numbers of EV's in the overall vehicles stock (0.01%).
- Hybrid vehicles do play an important role in the private car segment, in the freight vehicle segment, fully electric vehicles dominate.
- Within electric freight vehicles, small vans below one ton payload are dominating with 59%. Above six tons payload nearly no electric freight vehicles are registered.
- The highest density of EV's is reached in the payload segment up to 6 tons. Here a share of 0.09 % of the total vehicle stock is reached. Presumably EV's up to 3.5 tons account for these high numbers.

Summary of the freight transport sectors impact on freight EV implementation

The drivers and challenges and opportunities for electric mobility in urban freight transport discussed in this chapter are summarized below:

Drivers

- About 20% of the German GHG emissions are emitted by the transport sector, with road transport by far being the largest contributor (82% of these in 2010). Germany aims to reduce CO_2-emissions by 40% until 2020. According to the Tremod prognosis (Ifeu, 2011a), emissions from road traffic can be reduced from high levels of today, to reach 1990 levels again by 2020. Effectively, no reductions from road transport will be realized by 2020. Additional CO_2 saving efforts are necessary in road transport to reach climate goals.
- The group of commercial (freight) vehicles will come closer into focus in being a relevant segment for CO_2 reductions: commercial vehicles kilometrage will grow from 1/4 to 1/3 of the overall traffic. While CO_2 emissions from commercial transport will increase by 16% until 2025, in contrast to the passenger car sector with declining CO_2 emissions.
- The group of light commercial vehicles will grow by 29.3% from 2004 to 2025, mainly due to the expansion of delivery traffic (ITP, 2007). Substitution of

conventional light commercial vehicles with electric commercial vehicles for freight delivery in urban areas would have a major impact on adhering to the clean air plans of the cities as well as the overall German goals.

- The most relevant area of substitution of conventional commercial freight vehicles with EV's in urban transport is in the category below 150km. Furthermore the substitution of a certain percentage of conventional vehicles with EV's in commercial freight transport has a higher impact on energy, noise and CO_2-savings than if the same percentage in the transport-on-own account would be substituted. The commercial freight transport vehicle fleet driving up to 150km makes about twice as many trips carries double the amount of cargo and travels twice as many kilometres as compared to vehicle that transport freight on-own-account in Germany. Nevertheless, also the transport-on-own account has a considerable share that should not be neglected.

- City hubs (Urban Consolidation Centres) in which freight is collected and redistributed onto vehicles for last mile deliveries, could have a high and positive impact on the CO_2 emissions and the amount of transport work in the cities. Through in this model, the capacity utilization could be increased and drives without cargo could be reduced, by also collecting return freight on the way back.

- Numbers of EV stock imply that the commercial vehicle segment is suitable for electric vehicles. The commercial vehicle segment has relatively the largest fleet of EV's: in average 0.06% of the vehicle population is electric in Germany, this is six times more than for general vehicles numbers (including passenger cars), 1/3 of the total EV stock in Germany were commercial electrical vehicles.

Challenges

- The small available model range of heavy electric trucks and low kilometre range of EV's will reduce the applications of electrical vehicles in the category with the highest increase in kilometrage and CO_2-emissions: The heavy commercial vehicles on long distance trips.

Opportunities

- The majority of LCV is replaced after six to seven years. Since many currently registered LCV fall under the EURO3 exhaust norm that was valid for newly registered vehicles until end of 2005, it can be expected that a large number of LCV are to be replaced in the next years.
- The tightening of entrance restrictions for loud or CO_2 emitting vehicles into the inner city would make the usage of EV's more attractive.

4 Policies and Legislation on Freight Electric Mobility

Germany aims to become the lead provider and lead market in electric mobility and put one million electrically powered vehicles on German roads by 2020. The vision is to raise this number to six million by 2030 and to have the majority of vehicles on urban roads powered by renewable energy sources in 2050.

The goal of becoming the lead market and lead provider of electric mobility was defined in 2009 by the federal government in the "National Development Plan Electric Mobility" and was followed by the founding of the National Platform Electric Mobility (NPE), a group of experts in electric mobility. The NPE defined three phases to pursue Germany's goals, each with different focus and measures (NPE, 2011):

1. Market preparation until 2014; focus on R&D and regional showcases. 100.000 EV's on the road.
2. Market ramp up until 2017, focus on market development in vehicles and infrastructure. 500.000 EV's on the road.
3. Begin of mass market until 2020 with self-supporting business models. 1.000.000 EV's on the road.

According to this plan, Germany is in the first phase.

Table 9 below gives a chronological overview about the development of national policies and plans regarding electric mobility. It is followed by a more detailed description on the NPE and the governmental programs to foster electric mobility in Germany. Finally, a short description about the German so called "Energiewende" is given, as electric mobility is interrelated with and influenced by the German energy plans.

2009, 19 August	The German Federal government released a National Development Plan Electric Mobility (NEPE), jointly developed by the four ministries mainly involved in electric mobility (Economics, Transport, Research, Environment)
2009	Model region program, funding: 500 mio. €: to support activities described in the NEPE and stimulate the market preparation.
2010, 3 May	Based on NEPE the National Platform Electric mobility (NPE) was formed. The NPE is an expert group for electric mobility, discussing and analysing state of the art and developing guidelines for the government in form of a yearly report.
2010, 30 November	First (intermediate) report of NPE, containing an overview of electric mobility in Germany, its assets and challenges and formulating goals and next steps.

2011, 16 May	Second report of NPE, containing recommendations for future government pfuture government policies in the field of electric mobility.
2011, 18 May	New governmental program for electric mobility, in response to the second report of NPE, providing a comprehensive description of the measures it plans to carry out.
2012, April	Program: showcase electric mobility, funding: 180 mio. €. The showcases intend to make electric mobility visible and tangible for a broad public.
2012, 23. May	The German cabinet decided on new measures to promote EV's.
2012, 20. June	Third (progress) report of NPE: in the implementation progress of recommendations given in the second report are monitored.

Table 8: Overview on the Germany policy and plans on electric mobility

National Platform Electric mobility (NPE)

This section is a translation of (BMU, 2012).

The national platform E-Mobility NPE was founded on May 3rd, 2010. It consists of representatives of industry, scientist, politicians, labour unions and civil-society. In seven workgroups, each having around 20 highly reputed experts, the topics listed below are valued as important ant to stimulate for the development of electric mobility. Workgroups are coordinated by a steering committee, formed by the heads of the workgroups and representatives of the German federal government. The workgroups of the NPE are working on the following topics:

- Drive train technology
- Battery technology
- Charging infrastructure and integration to the power grid
- Norms, standards and certification
- Material and recycling
- Education and qualification
- Societal framework

The NPE is an advisory board to the German federal government. It observes and analyses developments in electric mobility and gives recommendations how the goals of the "National Development Plan Electric Mobility" can be reached. This is done in form of a yearly report.

The first (intermediate) report of NPE was released 30. November 2010, containing an overview of electric mobility in Germany, its potentials and risks, and formulated goals and next steps (NPE, 2010).

The second report, released in May 2011 listed recommendations for future government policy in the field of electric mobility. Becoming lead provider shall be achieved by establishing "technical R&D-Lighthouse programs", the path to becoming a lead market shall be paved by "regional showcases". To foster electric mobility in commercial vehicles the NPE suggests:

From 2012 on, a higher and faster tax depreciation for commercially used EV's (50% in the first year) to relief high investing costs and higher innovation cycles.

A yearly tax incentive from 2013 on to support the sale of EV's; 100 €/kWh should be awarded up to a cap of 20 kWh for commercial EV owners.

In June 2012, the 3rd report was handed to the government. This report monitors the implementation progress of recommendations given in the second report (NPE, 2012). The NPE criticizes that so far only two suggested measures have been implemented by the government: a compensation of tax-related disadvantages when utilizing an EV as company car and the prolongation of the exemption of EV's from vehicle tax from 5 to 10 years. Hence, the NPE projects discovered that without further incentives only 450.000 EV's will be on the road until 2020 and therefore recommends the following measures to stimulate the market:

- Non-monetary measures: privileges in parking, using bus lanes, sponsorship of car-sharing projects (implementation subject to regional law and policy).
- Monetary measures for private purchase: low credit costs of 2.5% p.a. for up to 30,000 € (2012), yearly tax incentives depending on battery capacity of 100€ per kWh (2013).
- Monetary measures for private use of company cars: Compensation of financial disadvantage of using company EV's for private transport (starting in 2012).
- Monetary measures for commercial purchasers: accelerated depreciation of commercial EV's (starting 2012), yearly tax incentives of 100 €per kWh (starting 2013).

Governmental programme for Electric Mobility

“Germany aims to take the lead in electric mobility and put one million electrically powered vehicles on German roads by 2020. As a step towards achieving this goal the Federal cabinet adopted the Government programme for Electric Mobility on 18 May 2011. Its strategy to promote research, development and market introduction of electric mobility is the result of joint efforts by the four Federal ministries for economics, transport, environment and education and research. The government programme builds on many recommendations for action given in the Second Report by the National Platform for Electric Mobility, which was submitted to the Federal government on 16 May 2011.”

The government programme provides for the introduction of the following key incentives and measures:

- Increase of research and development funding by an additional 1 billion Euro by the end of 2013
- Establishment of regional “showcases” and technical “lighthouse projects”
- 10-year vehicle tax exemption for cars with CO_2 emissions of less than 50g/km and bought before 31st of December 2015
- Adjustment of the taxation on company cars in order to eliminate present taxation disadvantages of electric vehicles compared to conventional vehicles as company cars
- Gradual switch of the vehicle fleet of the Federal government to electric vehicles (target value: as of 2013 onwards CO_2 emissions of 10 percent of all new cars to be less than 50 g/km)
- Special parking areas and less rigid access prohibitions
- Use of bus lanes
- Introduction of a special label for environmentally friendly cars within the framework of the 40th Ordinance on the Implementation of the Federal Emission Control Act (so-called “blue label”).” (Bundesregierung, 05)

Model regions, regional showcases and technical lighthouse project

Pilot regions, regional showcase and lighthouse projects are programs in which electric mobility is tested in practice and is financially subsidized and accompanied by scientific research.

a) Electric Mobility Pilot Region

The broad-based introduction of electric drive train systems in road transport involves not only technological challenges, but also organizational, structural, urban planning and legal issues. To be able to address this complexity in its entirety, the “Electric Mobility in Pilot Regions” financial assistance program was launched in 2009. It is funded by the Federal Ministry of Transport, Building and Urban Development with 130 million Euros from the second economic stimulus package.

The project focuses on battery-based electric mobility and its various applications in mobility and urban development. Over 130 applications were submitted, and from these eight pilot regions were selected that complement one another in terms of structure and size. They thus include large cities, large areas with urban and rural parts and rural regions.

This mean that the entire spectrum of electric mobility is covered, and the special requirements of different target groups are addressed: for instance commuters, small and large enterprises, cyclists and delivery vans were covered. In public transport, the focus lies on electric and hybrid buses and new approaches to mobility, among others. A total of over 200 projects are being funded in these regions, which will provide Germany with an in-depth impression of electric mobility (BMVBS, 2012). An overview of the geographical areas of the pilot regions can be found in Figure 41.

The electric mobility pilot regions (2009 – 2011)

Figure 41: Overview of the electric mobility pilot regions. Source: (NOW, 2009)

The final report of the pilot region tests, names the most promising applications for the first market implementation for commercial cases (NOW, 2012).

b) Regional Showcases. "The establishment of a small number of large-scale "showcases" is designed to explore unanswered questions, for instance regarding user behaviour in everyday conditions, and to demonstrate electric mobility in a way that is likely to appeal to the general public. Thanks to their size, the new showcases will allow to draw conclusions about the suitability for mass production of the tested electric mobility solutions. Showcases are also designed to help enhance the global visibility of the German industry's capabilities, to enable people to gain first-hand experience of electric mobility and to encourage public acceptance of this emerging technology. The positive experience already gained from the pilot regions will provide a reference and a foundation for further work. An open call for bids for the showcases is to be launched in 2011. Some of the existing eight pilot regions could, for instance, be subsumed into the showcase projects to be established. To implement the showcase program, the Federal Government will hire a joint project sponsor". (BMVBS, 2012)

c) Technical R&D lighthouses. In order to achieve the goal to become the lead supplier of electric mobility, the NPE has defined six so called "R&D Lighthouses", which have been implemented by the German federal government in the government program for electric mobility. The lighthouses will form a specially highlighted group within Germany's subsidized R&D programs relating to electric mobility. Lighthouses focus on individual fields of technology and application in research and cluster resources from industry and academia thematically. The following lighthouses will be focused on within the next three years:

- Battery
- Drive train and systemic vehicle integration
- Lightweight constructions
- Recycling
- Information and communication technology and infrastructure

Overview on Germany's climate politics and low carbon plans

Recent German energy plans, the so called energy turnaround, is often referenced in discussions about the necessary power demand, CO_2-savings potential and stability of the electric grid, all in relation to electric mobility. With the energy turnaround law, which was adopted mid-2011, the German discussions of the past 30 years about the use of nuclear energy and low carbon goals have been summarized in written goals and plans. The German Minister for Economic Affairs, Philip Rösler, denominated the energy turnaround as his core task for the upcoming legislative period (Süddeutsche, 2012). The most striking goals of the energy turnaround are:

- The seven oldest nuclear power plants are to be shut down immediately; the others are phased out successively in the years until 2022.

- The percentage of renewable energy of the energy usage shall be raised to at least 35 percent by 2020, 50 percent by 2030, 65 percent by 2040 and 80 percent by 2050.
- To reach a share of 35 percent renewable energy by 2020, an overall reduction of energy usage of 10 percent is aimed at.
- Greenhouse gas emissions shall be reduced by 40 percent below 1990 levels by 2020 and 80-95 percent by 2050

In summer 2012 the goals of the energy turnaround are largely discussed in the German media, especially under the premise to keep the increase of the electric energy price low. The price for the end consumer is estimated to rise due to two factors: more and more renewable power sources are installed, and owners are guaranteed a fixed price for the renewable power generated (called the "EEG - contribution", EEG stands for renewable energy law ("Erneuerbare Energien Gesetz")). The difference of the real market price for electrical power and the guaranteed price has to be paid mainly by the private consumers (industries get large rebates, the more energy they utilize). It is expected that the EEG Contribution will rise by two Cents per kWh in autumn 2012 (Schulz, 2012b).

Furthermore, Germany's power nets have a structural problem. Not all renewable energy, which is mostly generated by wind energy plants in the north, can be transported to the south, where industry is consuming most energy. Substantial sums will be invested in the construction of new electric power line systems and a smart grid. These costs will partly be transferred to the end consumer, in form of a higher price for electrical power (Schulz, 2012a).

Electric mobility is one pillar in the strategy of adhering to the climate goals of the energy turnaround and its future development is dependent on the electrical energy price, which is again influenced by the energy plans. The following chapter gives an overview about the history and development of Germany's low carbon plans.

Summary of policy impact on freight EV implementation

Enablers and barriers, opportunities and risks for electric mobility in urban freight transport discussed in this chapter are summarized below:

a) Enablers

- Already in the first step towards modern electric mobility, the national development plan from 2009, mapped inner city delivery with commercial vehicles as an important field of application for electric vehicles. This, and the extensive funding of electric mobility research and development (additional to current projects 1 billion Euro by the end of 2013) has given the possibility of testing e-urban freight solutions in the past three years, and will support the development and testing of real life applications in future.
- All EV's, including commercial delivery vehicles, are exempt from vehicle tax for 10 years, when firstly registered before 31. Dec. 2015.

- In order to make EV's as company cars more attractive, the calculation of the tax for the advantage of driving a company car privately was changed to exclude the price for the battery in the calculation. Presumable, vehicles in urban freight transport will not be used privately after work (where it needs to be charged), so this advantage does not affect electric vehicles for transport purposes.

- Electric mobility is seen as a measure to decrease dependency from oil.

b) Barriers

- No buyer's premium or incentives are reducing the high purchase price of EV's for the buyer.

c) Opportunities

- The final report of the pilot region, name the different usages of electric vehicles in commercial cases, as the most promising application for the first market implementation (NOW, 2012).

- Non-monetary measures proposed by the NPE, like privileges in parking or using bus lanes could accelerate the usage of EV's in urban freight transport, but implementation is subject to regional law and policy. In order to implement these privileges, the labelling of EV's needs to be adopted first.

- A financial privilege suggested by the NPE is higher and faster tax depreciation for EV's (50% in the first year) to minder the high initial costs relative to ICE's.

- Another financial privilege suggested by the NPE is a yearly tax incentive from 2013 onward to support the sale of commercial EV's; 100 €/kWh should be awarded up to a cap of 20 kWh for commercial EV owners.

- The German energy turnaround sets limits to reach by 2020 compared to base year 1990 for CO_2- emissions (40% less), energy consumption (10% less) and the share of renewable energy (35%). Electric mobility will play an important role in reaching those goals, with regards to CO_2-reduction and power grid stability.

d) Risks

- The price for electric energy is influenced by the shutdown of nuclear reactors, additional renewable power plants and further construction of the power grid. The profitability of EV's is influenced by the price of electric energy.

5. Initiatives on urban freight electric mobility

5.1 City Express Logistik

Project overview

Start of project:	2009
Project Status:	On-going
Involved city:	Hamburg, City Centre
Population size:	1.8 Million
Participants:	City Express Logistik GmbH Sector: Courier and Express Parcel (CEP)
Goods transported:	Paper, small electronic spare parts, household appliances.
Type of vehicles:	6 Pizza Scooters 'Eco-Carrier'. 2010 - 2011: 4 DFM (Chinese Vans). 2012: Citroen Berlingo First Electric
Ownership of vehicles:	City Express Logistik GmbH
Project budget:	N/A
Public subsidies:	None
Stakeholders involved:	City Express management and staff

Company and market description

City Express is one of Hamburg's leading courier, express and city logistics companies, founded 1973. Pioneering the usage of electrical vehicles in urban freight distribution, the company still is the only courier and express company active in this field in Hamburg (July 2012).

City Express Hamburg is acting as a "switching centre" for customer transport requests and communicates those to self-employed drivers with own vehicles, who report themselves as 'free to work' in any period/ district of Hamburg they decide on. Vehicles range from bicycles and motor-scooters over passenger car size or delivery vans with a pallet carrying facility, up to medium sized trucks. Committed to eco-friendliness and sustainability, City Express has won environmental prices and is in discussion with politicians and initiatives, giving impulses for greener city logistics solutions.

Project goals

The overall courier and express parcel (CEP) market is declining, as information on paper, the main product delivered in the past, now is often transmitted electronically. Nevertheless, paper still is the main transported goods today, but picked up and delivered are also other urgent goods that must reach another destination in the city within the next hours or by early next morning latest. Beyond this time line, customers would choose a parcel delivery service to transport their goods for cost reasons.

Due to the declining market environment and pressing conditions after the European financial crisis in 2008, City Express chose sustainability as measure to differentiate itself from competition. Especially in the context of Hamburg being the European Green capital 2011, positive publicity for eco-friendly projects and electric mobility were expected.

Project description

In 2009 when City Express began looking for suitable electrical vehicles, the German e-vehicle market was not offering scooters, cars or vans in a reasonable price range. In China, electric vehicles where available in a lower price range, thus after visits to a Chinese car manufacturers and electric vehicle workshops, City Express ordered four converted electrical vehicles. They were imported step by step via an import company, which promised the vehicles would pass the German TÜV (road worthiness) test. One of the vans never did pass the test, but the others started operation from April 2010 on. Moreover, City Express complemented the e-fleet with six Pizza Scooters of the 'Eco Carrier' type by Scooter Skillz (a Chinese Brand). The scooters are equipped with front and rear boxes which can carry one post box (front) or two post boxes (rear). In this way, two Scooters do replace a small car and can conduct deliveries, which would be too far for a bicycle courier, but too expensive to carry out by car. Like the conventional scooters at City Express, the electrical scooters are only used when weather conditions allows.

Experiences with the electrical scooters

The following list gives an overview about the experiences encountered using electrical scooters for urban freight deliveries:

- **Kilometre range:** The kilometre range of the electrical scooters is only sufficient for half a day usage; therefore, the drivers return to the companies central at midday and replace an empty scooter with a newly charged one.
- **Battery indication**: The battery indication is not very useful; it consists of two LED lamps: One green (battery charged) or red (battery flat). This binary behaviour does not allow any indication of the range left.

Experiences with the electrical vans:

The following list gives an overview of the experiences encountered using electrical vans for urban freight deliveries.

- **Kilometre range:** The kilometre range of 100km (as stated by the Chinese manufacturer) could never be reached in daily operation. A maximum of 80 km could be driven under optimum conditions: with the vehicle carrying no cargo, a moderate ambient temperature and with extremely energy efficient driving. In winter the range dropped to only 35/40km (this was even with the heating turned off). Another major drawback was the very inaccurate battery indicator. 5 - 6 times the vehicles stranded due to an overestimated battery charge level. Only once the vehicle needed to be towed, in other situations sympathetic customers offered an electric cable and a charge, one time even overnight.
- **Infrastructure:** Initially, City Express planned using the public charging infrastructure during delivery/pick-up stops. Two benefits where expected: first,

the extension of the maximal daily range by intermediate charging. The dwell time on delivery/pick up stops are rather short, but even an extra 5 km would have meant a 10% increase in range. Secondly, the reserved lots promised parking spaces reserved for EV’s in the city centre, where parking spaces are extremely rare. With these extra lots, parking in the second row, thus being a hindrance for traffic and the risk to receive tickets should have been reduced. In practice, the charging infrastructure of Hamburg was only completed by the end of 2011 and those spaces available where often taken by conventional cars for parking. Only since the beginning of 2012 the situation ameliorated, when towing sings had been established on the EV charging lots.

- **Acceleration**: Since the engines of the DFM vans only possessed 8kW, City Express reported that the gearbox actually was useful in daily operation to get the vans accelerated. Still, bringing the vehicle up to speed was slow, but the vans where not a hindrance to the surrounding traffic.

- **Self-employed drivers:** The business case of City Express is to act as booker between customer requests and self-employed drivers, picking up and delivering freight. The self-employed drivers are (at the time of writing) not willing to buy an electric vehicle, due to the high initial costs, the range restrictions and thus lacking flexibility: in most cases the vehicle is used for private transport after work, therefore the EV would not regularly return to a base for charging after working hours.

- **EV drivers**: Since the regular drivers who work for City Express do own and drive their (conventional) vehicles, City Express had to hire new drivers for the EV’s. The EV drivers have to possess other and sometimes more refined skills than conventional drivers and need to understand and identify themselves with the EV technology: EV limitations in speed, acceleration and range demand a careful and economic driving style. Furthermore, a requirement for the drivers is that they act as promoters for the new, eco-friendly technology and are requested to convey the message “delivered CO_2-neutrally” towards the customers. For this reason, a degree of communication talent was required. Still, a person like this would need to accept the low rates earned in delivery business. City Express found a solution by appointing self-employed students, who were working as promoters and drivers.

- **Dispatching**: An adoption was necessary in the dispatching process: usually the self-employed drivers are offered the delivery assignments in the same order they report themselves as “free to work” in a certain area. Due to the high initial and low operational costs, EV’s need to drive as many kilometres as possible during the day to become profitable compared to conventional cars. For the scheduler of City Express this meant a change in the sequence of assigning the work: as soon as an EV (belonging to the central) reported free, it would be preferred over any idling driver of a conventional car and receive the next possible delivery order. Dispatching software available today is not ready to manage electrical vehicles: currently, vehicles do not submit their battery charge level to the system. Therefore in the afternoon, when the range of the EV decreases, it is necessary for the scheduler and the driver to discuss whether the next delivery order can be fulfilled. This additional consideration is a major drawback for the fast-paced work of a scheduler.

- **Reactions to the EV's:** The company reports that new customers can be gained with the argument of clean and environmental deliveries and the relationships with existing customers are tightened. A driver of the City Express EV's summarizes that almost all customers where positive about the climate friendly delivery. Only a very small minority was indifferent about the transport method, as long as the freight was delivered in time. The driver reported that his personal highlight was, when the customer and his management board were standing at the windows giving standing ovations, while the EV drove away after a delivery. The downside of this enthusiasm was that customers who specially ordered the delivery via EV where displeased when the cars were busy and the delivery had to be executed with a conventional vehicle.

Dispatching staff do agree that EV's offer environmental benefits, but are inconvenient as their workflow is affected by the additional work of scheduling the EV's.

Customers, management and driver are enthusiastic about the new eco-friendly delivery method by EV's. Following are quotations of the driver interviewed, to spotlight his identification with the EV's:

- "Driving an EV, the "direct" feeling and the acceleration of the engine is fun!"

- "I feel a kind of belonging, being a part of an integrated system with the environment. I am proud to be part of an innovative movement, making our future a bit better."

- "My job did become more communicative. I talk more to customers and pedestrians during the day and their feedback is overwhelmingly positive. At the end of the day I feel affirmed instead of stressed: usually an express drivers does receive mostly negative reactions during the day, for example because of a slow delivery, due to the traffic congestion, or when parking in the second row and hindering the traffic.

- "The following point has even enriched my life beyond working hours; deceleration, which is extraordinary in our daily live. As an express driver I am working under a tight time schedule. With the EV I have to be in time for the delivery, but at the same time have to balance the additional task to drive in an energy saving way. I observed vehicles around me sharply accelerating to cross a changing traffic light, being next to me again a few traffic lights further. My more regardful driving style relaxed my working day and makes it safer. Moreover, this decelerated attitude carries into other tasks of my daily life!"

Since June 2012 City Express switched to newer and more reliable European technology, selling the DFMs and using a Citroën Berlingo First Electric. The Berlingo was available at a highly competitive price for an electric vehicle, since a new version of the electric Berlingo with Li-Ion Batteries was available by the end of the year 2012; Citroën was selling off over capacities from an unfulfilled order of the Berlingo First Electric from the Spanish government.

Project results in summary

The technology of the Chinese vans was adequate for the price at the time of purchase, but manager and drivers are looking forward to using the Citroen Berlingo First Electric. Expectations are that the modern vehicle will offer a more reliable battery level indication and kilometre range in winter, thus it will be easier to conduct the daily delivery tasks. A second electric Berlingo might be acquired by City Express in the context of another project. Other plans on expansion of the freight delivery with electrical vehicles exist. So far the usage of the vehicles has not been economic. Theoretically, transferability to courier and express services is given, but competitors of City Express in Hamburg are not yet confident that the usage of EV would be financially viable for them.

The following list gives a summary of the internal enablers and barriers, as well as external opportunities and risks for City Express, using electrical vehicles in freight distribution:

a. Enablers

- The early implementation of electric mobility in courier and express services gave City Express a head start over the competition to learn about the new electric vehicle technology and the processes that need to be tailored in the daily workflow. Management, drivers, dispatching, servicing the vehicle and internal accounting needed to be altered.
- City Express received good media coverage and could successfully use eco-friendly delivery as a marketing tool.
- Relationships with existing customers were strengthened and new customers gained.
- Positive identification of the driver with the EV and the environmentally sound work.
- Positive feedback of the driver about EV technology: the EV feels “direct” and the acceleration of the engine is “fun”.

b. Barriers

- The battery indication of the Chinese EV’s was very imprecise: the electric vehicle stranded, leading to downtime and financial loss.
- The kilometre range of the DFMs under harsh weather conditions was insufficient (below 40 km).
- EV servicing, maintenance and accounting became additional tasks, since EV’s need to belong to a company’s fleet to ensure their return for charging overnight.

- Adequate drivers with different set of skills (identification with the technology, understanding the need for an economic driving style and an ability to communicate advantages of EV's to customers) had to be identified and employed.
- The dispatching process had to be altered, taking into account the technical characteristics and limitations, to operate it in the most profitable way.
- Dispatching software does not communicate with EV's to take battery level into consideration when scheduling.
- Purchase costs of EV's are too high; operation of the EV's has yet to become profitable. Only EV's with subsidies or at discounted rates might become economic in future.
- Initially, it was planned to use the public charging infrastructure during delivery/pick-up stops, in order to extend the maximal daily range by intermediate charging and to take advantage of the reserved lots, as parking spaces in the city centre are rare. In practice, the charging infrastructure of Hamburg was only completed by the end of 2011 and those spaces available where often taken by conventional cars for parking. Only since the beginning of 2012 the situation bettered, when towing sings had been established on the EV charging lots.

c. Opportunities

- Extra parking lots or special delivery zones for electric vehicles only would accelerate their usage in the CEP market.
- Customer demand and interest in environmental friendly transport is growing (as long as delivery speed and costs can be kept at the same level).

d. Risks

- Possible loss of customers, when requests for delivery by an EV had to be carried out by a conventional vehicle due to occupied EV's.
- Public parking lots for charging were blocked by conventional cars, thus constricting charging during delivery time and limiting the maximal daily range.
- EV's belonging to the company need to be preferred in dispatching delivery assignments, to maximize their daily kilometrage and capitalize on low operational costs. This could lead to dissatisfaction of self-employed drivers of conventional cars, who pay a monthly brokerage fee to the central: they might fear the central preferred EV's to their ICE vehicles, leading to a lower number of dispatched deliveries and thus a loss of income for them. Since the number of EV's at City Express had been small, this matter did not turn into an issue, but as soon as the number of EV's in the company would increase, it could become problematic.

5.2 ColognE-mobil

Project overview
The data in this chapter is quoted from (ColognEmobil, 2012).

Start of project:	22. Feb 2010
Project Status:	Finished end 2011
Involved city:	Cologne, City Centre
Population size:	1 Million
Participants:	Ford Germany (Car Manufacturer), RheinEnergie (Energy Supplier), University Duisburg-Essen (Scientific evaluation), City of Cologne
Sector:	CEP, communal waste management, intra-company haulage
Goods transported:	Parcels, waste, lobs and greenery
Type of vehicles:	10 Ford Transit BEV, 10 Ford Transit Connect BEV, 5 Ford Focus BEV
Project budget:	15, 2 million €
Public subsidies:	7, 5 million €

Project description and goals
The project CologneE-mobil was subsidized within the federal program "electric mobility pilot regions" by the Federal Ministry of traffic, construction and city planning (BMVBS). The project goal was to test commercial BEV and infrastructure in daily city logistic tasks within the city of Cologne. The city of Cologne, as one of the project partners, was responsible for regulatory approval and the evaluation of emission measurements, the 14 electrical charging stations on company ground and public charging points where provided by the project partner and energy supplier RheinEnergie Köln. Usage of the EV's started in April 2010 with ten electrical commercial vehicles of the type Ford Transit, 15 additional 15 EV's where added in the second project phase in early 2011 (10 Ford Transit Connect BEV, 5 Ford Focus BEV).
Fields of application where parcel service, collection and transport of waste from public dustbins, and the collection and transport of greenery and lobs from public parks, with a total sum of 50.000 kilometres driven and 1.500 charging activities by the end of the project. Following aspects were researched by the University of Duisburg-Essen: durability of the batteries, charging cycles in daily usage, acceptance of EV's and charging infrastructure. A future projection of energy usage and CO_2 reductions were made by a simulation for the German federal state North-Rhine Westphalia.

Project results in summary

"Electrical vehicles are suitable for inner city delivery and distribution already today". "The usage of EV's is technically viable and can be economically sound" (ColognEmobil, 2011). Investments in infrastructure public infrastructure are not necessary for urban freight transport with electrical vehicles. "Intensive research of 15 chairs at the University of Duisburg-Essen (UDE) have shown that many concerns with regards to range, costs, energy consumption or capacity overload of the electric network are unfounded in urban distribution traffic" summarized project speaker Prof. Dr. Ferdinand Dudenhöffer of UDE the project ColognE-mobil (ColognE-mobil, 2011). Further he noted "since the driving patterns in other German cities are similar to Cologne, we follow that 10% of the vehicles in German cities could be substituted by EV's already today." Users and customers of the project agree - the project has been a success.

Electric mobility profits from the clearly defined requirements in freight transport. Apart from costs, the main aspects in freight transport are kilometre range and carrying capacity. The usability of EV's in commercial transport is limited, due to the increased effort for tour planning and the range and payload restrictions. Those limitations are less problematic in urban transport settings, since range and cargo capacity are often sufficient, due to constricted delivery zones and moderate demands for cargo capacity. Additionally, in urban stop and go traffic, the battery electric vehicles can optimize energy efficiency by using recuperation.

The following list summarizes the results of the model region project ColognE-mobil:

a) Enablers

- Freight transport in urban stop-and-go traffic has a limited demand on kilometre range and cargo capacity, hence it is the ideal area of application for electrical vehicles: EV's are energy efficient in halting traffic, but limited in range and carrying capacity compared to conventional vehicles.
- Total costs of ownership where calculated on basis of an energy efficiency analysis. The result was that for parcel delivery services using a Ford Transit the yearly costs of an EV can fall below the costs of a conventional vehicle after three years of operation, due to the low operational costs, compare Figure 42.

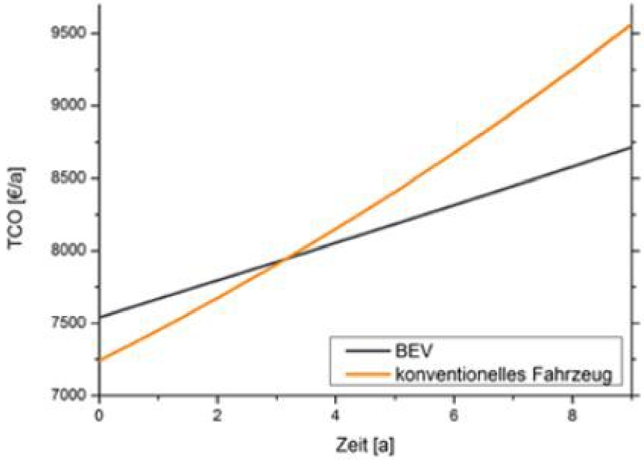


Figure 42: Yearly costs for mobility of electric and reference vehicles in parcel delivery
Source: (ColognEmobil, 2012)

- The low noise emission of EV's was subject to research. Drivers, pedestrians and customers of commercial EV's rated the low noise emissions positive.
- The high hinge moment of the electric engine was rated positive by the drivers, because it makes the vehicle agile even at low speed.
- Users and customers reported the project had been a success.
- The kilometre range of the Ford EV's was sufficient for urban transport demands: The daily range depended on customer and usage profile and ranged from 25 to 70 km, with a mean value of 40 km. Maximum daily range averaged at 100 km, the possible maximum range was seldom reached.
- Public charging of the commercial vehicles was uncommon during the project: the EV's where mainly charged at the company base.
- Operation of EV's in cleaning of parks and public spaces was advantageous with regards to emissions and noise.
- Tests with 240 passengers showed that EV's pose no bigger risk to the safeness of passengers than normal modern conventional vehicles. For the small group of blind or visually handicapped passengers an optional signalling sound would be useful.
- Reduction of CO_2: depending on the journey characteristics and type of energy mix used for charging, an electrical vehicle reduces CO_2-emissions in the city of Cologne by 35 - 70%.
- The EV technology worked reliable. The prototypes had a few minor problems, which could be eliminated during the project, before start of mass production.

b) Barriers

- The reduced kilometre range of EV's at colder ambient temperatures was criticized.
- The cable bound charging process is to be improved for public charging. Currently the cable can be unplugged by anyone, even while the vehicle is still charging.
- The low noise of an EV became problematic when cleaning parks and green spaces. Human and animals perceived the vehicles late.

- Apart from the issues of limited range and cargo carrying capacity, broadly agreed upon, the usability of EV's in commercial transport was also limited, because of the increased effort for tour planning.

c) Opportunities

Items listed in this section where gathered during the project ColognE-mobil in interviews and derived from test drive data, combined with detailed traffic analysis. The latter was used as input data for a simulation in which 10% of the daily traffic (33,370 vehicles) in Cologne were substituted with EV's.

- Range of EV's is sufficient for urban use: In average the EV's would conduct 3 journeys per day with a daily range of 30 km. One battery charge of a 20 kWh battery would last 4 days.
- Simulation results show that no changes to the existing energy grid would be necessary for two reasons: firstly, vehicles would mainly charge during night-time, when enough energy is available. Secondly, 33,370 EV's would consume 56,575 MWh per year, which is equivalent to only 3.2% of the total energy consumption of all private households of Cologne.
- A public charging infrastructure will not be necessary. In the simulation an estimated 10% of the traffic could be substituted by EV's. Those would be charged at regular household power sockets at work or at home.
- Stable energy costs even with 10% EV's in Cologne: Due to the low energy consumption, energy costs would not rise significantly, even with the phase out of nuclear power plants in Germany.
- In qualitative interviews, commercial fleet managers of delivery services, nursing services, handcrafts and public fleets voiced positive about electric mobility. Fleet sizes managed ranged from only a few vehicles up to 60.000 vehicles. A precondition for those potential users is that the vehicles are charged with green energy. An analysis of the mobility requirements showed that EV's available today are technically ready to be utilized. Only in a few cases the kilometre range extended possible range, or dwell time for charging was too low. Safety concerns where no issue. Once EV's become economically comparable to other technologies, they would be implemented in many fleets.

d) Risks

- The construction of a full network of public charging infrastructure is expensive and assessed to being not economically viable.
- Customer service and charging systems of energy providers are not ready to handle the new requirements. Combined products integrating power supply for household and public charging are to be developed.

5.3 DHL

The information in this chapter was collected in a personal interview and is additionally quoted form (NOW, 2012), (DPDHL, 2012) and (Tauer, 2012).

Project Overview

Start of projects:	Since 2010
Project Status:	On-going
Involved city:	Berlin, Bonn, Düsseldorf, Hamburg, Rosenheim
Population size:	Urban Areas
Participants:	Various
Sector:	Parcel, Package, Express Goods
Transported:	Mail, Parcels, express goods
Type of vehicles:	Various, see text
Ownership of vehicles:	DPDHL Fleet
Project budget:	N/A
Public subsidies:	Various

Company and Market Description

DHL is part of Deutsche Post DHL and the global market leader in the logistics industry. Deutsche Post DHL (DPDHL) is the world's leading mail and logistics services group with about 470,000 employees in more than 220 countries, generating revenues of €53 billion. With "living responsibility" as its motto, the group focuses its commitment to social responsibility with programs in environmental protection, disaster management and education. Business pillars are express-, mail- and logistics delivery services. Within DPDHL, DPDHL Fleet Management is responsible for the company's fleet, consisting of 8,700 company cars, 34,100 vans, 8,900 parcel transporters up to 3.5t and 5,100 trucks over 3.5t (only street legal vehicles listed).

Project Goals

Two superior goals for DPDHL Fleet Management to introduce electrical vehicles are

- Reduction of the carbon footprint: In their environmental program GoGreen DPDHL pledges to reduce CO_2-emissions, including emissions of suppliers, by 30% as compared to base year 2007. One of five GoGreen action areas is improving efficiency, by the emission reduction from vehicles, aircrafts and buildings. Actions taken on vehicle CO_2 reduction include fleet renewal and substitution by alternatively propelled vehicles.

- Reduction of the vehicles total costs of ownership (TCO). Especially with regard to increasing costs for fuel, the company is testing alternatives, like electrical vehicles, at an early stage.

In particular the user acceptance, kilometre range compatibility, failure safety of the EV's and the integration of the new technology in company processes are assessed.

a) The Electrical Fleet

In Germany the following fully electrical vehicles have been or will be tested in the mail or parcel delivery sector (EV's tested for DPDs Global Business Services and hybrids not included):

Class	Supplier	Type	Number	Status
Passenger car	Toyota	IQ EV	10	Planned
< 2,3t	VW Ford Street Scooter Renault	e-Caddy Transit Connect Electric Van Kangoo	10 2 20 12	Finished On-going Planned Finished
< 2,8t	Xenova VW Mercedes	Prototype eT! eVito	4 1 48	On hold Planned On-going
< 3,5t	Iveco	e-Daily	13	On-going

Table 9: DHL delivery projects testing electric vehicles in Germany. Source (Tauer, 2012)

Project Description

In 2011 more than 5% of the DPDHL fleet featured alternative drive systems and fuels. The number of electric / fuel cell vehicles increased from 80 (2010) to 131 (2011). Since 2010 several projects involving electric vehicles have been conducted or are planned for the near future. The majority of the EV's are deployed in Germany and the US, with more projects on-going or planned in Spain, Finland, UK, and the Netherlands.

Listed below are examples of the projects containing electric vehicles in 2010/2011 at DPDHL:

- Piloting of 13 e-vehicles in Berlin as part of the government-funded "E-City-Logistik" and "EmiL" initiatives.
- Cooperation with VW in Germany to develop the new concept vehicle "eT!". The goal of this collaboration is to gauge the feasibility of high-tech vehicles in delivery operations.
- The mail division took part in the government-sponsored pilot "E-mobility in commuter traffic" in Germany's Ruhr region and tested 12 e-vehicles on its mail and parcel delivery routes.
- DPDHL commissioned a consortium of small to medium-size automotive suppliers and research institutions to develop a production concept for an economically optimized series of e-vehicles for use in mail and parcel delivery.
- In 2011, the express division successfully switched to an all green fleet of electric vehicles to handle its deliveries in downtown Manhattan, New York. Express items are now being delivered by a fleet of 30 e-vehicles.

Tested EV's are used to deliver parcels in the urban area and parcels and mail in the urban hinterland, focusing primarily on the last mile distribution. The daily driving profile of the DPDHL fleet is characterized by the following main points:

- Low yearly kilometrage: around 11.000km per year.
- Six working days per week, giving an average kilometrage of app. 35 km/day
- Many stops per day (100-150) during which the vehicle is stopped and locked.
- Extremely short distanced in between stops.
- Delivery times between 7:00 a.m. and 07:00 p.m.
- Overnight parking of the vehicle at a company base.

Vehicle classes utilized at DPDHL are classified in passenger car class, various van classes and heavy trucks (>3.5t). Passenger cars and heavy trucks over 3.5t were categorized as unsuitable for electric mobility: passenger cars in the DPDHL fleet have a too high demand in flexibility and kilometre range. DPDHL considers passenger size EV's with range extender, as a possible future option in this section. Within the heavy trucks the classes up to 7.5t and 12t are most interesting, as in this segment large numbers of vehicles could be replaced by EV's. Most of these trucks are driven with high kilometrage and a large volume requiring trailers, circumstances in which an electrical vehicle is sub-optimally suited. Future options for this class are hybrid and biofuel vehicles.

A special interest lay in testing of the van size classes up to 3.5t (VW Caddy, Mercedes Vito, Iveco Daily size). These classes account for over 75% of the total road legal vehicles of the DPDHL fleet and the usage profiles are very similar. Therefore a good substitution rate could be expected, once an EV model passed the test successfully. Preconditions for a substitution of a conventional diesel vehicle by an EV beyond testing were defined as follows:

- Minor reduction of volume and payload, especially in the 3.5t class.
- Minor limitations regarding top speed and kilometre range.
- Possibility to recharge the vehicles during times of nightly shutdown or loading of freight.
- Green energy used for charging the battery.
- Economic benefit, i.e. the TCO including energy / battery costs of the EV must be cheaper or at least similar to a comparable diesel vehicle.

Interestingly, the need for technical reliability had not been listed here.

Project results in summary

Characteristics of electric vehicles in van size class up to 3.5t are best for the daily business of last mile delivery. The range of the EV's is sufficient for a substantial part of the planned daily routes in last mile deliveries. Apart from limitations due to the reduced payload, the negative TCO of PPDHL's test, as compared to conventional vehicles, is the most problematic issue. The possibility to increase the delivery window by expanding delivery hours is lower than in textile industry. A delivery window of about two hours earlier and later than before, was accepted by the customers. Though EV's are not profitable yet, they are a future option for DPDHL. More tests to develop input for the EV manufacturing industry are planned. The findings from the projects carried out are summarized in the following lists:

a) Enablers

- The vehicles offered good driving comfort: an impressive acceleration, an "automatic gear-box", silent operation.
- Being prototypes the EV's were surprisingly fail-save (much better than the conventional vehicles especially in the harsh winter 2012, in case of Iveco Daily).
- The drivers' initial rejection of the EV's turned to enthusiasm during the tests: drivers identified with the vehicles as they offer a clean and silent technology and enjoyed fail-safe and comfortable operation. A driver reported that he denied switching back to a conventional Iveco Daily, when 'his' Iveco e-Daily should be exhibited at a show for a few days.
- High interest and attention from customer's side.
- Daily operational costs for energy are substantially lower than fuel costs.
- EV's are free from vehicle tax for 10 years.
- Costs for service and maintenance of EV's are 20 - 30% lower than for conventional vehicles.
- DPDHL is insuring the vehicles themselves and can internally offer lower rates than for conventional vehicles.
- An expansion of the delivery window of two hours in the morning and the evening is accepted by customers and staff.

b) Barriers

- Restricted flexibility of EV's due to range limitations leads to the need of tailoring logistic planning for the specific applications cases.
- Intensive driver training was necessary for the prototypes. This issue will be resolved when mass production starts, becoming a normal briefing for a new vehicle.
- The loss in payload of 200 - 250kg is critical. Maximizing the gross vehicle weight is not a solution. Tours with vehicles over 2.8t need to be tracked by tachographs. When operating truck over 3.5t, the driver needs a truck license and a professional driver's qualification. Exemptions for EV's due to additional battery weight are needed, to be able to operate the EV with a similar payload in the same vehicle class as conventional cars.
- Options for technical configuration were limited for prototypes.
- High initial costs (for leasing or purchasing).
- Insecurity about the residual value after the expected lifetime of the vehicle.
- Costs for initial infrastructure setup.
- Additional costs for IT and telecommunication.
- TCO of EV's is not economic viable yet (compared to conventional vehicles).

- Silent operation problematic in pedestrian areas. A manually switchable sound (instead of using the horn) is desirable.
- Limited top speed below 100km/h is not reasonable.
- Energy demand is higher in last mile operation than average values listed by manufacturers: 0.28 – 0.33 kWh/km (<2.3t), 0.37 kWh/km (<2.8t), 0.45 – 0.6 kWh/km (< 3.5t).
- Energy demand increases in winter (+30-60%).
- The battery capacity reduction over time due to battery aging is problematic, as the kilometre range decreases. (For example: Renault guarantees 75% residual battery capacity after 4 years).
- The above 3 points lead to a realistic range of only 60 - 70 km in summer or 40 km in winter (with restricted use of heating).
- Public charging during delivery stops is inefficient, since dwell time is less than 10 minutes (this will be improved with more fast-chargers available).

c) Opportunities

- Car manufacturers can increase range and technical viability by implementing measures as stronger recuperation, a driver's cabin closed to the loading area, alternative heating systems and pre-heating of the driver's cabin while charging.
- Fast charging at public charging stations would offer an increased usability (though logistic planning would need to be adapted in this case).
- Vehicles in CEP business are highly visible in traffic, making them a good means of communicating the advantages of electric mobility to the public.
- A conservative drive style can save up to 30% of battery capacity and increase the daily range of the EV.

d) Risks

- Kilometre range at cold ambient temperatures must increase constant to ensure reasonable usage.
- A reduction of payload due to heavy batteries is not acceptable. A maximization of the gross vehicle weight on the other hand would lead to stronger limitations for EV's than for the comparable conventional cars: for example the required usage of a tachograph, a truck driver license and a professional driver's qualification. Exemptions for EV's due to the additional weight are necessary to ensure that EV's become technically comparable to conventional vehicles.
- Plugs and charging equipment is incompatible - standardization is required.
- Implementation of smart grid and load management for large electrical fleets is not clarified.
- Solutions to ensure charging in case of power outage are necessary.
- Although EV's are highly visible in CEP business, their effective kilometrage is rather low - less than 40km in the test with the Iveco e-Daily in the e-city logistic project. Of their abidance on public roads CEP vehicles are parking 85% of the time, driving only 15%. This makes their contribution to emissions savings rather small - though still a significant factor, when considering the whole fleet.

5.4 Effenberger Bakery

The information in this chapter collected from an personal interview and is quoted form (NOW,
2012).

Project overview

Start of project:	March 2012
Project Status:	On-going
Involved cities:	Hamburg, city centre
Population size:	1.8 Million
Participants:	Effenberger Bakery
Sector:	Intra Company Haulage
Goods transported:	Bakery products
Type of vehicles:	4 Karabag Ducato-E
Ownership of vehicles:	Effenberger
Project budget:	400,000 €
Public subsidies:	50 %

Company and market description

The Effenberger Bakery is a regional biological whole grain bakery located in Hamburg. With a staff of around 20 persons, they produce and grind their bread daily in their energy optimized bakery in Hamburg city centre and distribute to 5 outlets and to resellers within the city.

Project goals

- Contributing to a cleaner environment in the city (quiet and zero emission transport).
- Proving the feasibility to use electrical transport vans in intra company haulage.
- Enhancing and shaping the image of an ecological responsible company.

Project description

Effenberger owns and uses the four electrical vehicles since March 2012. They deliver from the bakery to 5 outlets, all located in residential areas within the Hamburg city centre and to resellers. Each van is loaded in the morning and is delivering the bread to 1 - 3 outlets and to resellers. Drivers are usually the staff of the outlet. The daily delivery route is static and planned in advance; the longest daily travel distance of a van is 33 km. For this reason the maximum range of the Karabag DucatoE's, which is stated being 100 km is sufficient for the intended usage. (FHFFM, 2011), (NOW, 2012)

a) Financial support

The Effenberger bakery considers their business model as a holistic and idealistic one. The electric vehicles with the low noise and greenhouse gas emission fit into the business idea of a responsible, sustainable, regional company. The vehicles themselves do not need to operate economically, as long as the business as a whole is profitable. In their bakery, Effenberger invested in solar energy, are reclaiming heating energy from their backing ovens, installed LEDs and heat insulated the historical house they are located in. These measures do make their bakery 2/3rd more energy efficient than an average bakery. Savings realized from the energy efficiency efforts are reinvested in new sustainable projects, which has been the replacement of the company fleet with electric vans this year. The Karabag DucatoEs are subsidized by the City of Hamburg each with about 50.000 € (50%). Nevertheless the vans are still very expensive with leasing rates 3.5 times higher than for conventional Fiat Ducatos.

b) Customer attitude

The business model of Effenberger is based on the pledge to produce a healthy and regional product as environmentally sound as possible. Reactions of customers and the press to the new eco-friendly delivery of the bread had been very positive. The operations manager of Effenberger pointed out that the customers are impressed and satisfied that Effenberger expands its responsibility from the origin of the grain to the delivery of the finished product. “Customers expect us to be the forerunner in embracing and implementing new clean technologies like electric mobility”.

c) Policy support

The municipality of Hamburg permitted the charging of 2 vehicles on a green strip belonging to the bakery. This area has been marked as a distance space before with no vehicle parking allowed. For the company this mean, apart from the easy access to the available bakery’s high power current for charging, the availability of two new parking places on their premises and therefore two cars less on the curb side of the residential area. This helps to reduce the pressing parking situation for residents and the drivers of the DucatosE’s.

d) Impact on people

Main stakeholders that benefit from the clean and silent technology are the drivers of the vans and the inhabitants of the residential areas in which the bakery and the outlets are located. Both groups enjoy the daily advantage of less noise during delivery tours and no local greenhouse gas emissions. A plus for both groups are the additionally allotted parking places, as 50% of the DucatoE drivers are allowed to parking directly on the companies premises, leaving more space to the residents to find a parking lot.

Project results in summary

The Effenberger bakery management and their customers are enthusiastic about the electrical delivery vehicles. As the whole company fleet has been replaced by EV’s, there is no more room for development, but management hopes that through their commitment they will be perceived as a role model for more companies to switch to electric vehicles.

a) Enablers

- Existing customers demand Effenberger to be the forerunner in embracing and implementing new clean technologies like electric mobility.
- Positive and extensive press coverage used as commercial measure.
- Gaining of new customers.

- 50 % financial subsidy to the EV's leasing price by the City of Hamburg.
- Permission of the municipality of Hamburg to charge 2 vehicles on a green strip belonging to the bakery. This area has been marked as a distance space before with no vehicle parking allowed.
- The Effenberger bakery considers their business model holistically. The electric vehicles with the low noise and greenhouse gas emission fit into the business idea of a responsible, sustainable, regional company. The vehicles themselves do not need to operate economically, as long as the business as a whole is profitable.

b) Barriers

- Leasing costs are 3. 5 times higher than for a conventional model.

c) Opportunities

- The Effenberger management hopes that through their commitment they will be perceived as a role model for more companies to switch to electric vehicles.

5.5 Hermes Logistics

Project overview

Project runtime:	11. 2010 - 12. 2014
Project Status:	On-going
Involved cities:	City centre of Hamburg / Berlin
Population size:	1.8 / 3.5 Million
Participants:	Hermes, Daimler, IKONE Pilot Region Project
Sector:	Courier, Express, Parcels (CEP)
Goods transported:	Mail, parcel, furniture, bulky goods
Type of vehicles:	20 Mercedes Vito E-CELL
Ownership of vehicles:	Hermes
Project budget:	N/A.
Public subsidies:	50 %

Company and market description

Hermes Logistik Gruppe (HLG) belongs to the Hermes Europe company and is Germany's largest post-independent logistics service provider for deliveries to private customers. Hermes transports nearly everything from letters through parcels to furniture and bulky goods. With over 14,000 parcel shops it also has the largest national network of drop-off/pick-up points for private parcels and mail-order returns. Already one in three B2C parcels in Germany are delivered by the Hermes Logistik Gruppe making HLG one of the most important specialists in private front door deliveries with one million customer contacts every day (Hermes, 2012). In total Hermes has about 12.000 vehicles on the roads within Germany. 500 Vehicles belong to Hermes themselves; additional 500 - 700 vehicles are leased out to subcontractors. The rest (about 11.000 vehicles) belong to subcontractors.

Project goals

HLGs mother company, the Otto Group, issued a group wide plan to reduce CO_2-emissions until 2020 by 50%. In the transport sector Hermes adheres to these goals by a yearly reduction of 2% mainly by replacing the company fleet with modern Euro 5 compliant vehicles. Furthermore, for last mile deliveries, Hermes is active in various projects - one of them is the testing of Vito E-Cells - generating input data for research and industry to further develop the vehicles.

Project description

Within the pilot region project IKONE, Mercedes has produced 170 Vito E-Cell. The EV's have been distributed to several test partners, in regional freight distribution, intra-company haulage and service delivery. Hermes Logistics is a major test partner for testing 20 e-Vitos in daily parcel distribution for a 4 years project time. 12 of the vehicles are lend to 5 subcontractors in Berlin delivering to the end customer. The vehicles in Hamburg are used in different areas: 4 are used for intra-company haulage, 2 in parcel delivery and pick up between parcel shops, and 2 are tend to a subcontractor for parcel delivery to the end customer (FHFFM, 2011), (NOW, 2012).

Project results in summary

In the current test phase the pilot Mercedes Vito E-Cells are not profitable yet. Hermes sees the project as an investment in the future, in which they believe the urban parcel distribution will be electric.

a) Enablers

- The realistic range of the Vito E-CELLS of 80 km is sufficient for the daily delivery tours.
- The vehicles are charged on the company grounds and are not dependent on public charging infrastructure. During deliveries EV drivers are more interested in using the reserved charging spots for EV's as parking lots instead of for charging.

b) Barriers

- Only 8% (around 1000) of the vehicles transporting freight for Hermes actually belong to the company and therefore are controlled by Hermes. Of these, 50% are used to transport parcels in-between parcel shops, and another 50% are lend to contractors.
- The conventional vehicles used to transport parcels between parcel shops are a medium Mercedes Sprinter model with standard roof having a load volume of 9 m^3. The tested Vito E-Cell has a load volume of only 5.2 m^3. Hence, two e-Vitos need to be run to replace one conventional Sprinter, doubling the costs for vehicles and drivers.
- The subcontractors leasing rates for Vito E-Cells are about three times higher than for a conventional Mercedes Vito. Since subcontractors are not willing to balance the additional costs, the vehicles need to be subsidized by Hermes. Apart from the high purchase price, uncertainty of the residual value after the leasing period leads to these high leasing rates.
- Hermes subcontractors for the parcel delivery to and drop off at customers; usually employ subcontractors on their own, who often are single, self-employed drivers. Those usually own their vehicles and utilize it in their free time before and after work. Electric vehicles need to stay at the company grounds to be recharged overnight and cannot be used after work. To implement EV's for distribution at subcontractors, new structures need to be established.
- Technical reliability of the software and battery had been poor in the prototypes, especially in the harsh winter weeks of January 2012. 50% of the fleet in Berlin had to be replaced by diesel vehicles to ensure sound operation.

c) Opportunities

- An electric vehicle of Sprinter size with an increased load volume would fit better to Hermes needs in parcel delivery in between parcel shops.

d) Risks

- The technical unreliability's of the past have led to a sceptic attitude of subcontractors towards the testing of the EV's. This might influence the willingness to participate in further tests.

5.6 Isolde

The information in this chapter is quoted form (DPD, 2009) and (TU-Harburg, 2002).

Project overview

Start of project:	End 1996 - 2000, DPD until today
Project Status:	Partly on-going
Involved cities:	Passenger area of Nürnberg
Population size:	500,000
Participants:	DPD, German Parcel, Dachser, Bahntrans, Kühne & Nagel, Nedlloyd Unitrans, Fraunhofer AVK
Sector:	Freight forwarding and CEP
Goods transported:	Shopping goods, parcels, bulky goods, recycling package material
Type of vehicles:	DPD Conversion
Ownership of vehicles:	DPD
Project budget:	2.6 Million German Marks

City and market description
The city of Nürnberg is the second largest industrial location in the German federal state Bavaria. When the project ISOLDE started by end of 2000, the greater area of Nürnberg had around 1.8 million inhabitants. About 18% of the working population could be associated to the traffic and logistics sector. The tri-modal logistic centre of Nürnberg was the largest of its kind in the south of Germany. Nürnberg possesses a medieval city centre and the largest pedestrian area of Europe, to which delivery vehicles only have access until 10:30 a.m.

Project goals
The goal of the ISOLDE project was to strengthen attractiveness, economic potential, competitive ability and ecological quality of the city centre of Nürnberg by implementing the city logistics concept ISOLDE.

Project description
Isolde stands for “Inner city service with optimized logistic services for retail industry”. It started end of 1996 as cooperation between four freight forwarding companies and two CEP services and was the most comprehensive city-logistics concept of its time. The freight was bundled at a logistic centre close to the inner city. Further services like the delivery of bulky or shopping items, the removal of recyclable package material and storage services where offered and financed by participating retailers.

The project was nearly resolved by 2000: storage service for retailers and shoppers as well as home delivery where not accepted by the customers, due to cost reasons and reluctance of the customers to leave their shopping in the hands of a delivery service. The freight forwarding part of the project was suffering from unsteady freight flow and high logistic complexity and operational expenditures. The freight forwarding dimension was excluded from the project. At the project end, only the two CEP services where operational. By mid-2000, a subcontractor of DPD took over the distribution of goods into the pedestrian area and implemented the delivery with an electrical vehicle.

In 2009 DPD announced that the 1 million parcels had been delivered without emissions in the pedestrian area of Nürnberg. An average of 500 parcels is currently distributed each day by two electrical vehicles (FHFFM, 2011), (NOW, 2012).

Project results in summary
DPD intends to continue its commitment to the ISOLDE CEP concept, which has proved successful with regard to economy, ecology and popularity with customers.

a) Enablers

- There is no time limitation for electric vehicles to enter the Nürnberg pedestrian area. This gives EV's a major advantage compared to conventional delivery vehicles, which are not allowed to enter this zone after 10.30 a.m. As a result DPD customers benefit from an all-day delivery and pickup service.
- The concept has proved successful with regard to economy, ecology and popularity with customers.

b) Barriers

- Storage service for retailers and shoppers as well as home deliveries were not accepted by the customers, due to cost reasons and reluctance of the customers to hand their shopping over to a delivery service.
- The freight forwarding part of the project was suffering from unsteady freight flows and high logistics complexity and operational expenditures. The freight forwarding dimension was therefore excluded from the project.

5.7 Joey's Pizza Delivery

The information in this chapter is quoted form (Joey's, 2012).

Project overview

Start of project:	April 2012 - October 2012
Project Status:	On-going
Involved cities:	Hamburg, city centre
Population size:	1.8 Million
Participants:	Joey's Pizza, E.ON Hanse
Sector:	Intra Company Haulage
Goods transported:	Fast Food
Type of vehicles:	6 Pizza Scooters of 3 manufacturers (Govecs, Emco und Akumoto), one Citroën C-Zero, one Renault Twizy, one Karabag E-Cinquecento.
Ownership of vehicles:	N/A.
Project budget:	N/A.
Public subsidies:	50 %

Company and market description

Joey's is Germany's largest fast food delivery company. In 190 franchise subsidiaries, Pizza, Pasta and other food is ordered online or by telephone and delivered to the customer within 30 minutes. To date the German fleet of Joey's consists of 400 vehicles, 1,000 Scooters and 400 bicycles. The delivery is made by bicycle or scooter for the short delivery distances in the city centres - the cars are mainly used for larger deliveries in the countryside.

Project goals

Apart from gaining experience with the EV's the following questions should be answered after the six month project runtime:

- Are the electric vehicles reliable?
- Is the range coverage and recharging time adequate?
- Can the EV's be operated more economically than conventional vehicles?
- Is the risk of accidents bigger when using the silent vehicles?
- Is the Renault Twizy suitable for delivery, i.e. how many Pizzas can fit into it?
- How is the customers and residents reaction to less noise and exhaust emissions?

Project description

An outlet of Joey's operating in the city centre of Hamburg has launched a pilot test of six electrical Scooters and the Citroën C-Zero for pizza delivery. A Renault Twizy is included in the test as well. The project was started in April 2012 and has a runtime of 6 months. Technical reliability for the transport of the warm meals and economic operation are important to the company. The outlet has completely switched its power supply to green energy. The energy supplier also installed the charging stations for the vehicles. The EV's are charged overnight, with a boost during the less busy afternoons. If the test results are positive, Joey's considers to successively change-over the whole company fleet to electric vehicles (FHFFM, 2011), (NOW, 2012).

Project results in summary

After four month of the tests in spring and summer, managers and drivers made a positive first summary, well aware of the fact that in wet fall and cold winter the EV's will be more stressed. The tests are now extended. More EV's are tested at different outlets, also at a more hilly location. If the scooters perform equally well there and in the cold season, the complete scooter fleet could be exchanged with e-Scooters. The tested electric cars seem not to become a similar good option, as the leasing rates are still much too high.

a) Enablers

- The test of the CO_2 free delivery is used as a marketing tool and image building measure.
- In the calculation, the e-Scooters are cheaper after 20 months already, when the goal of 30.000 kilometres per year is reached: the initial costs of 4.000€ are 2.500€ more expensive than for the conventional scooters, but operational costs are around 0.05 /EUR cheaper per driven kilometre (energy usage: 5 kWh per 100 km, energy price: 0.21 € per kWh equals 0,0105€ per kilometre (80 km per day, 7 days a week).
- The business model with a 7 day week and two main delivery times (lunch and evening) is ideal for electric vehicles: They are fully charged overnight and can be partly charged during the less busy time in the afternoon. Therefore the range of the Scooters is estimated to reach 80 km per day – 30.000 km per year.
- The e-Scooters have strong advantages for the delivery staff: "they do not stink, are silent and passengers do accept the e-Scooters, when squeezing into corners for parking", according to a driver.
- With the e-Scooters, drivers have two unwelcome tasks less - neither they need to drive to filling stations anymore, nor do they need to balance the fuel bills with the company anymore.
- Technically the e-Scooters have been reliable so far.

b) Barriers

- The electric cars are still too expensive when purchasing or leasing, to amortize in an acceptable time.

c) Opportunities

- Silent and emission free delivery can lead to residents and customer satisfaction.
- With decreasing battery prices the e-Scooters amortize even faster than in 20 months.

d) Risks

- The e-Scooters still have to proof failsafe and the battery range stable during the wet fall and cold winter.

5.8 Meyer&Meyer

The information in this chapter is quoted form (NOW, 2012), (Meyer, 2011a), (Meyer, 2011b).

Project overview

Start of projects:	Specification Jan 2010, operation May 2011
Project Status:	On-going Involved
City:	Berlin
Population size:	3.5 Million City Centre
Participants:	Meyer & Meyer, Fraunhofer IPK
Sector:	Courier, Express, Parcel (KEP)
Goods transported:	Textiles
Type of vehicles:	Two 12t MAN converted by AGV
Ownership of vehicles:	Meyer / Meyer
Project budget:	650,000 €
Public subsidies:	50 % in pilot region project "E-City Logistics"
Stakeholders involved:	Customer C&A, pilot region Berlin, BMVBS, Fraunhofer IPK

Company and market description

Meyer&Meyer is a medium-sized, owner-managed family company with headquartered in Osnabrück, Germany. Specialized in European fashion logistics, the company offers its customers services, which range from raw goods and production logistics to storage, processing, quality assurance and sales-ready distribution of the goods to the retail sector. Meyer&Meyer call this its "From Sheep to Shop Principle". Alongside fashion logistics, the company has developed other specific logistics solutions for bicycles, furniture and many other sensitive goods. With about 2.000 employees, Meyer&Meyer control logistics activities in Europe, Asia and North Africa from more than 60 production locations. Meyer&Meyer has up to 1.000 vehicles in daily operation.

Project goals

- The potential of inner-city delivery with the low-noise EV was to be assessed, with respect to an earlier or later delivery. Implementation of a policy permitting a delivery outside of the regular hours was to be tested.
- The experience with the EV's was assessed by Fraunhofer IPK, verifying emission reductions of CO_2 (expectation: more than 90% reduction) and PM and NO_x (expectation 100%).
- Another goal was to increase the efficiency of electric vehicles by tailored logistics concepts. The project data documented by the Fraunhofer Institute was serving to further optimize loading and operational cycles and create combined energy-logistics management.

Companies from the fashion industry have an interest in sustainable transport and logistics solutions and actively demand these from their service providers. Meyer& Meyer actively communicated their role in trialling electric mobility, receiving broad media coverage, using the implementation of the electric trucks as a marketing measure.

Project description

As a partner of the "Electric Mobility in Pilot Regions" project Meyer&Meyer has developed a sustainable transport and logistics concept for the supply of C&A stores in Berlin's city centre. Together with vehicle manufacturer AGV from the Netherlands, two 12t trucks have been converted from standard diesel vehicles to running with electric engines. The vehicles do charge at the company's own charging station in Potsdam using only power from renewable sources.

Textiles are transported in removable containers, distributed from a major logistics centre of Meyer&Meyer in Peine to a logistic hub in Potsdam, just outside Berlin by conventional trucks. In Potsdam, the containers are transhipped onto the EV's, delivering the freight directly to the city centre of Berlin. Meyer&Meyer operated in multi-shifts.

Project results in summary

After the finish of the project, the vehicles are still in daily operation. To develop this scheme further, a new project application has been filed under the "showcase" program.

a) Enablers

- Reduction of emissions as projected.
- Logistic processes and tour planning did not need to be adapted for the EV's.
- Customer valued the advantages of clean and silent operation.
- Training and inclusion of drivers was important and led to a high level of acceptance.

b) Barriers

- Charging times are considered to be forced downtimes: the expensive EV's can only amortize when operated in multi-shifts, for which a battery swap system is needed.
- Missing technical support infrastructure made regular maintenance impossible. The vehicle supplier AGV went bankrupt and did not support the EV's anymore. The own mechanics of Meyer& Meyer had to be trained to handle the high voltage technology. Spare parts, supplied exclusively by AGV, where delivered late, hence maintenance were time and cost consuming.
- Charging infrastructure had to be adapted several times; it was overloaded by the high capacity need of the e-Trucks.
- Technical defects in infrastructure and battery lead to downtimes.

c) **Opportunities**

- Operation of the silent EV’s in multi-shifts expands their usage into early morning and late evening hours fringe times, thus relieving city traffic during rush hours.

5.9 United Parcel Service

The information in this chapter was collected via a personal interview and is additionally supplemented by (NOW, 2012) and (FHFFM, 2011).

Project overview

Start of project:	1.1.2010 - 30.06.2011
Project Status:	On-going
	Involved cities: City centre of Hamburg, Frankfurt/M., Düsseldorf, Cologne, Munich and Nürnberg
Population size:	0.5 to 1.8 Million
Participants:	UPS, involved cities
Sector:	CEP
Goods transported:	Mail, Parcels
Type of vehicles:	12 Modec trucks 6 EFA-S trucks
Ownership of vehicles:	UPS
Project budget:	N/A.
Public subsidies:	N/A.

Company and market description

United Parcel Service (UPS) is a US based globally active package delivery company. It delivers more than 15 million packages a day, internationally and domestic by rail, road, air.

Project goals

The goals of UPS where to identify under which preconditions an EV can be utilized in local distribution and consolidation of goods. Furthermore, input for an optimized vehicle production should be gathered.

Project description

UPS started to test 12 Modec electrical trucks in daily urban parcel delivery; 6 in UK and 6 in Germany. UPS describes the range of 90 - 100 km being ideal for city delivery, but not enough for parcel transport overland. In Germany, the electrical trucks were collecting and delivering parcels in the inner city areas of 6 bigger cities, Hamburg, Frankfurt/M., Düsseldorf, Cologne, Munich and Nürnberg. In total about 104.000 kilometres were driven (FHFFM, 2011), (NOW, 2012).

Project results in summary

In general the public, the customers and the drivers were positive about the usage of the electric vehicles. A project result was that electrical trucks can replace conventional trucks, when circumstances match their profile, like a suitable delivery volume and a high density of stops on the route. A considerable percentage of the tours in urban areas could be covered with the existing technology.

The project itself revealed multiple issues: The Modec trucks had drawbacks compared to the conventional UPS P80 trucks: purchase price was double the price of a regular "brown truck". Therefore, even under favourable conditions, the TCO would be negative, when calculated over this decade. At the same time, the Modec trucks had a reduced load volume and payload (1,5t instead of 4t) and technical problems. In the last third of the project, the car manufacturer Modec got into economic problems, and finally filed for administration in 2011, hence the technical support for the vehicles ceased.

In parallel to the Modec testing, UPS had started cooperation with the German company ElectroFahrzeuge-Schwaben (EFA-S). EFA-S had converted a 15 year old conventional UPS P80 into an electrical version. This approach had several advantages: The ergonomics of the original vehicle could be kept, the payload stayed nearly constant (3,5t), the load volume was the same. The known vehicle architecture was easier to integrate into operational processes. Moreover, by reusing an existing truck, which was constructed for durability, wasting of material could be reduced and the price UPS was paying for their vehicle to receive a second life as electric truck was less than buying a new conventional P 80. UPS has ordered and is testing 6 more EFA-S conversions in a follow-up project called "ELMO".

a) Enablers

- In spite of the initial reluctance, EV's could reach a good acceptance among drivers and managers of UPS.
- Customers' reactions were positive from the beginning.
- Public interest was high and resonance from press positive.
- The silent operation did not lead to reduced safety. No dangerous situations or accidents were reported.
- When utilized on a tour profile with a high density of stops and low parcel volumes the Modec trucks could replace conventional trucks.

b) Barriers

- Operating procedures and equipment needed to be customized to integrate the EV's.
- Limited load volume, payload and kilometre range led to a reduced availability.
- Even when calculated under favourable conditions, the TCO for the decade would be negative as compared to conventional vehicles.
- Technical issues were expected for the prototypes, but required workload for analyses and optimizations were higher than expected.

c) Opportunities

- A considerable percentage of the tours in urban areas could be covered with the tested EV technology.

6 Conclusions of Experiences in Germany

Urban freight delivery is a possible first field of application for EV's. The technology of EV's is often suitable to cover the requirements regarding range and payload in urban delivery. The CO_2-emission savings from EV's (when charged with green energy) can help to adhere to local air quality plans of the cities, as well as to federal emission reduction goals. Depending on the specific case, electric vehicles can be profitable, especially when deployed in multi-shifts with intermediate charging, or when the vehicles have special rights in entering emission zones or areas normally restricted for ICE vehicles. Supporting the implementation of EV's in urban freight transport offers the potential to use EV's as show case for electric mobility in public.

Still, special rights and financial support are tested and granted only during EV projects by the local governments. No nationwide advantages for EV's in commercial transport business have been adopted by law, like specially allotted parking space, enhanced delivery times or entrance rights.

Purely analysing technical abilities of EV's and financial factors would fall short when evaluating the effects of electric mobility. A factor, usually more typical in Germany for the relationship between private consumer and his vehicle, comes into effect for commercial electric vehicles: enthusiasm. Enthusiasm for a silent technology, a clean technology, a vibration less technology, an innovative technology and a chance to be part of a "better" future already today, are important factors which can speed up the further introduction of EV's on the German market. Customers who have received freight by EV's are actively demanding their freight delivered with an EV again.

For this reason it is important to make electric mobility tangible for as many people as possible to promote the new technology. The German government is aiming at this in the current showroom projects. Still, if no additional political stimulation is undertaken, the National Platform of Electric Mobility (NPE) estimates that in mid-2012 EV numbers will fall 400.000 units short from the goal of reaching one million in 2020. This is despite the fact that Federal Chancellor Angela Merkel remains the goal of one million EV's in 2020 and therefore will intensify German federal support for achieving this goal.

Politics can offer monetary or non-monetary incentives and try to overcome barriers with rules and regulations. On the one hand, Germany is traditionally an "automotive country". A high level of wealth and jobs depend on a functioning car industry, which still sells 99% of its vehicles with combustion engines today. For this reason, drastic measures like a tax on CO_2-emitting vehicles to finance a buyer's premium of EV's, or a higher mineral taxation on diesel fuel will be very hard to implement against the strong automotive lobby and German voters. On the other hand, the future of Germany is depending on offering innovative vehicles for export and reducing emissions in its own country, especially in the cities. In a balancing act, the German government tries to reduce CO_2-emissions from road traffic and foster electric mobility, while not disturbing the existing automotive industry. So far, mainly research and development has been supported. In future most-likely non-monetary incentives will pave the way to increase EV numbers in Germany.

Overview

In this chapter, the results of the urban freight transport initiative utilising electrical vehicles are evaluated. Topics are clustered according to a scheme developed within the partners of Work Package 7. Groups are defined as:

- Technical
- Financial
- Energy Supply / Infrastructure
- Environmental
- Processes / Logistics
- ICT
- Regulation
- Human Factor

The clustered success factors or challenges for electric mobility in urban freight logistics are evaluated, possible risks and opportunities are rated and subsequently interrelated with policy state of the art. This interrelation highlights gaps in policy, which then are summarized. This chapter concludes with a summary of the impacts of freight EV's within city distribution.

Main functions of freight EV's within city distribution.

The following types of goods are transported in the reported urban freight transport initiatives in Germany:

- **CEP:** Mail, parcels, paper, small electronic spare parts, household appliances, furniture, other bulky goods.
- **Spedition /Logistics:** Textiles.
- **Communal:** Waste, greenery.
- **Food:** Bread, fast food.

6.1 Evaluation of Technical Factors

Success factor: The kilometre range and tour profile for urban freight transports are highly suitable for EV strengths.

a) Examples:

- The realistic range of the Mercedes Vito E-CELL of about 80 km, which is sufficient for the daily delivery tours of Hermes (section 5.5).
- The kilometre range of the Ford EV's was sufficient for urban transport demands: The daily range depended on customer and usage profile and ranged from 25 to 70 km, with a mean value of 40 km. Maximum daily range averaged at 100km, the possible maximum range was seldom reached (section 5.2).
- When utilized on a tour profile with a high density of stops and low parcel volume the Modec trucks could replace conventional trucks (section 5.9).
- Freight transport in urban stop-and-go traffic with a limited demand for kilometre range and cargo capacity is the ideal area of application for electrical vehicles: EV's are energy efficient in halting traffic, but limited in range and carrying capacity compared to conventional vehicles (section 5.2).

b) Opportunities:

- A considerable percentage of the tours in urban areas could be covered with existing EV technology (section 5.9).

c) Current state of policy:

- Urban commercial freight transport was identified 2009 in the NEPE as a possible field of application for EV's. This had been confirmed by tests in model regions in 2011 (NOW, 2012). A few new projects have been setup building on the model region results, but no further action was taken to support urban freight from policy side.

d) Gaps in policy:

- Introduction of policies to stimulate the usage of EV's in urban freight delivery (suggestions see financial and regulation evaluation).

Success factor: EV's are relatively fail-safe.

This is true for certain models, where even prototypes where more reliable than the conventional serial model, while other EV's are still curing start-up deceases.

a) Examples:

- Being prototypes the EV's where surprisingly fail-save (much better than the conventional vehicles especially in the harsh winter 2012, in case of Iveco (section 5.3)).

- The e-Scooters proved technical reliable in daily operation (section 5.7).
- The EV technology worked reliable, except a few minor problems of the prototypes, which could be eliminated thanks to the test, before start of mass production (section 5.2).
- Battery indication too imprecise, leading to downtime and financial loss (Chinese vans, section 5.1).
- Missing technical support infrastructure made a regular maintenance impossible. The vehicle supplier AGV went bankrupt and did not support the EV's anymore. The own mechanics of Meyer&Meyer had to be trained to handle the high voltage technology. Spare parts were supplied exclusively by AGV. Due to the problems at AGV, they were delivered late, hence maintenance was time and cost consuming (section 5.8).
- Problems with software (section 5.5).
- A top speed limitation below 100km/h is not reasonable (section 5.3).

b) Risks:

- Some EV's where only recently tested and still need to prove fail safe in winter (chapter 5.7).

c) Current state of policy:

- None.

d) Gaps in policy:

- None.

Success factor: EV's offer driving comfort for commercial drivers spending their work day in the vehicle.

a) Examples:

- The vehicles offer a good driving comfort: an impressive acceleration, an "automatic gear-box" and silent operation (section 5.3).
- Drivers highlighted the high hinge moment of the electric engine, making the vehicle agile even at low speed (section 5.2).
- An example of a positive feedback of the driver about EV technology: "the EV feels 'direct' and the acceleration of the engine is fun!" (Section 5.1).

b) Risks:

- None.

c) Current state of policy:

- None.

d) Gaps in policy:

- None.

Success factor and challenge: Silent operation and its impact to the safety of passengers.

The silent operation of the EV's is perceived positively by city residents, passengers and drivers (section 5.2.). Still, in some situations the unexpected silent vehicle can be a risk.

a) Examples:

- The silent operation did not lead to reduced safety. No dangerous situations or accidents were reported (section 5.3).
- Silent operation can be problematic in pedestrian areas. A manually switchable sound (instead of using the horn) is desirable (section 5.3).
- Tests with 240 passengers showed that EV's pose no bigger risk to the safeness of passengers than normal modern conventional vehicles. (Section 5.2).
- The low noise of the EV became problematic when cleaning parks and green spaces. Human and animals perceived the vehicles late (section 5.2).

b) Risks:

- For the small group of blind or visually handicapped passengers an optional signalling sound would be useful (section 5.2).

c) Current state of policy:

- None.

d) Gaps in policy:

- Regulation for a manual switchable signalling sound for pedestrian areas or parks would improve safety. Possible need for a "sound on"-road sign in the near of facilities for blind people (section 5.2).

Challenge: Energy demand is higher in last mile operation than average values listed by manufacturers.

a) Examples:

- Energy demand is higher in last mile operation than average values listed by manufacturers: 0.28 – 0.33 kWh/km (<2.3t), 0.37 kWh/km (<2.8t), 0.45 – 0.6 kWh/km (< 3.5t) (section 5.3).

b) Risks:

- Freight delivery companies must be sure the EV technology is reliable. Delivery of the freight in time is crucial to the businesses. If manufacturers claim the EV has a range of 150 km according to own measurements or NEDC (New European Driving Cycle), but under realistic conditions like cold, load, urban traffic, this value can never be reached, companies loose trust in the EV technology.

c) Current state of policy:

- None.

d) **Gaps in policy:**

- The kilometre range determined by the NEDC is unrealistic for EV's. A realistic range value is especially crucial for the commercial sector. Implementing more realistic test procedures into the drive cycles is necessary. For the urban freight transport sector, influence factors to be considered are different temperatures, urban driving and freight loaded. Alternative tests for EV's are developed for example by TÜV Süd ("E-Car Cycle") or ADAC ("EcoTest"). In both test the same EV reaches realistic values for the kilometre range, that lie up to 50% below the values determined by NEDC. For the urban commercial freight sector it would be important to have a drive cycle that determines kilometre range values for urban driving, with freight loaded at different temperatures and topography.

Challenge: Battery stability. Currently the kilometre range declines over time and under harsh winter conditions.

While urban freight transports kilometre range and tour profile is suitable for EV's and the vehicles in their early development stage are already quite fail save, the battery stability is the biggest technical problem.

a) **Examples:**

- Kilometre range under harsh winter conditions is insufficient (section 5.1).
- Technical reliability of the software and battery proved poor in some prototypes, especially in the cold winter of 2012 (section 5.5).
- Energy demand increases in winter + 30 - 60% (section 5.3).
- Battery capacity reduction over years (example: Renault guarantees 75% residual battery capacity after 4 years) (section 5.3).

b) **Risks:**

- Kilometre range at cold ambient temperatures must become more constant to ensure reasonable and economic usage (section 5.3).

c) **Opportunity:**

- The realistic range for LCV in test was only 60 - 70 km in summer or 40 km in winter (with restricted use of heating). Car manufacturers can increase range and technical viability by implementing measures as stronger recuperation, alternative heating systems and pre-heating of the driver's cabin while charging (section 5.3).

d) **Current state of policy:**

- None.

e) **Gaps in policy:**

- None.

Challenge: Loss of payload due to heavy batteries.

a) Examples:

- The loss in payload of 200-250 kg due to heavy batteries is critical. Maximizing the gross vehicle weight is not a solution. Driving of a vehicle over 2.8t needs to be tracked by a tachograph, over 3.5t a truck driver's license and a professional driver qualification are required. Exemptions for EV's due to additional battery weight are needed, to be able to operate the EV with a similar payload in the same vehicle class as the conventional cars (chapter 5.3).
- Currently only a limited model variety is available. In a test two 1.5 ton EV's had to replace one 3.5 ton conventional vehicle, doubling costs for drivers and vehicles (section 5.5).

b) Risks:

- Drivers and technology of electric commercial vehicles are more expensive than for comparable conventional vehicles, if a weight limit is exceeded.

c) Current state of policy:

- None.

d) Gaps in policy:

- Extended weight limits are needed for commercial EV's due to the heavy batteries. A reduction of payload is not acceptable. A maximization of the gross vehicle weight on the other hand would lead to stronger limitations for EV's than for the comparable conventional car: for example the required usage of a tachograph, a truck driver's license and drivers' qualification, which is also not acceptable. Exemptions for EV's due to the additional weight are necessary, to ensure EV's become technically comparable to conventional vehicles (chapter 5.3).

Challenge: Incompatible plugs and charging equipment.

a) Examples:

- In tests with multiple EV's incompatible plugs and charging equipment posed a barrier. Standardisation is required (section 5.3).

b) Risks:

- Different EV models in the same fleet can only be operated with a higher effort, when using different plug standards (section 5.3).

c) Current state of policy:

- None.

d) Gaps in policy:

- Standardisation of plugs and charging equipment is required.

6.2 Evaluation of Financial Factors

Factor: Total Cost of Ownership of EV's.

EV's purchase price is high, but operational costs are low compared to conventional diesel vehicles. This is due to low electrical energy prices, good energy efficiency, cheaper vehicle insurance, voided vehicle taxes and lower maintenance costs. For specific fields of application the TCO of EV's can be cheaper than the equivalent diesel model. A summary of statements from the case studies are given below:

a) Examples of Enablers:

- Daily operational costs for energy are substantially lower than fuel costs (chapter 5.3).
- EV's are free from vehicle tax for 10 years (section 5.3).
- Costs for service and maintenance of EV's are 20 - 30% lower than for conventional vehicles (section 5.3).
- DPDHL is insuring the vehicles themselves and can internally offer lower rates than for conventional vehicles (section 5.3).
- The concept has proved successful with regard to profitability (section 5.6).
- In one case, total costs of ownership where calculated on basis of an energy efficiency analysis. This led to the fact, that for a certain parcel delivery service using a Ford Transit, the yearly costs of an EV can fall below the costs of a conventional vehicle after 3 years of operation, due to the low operation costs (chapter 5.2).
- E-Scooters are profitable after 20 month already, when the goal of 30.000 kilometres per year is reached (section 5.7).
- The Effenberger bakery considers their business model holistically. The electric vehicles with the low noise and greenhouse gas emission fit into the business idea of a responsible, sustainable, regional company. The vehicles themselves do not need to operate economically, as long as the business as a whole is profitable (section 5.4).

b) Examples of Challenges:

- Purchase costs of EV's are too high; operation of the EV's has yet to become profitable. Only EV's with subsidies or at discounted rates might become economic in the near future (section 5.1).
- The subcontractors leasing rates for Vito E-Cells are about three times higher than for a conventional Mercedes Vito. Since subcontractors are not willing to pay the additional costs, the vehicles need to be subsidized by Hermes. Apart from the high purchase price, uncertainty of the residual value after the leasing period leads to the high leasing rates (section 5.5).
- High initial costs (for leasing or purchasing) (section 5.3).

- Insecurity about the residual value after the expected useful life (section 5.3).
- Costs for initial infrastructure setup (section 5.3).
- Additional costs for IT and telecommunication (section 5.3).
- TCO of EV's is not economic yet as compared to conventional vehicles (section 5.3).
- In one certain case, even when calculating under favourable conditions, the TCO for the actual decade would be worse compared to conventional vehicles (section 5.9).
- In most cases the electric cars are still too expensive when purchasing or leasing, to amortize in an acceptable time (section 5.7).

c) Opportunities to reduce EV's TCO:

- Increasing energy efficiency of EV's, higher diesel prices or higher vehicle taxes for diesel models would shift TCO to become more positive for EV's.
- Decreases in battery prices will have the biggest impact on EV TCO.
- Battery leasing or EV leasing minders the risk of a low residual value for single companies, since the risk of battery failure is taken out of the calculation.

d) Risks leading to an increase of EV's TCO:

- Increasing energy efficiency of diesel models or higher electric energy prices would shift the TCO relatively to diesel vehicles to the more negative.
- Rising costs for electrical energy would shift EV's TCO to the worse.

e) Current state of policy:

- 10 years tax exemption for EV's (saving for a van size EV < 1.5t: 50 € p.a., for a truck <12t 100 € p.a.)
- Diesel vehicles are taxed higher than petrol vehicles. Vehicle taxation is adopted step by step to include a CO_2-emission factor (valid for all vehicles by 2013).
- European exhaust emission values do limit emissions from diesel. From 2013 on the new Euro 6 limit values will support the development of more energy efficient conventional vehicles.
- Fuel costs are influenced by mineral oil tax. The mineral oil tax offers a leverage for politics to increase the price per kilometre of conventional (especially diesel) vehicles. Since 1994 diesel is taxed 18.41 €-Cents less than petrol. Diesel commercial vehicles are the direct competitor of electrical commercial vehicles - there are very little petrol commercial vehicles on German roads. In April 2012, the EU parliament has rejected a proposal to standardize the mineral oil taxation on basis of energy density and CO_2-emissions. This proposal would have made diesel fuel effectively more expensive (or petrol cheaper).

- With the Energy turnaround, a time plan to switch off nuclear power generation has been provided. Renewable energy plants are constructed. Power generated by these plants is sold at a guaranteed and higher price per kWh, this gap and a part of the planned grid reconstruction will be paid by the consumer. Rising electrical energy prices for consumers are widely expected in Germany soon, although the energy price at the European Energy Exchange has slightly fallen since the beginning of 2011.
- The missing federal buyer's premium is partially replaced by local payments. As an example the city of Hamburg offers to cover up to 50% of the costs gap between an EV and the comparable conventional vehicle for commercial vehicles.

f) Gaps in policy

- The current tax exemption for EV's is a low monetary stimulation. Yearly savings from 50 - 100 € are marginal and cannot lead to the desired impact.
- In Germany no federal buyer's premium like in other markets exists to support the acquisition of EV's. The NPE suggests a yearly tax incentive from 2013 on, to support the sale of EV's; 100 €/kWh should be awarded up to a cap of 20 kWh for commercial EV owners. Another proposal from the Bundesverband Electromobilität is to add to the vehicle tax a 10 – 60 € premium, depending on CO_2 - emissions and to finance a 5.000 € buyer's premium for EV's with it. So far all financial incentives have been rejected from the government.
- In order to minder the risk of the unknown residual value of EV's and to relief high purchase costs, the NPE suggests a higher and faster tax depreciation for EV's (50% in the first year).

Success factor: Electric mobility's "soft" financial advantages

The "soft" financial leverage of using EV's is not to be overlooked, though often not directly measurable. Press coverage of the eco-friendly delivery is helping in gaining new customers. Relationships to existing customers can be strengthened and new business generated. Another factor listed in the evaluation of the 'human factor' is the positive identification of staff like drivers with EV's. "Happier" staff would stay with the company, and reduce costs caused by fluctuation.

a) Examples of Enablers:

- City Express received good media coverage and could successfully use eco-friendly delivery as marketing tool (section 5.1).
- Relationship with existing customers was strengthened and new customers gained easily (section 5.1).
- Customers valued the advantages of clean and silent operation (section 5.8).
- The test of the carbon free delivery is used as a marketing and image building measure (section 5.7).

- Positive and extensive press coverage used as commercial measure (section 5.4).
- Gaining of new customers (section 5.4).
- Public interest was high and resonances from press were positive (section 5.9).

b) Gaps in policy:

- None

c) Current state of policy:

- None

6.3 Evaluation of Energy Supply and Infrastructure Factors

Success factor: Expensive public infrastructure not necessary for charging

Commercial EV's are charged mainly overnight on company grounds. Most EV owners are also interested in quick charging solutions or battery swap systems. Only in few cases the public charging infrastructure was of interest for charging during the short dwell times. The companies involved in CEP were rather interested in using the charging lots as reserved parking spaces.

a) Examples:

- Public charging of the commercial vehicles was uncommon during the project: the EV's where mainly charged at the company base (section 5.2).
- Public charging during delivery stops is inefficient, since dwell time is less than 10 minutes (section 5.3). The introduction of fast charging will most likely have an impact on this, and make it more attractive to charge along the route.
- Initially, it was planned to use the public charging infrastructure during delivery/pick-up stops, for the extension of the daily maximal range by intermediate charging and to take advantage of the reserved lots, as parking spaces in the city centre are extremely rare (section 5.1).
- The vehicles are charged on the company grounds and are not dependent on public charging infrastructure. Reportedly, EV drivers are more interested in using the charging spots reserved for EV's as parking lot during delivery (section 5.5).
- The creation of the public charging infrastructure is expensive and not economic for the next years (section 5.2). Charging times are considered to be downtimes: the expensive EV's can only amortize when operated in multi-shifts, for which a battery swap system is sometimes required (section 5.8).

b) Opportunities:

- Quick (fast) charging at public charging stations would offer an increased usability (section 5.4).

c) Current state of policy:

- None.

d) Gaps in policy:

- The setup of public charging infrastructure has been perused as the most important step to support the implementation of electric mobility. This might or might not be true in the private sector, for users in freight delivery, offering parking places reserved for (commercial) electrical vehicles would be an unlike stronger non-financial stimulus.

Challenge: In-house charging infrastructure

The following infrastructural challenges have been faced by the freight delivery companies during EV testing - these are technical issues to be solved internally or in cooperation with the energy provider. So far political interaction does not seem necessary.

a) Examples:

- In-house charging infrastructure had to be adapted several times; it was overloaded by the high capacity need of the e-trucks.
- Implementation of smart grid and load management for large electrical fleets is not clarified.
- Solutions to ensure charging in case of power outage are necessary.

b) Risks:

- Technical solutions and risk management for a stable in-house charging infrastructure for large commercial fleet are needed.

c) Current state of policy:

- None.

d) Gaps in policy:

- None.

6.4 Evaluation of Environmental Factors

Success factor: EV's are silent and do not produce local air pollutants

a) Examples:

- The reduction of air pollutant emissions has in most cases been named as a reason for testing or utilizing EV's.
- Especially the operation of EV's in cleaning of parks and public spaces were advantageous in regards of emissions and noise.
- Electrical vehicles in the pilot region project ColognEmobil saved 35 - 70% CO_2-emissions in the city of Cologne, compared to conventional vehicles.
- The concept has proved successful with regard to ecology.

b) Risk:

- Although EV's are highly visible in CEP businesses, their effective kilometrage is rather low - less than 40km in the test with the Iveco e-daily in the e-city logistic project. In one project it was reported that CEP vehicles are parking 85% of the time and driving only 15%. This makes their contribution to emissions savings rather small - though still a significant factor, when considering the whole fleet.

c) Current state of policy:

- None.

d) Gaps in policy:

- Unlimited right of entry to restricted entrance zones in heavily polluted or inner city pedestrian areas for low emission vehicles.

6.5 Evaluation of Process and Logistics Factors

Adaption of internal processes for using EV's

Logistic companies most likely would need to adapt their processes and normal routines to implement the EV's in their daily operations. Depending on the company, this can be more difficult or may even be necessary in different areas.

a) Examples of enablers:

- By early implementation of electric mobility into the company, know-how about the change of internal processes is giving a head start over the competitors. Management, drivers, dispatching, servicing the vehicle and accounting might need to be altered (section 5.1).
- Logistic processes and tour planning did not need to be adapted for the EV's (section 5.8).
- The business model of a pizza delivery company, with a 7 day week and two main delivery times (lunch and evening) is ideal for electric vehicles: They are fully charged overnight and can be partly charged during the less busy time in the afternoon. Therefore the range of the Scooters is estimated to reach 80 km per day and 30.000 km per year (section 5.7).
- With the e-Scooters, drivers have two unwelcome tasks less - neither they need to drive to filling stations anymore, nor they need to balance the fuel bills with the company anymore (section 5.7).

b) Examples of challenges:

- Restricted flexibility of EV's due to range limitations leads to the need of tailoring logistic planning for the individual application cases (section 5.3).
- Apart from the issues of limited range and cargo carrying capacity, broadly agreed upon, the usability of EV's in commercial transport was also limited, because of the increased effort for tour planning (section 5.2).
- EV service, maintenance and accounting became additional tasks, since EV's needed to be acquired by the company, to ensure charging overnight on the company grounds (section 5.1).
- Adequate drivers with a different set of skills (identification with the technology, understanding the need for an economic driving style and an ability to communicate advantages of EV's to customers) had to be identified and employed (section 5.2).
- The dispatching process had to be altered: to maximize the daily range and capitalize on the low operational costs, EV's need to be preferred in dispatching delivery assignments (section 5.2).
- Subcontractors for the parcel delivery to and drop off at customers; usually employ subcontractors on their own, who often are self-employed drivers. Those usually own their vehicles and utilise it their free time before and after work. Electric vehicles need to stay at the company grounds to be recharged

overnight and cannot be used after work. To implement EV's for distribution at subcontractors, new structures need to be established (section 5.5).

- Operating procedures and equipment needed to be customized to integrate the EV's (section 5.9).
- Technical issues where expected for the prototypes, but required workload for analyses and optimizations where higher than expected (chapter 5.9).

c) **Current state of policy:**
- None.

d) **Gaps in policy:**
- None.

6.6 Evaluation of Information Communication Technology Factors

Challenges: Software for urban freight delivery not prepared for EV's yet

a) Examples:

- Dispatching software does not communicate with EV's, and is therefore not able to take battery level into consideration when scheduling pick-ups and deliveries.

b) Risks:

- EV's have high initial but low operational costs. In order to become financially more attractive than conventional vehicles, they need to operate as close to their daily maximal range as possible. In fleets larger than a few vehicles with dynamic scheduling, the dispatching software must take into account the remaining (and predicted) battery level.

c) Current state of policy:

- None.

d) Gaps in policy:

- None.

6.7 Evaluation of Regulatory Factors

Success factor: Zones with limited entrance for conventional vehicles.

a) Examples:

- There is no time limitation for electric vehicles to enter the Nürnberg pedestrian area. This gives EV's a major advantage compared to conventional delivery vehicles, which are not allowed to enter this zone after 10.30 am in the morning. As a result DPD customers benefit from an all-day delivery and pickup service (section 5.6)

b) Current state of policy

- A 'blue label' for EV's is under discussion. In order to implement general non-monetary privileges for EV's, a labelling of EV's needs to be adopted first. In Nürnberg there is no time restriction for electric vehicles to enter the pedestrian area.

c) Gaps in policy:

- To implement the 'blue label' to mark EV's.
- Once the 'blue label' would be in place, the implementation of privileges like free parking, the usage of bus lanes or special entrance rights would be subject to regional law and policy.

Success factor: Operation of freight delivery EV's in multi-shifts relieves city traffic

a) Examples:

- Operation of the silent EV's in multi-shifts expands their usage into early morning and late evening hours fringe times, thus relieving city traffic during rush hours.
- An expansion of the delivery window of two hours in morning and evening each is accepted by customers and staff.

b) Opportunity:

- The operation of EV's in multi-shifts allows intermediate charging. This increases the daily kilometre range of the EV, thus making its operation more profitable.

c) Current state of policy:

- Delivery window expansions are individually decided upon by the communal government and vary locally.

d) Gaps in policy:

- To define more reliable policies on early and late delivery for EV's - maybe even countrywide.

Success factor: Exceptional parking permissions

a) Examples:

- The municipality of Hamburg permitted a company to charge two vehicles on a green strip belonging to and next to the company. This area had been marked as a distance space before with no vehicle parking allowed.

b) Current state of policy

- Exceptions are granted on a single decision base for EV's.

c) Gaps in policy

- None.

6.8 Evaluation of Human Factors

Purely analysing technical abilities of EV's and financial factors would fall short when evaluating the effects of electric mobility. A factor for the relationship between the private consumer and the vehicle comes into effect: "enthusiasm". Enthusiasm about a silent, clean, vibration less and innovative technology, which at the same time is providing status of a being a first mover. Customers who have received freight by EV's would want to have their freight delivered with an EV again.

Success factor: Drivers identify with 'their' EV and work

a) Examples:

- "I feel a kind of belonging, being a part of an integrated system with the environment. I am proud to be part of an innovative movement, making our future a bit better" (section 5.1).

- "My job did become more communicative. I talk a lot to customers and pedestrians during the day and their feedback is overwhelmingly positive. At the end of the day I feel affirmed instead of stressed: usually an express drivers does receive mostly negative reactions during the day, for example because of a slow delivery, due to the traffic congestion, or when parking in the second row and hindering the traffic"(section 5.1).
- Drivers' initial rejection of the EV's turned to enthusiasm during the tests: drivers identified with the vehicle as future, clean and silent technology and enjoyed fail-safe and comfortable operation. A driver reported he denied switching back to a conventional Iveco Daily, when 'his' Iveco E-Daily should be exhibited at a show for a few days (section 5.3).
- Training and inclusion of drivers was important and led to a high level of acceptance (section 5.8).
- In spite of an initial reluctance, EV's could reach a good acceptance among drivers and managers of UPS (section 5.9).
- Users reported the project had been a success (section 5.9).
- The e-Scooters have strong advantages for the delivery staff: "they do not stink, are silent and passengers do accept the e-Scooters, when squeezing into corners for parking." (section 5.7).

Success factor: Customers support EV's and adapts to the new requirements

a) Examples:

- Customer demand and interest in environmental friendly transport is growing (as long as delivery speed and costs can be kept at the same level).

- Customer valued the advantages of clean and silent operation.

- Customers' reactions were positive from the beginning.

- The concept has proved successful with regard to popularity among customers.
- Customers reported the project had been a success.
- A considerate drive style can increase the daily range of EV's by 30% (section 5.3). This makes the driving behaviour an important factor next to the ambient temperature and loaded weight, when discussing influence factors on the maximum range. A considerate drive style includes among others gentle acceleration and using recuperation when braking.
- Energy saving driving habits for EV's is to be evaluated and communicated to EV drivers. Possible training measures could be implemented to extend the daily range, thus making EV's more profitable.

Success factor: Visibility of electrical delivery vehicles

- Vehicles in CEP businesses are highly visible in traffic, making them a good means of communicating the advantages of electric mobility to the public.
- The Effenberger management hopes that through their commitment they will be perceived as a role model for more companies to switch to electric vehicles. (section 5.4)

a) Current state of policy:

- None.

b) Gaps in policy:

- Policy makers have identified commercial vehicles as a possible first field of application, as technology maps the demands and the TCO can be cheaper, compared to conventional vehicles. No nationwide advantages for EV's in CEP businesses have been granted, like free parking, special delivery times or entrance rights. Supporting the usage of EV's in CEP businesses has a high potential to utilise those vehicles as 'messengers' for electric mobility in the public.

Challenges: Risk of losing potential EV users by early testing of prototypes

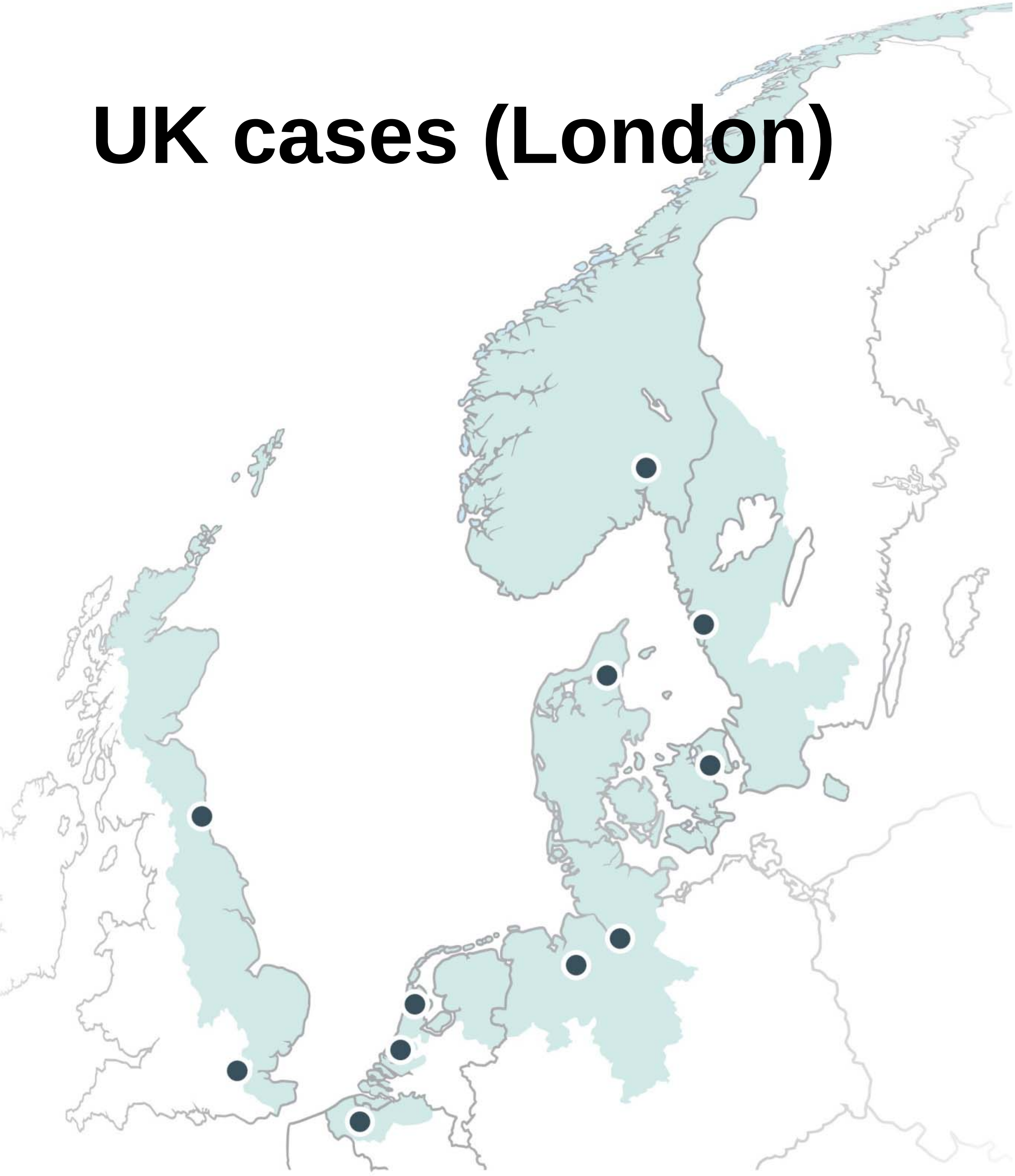
Early tests with unreliable prototypes can pose a risk for the implementation of electric mobility:

a) Examples:

- The technical unreliability of the past has led to a sceptic attitude of subcontractors towards the testing of EV's. This might influence the willingness to participate in further tests.

e-mobility NSR

UK cases (London)



1 Introduction

To cover all of the North Sea Region countries in this E-Mobility NSR report, it was decided that a brief overview of London's policies on electric vehicles and examples of the usage of electric commercial vehicles in urban freight distribution in London should be described in this report. Due to limited resources case studies have mainly been referenced from the homepage sourcelondon.net

2 Methodology

As mentioned above information about EV's and case studies from London are mainly compiled from a website www.sourcelondon.com**.**The website was stated as the central point for informations on EV's in London, containing info on policies, vehicles used and case studies on electric vehicle usage. The London cases where not supplemented by personal interviews or studies of supplementary research reports. Thus, reflections on London should be seen as an overview rather than a descriptive analysis.

3 Policies and legislation on freight electric mobility

UK wide grant: In the UK, buyers of electrical vehicles that are on a list of the government are granted a £5.000 premium. The plug-in car grant was conceived as a £230m incentive by the Labour government to cut the upfront cost of electric vehicles, which typically cost at least a third more than conventional combustion engined cars. The subsidy survived the coalition's cuts with the provision that it will be reviewed in 2012 - only the first year of funding, £43m or 8.600 cars, is guaranteed (Vaughan, 2011).

London policy "The EV Delivery Plan":
In 2009, Boris Johnson, Mayor of London, published the "Electric Vehicle Delivery Plan for London" with the aim of making London the electric vehicle capital of Europe (Mayor of London, 2009). The following is an abstract of the EV Delivery Plan:

"The EV Delivery Plan sets out a comprehensive strategy to stimulate the market for electric vehicles in London: The strategy is grouped around three key themes:

Infrastructure: *A comprehensive network of charge points across London.*

- *Work with the boroughs and other partners to deliver 25.000 charge points across London by 2015 - including a network of fast charge sites:*
    - *500 on-street, 2.000 in off-street public car parks, station car parks;*
- *22.500 will be provided in partnership with businesses - to be located in employers' car parks and retail/leisure locations;*
- *London Plan policy: a requirement to provide charge points in all new developments.*

Vehicles: *Electrify public sector vehicle fleet and stimulate wider EV market.*

- *Deliver 1.000 electric vehicles in the GLA fleet by 2015.*
- *Active support to extend the number of EV's in the public sector vehicle fleets e.g. the boroughs and central Government.*
- *Work with fleet users and companies to expand the use of EV's in business fleets.*

Incentives, marketing and communications: *Increase and communicate customer benefits:*

- *Guarantee the Congestion Charge discount worth up to £1.700 a year.*
- *Working with the boroughs to develop implified range of parking incentives.*
- *Encouraging uptake of electric vehicles in car clubs.*
- *Working with the boroughs to develop a London-wide membership scheme for EV users - giving access to the charge point network and the congestion charging discount."*

The EV delivery plan was formulated in 2009. So far, the goals have been reached as follows:

Infrastructure: *"In June 2012 there were 708 charging points available. By 2013 1.300 charging points across London are planned. The publicly accessible charge points are located at supermarkets, on the street, London Underground car parks and car parks all over London. Customers can register with Source London, pay an annual fee and receive a card in the post which will unlock any of the Source London charge points to charge the vehicle at no additional cost (parking charges may apply)"* (sourcelondon.net, 2012).

Incentives: The following is a list of the London incentives for business users owning electrical vehicles:

- EV's will be exempt from company car tax for 5 years and electric vans will be exempt from van benefit charge for 5 years.
- Pure electric and plug-in hybrid EV cars (M1 class) are eligible for a Government grant of 25% of the vehicle's price (up to a maximum of £5.000) from January 2011, subject to certain vehicle criteria.
- Other tax benefits for purchasing EV's.
- Electric vehicles qualify for a 100 percent Congestion Charge discount.

Vehicles: By 2012, there are 2.313 electric vehicles in London.

4 Initiatives on Urban Freight Transport with Electric Vehicles

4.1 Abby Couriers

Figure 43: Goupil electric van. Source: www.sourcelondon.net

Company and market description
Branch: Courier services

Abby courier service is a family run enterprise, with three main offices located in Essex, London and Hertfordshire. The electric vehicles are based in Vauxhall and mainly drive in South-west London. The company aims to increase the area of operation London wide.

EV Fleet
The fleet consists of three Goupil electric vehicles, but Abbey Couriers plans to expand this number. The EV's are fairly small with a payload of 60 kg and a range of 70 miles or 10 hours. The top speed is only 30mph, which is sufficient for the slow traffic situation in London. The EV's are driven by two full-time drivers.

Project description and goals
The electric vehicles were chosen for environmental and financial reasons. Abby Couriers is conscious about the environmental impact of the courier business. They have formulated an environmental management policy statement on their website and state that *"electric vehicles are a good way to help us improve our carbon footprint"*.

Finances and costs
The higher purchase costs for an electric vehicle are higher, but Abbey Courier is saving *"roughly £95 per week by not having to pay the Congestion Charge or road tax and through fuel savings"*.

Reactions

The reactions of customers and drivers to the EV's were very positive *"Pedestrians need a bit more time to get used to seeing them on the road. But overall the response has been positive and there has been lots of interest within the capital and even abroad in the vehicles and how they can be incorporated into our business; they certainly capture the imagination."*

Problems

A general problem with EV's is the rapid technical development of EV's. Potential users are waiting for the technology to be more ready and do fear that their vehicles would be outdated rapidly. Abby Couriers on the contrary see a *"big benefit in getting in there first and taking the lead"*.

Source: https://www.sourcelondon.net/abby-couriers

Project results in summary

Electric vehicles have bought the company a number of environmental and cost benefits. Even more than this though, they are helping to build the work profile as customers in London are now asking for their goods to be delivered in our electric vehicles, so the company is helping our customers to improve their environmental credentials as well.

a) Enablers

- Reduction of environmental impact.
- Savings of roughly £95 per week by not having to pay the Congestion Charge or road tax and through fuel savings.
- Customers' and drivers' reactions are very positive.

b) Barriers

- EV technology is constantly developing. Potential users are waiting for the technology to be more ready and do fear that their vehicles would be outdated rapidly.

c) Opportunities

- The benefit of taking the lead with EV delivery is the building of work profile: customers in London are asking for their goods to be delivered with electric vehicles.

4.2 Brewers

Figure 44: Custom made Modec truck. Source: www.sourcelondon.net

Company and market description
Branch: decorators merchant

Brewers is the largest independent decorators' merchant in the UK.

EV Fleet
Brewers has had one Modec van in its delivery fleet since April 2008.

Project description and goals
The Modec is utilized for daily delivery into the Congestion Charge zone, *"making on average 30+ deliveries of sold orders to clients' sites and home addresses"*.

The Modec has a payload slightly over 2 ton, hence it is replacing two 3.5t (gross weight) panel vans. *"The steering and turning circle of the purpose built Modec is a great asset for manoeuvring in London's streets and squares."* Brewers have a charging point within the company to charge the Modec overnight.

Finances and costs
Initially, the operation costs of the Modec where projected to be about £2.000 higher per year than for one 3.5t panel van. Since the Modec is replacing two panel vans, the higher costs where acceptable. Additionally, Brewers valued the EV's *"green credentials"* and that *"the Modec catches the eye, giving the company a moving billboard in central London"*. After the first two years of operation, Brewers found the costs were less than expected. Taking into account the increased fuel cost, the congestion charge and other operational costs the TCO of the Modec had been slightly cheaper than the TCO of a conventional 3.5t van.

Reactions
Brewers reports they received "*a positive reaction from everybody, whether it be suppliers, customers or the general public. Some workers have even come down from the scaffolding to have a closer look and quiz our driver about the vehicle we were driving. It is a different beast to look at - it is definitely noticed more than normal vans that just blend into the background."*

Problems
Main problems were related to the battery, which had to be replaced three times. On one occasion the rear axle broke up. Each problem has been attended to with Modec's backup service.

Project results in summary
"*Fleet operators need long-term certainty to put EV's on the road as the capital expenditure is high. Government needs to demonstrate, promote and commit into the keeping of the current operational and tax regime along with discounts on any congestion/road user charges."*

Source: https://www.sourcelondon.net/brewers

a) Enablers

- *"The carrying capacity in both terms of volume and weight fits the company's needs."*
- *"The steering and turning circle of the purpose built Modec is a great asset for manoeuvring in London's streets and squares."*
- *"With the increase in fuel cost, congestion charging and running costs lower than projected, the actual net result has been a slight saving on that of a 3.500 kg gross weight van (which even would offer less volume and weight capacities)."*
- *"We have had a positive reaction from everybody, it be suppliers, customers or the general public."*
- *"The electric truck gives the company 'green credentials'."*
- *"The vehicle has road presence and catches the eye, giving the company a moving billboard in central London."*
- *"Technical problems had been attended to by the Modec backup service."*

b) Risks

- *"Fleet operators need long-term certainty to put these vehicles on the road as the capital expenditure is high. Government needs to demonstrate, promote and commit into the keeping of the current operational and tax regime along with discounts on any congestion/road user charges."*

4.3 Enterprise Mouchel

Figure 45: Enterprise Mouchel Modec truck. Source: www.sourcelondon.net

Company and market description
Branch: Highways maintenance service

"EnterpriseMouchel was formed in 2007 as a result of a joint venture between Enterprise and Mouchel. The joint venture works in South London on the Transport for London (TfL) Road Network. It provides highways maintenance services including traffic management, winter service operations and full maintenance and repairs for the Blackwell Tunnel."

EV Fleet
TfL demanded its operations to be carried out by an environmental friendly fleet. Enterprise Mouchel evaluated the vehicles on the market and rated them against TfL's operational requirements. As a result, EnterpriseMouchel purchased eight Modec vehicles in 2007, enlarging the fleet with two more Modecs in 2008. EnterpriseMouchel point out that apart from being an electric vehicle, the Modec offers an *"unique cab design, which provides dual access points and clearer visibility, enabling an effective health and safety solution for reactive highways maintenance operations."*

Project description and goals
The operational tasks carried out with the Modec developed from an initial general utilisation on highways *"into more specialised applications - supporting traffic management and incident response units"*.

Finances and costs
Financial advantages of EV's are the exemption from the congestion charge, from the road fund licence, tachographs or class O licence. Electric vehicles also have low maintenance costs.

Project results in summary

"The successful introduction of Modec electric vehicles for TfL has led to Enterprise Mouchel replicating the use of the vehicles for its highways operations at the London Borough of Islington and Staffordshire County Council."

Source: https://www.sourcelondon.net/ enterprisemouchel

a) Enablers

- Environmentally friendliness.
- Electric vehicles have cost advantages due to policy benefits, including being exempt from the congestion charge, and not requiring a Road Fund License, Tachographs or class O License.
- Electric vehicles require minimal maintenance which improves performance.

4.4 Gnewt Cargo Ltd.

Figure 46: Logo of Gnewt Cargo. Source: www.sourcelondon.net

Company and market description
Branch: Inner city delivery and logistics

Gnewt operates "*across London's central postcode area and currently delivers from 800 to 1.000 parcels per day*".

EV Fleet
The EV fleet consists of electric scooters, electric cargo cycles and electric vans.

Project description and goals
Gnewt offers its inner city logistics services to companies who desire their parcels to be delivered in an environmentally friendly way. The goods are consolidated in micro-consolidation distribution centres and are delivered with electric vehicles.

Finances and costs
"Quantifying savings at the moment is difficult! Carbon emission savings are significant and, with the help of Westminster University's independent case studies, quantifiable. Financial benefits are progressive so as we grow, so do the savings to us as a business, but also to our clients."

Reactions
"Gnewt received a great response from the public towards the electric vehicles. Being in the public eye all day, the vehicles attract a lot of attention and the reaction has always been positive. Companies also advertise on the sides of the vehicles which again attract a lot of attention and positive PR. Gnewt also received a Green Apple award for environmental best practice."

Problems
The main issue for Gnewt is the high purchase price of the EV's, which (at that time) was not subsidised. Furthermore, a central information point on EV's and their features would be desirable, offering an overview of available vehicles and characteristics, services and quality.

Source: https://www.sourcelondon.net/gnewt-cargo

Project results in summary

a) Enablers

- The response from the public towards the electric vehicles is very positive.
- The side of the EV's is used for advertisement, attracting additional attention and positive PR.
- The publicly accessible charging points allow the van drivers to park and charge the battery during lunch to increase their daily kilometre range.

b) Barriers

- The main barrier is the high purchase price of the EV's, which (at that time) was not subsidised.

c) Opportunities

- Source London is reuniting different charging point networks in London, allowing access with only one registration. This will save time, money and create less confusion.
- A central information point on EV's would be desirable, offering an overview on available vehicles and characteristics, services and quality. As seen in the other country reports, multiple countries are offering such portals for the companies, e.g. www.klimabiler.no

4.5 Melrose and Morgan

Figure 47: Axiam Mega van. Source: www.sourcelondon.net

Company and market description
Branch: Fresh produced and prepared dishes.

"Melrose and Morgan is a food and grocery shop providing a range of seasonal foods. Melrose and Morgan offer fresh produce for cooking at home as well as a wide range of prepared dishes."

EV Fleet
The company purchased a second-hand Axiam Mega van for around £15k. The car is in operation since three years.

Project description and goals
Melrose and Morgan use the EV "*to make deliveries between the production unit and the shop and also in and around central London to supply wholesale customers or to support events they are catering*." The maximum daily journeys are below the 25 miles which are possible with the second hand EV. The van is charged daily at the production unit at an installed charging point, public charging points are not utilized.

The key motivation to obtain an EV for delivery purpose was to reduce the initial and operational costs of the newly set up business. The second key reason was the possibility to use the branded EV as a marketing instrument to promote the grocery shop.

Finances and costs
Driving within central London, Melrose and Morgan reduced their operational costs since the EV is exempt from the daily Congestion Charge as well as the road tax. Moreover, charging with electrical energy is cheaper compared to the costs of fuelling a diesel vehicle. On the downside the insurance was expensive and initially difficult to find. Meanwhile costs for the insurance premium have been reduced from £1.400 to around £1.000.

Reactions
"The vehicle is often a talking point with customers who are interested in the vehicle and how it works, particularly as many of our customers own either an electric or hybrid car. Kids are fascinated by the vehicle as it is so different to other vans on the road and I tend to find tourists who want to take pictures of the vehicle."

Problems
"At the time of purchase there wasn't a great deal of information available as to basic nuts and bolts of the vehicle which I needed to know, e.g. did the vehicle require water or oil, where the battery was, and whether the battery is different from other types of car or household batteries. I have had a few problems, e.g. to wait three weeks for a replacement battery from France, so I had to hire a van in the meantime. When there was a huge amount of rain a fuse blew."

Source: https://www.sourcelondon.net/melrose-and-morgan

Project results in summary

a) Enablers

- *"EV's reduced the setting up and running costs of the business, particularly as driving within central London would have meant having to pay the Congestion Charge every day in addition to the costs of diesel and road tax."*

- *"By branding the van it immediately offered the business a good, continuous marketing opportunity to promote the grocery shop."*

- *"Range has not been an issue as far as the types of journeys the company tends to do are fairly localised, and the current maximum range is 25 miles, which suits the type of journeys the company needs to make."*

b) Barriers

- *"Insurance can be expensive. Initially the company's insurance broker found it difficult to find insurance."*

- *"The lack of information about EV technology at the time of purchase."*

- *Replacement of broken parts can be time consuming, due to long delivery times.*

c) Opportunities

- *The charging network SourceLondon would provide access to all London based charging points. This will improve the possibilities for unplanned charging stops, when the battery is low.*

4.6 Nappy Ever After

Figure 48: The Bradshaw EV. Source: www.sourcelondon.net

Company and market description

Branch: Services

“Nappy Ever After is a non-profit company which provides weekly cotton nappy laundry services to homes and nurseries in central and north London.”

EV Fleet

Nappy Ever After purchased in 2005 a Bradshaw Taxi Travel electric van for performing their services.

Project description and goals

The vehicle was acquired to provide customers with a more environmental friendly delivery service. *“The vehicle is operated in full load, carrying clean nappies to customers and returning dirty nappies back to the shop premises or to the laundry in Tower Hamlets. The service operates within the London boroughs of Camden, Islington and Hackney, typically covering 20 miles a day.”*

The battery capacity can limit the area the service can cover, especially in the winter months or when carrying heavy loads. However, Nappy Ever After feels that the limited range of the vehicle does have its advantages. “Drivers learn to make the deliveries efficient, conserve energy and think in a more environmentally friendly way. This is a good thing and reduces unnecessary road traffic”. The van is charged overnight and typically takes seven hours.”

Problems

Initially, the drivers had operating and driving issues with the EV.

Finances and costs

	Electrical Van	Diesel equivalent	
Tax disc	0	185	£
Congestion charge	0	up to 520	£
Low Emission Zone	0	up to 1580	£
Fuel costs	240	2,285	£

Table 10: Typical operational savings of the EV per year.
Source: www.sourcelondon.net/nappy-ever-after

Source: https://www.sourcelondon.net/nappy-ever-after

Project results in summary

"An electric van is particularly suited to short trips making it perfect for an urban delivery service such as Nappy Ever After's. Employees of Nappy Ever After often see dry-cleaning and flowers being delivered by similar sized vehicles and wonder why they don't invest in a small electric vehicle."

a) Enablers

- Carbon friendly delivery, producing no CO_2 or other local emissions.
- The limited range of the vehicle has the advantage that drivers learn to drive in a more energy conservative way.
- The yearly costs from operation are 19 times lower - with an EV, Nappy Services saves up to £4.330 per year, due to congestion charge, environmental zone, tax disc and lower energy costs.
- Free parking in central London at public charging stations.
- Proof of the company's commitment to the environment.
- Driving an electric vehicle is*" rewarding and safer".*

b) Barriers

- *"The battery capacity can limit the area the service can cover, especially in the winter months or when carrying heavy loads."*
- *"The company initially had some operating and driving issues to deal with."*

4.7 Office Depot

Figure 49: Van of Office Depot. Source: www.sourcelondon.net

Company and market description
Branch: Office Solutions supplier

Office Depot is one of the leading suppliers of office solutions in the UK. The company provides office products and services to customers in various countries

EV Fleet
In November 2009 Office Depot invested in a green fleet, replacing seven diesel vans with six cargo cycles and four electric vans.

Project description and goals
The EV's are operated from a satellite depot in the city centre and cover over 90% of Office Depot's van deliveries in the city. The fleet is fully recharged overnight at the depot. *"Although the EV's have a smaller load capacity (445kg in 3m^3) than the company's diesel vehicles (1270kg in 9m^3), they can carry the same payload throughout the course of the day. This is because they can return to the close by satellite depot to reload with stock delivered from the company's Heathrow depot, 20 miles away. A typical delivery round for an electric van/cargo cycle will involve dropping off around 145 parcels of stationery products and will take between six and six and a half hours to complete."*

Finances and costs
"The initiative has proved cost neutral, mainly because of the low set-up and management costs of the satellite depot in central London."

Reactions
The feedback from customers and employees on the EV's was described as *"incredibly positive"*.

Environmental
A study by the University of Westminster came to the conclusion that Office Depot has reduced the CO_2-emissions of its vehicles in the City of London by 62%

Source: https://www.sourcelondon.net/office-depot

Project results in summary
The company is firm in its ambition to remain as industry leader in green delivery solutions and is now looking at the feasibility of expanding its green fleet across the UK and Ireland.

a) Enablers

- No costs for Congestion Charge.
- Ease of parking (due to smaller vehicle size).
- Ease of travel through the busy city roads (due to vehicle manoeuvrability).
- The initiative has proved cost neutral.
- Positive feedback of employees and customers.

b) Opportunities

- Smaller vehicles and cargo cycles help to reduce congestion.
- Reduction of CO_2-emissions in the City of London by 62%.

4.8 Sainsbury's

Figure 50: Truck of the brand Smith Electric performing services for Sainsbury.
Source: www.sourcelondon.net

Company and market description
Branch: Online food order and delivery

"Sainsbury's is the third largest chain of supermarkets in the United Kingdom. The company operates 502 supermarkets and 290 convenience stores. Sainsbury's Online is the Internet shopping brand, where customers choose their grocery items online and items are delivered to the customers from a local store (165 stores operate an online service) by van. This service is available to nearly 90% of the UK population."

EV Fleet
Sainsbury's online started trialling Smith Electric Vehicles for home shopping delivery applications in and around Central London in 2005. After one year of trials, the project was rated a success. 8 vehicles were ordered in 2007, a further 50 in 2008. *"The company's fleet of currently 70 electric delivery vehicles is the largest fleet of electric delivery vehicles in the UK, meaning 60 percent of central Londoners have their groceries delivered in an EV."*

Project description and goals
"The trial allowed the company to learn the importance of having robust charging routines in place and close ties to electric vehicle maintenance providers. The EV's are plugged in whenever they are at the store; there are three drop off cycle's per day and the EV's charge for half an hour between these runs. They return home for the last time at around 10pm and the vehicle has its main charge overnight."

Finances and costs
Reduced running costs like fuel savings, Congestion Charge exemption, tax breaks.

Reactions
The company's stakeholders are increasingly valuing emission free operations, hence the use of the EV's have proven to be a soft benefit. Sainsbury's won the Innovation Award from the Energy Saving Trust in 2007 and the Observer Fleet Hero Award in 2008.

Source: https://www.sourcelondon.net/ Sainsbury's

Project results in summary

a) Enablers

- *"The EV's are plugged in whenever they are at the store; there are three drop off cycles per day and they charge for half an hour between these runs."*
- Reduced running costs like fuel savings, Congestion Charge exemption, tax breaks.
- Reduced maintenance costs.
- Improved driver safety and drivability.
- *"50% CO_2 savings compared to diesel as well as reduced particulates, NO_x and noise, equals 5 tonnes of CO_2 savings per electrical truck per year."*
- "*The company's stakeholders are increasingly valuing emission free operations."*

b) Opportunities

- Training the drivers is a key to maximize the range of the EV's; *"for instance through regenerative braking"*.
- The company is also looking at fitting solar panels to their vehicles to charge the battery.

4.9 Speedy Hire

Figure 51: Modec truck at Speedy Hire. Source: www.sourcelondon.net

Company and market description
"Founded in 1977, Speedy is the UK's leading provider of equipment rental and support services to a wide range of clients across the construction, infrastructure, industrial, manufacturing and facilities management sectors - as well as to local trades and industry. Speedy operates from over 325 fixed sites together with a number of on-site facilities at client locations throughout the UK, Ireland and the Middle East."

EV Fleet
In order reduce CO_2-emissions Speedy purchased 4 Modec electric vehicles in October 2007. The pilot testing proved successful and Speedy invested in a further 4 vehicles within the London area, and one each in Manchester and Glasgow.

Project description and goals
The EV's deliver and collect hire equipment from customers in urban areas. On most working days the maximum kilometre range is fully exploited and batteries are recharged in individual depots overnight. The EV's *"have been a key differentiator in winning contracts, especially high profile sites in London as clients seek to reduce the environmental impact of their supply chain."*

Reactions
Some clients actively request to be serviced by the EV's.
Source: https://www.sourcelondon.net/ speedy-hire

Project results in summary

a) Enablers

- The EV's have been a key differentiator in winning contracts, especially high profile sites in London as clients seek to reduce the environmental impact of their supply chain.
- Each EV is saving 9 tonnes of CO_2 per year.
- Some clients actively request to be serviced by the EV's.

4.10 Tesco

Figure 52: Tesco electric truck delivered by Modec. Source: www.sourcelondon.net

Company and market description
Branch: Online grocery delivery

“Tesco.com is part of Tesco plc. the UK’s largest retailer. With over a million active customers and up to 80.000 daily deliveries it is the largest online grocer in the world “.

EV Fleet
Tesco.com operates 15 Modec electric vehicles, which mostly deliver out of the Bromley-by-Bow store in London.

Project description and goals
In 2009, Tesco has committed to become a zero-carbon business by 2050. As part of this strategy Tesco.com purchased 15 electric delivery vehicles in 2007. The vehicles average about 90 miles per day. They are charged overnight at the store for about 8 hours, and receive short boosts on site during the day.

Source: https://www.sourcelondon.net/ Tesco

Project results in summary

a) Enablers

- *“Tesco.com estimate that each electric vehicle saves between 13 and 15 tonnes of CO_2 each year.”*
- *“Experience so far with environmentally-friendly technology has been extremely positive.”*
- *“Customers want to know that Tesco is caring for the environment and reducing CO_2 emissions.”*
- Tesco’s business model allows intermediate charging that prolongs the kilometre ranges of the EV’s. The vans are charged overnight at the store for about 8 hours, and receive short boosts on site during the day.

4.11 United Parcel Service

Figure 53: UPS Modec truck. Source: www.sourcelondon.net

Company and market description
Branch: Freight transport logistics

"UPS is a global leader in logistics, offering a broad range of solutions including the transportation of packages and freight, the facilitation of international trade, and the deployment of advanced technology to more efficiently manage their business. The company delivers more than 15 million packages a day to 6.1 million customers in more than 220 countries and territories around the world. It currently employees 408.000 people and generated in 2009 a revenue of US$45.3 billion.

EV Fleet
UPS acquired twelve Modec electric vehicles in November 2008, of which six where integrated in the UPS's UK fleet in February 2009, the other six in Germany.

Project description and goals
The electric vehicles "*operate out of UPS's Camden facility, which lies within London's Low Emission Zone and is the company's central package facility in the capital*". Before purchasing the Modecs, a nine month trial of the vehicle's capabilities was successfully passed. During the trial it showed that only 25% of the full battery charge was used per working day. The vehicles were tested on almost all routes and showed promising results. The EV'S are charged in the depot overnight in dedicated loading bays in about 4 to 5 hours. Staffs cleaning the vehicles also are responsible of charging it.

Finances and costs
Compared to the conventional diesel vehicles operated by UPS, the EV's have reduced operating costs, due to reduced maintenance and fuel costs and exemption from Congestion Charge and road tax exemptions

Reactions

After an initial familiarisation period the drivers' are proud about their EV's and the public attention they receive. They were especially satisfied with the turning range in narrow London streets and the noiseless operation of the EV's. Source: https://www.sourcelondon.net/ups

Project results in summary

a) Enablers

- Reduced maintenance and fuel costs.
- Congestion Charge and road tax exemptions.
- The vehicles have been tested on almost all routes, the results are promising.
- The company's drivers are especially satisfied with the turning range in narrow London streets and the noiseless operation of the EV's.
- The drivers' are proud about their EV's and the public attention they receive.
- The EV's are also used as display to promote and highlight the company's sustainability initiatives.

b) Barriers

- *"It took some time for UPS drivers to get used to the new package car model."*

5 Summary and Conclusions

In this section, the results of the regional case studies are evaluated. The main functions of freight EV's within city distribution are highlighted.

Analog to the evaluation of the German regional cases, the results of the London regional case studies are clustered. Topics are agreed upon according to a scheme developed within the partners of WP7. The groups are defined as:

- Technical
- Financial
- Energy Supply / Infrastructure
- Environmental
- Processes / logistics
- ITC
- Regulation
- Human Factor

The case reports have been quoted from the website sourcelondon.net, as described in the London methodology chapter 2. For this reason the results may be filtered or biased by the interview scope of the website owner. There was very limited or even no information about information and communication technology or regulatory factors found in the case studies.

The clustered success factors or challenges for electric mobility in London's urban freight logistics are evaluated, possible risks and opportunities are rated and subsequently interrelated with policy state of the art. As the analysis of the London cases has not been carried out in the same level of depth, as the other country cases, gaps in policy will only be highlighted when mentioned in the cases.

Main functions of freight EV's within city distribution.

The following types of goods are transported in the reported urban freight transport initiatives in London:

CEP: Mail, parcels, paper, small electronic spare parts, household appliances, furniture, other bulky goods.

Transport-on-own-account: Painting and decoration products, fresh produce and prepared dishes, nappies, office solutions, online ordered grocery.

Services: Tools, equipment and construction materials.

5.1 Evaluation of Technical Factors

Factor: EV technology is suitable for companies inner city transport needs

a) Examples of Enablers:

- Experience so far with environmentally-friendly technology has been extremely positive.

- Tesco's business model allows intermediate charging that prologues the kilometre ranges of the EV's: The vans are charged overnight at the store for about 8 hours, and receive short boosts of energy on site during the day.

- Ease of travel through the busy city roads (due to vehicle manoeuvrability).

- The steering and turning circle of the purpose built Modec is a great asset for manoeuvring in London's streets and squares.

- Ease of parking (due to smaller vehicle size).

- Improved driver safety and drivability.

- The company's drivers praise the Modec vehicles as they have an acute turning range, which is very helpful in the capital's streets and are very quiet compared to their diesel counterparts.

- The vehicles have been used for almost all routes, to test their viability and the results are promising.

b) Examples of Barriers:

- EV technology is constantly developing. Potential users are waiting for the technology to be more ripe and do fear that their vehicles would be outdated rapidly.

Factor: Technical issues

a) Examples of Enablers:

- Technical problems had been attended to by the Modec backup service.

b) Examples of Barriers:

- During three weeks waiting time for a replacement battery from France an ICE van had to be rented.

- The battery capacity can limit the area the service can cover, especially in the winter months or when carrying heavy loads

- Initial operating and driving issues had to be addressed.

5.2 Evaluation of Financial Factors

Factor: Savings, additional earnings and additional costs of EV's

Electric vehicles operated in London were reported to be either cost neutral or even offer cost advantages due to policy benefits, including being exempt from the congestion charge, and not requiring a road fund license, tachographs or class O license.

a) Examples of Enablers:

- Savings of roughly £95 per week by not having to pay the Congestion Charge or road tax and through fuel savings.
- With the increase in fuel cost, congestion charging and lower than projected running costs, the actual net result has been a slight saving on that of a 3,5t van (which even would offer less volume and weight capacities).
- Electric vehicles require minimal maintenance, improving performance.
- Companies advertise on the sides of the vehicles, which again attracts a lot of attention and positive PR.
- Yearly costs from operation is 19 times lower - with an EV Nappy Services can save up to 4.330 £ per year, due to congestion charge, environmental zone, tax disc and lower energy costs.
- The initiative has proved cost neutral.

b) Examples of Barriers:

- Insurance can be expensive and was not easy to find, initially.

c) Current state of policy

- A buyer's premium of £5.000 for EV's listed by the government.

d) Gaps in policy

Fleet operators need long-term certainty to put these vehicles on the road as the capital expenditure is high. Government needs to demonstrate, promote and commit into the keeping of the current operational and tax regime along with discounts on any congestion/road user charges.

Factor: Soft financial benefits

a) Examples of Enablers:

- Benefit of taking the lead with EV delivery: building of work profile, customers in London are now asking for their goods to be delivered with electric vehicles.
- It gives the company 'green credentials'.
- The vehicle has road presence and catches the eye, giving the company a moving billboard in central London.

- By branding the van it immediately offered the business a good, continuous marketing opportunity to promote the grocery shop.

- Proof of a company's commitment to the environment.

- The use of greener technologies has proven to be a soft benefit, as the company's stakeholders are increasingly valuing emission free operations.

- The EV's have been a key differentiator in winning contracts, especially high profile sites in London as clients seek to reduce the environmental impact of their supply chain.

- The EV's are also used as display to promote and highlight the company's sustainability initiatives.

5.3 Evaluation of Energy Supply and Infrastructure Factors

Factor: Source London unifies access to public charging infrastructure

Examples of Enablers:

- With Source London operating across different London boroughs and being able to access all of their charging points with only one registration would save a lot of time, money and confusion.

- These publicly accessible charging points would also allow van drivers to park and plug-in whilst they are on lunch to increase the range they can cover in one day.

- *“One day I was nearly caught out as I was running low on battery charge and thought I could just use an on-street charge point, but when I found a charge point I found that this wasn’t the case so the Source London network will be ideal to charge up with.“*

- Free parking in central London at public charging stations.

5.4 Evaluation of Environmental factors

EV's offer silent and locally emission free delivery of goods. The reduction of air pollutant emissions has naturally been named in most cases as reason for testing or utilizing EV's. In two projects, the CO_2 savings during daily operation have been calculated. Based on the electrical energy mix used for charging the EV's, savings from 50- 62% where realized.

Factor: Reduction of environmental impact.

Examples of Enablers:

- Reduction of environmental impact.
- Environmentally friendliness.
- Carbon friendly delivery, producing no CO_2 or other emissions at street level.
- Smaller vehicles and cargo cycles help to reduce congestion.
- Reduction of CO_2-emissions in the City of London by 62%.
- 50% CO_2 savings compared to diesel as well as reduced particulates, NO_x and noise, equals 5 tonnes of CO_2 savings per electrical truck per year.
- Each EV saving 9 tonnes of CO_2 per year.
- Tesco.com estimate that each electric vehicle saves between 13 and 15 tonnes of CO_2 each year.

Process and logistics factors evaluation

Factor: Information on EV's

Examples of Barriers:

- There is no central point of contact to speak to about electric vehicles to make sure people know what they are buying and are confident that they are getting a quality, environmentally-friendly vehicle .
- Lack of information about EV technology at the time of purchase.

5.5 Evaluation of Information Communication Technology Factors

There has been no information in the London regional cases relevant for this chapter.

5.6 Evaluation of Regulatory Factors

There has been no information in the London regional cases relevant for this chapter.

5.7 Evaluation of Human Factors

In some London cases it is reported that driving an electric vehicle is safer than driving conventional vehicles. A reason might be that a part of the commercial EV's in London are technically simple vehicles, with low top speed and battery capacity. Hence, a slower and more energy conservative drive style is necessary to save limited kilometre range. This implies a change of mind in drivers' behaviour. "Drivers learn to make the deliveries efficient, conserve energy and think in a more environmentally friendly way. This is a good thing and reduces unnecessary road traffic".

Factor: Drivers attitude

- Driving an electric vehicle is rewarding and safer
- The company's drivers praise the Modec vehicles as they are very quiet compared to their diesel counterparts
- Drivers identify with the EV's as they get so much interest from the general public on the road
- It took some time for UPS drivers to get used to the new package car model

Factor: Customers and public reaction

a) Examples of Enablers:

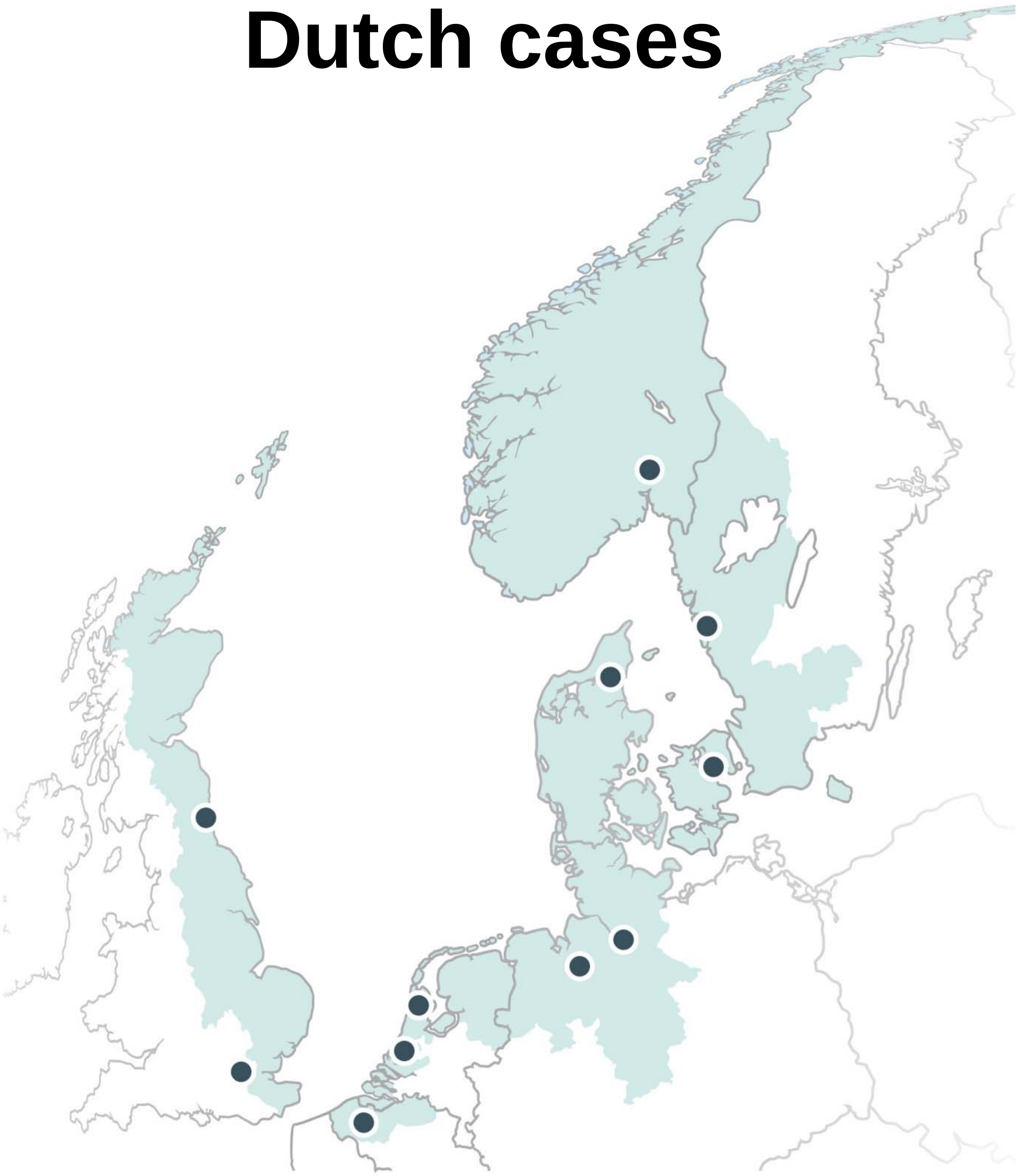
- Customers' reaction is really positive.
- We have had a positive reaction from everybody, whether it be suppliers, customers or the general public.
- We have had a great response from the public towards the electric vehicles we use.
- Customers want to know that Tesco is caring for the environment and reducing CO_2 emissions.

Factor: Change of drivers behaviour

The limited range of the vehicle does have its advantages. 'Drivers learn to make the deliveries efficient, conserve energy and think in a more environmentally friendly way. This is a good thing and reduces unnecessary road traffic'

e-mobility NSR

Dutch cases



1 Introduction

This report presents the review of projects in The Netherlands, in which electric vehicles are operated or tested in practice in urban freight transport and distribution. The aim of this review is to identify enablers and barriers regarding the start-up and wider application of electric vehicles in urban freight transport.

The report starts with a brief overview of major characteristics of the freight transport sector, its vehicle fleet and features of the market of urban freight transport. In chapter 3 the major policies concerning freight electric mobility are discussed. The next chapter 4 covers the description of the individual projects on electric vehicles in urban freight transport. Based on the findings in this review of projects the strengths, opportunities and challenges for urban freight electric mobility are sketched. The final chapter contains the summary and conclusion part.

2 An overview of the freight transport sector

Profile of the freight transport sector and freight transport trips

- Road transport is by far the most important transport mode. Its share in domestic freight transport is almost 90%;
- Domestic freight transport is performed by haulage companies (70%) and by companies on own account (30%);
- There are about 12.000 haulage companies. Small-scale business is typical for the industry. Companies that have one truck count for 33% of the industry. More than 60% of all haulage companies operate with less than 5 trucks;
- The average distance in domestic transport is about 90 kilometres for haulage companies and about 40 kilometres for transport on own account;
- About 70% of all trips on own account are on a distance of less than 50 km. Haulage companies perform about 43% of their domestic trips in this distance range, and about 65% of all their trips are on a distance less than 100 km;
- The average trip distance varies by type of product: building materials are transported on relatively short distances (55 km) as well as ores and metals (50 km), while food and livestock products are transported on relatively long distances (130 km respectively 140 km).

Characteristics of the freight vehicle fleet

Road transport is (measured in tonne km) mostly performed by trucks and tractor trailers; these vehicles have a maximum gross weight over 3.500 kg. In addition, vans (< 3.500 kg) play a role in freight transport. It is interesting to note that measured in number of vehicles the van by far exceeds the number of trucks and road tractors. Although the market share of vans seems more or less stabilised now, the number of vans has increased dramatically, especially during the nineties. In the period 1990 to 2011 the number of vans increased by more than 220%.

	2004		2008		2012	
Trucks	77.500	7%	73.000	7%	72.000	7%
Road tractors	62.000	6%	70.000	6%	69.000	6%
Vans	892.000	84%	921.000	85%	922.000	85%
Special vehicles*	26.000	3%	20.000	2%	18.000	2%
Total	1.057.500	100%	1.084.000	100%	1.081.000	100%

Table 11**:** Composition of the freight vehicle fleet in The Netherlands, 2004 – 2012
* fire engines, cleaning, crane and salvage vehicles a.o. Source: Bovag/Rai, 2012

Vans drive on average about 18.000 kilometres per year. However, the characteristics of vans and their use vary significantly between different user groups. On average their depreciation term is 6 years, but the variation is large (e.g. in the courier industry a depreciation term of 2 years is not uncommon). In addition to type of company the size of a company is often a distinguishing factor for the age structure of a van fleet. Large companies usually have a younger fleet. Moreover, the van fleet is overall younger than the fleet of trucks, but the fleet of road tractors is youngest (see table 12). Vans which are leased are usually depreciated in 4 years. The share of leased vans in The Netherlands is estimated at 20-25% (Nieman, 2012).

	< 2001	2001 - 2005	2006 - 2010
Trucks	37,0	26,5	36,5
Road tractors	12,0	30,5	57,5
Vans	28,8	34,2	37,0

Table 12: Age structure of the freight vehicle fleet in The Netherlands (in %), 1/1/2011. Source: TLN, 2012

The use of electric vehicles in urban freight transport is still in its infancy. In the segment of vans (weight < 3.500 kg) the number of electric vehicles, however, rapidly increases. In February 2012 more than 200 electric vans were registered. As regards trucks (weight > 3.500 kg) the number of vehicles is much smaller: 21 vehicles (see table 13). The limited number of electric trucks indicates that this segment is even more in its pioneering phase.

Type of vehicle	(end) 2010	(end) 2011	(half February) 2012
Vans (< 3500 kg)	91	159	213
Trucks (> 3500 kg)	15	21	21
Total	106	180	234

Table 13: Development of the electric freight vehicle fleet in The Netherlands, 2010 – 2012. Source: Nieman, 2012

According to data of the Ministry of Economic Affairs (Agentschap NL) by the end of May 2012 a total number of 344 electric vans (< 3.500 kg) and 23 trucks (> 3500 kg) were registered. These volumes together represent a share of 0,03% of the total freight vehicle fleet. As regards the vans the Kangoo Express Z.E. is by far the most popular type of electric van (see table 14).

Model	Number of vehicles
Kangoo Express Z.E.	175
Ford Transit Connect	43
Piaggio Porter Electric	31
Citroen Berlingo Electrique	23
Renault Express Electro	12
Mercedes Benz Vito E-Cell	12

Table 14: Top 5 of registered electric vans in The Netherlands (May 2012)
Source: www.agentschapnl.nl/nieuws/cijfers-elektrisch-rijden-special-bedrijfswagens

Characteristics of the urban freight transport market

Comprehensive data on the volumes and types of inbound and outbound flows of Dutch cities are not available. In general the share of shop deliveries in the total flow of goods in cities is less profound than one would expect, namely less than 10% (Ploos van Amstel, 2011a).

Data collected for the city of Amsterdam has indicated that the largest flows (in terms of counted vehicles) relate to construction (37%), horeca and food service (21%) and delivery of packages (10%).

It was found that vans in particular play an important role in construction, horeca/food service and services, e.g. computers, copiers, (coffee) automatons, elevators, cleaning and package deliveries (including fashion and lifestyle). The role of vans in package deliveries is, however, likely underestimated, since these vehicles were more difficult to identify in the survey. This conform a major remark made in this survey that the majority of transport in the inner city takes place on own account. This observation implies that possibilities to bundle flows are limited.

Trucks were predominantly represented in horeca/food service, construction and garbage (see table 15). The observations regarding the type of goods for which vans in Amsterdam are used for correspond well with data about the ownership of vans: construction (30%), retail and wholesale (25%), business service (20%), transport (15%) and other (10%) (Nieman, 2012).

Type of products	Vans	Trucks
Horeca and food service	15%	36%
Construction	43%	18%
Garbage	1%	16%
Retail non food	1%	13%
Retail food	1%	4%
Package deliveries	12%	4%
Service and cleaning	13%	2%
Social services	11%	2%
Others	3%	5%
Total	100%	100%

Table 15: Distribution of urban freight transport movements in Amsterdam, by type of product and vehicle type, 2011. Source: Ploos van Amstel, 2011b

For cost-efficiency reasons (large) trucks remain popular in urban freight transport, despite of size and axe load regulations in many cities. Transhipments from large to small vehicles, e.g. at the border of the city or at a distribution centre (where goods are temporary stored or are on-going by means of cross docking) is not so common yet.

In international perspective The Netherlands is one of the frontrunners in using electric freight vehicles (see table 16).

Country	Number of vehicles (vans and trucks)
Belgium	70
Denmark	106
Germany	338
France	1,566
Netherlands	217
Norway	103
Austria	38
Portugal	13
Spain	459

Table 16: Electric freight vehicles by country, 1 January 2012. Source: Weeda a.o., 2012

This major position of The Netherlands is even more manifest when the number of electric vehicles is related to the size of the freight vehicle fleet of the different countries (see figure 1). From this perspective it is clear that Norway and Denmark are also major countries concerning the development of electric freight transport.

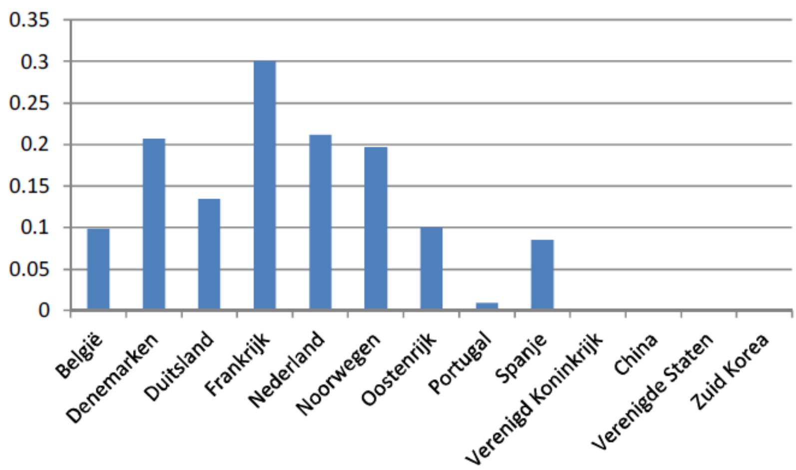


Figure 54: Number of electric freight vehicles per 1.000 freight vehicles
Source: Weeda a.o., 2012

3 Policies and Legislation on Freight Electric Mobility

Support for development and market introduction of electric freight vehicles is on the one hand obtained through specific policy plans for electric mobility and on the other hand through policy plans that municipalities have developed regarding urban freight distribution.

Electric mobility policy plans

A national policy regarding electric transport started in 2009 when the Ministry of Transport and Economic Affairs launched the policy document Action Plan for Electric Driving (Ministry of Transport and Ministry of Economic Affairs, 2009). The ambition of this plan was to develop The Netherlands in the period 2009-2011 into a guide for other countries and international laboratory for electric driving, and based on obtained knowledge and experiences during this period, to enlarge the number of initiatives regarding electric driving to accomplish large-scale introduction in the market. The target is to have 200.000 electric vehicles driving in The Netherlands in 2020. The share of electric freight vehicles in this target is not specified. The plan covered a total available budget of maximum 65 million Euro provided by the Dutch national government. Key elements of the plan included *the establishment of an expert team* (being a co-operation between the government, market actors and social organisations) on the one hand to remove barriers for electric transport and to boost market development, and *concrete measures* by the Dutch national government on the other hand.

The concrete measures covered the following activities:

a) Initiating a subsidy program for electric driving (titled: Proeftuin voor hybride en elektrisch rijden), that is aimed at supporting experiments with electric vehicles. The goals of these experiments are to test (e.g. technology, user-friendliness), learn (e.g. about its added value and acceptance) and demonstrate and prove the usefulness of the electric vehicle, and hence to contribute to further development and market introduction of electric vehicles. Total budget of the subsidy program was € 10 million;
b) Encouraging the government (at national and local level) as well as other fleet owners to act as launching customers to support demand for electric mobility and hence enable economies of scale to producers of electric vehicles;
c) Encouraging the development and construction of infrastructure (charging and energy) needed for electric vehicles;
d) Supporting R&D regarding electric transport;
e) Bringing together relevant policies (mediator role);
f) Other supporting policies, in particular fiscal favouring of electric vehicles.

In this national policy framework measure a) and f) have proven to be most relevant so far for electric freight mobility. In the subsidy program ‘Proeftuin voor hybride en elektrisch rijden’ (measure a)) total 9 initiatives are subsidized and 4 of these projects concerned urban freight electric mobility. These initiatives are included in the project descriptions later on in this report.

The fiscal supporting policies cover the following incentives:

- An exemption for the registration tax of electric vehicles;
- An exemption for the road tax of electric vehicles;
- A reduction in fiscal profit through a 36% deduction of the investment costs of an electric vehicle and the possibility to choose a favourable fiscal depreciation schedule (MIA/Vamil). Both these incentives apply to the electric vehicle and the charging facility.

In order to accelerate the development of E-mobility in general the national policy is from 2011 to 2015 increasingly focussed on creating synergies measures, for instance by defining promising market segments (including logistics and distribution) and definition of so called focus regions (Ministry of Transport and Ministry of Economic Affairs, 2011). These focus regions are regions, and especially large cities, where the expected benefits of electric mobility are the largest. In these regions local actors, including the national government are intended to cooperate on complementary issues regarding electric mobility. The urban regions of Amsterdam, Rotterdam and Utrecht are among the major focus regions.

These cities also have their own plans for electric mobility, like several other Dutch cities have, but as far as electric freight mobility is concerned, these policies are usually part of their urban freight distribution policy plans.

In addition to the Action Plan for Electric Driving and its follow up, other national programs support electric driving. In the framework of the National Air Quality program (Nationaal Samenwerkingsprogramma Luchtkwaliteit, NSL) a budget of 25 million Euro is reserved by the Ministry of Infrastructure and Environment (former Ministry of Transport) to subsidise the purchase of clean vehicles that are registered in the period from 1 October 2012 until 1 January 2015. The subsidy for an electric vehicle amounts 3.000 Euro per vehicle. The subsidy can be received both for private and business vehicles (i.e. vans). However, also other clean vehicle types (e.g. CNG) can claim this subsidy.

Urban freight distribution policy plans

Efficient and clean urban freight transport is an issue high on the agenda of Dutch municipalities. The role of the national government in urban freight distribution policy is, however, limited. The major national policy line has always been that commerce and industry (i.e. transport companies, shippers, retail and horeca) and the local government (i.e. municipalities) together have the main responsibility for efficient distribution, and hence for a reduction of congestion, transport costs, emissions and improvement of traffic safety.

Key problems hindering efficient distribution are concentrated around the existence of *time windows for deliveries* (i.e. time periods in which distribution vehicles are allowed to enter a shopping area or a discharging berth), specific *vehicle requirements* *regarding vehicle length or vehicle weight*[1], and more recently also the introduction of *environmental zones.* In such a zone (or specific area of the city) vehicles are only allowed when they meet higher requirements regarding polluting emissions and noise production.

Almost 60% of all municipalities have implemented one or more of these restrictive measures to anticipate increasing freight traffic in their cities and to mitigate the negative effects of this traffic. Although these measures were primarily initiated by environmental concerns they have also raised the interest of municipalities and the market actors in looking into more efficient urban freight distribution solutions. Considering the relevance of uniformity in measures taken by different municipalities the establishment of the Covenant 'Clean trucks and environmental zones' in 2006 was a major milestone. Currently more than 20 municipalities have signed the covenant and a majority has implemented environmental zones (see figure 55). The existence of these zones encourages the use of electric vehicles since such vehicles are of course allowed in these zones.

Since the existence of time windows for deliveries can be a barrier for urban freight distribution, several municipalities have introduced an exemption for environmental-friendly vehicles to deliver outside these time windows. In some cities, like in Amsterdam, transport companies that operate an electric vehicle may also get an exemption for the maximum allowed vehicle weight to enter the city centre. In this way these municipalities are giving an incentive to operate electric vehicles.

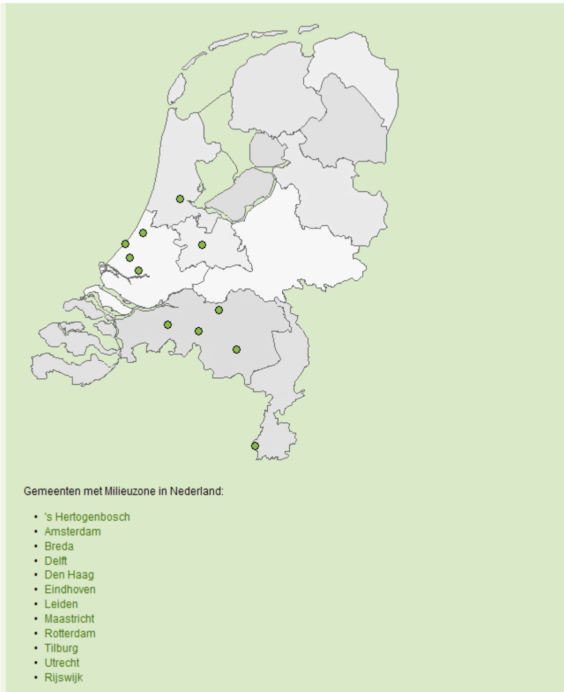


Figure 55 Dutch cities having environmental zones
Source: www.milieuzones.nl

[1] This will lead to less efficient use of a company's truck fleet, because vehicles can not be easily interchanged between cities or regions (i.e. there is restricted flexibility in the operation of vehicles) and/or the loading degree of the vehicles is restricted. Ultimately these conditions may force a company to have a larger fleet.

4 Initiatives on Urban Freight Transport with EV's

In this section the following initiatives regarding the use of electric vehicles in freight transport are discussed in more detail.

Utrecht:

- **Cargohopper:** small electric train (tractor with small trailers) for deliveries in the inner-city;
- **Bierboot (Beer boat):** electric boat for delivery of beverages in the inner-city (follow up of conventional boat for delivery of beverages).

Amsterdam:

- **020stadsdistributie:** distribution of cooled/frozen products with electrified truck in the inner-city;
- **Electric City Supplier (Mokum Mariteam):** clean, smart and quiet barge transport;
- **Peeters Vervoercentrale:** bundling of goods at the border of the city and delivery by electric truck;
- **Home delivery service:** home deliveries for retailer(s) in the urban region of Amsterdam;
- **Technische Unie:** distribution of wholesale articles in the region of Amsterdam
- **Removal truck:** electric truck for removals;
- **Package delivery (UPS):** package deliveries in the urban region of Amsterdam.

Rotterdam:

- **Binkey[2]:** garbage transport with electric trucks.

Nijmegen:

- **CityShopper:** urban grocery delivery service.

Zutphen:

- **Delta Stadsdistributie:** distribution of goods by an electric mini-truck (and trailer) from the border of the city to the city centre and the main business area of Zutphen.

The Hague:

- **COMS:** mini-electric vehicle of TNT for post and package delivery in the city centre.

[2] Currently also brought into use in the cities of Amsterdam, The Hague, Groningen, Zutphen, Breda, Tilburg and Utrecht.

4.1 Cargohooper

Status: in operation (since April 2009)

Involved city: Utrecht

Participants

Hoek Transport in Utrecht has been the initiator and driving force in the Cargohopper-project. However, the development process has taken place in close cooperation with *technical partners (e.g. Alke)* concerning the development of the vehicle as well as together with the *municipality of Utrecht* and the *province of Utrecht*.

Figure 56: Cargohopper in Utrecht

Project description

Cargohopper is a zero emission electric propulsed vehicle that is able to tow 3 mini-trailers carrying boxes (swap bodies) that measure the size of three Euro pallets each. Eight of these boxes also fit to the dimensions of a regular trailer of 13,6 metres and this enables to transport these boxes also efficiently by a standard truck. The boxes are preloaded outside the city a distribution centre and transported to the border of the inner-city by means of a standard truck. Here there is a transhipment point where the boxes are put on the Cargohopper by means of a forklift. Next the Cargohoppers drives into the inner-city, including pedestrian zones, to deliver goods to the shops.

Goals

Reducing the number of traffic movements into the inner-city;

- Contributing to a cleaner environment in the city (quiet and zero emission transport);
- Offering a sustainable solution for city freight distribution in the whole urban region of Utrecht (expanding the geographical scope of the concept);
- Promoting the concept to other urban regions;
- Increasing the scale of operations of this distribution concept in order to reduce development costs and to increase the attractiveness of the concept for deliveries to large shopping companies.

Project scope (timing, geography, market)

The Cargohopper is in operation since April 2009. The vehicle is designed for delivery of packages (not for pallets) and is meant to operate in the city centre. Initially the customers of Cargohopper consisted of shops that used to be delivered by TransMission (a cooperation of freight distribution companies in which Hoek Transport is partner). Later on the customer group was extended. The concept is focussed on non-food products, fashion and shoes in particular. In return trips clean (package) waste is transported.

Financial Support

The Cargohopper has been developed without subsidy. This was a starting point for its development, because Hoek Transport believed in a sound business model based on its long term experience as a city freight distribution company in Utrecht. Moreover, it was believed that having a subsidy to operate the vehicle (a contribution in the exploitation) would create a negative image about the viability of the concept. The development costs of the vehicle, hold by Hoekman Transport, amounted about € 85.000. Although Cargohopper was developed without subsidy the project did receive a sustainability subsidy of about € 160.000 from the province of Utrecht. The money has been partly used to invest in solar panels for the top of the loading units and partly for knowledge dissemination.

Customer attitude

There was a need for willingness of suppliers to have their goods transported by Cargohopper to their inner-city customers (shops). This was not a problem since the transport rates of Cargohopper are competitive to regular distribution and the liability for the goods during transport did not change, as far as the distribution services were carried out by Hoek Transport yet. When Cargohopper was introduced the distribution operations of Hoek Transport changed, but not the responsibility.

Since Hoek Transport used to offer regular city freight distribution services the company already controlled substantial flows. These flows of existing customers of Hoek Transport could easily be transferred to Cargohopper. This explains the rapid and smooth implementation of the Cargohopper-concept.

Policy

The municipality of Utrecht permitted to deliver shops outside the regular time windows for deliveries.

Impacts of the project

People: The Cargohopper can drive without causing noise and smells. The combination of a low speed (max. 25 km/h and at a food space in pedestrian zones) and limited vehicle width (1,25 m) assures that it does not hinder other traffic. The possibility to pass by the Cargohopper, even at the narrow streets that are very typical for the inner-city of Utrecht, avoids traffic jams. These features make the Cargohopper very public-friendly and make visits to shops while the public is shopping (i.e. outside delivery time windows) much more acceptable. Moreover, it is considered to contribute to the safety of the inner-city traffic.

In addition, Cargohopper has been certified for trainee posts for young people that are educated for a job in the transport sector. People of young age are allowed to drive the truck (under supervision) and can get an interesting opportunity to learn about logistics. As such it contributes to the attractiveness of educations in the transport sector and to promoting transport jobs.

Planet: Since Cargohopper makes use of solar energy it can operate CO_2-neutral. The total CO_2 reduction was estimated at 33 tonnes (based on a saving of 22.400 liter of diesel) in the period from April 2009 to August 2010.

Profit: Three types of actors in the distribution chain can benefit from the Cargohopper-concept: the city freight distribution company, regular transport companies and the shops in the centre.

City freight distribution company: Cargohopper is a zero-emission vehicle, and therefore may drive in every emission zone and may deliver outside regular time windows. This privilege of the Cargohopper, together with its great manoeuvrability, enables to use inner-city routes that cannot be used by vans. This makes it possible to have more efficient trips, and consequently save transport kilometres and thus costs. Outbound shipments (e.g. retour deliveries and clean waste) of the shops are used to fill the Cargohopper in its return trips from the inner-city. In this way the utilization rate of the vehicle is increased and this improves the overall cost performance.

Regular transport companies and shops in the centre can benefit from the fact that the goods are collected and bundled at the border of the city. If transport companies can avoid the trips to the inner-city by delivering at a distribution centre outside the city they save time. Shops can benefit from the possibility that their goods can arrive in one (daily) shipment. Unloading goods into their shop will therefore less disturb their selling activities. Eventually, they can transfer a much larger part of their stock to the distribution centre and the space saved for stock in the shop could be used to enhance the floor space for selling their products.

In the autumn of 2011 the Cargohopper was offering its inner-city services to about 10 transport companies and two large shopping companies (retailers). The number of shipments has grown continuously. In April 2011 Cargohopper had about 50 shipments per day. Since the floor capacity of Cargohopper is about $20m^2$ it can save about 3 trips of a full-loaded van. In practice, the productivity of Cargohopper per trip is comparable to the performance of 5 to 8 vans.

It is estimated that the Cargohopper can save on annual base about 100.000 van-kilometres or 20.000 litre of diesel fuel. Between April 2009 and August 2010 Cargohopper handled 10.000 deliveries and 55.000 packages. As a result it saved 1.500 regular van trips between the distribution centre at the border of the city and the inner-city and this means about 112.000 kilometres.

Achievements and prospects of the project

The success of Cargohopper gave cause to the development of another vehicle, Cargohopper 2. This vehicle was introduced in June 2011. The Cargohopper 2 is considered to be complementary to the first design.

Figure 57: Cargohopper 2 – New design and features

The carrying capacity of Cargohopper 2 is greater than the capacity of the initial vehicle. Its pay load increased from 1 to 2.5 tonne. The vehicle can load pallets (maximum 10) and/or roll containers (maximum 20). The possibility to load such load units is a response to the fact that transport demand for such units is much larger than for packages. The Cargohopper 2 can drive faster (65 km/h) and its action radius is extended to 150 km based on a speed of 50 km/h. As a result Cargohopper can now also deliver to the suburbs of Utrecht and even to neighbouring cities (e.g. Maarssen and Nieuwegein). Just as the first Cargohopper the truck is solar-electric propulsed. The use of high output solar cells that are integrated in the roof panels generate 22% more energy per m^2 than the panels applied in the first Cargohopper. The trailer roof measures 11.7 m^2 with solar panels and provides a peak power of 1.9 Kw. Cargohopper 2 has been developed by Hoek Transport in cooperation with Divaco Benelux and Solar Car International.

The development of Cargohopper 2 could partly be financed by a money prize (€ 250,000) that Cargohopper won in the National City freight Distribution Award 2009 for being the most innovative private/public distribution concept.

The Cargohopper is not just a dedicated solution for the city of Utrecht, but the concept could also be applied in other cities. In the meantime other Dutch cities have shown interest (Amsterdam, Groningen, Deventer) or even initiated very similar concepts (e.g. Zutphen), and there is also interest abroad (e.g. in Vlaanderen in Belgium). Since January 2012 the Cargohopper is now also being operated for deliveries in the inner-city of Amersfoort. It is planned to start operations in Enschede and Amsterdam in the second part of 2012.

Hoek Transport believes that the Cargohopper-concept could play a role in home deliveries in future. The increasing number of products that are bought via Internet is considered to be a promising market.

4.2 Bierboot (Beer boat)

Status: in operation (since Jan. 2010)

Involved city: Utrecht

Participants

Municipality of Utrecht (Stadswerken and Havendienst) (initiator and exploitation company), Vuyk Engineering Rotterdam (vessel design), Bocxe (ship yard) and Koeleman Electro (electro-technical company)

Project description

An electric propelled boat that delivers beverage to hotels, restaurants and cafés (horeca) in the city centre of Utrecht. The crane on board also runs on electricity. The project is a follow up of the previous successful initiative to deliver beverages with conventional (diesel propelled) boat, which was already implemented in 1996. Since demand for such deliveries has increased (e.g. since 2005 also fresh, cool and freeze products are transported), it was decided in 2008 to implement an additional boat. In view of sustainability goals it was decided to develop an electric-propelled boat. In this concept a few locations are assigned where large trucks can deliver their goods to be loaded by the boat.

Figure 58: The Beer boat

Goals

The motivation for starting urban distribution with a boat in 1996 was damage to the historic cellars caused by the unloading of trucks. Moreover, trucks were severely faced and causing traffic jams on the narrow streets near the canals, were faced with weight and dimension limitations as well as time windows for the delivery of goods. Altogether, the distribution of these horeca became more and more problematic and costly.

The introduction of the electric boat is aimed to contribute to improving the air quality (reducing emissions), the accessibility of the city centre, the liveability of the historic centre as well as protection of the cultural heritage and improving working conditions.

Project scope

Delivery of products (mostly beverages, but increasingly also other products) to the horeca in the historic centre of Utrecht. Incidentally the boat is used for very different types of transport, e.g. removals.

Technical specifications

Operating range: 8 – 9 hours sailing
Vehicle dimensions: 18.80 (l) x 4.26 (w) x 1.10 (d) metres
Pay load: 40 roll containers

Support

Financial: the total purchase costs amounted 800.000 Euro, of which 400.000 Euros is to be covered from its exploitation. The remainder is brought in partly by a subsidy from the municipality of Utrecht and partly by an EU-subsidy (EFRO).

Policy: the municipality played a leading role in accomplishing this project: it initiated the project and is also responsible for the exploitation of the boat.

Impacts of the project

People: deliveries by boat comply with working conditions (ARBO-regulation): goods no longer have to be toiled downed along small stairs to the cellars

Planet: the estimated CO_2 reduction is 16.5 tonnes on an annual base

Profit: the rates for transport services on water are conform to the rates for truck deliveries

Key results and achievements of the project

Encouraged by the success of the conventional and electric beer boats, a second electric boat has come in operation since April 2012. This boat is operated in garbage transport. The Ecoboot is considered to be an example project for other European cities.

4.3 020stadsdistributie.nl

Status: in operation (vehicles are operated since February/April 2010)

Involved city: Amsterdam

Participants
L.A.J. Duncker BV (transport company) and the municipality of Amsterdam

Figure 59: 020Stadsdistributie.nl

Project description
Temperature-controlled food products that are transported by conventional trucks to a distribution centre in the city of Amsterdam (Food Centre Amsterdam) are bundled and delivered by electric vehicles (a truck and a van) from the FCA to clients in the inner city of Amsterdam.

In addition to electric propulsion the vehicles are equipped with a zero CO_2 emission cooling system for the cargo-space. Diesel cooling is substituted by a quiet and environmental-friendly cryogen cooling system. This system uses a waste product (carbonic acid) to cool. Moreover, cryogen offers a better cooling performance than diesel cooling. The reason for choosing the more expensive solution of cryogen instead of electric cooling is to maximize the use of battery capacity for driving.

Goals
- Reduction of the number of transport kilometres in the city centre and increasing the number of visiting addresses per trip;
- Contributing to the air quality in the city centre.

Driving forces for 020stadsdistributie to start operations with electric vehicles are on the one hand ideological and inspired by interest in this way of transport by the holding. In addition, their involvement in electric transport also anticipates on stricter (future) policy of the municipality of Amsterdam regarding urban freight transport and urban mobility in general. The step to start operations with electric vehicles fits to the business strategy of 020stadsdistributie to strengthen its market position in urban freight transport.

Project scope
The electric vehicles are almost exclusively used for deliveries in city centre. This area is the most appropriate application field, also taking into account that the driving speed in the city centre is modest (if the electric truck is driving faster than 50 km/h electricity use increases significantly!). The majority of products transported by these vehicles consist of cool (daily fresh) and freeze products, however also other food products are transported. The truck is well designed for transporting roll containers as well as pallets. Due to limited cargo space in the van this vehicle is mainly used for the small shipments (e.g. packages of food products).

Support

Financial: the company received a subsidy from the municipality of Amsterdam regarding the investment (purchase) of the electric vehicles

Policy: the municipality granted an exemption to the regulation that vehicles heavier than 7.500 kg gross weight (own weight plus pay load), may not drive in the inner-city of Amsterdam. The electric truck is not allowed to deliver outside the time windows for deliveries (partly 7:00 to 11:00 hours and partly 7:00 to 12:00 hours), but the time windows are only applicable to a small part of the city. It is not considered as disadvantageous.

Impacts of the project

People: the drivers are in general very positive and proud about driving an electric truck. This attitude has also a positive emanation on the perception and attitude of the clients of 020stadsdistributie

Planet: for one of its large clients Marqt (a biological grocery having two shops in the city centre) the CO_2 emission effects have been estimated. The total CO_2 emission reduction was estimated at 18 tonnes on an annual base. This performance was on the one hand the result of delivering with the electric truck, but also due to the fact that more bundling of flows has taken place: the number of truck visit to Marqt shops dropped from 93 to 13 visits per week.

Profit: the total (life-time) exploitation costs are unsure/unknown, however, the fuel costs savings are substantial and the maintenance costs are expected to be lower over a period of 7 years. The aim is to attract more customers through this electric transport concept. So far 020stadsdistributie has experienced about 3 times a downtime of the electric truck, where intervenience of the supplier was needed.

Key results and achievements of the project

The implementation of electric vehicles has been an encouragement for 020stadsdistributie to focus even more on bundling flows. Although the range of the truck is satisfying to 020stadsdistributie, a more extended range of future vehicles would be desirable, as it would offer opportunities for a higher utilisation rate of the vehicle (starting earlier in the morning, ending later in the day).

Implementation of an electric truck tractor could offer opportunities for new transport-logistic concepts. For instance, the trailer of a conventional truck-trailer combination could be uncoupled at the premises of 020stadsdistributie and delivered in the city pulled by an electric truck tractor.

020stadsdistributie remains interested in electric transport and in possible extension of its fleet, but it will also keep an eye upon other alternative fuels (e.g. LNG, CNG and biodiesel). Sensitivity to moisture is considered as still one of the weak features of electric propulsion.

4.4 Electric City Supplier / Vracht Door de Gracht (Mokum Mariteam)

Status: in operation (since October 2010)

Involved city: Amsterdam

Participants
Mokum Mariteam is a co-operation of rederij't Smidtje, rederij De Nederlanden and Canal Company (shipping lines that already have experience with zero-emission cruise vessels), Koninklijke Saan (crane rental and special waterway transport company) and Icova (buying co-operation for waste). The municipality of Amsterdam has been involved in several ways (see section: Support: policy)

Figure 60: Supplying the city from the canals of Amsterdam

Project description
A crane vessel, which is propelled by silent and clean electro motors, is applied for deliveries in the city of Amsterdam making use of the fine-structured canal system. If the vessel cannot directly deliver in front of the door, a short haul over land (max. 150 meters) is carried out by a manual electric pallet wagon or a platform truck which are on board. At longer haul distances a freight bike or other sustainable modes are used.

Goals
General goals for the municipality of Amsterdam:
- reducing (heavy) truck traffic;
- stimulation of silent and clean engines;

Specific project goals:
- realisation of a fine-structured distribution and collection network for sustainable freight transport on water: (re-) usage of existing infrastructure, i.e. the canal system;
- improvement of the accessibility and quality of life in (foremost the historic city centre of) Amsterdam;
- pursuing the cradle-to-cradle concept: organic waste that is collected with the vessel is delivered to a biofactory and the biodiesel that is produced from the organic waste is used as fuel for the diesel generators of the vessel that are

supplementary to the use of electro motors. So the vessel can use fuel produced from return flows (waste) collected, transported and delivered by the vessel.

Project scope

Possibility to transport pallets, roll containers as well as big bags, gauze containers and ecocassettes. Many different products can be transported, e.g. food and beverage, linen for hotels, books for museums and book shops, building materials and even cool and freeze products (in a cool container).

Major clients include the Verenigde Bedrijven (associated companies) of Food Centre Amsterdam (FCA), which is a wholesale trade organisation for food in the Amsterdam region. FCA delivers products to retailers: supermarkets, hotels, restaurants, cafes and care institutes. Other early adapters of this transport concept are a building construction company (BBN Bouwmaterialen), a hotel (Intercontinental Amstel Hotel), the municipality of Amsterdam (the department responsible for the pavement and street furniture) and a theatre (Carre). A very special type of clients being served are event organizers (e.g. Amsterdam RAI, stichting Vriendelijke Keukens, Winter Magic). In return trips if possible waste (e.g. from hotels, restaurants and the theatre) and remnants are transported.

Technical specifications

Operating range: 8 – 10 hours sailing time

Recharging time: fully charged in 8 hours

Electric motor power: 52 kW (batteries). Two (low silence) common rail diesel generators (2 x 35kW) are used for sailing outside the innercity. Sailing with the diesel generators also contributes to recharging the batteries.

Vehicle dimensions: 20 m (L) x 4.25 m (W); The average empty draught is 1 meter. The dimensions are similar to the maximum dimension of cruise vessels and hence it can operate on almost all canals of the city.

Crane: the vessel has a hydraulic crane (capacity: 17 tonnes). Reach: about 15 meters (when lifting 760 kg)

Electric pallet wagon (for pre- and post-haulage)(Kiki): dimensions: 2.2 m (L) x 1.3 m (W); payload: 1.2 tonne

Payload: 85 m^3 or 56 tonnes. This is the capacity of about 3 to 4 fully loaded city trucks. The payload in units is 57 roll containers or 38 Euro pallets.

Figure 61: “Kiki”: The electric vehicle that is used to perform short pre- or post-haul to or from the vessel

Support

Financial: a subsidy was received from the Ministry of Transport (by a subsidy program aimed at encouraging innovations in inland shipping), the province of Noord-Holland (by a subsidy program aimed at encouraging improvement of the air quality) and Stichting Doen. The latter is a fund of charity lotteries. Stichting Doen is boosting sustainable, cultural and social frontrunners in society.

Policy: a department of the municipality Amsterdam that is responsible for the pavement and street furniture supports the concept by buying transport services. Furthermore, the municipality used the transport services of Mokum Mariteam for a removal of one of its departments. In addition, Mokum Mariteam is allowed to use the business site of this department that is located near water as a transhipment centre for goods between trucks and the vessel. This possibility increases the potential market for this barge concept.

Impacts of the project

People: the citizens of Amsterdam appreciate the distribution concept, because it reduces noise and traffic jams on the narrow streets

Planet: the concept contributes to a reduction of CO_2, particular matters and noise. Moreover, it claims savings in energy consumption.

Key results and achievements of the project

The concept of urban freight distribution with barge vessels is possible and attractive due to the dense network of canals in the city centre of Amsterdam. As such it is a sustainable solution. The fact that the vessel is electrified enhances the sustainability performance of the concept. The success of the concept gave cause to add another electric vessel to the fleet in 2011.

4.5 Peeters Vervoercentrale

Figure 62: Smith Newton Truck from Peeters Vervoercentrale

Status: In operation (since mid-2009)

Involved city: Amsterdam

Participants:
Peeters Vervoercentrale (transport company) and municipality of Amsterdam

Project description
Goods that are delivered by other transport companies to a transhipment centre in the Western part of Amsterdam (Westpoort) are bundled and distributed by Peeters Vervoercentrale with an electric truck. The truck is used for deliveries in the city centre, but also in the port area of Westpoort. The truck is operated in maximum 3 tours per day, which corresponds to a total average distance of about 120 km.

Goals
Peeters Vervoercentrale would like to be a frontrunner in electric transport and to anticipate future restrictive policies on entrance of environmental-unfriendly vehicles.

Project scope
The truck is used for distribution of all kinds of general cargo: pallets and packages.

Support
Financial: Peeters Vervoercentrale received a subsidy for the purchase costs from the municipality of Amsterdam

Policy: Peeters Vervoercentrale is eligible to get an exemption that trucks weighing over 7.5 tonne are allowed to drive in the city centre. Currently the municipality is exploring possibilities to extend the number of streets where deliveries outside the time windows are allowed.

Impacts of the project
People: drivers had to get used to the (slightly lower) maximum speed, but after their first experiences they were positive and have the opinion that it is convenient to use in the city (e.g. good acceleration performances). Since the vehicle is so quiet, drivers should be more alert to other road users and pedestrians. Using the electric truck in the fleet puts some higher requirements on the planning department: planners need to be aware about the limited operating range, and hence, there is a bit less flexibility in planning the operations of the electric truck.

Planet: the company has not calculated its CO_2 reductions so far.

Profit: It is still difficult to evaluate the profitability of the truck. Fuel and maintenance costs are lower than for a standard truck, but the purchase costs are higher. Critical for profitability are the lifetime of the batteries (renewal of the batteries would cost 50.000 Euro) and the residual value of the truck.

Other transport companies that outsource the last miles of the urban delivery to Peeters can save on time consumption of their trips and hence on costs. Several companies already do outsource these deliveries, but many companies also like to perform the deliveries themselves.

Key results and achievements of the project

Peeters Vervoercentrale is positive about the electric truck and is currently considering purchasing an additional vehicle. Inconveniences perceived so far with the existing electric truck are only related to recharging. As a result, batteries are not fully recharged during night. Temporary solution for this problem is to regularly check the recharging during night (which is not laborious, because Peeters Vervoercentrale has also night shifts).

Mentioned benefits are its savings on fuel costs, low maintenance costs and its sustainability performance (noise and emissions). Companies that have locations in the city centre ask their suppliers to deliver to Peeters Vervoercentrale in order to receive their goods bundled in one time (i.e. one truck visit at their premises).

4.6 Home delivery service of groceries

Figure 63: Delivery truck of Peter Appel

Status: stopped / reconsideration phase

Involved city: Amsterdam

Participants:
Peter Appel (transport company) and Albert Heijn (grocery)

Project description:
Grocery products are moved by a regular large trailer from the distribution centre of Albert Heijn to a hub (transhipment centre) at the border of the city of Amsterdam. From this centre an electric truck is used for home deliveries. The cargo volume carried by a larger trailer corresponds to the cargo volume of 7 city distribution vehicles.

Goals
Peter Apple had the plan to invest in 40 electric vehicles to perform the home deliveries for retailer Albert Heijn in the urban region of Amsterdam. The motivation to start with an electric truck were threefold: 1) together with its customer (Albert Heijn) looking for innovative solutions to further optimise distribution of goods, 2) anticipation on the future shortage of fossil fuels (i.e. increasing fuel costs) and 3) anticipation on stricter regulation of the municipality regarding the access of environmental-unfriendly vehicles.

Project scope
Transport of grocery products

Support
Financial: a subsidy was received from the Dutch Ministry of Transport in the framework of the program ‘Proeftuin Hybride en Elektrisch Rijden’ which is aimed at supporting practical experiences with electric driving. These practical experiences are intended to contribute to the roll out of electric driving in The Netherlands

Policy: the municipality supported Appel Transport in exploring suitable locations for the hub (transhipment centre). The availability of space was an important location criterion, because of the need of large parking space and recharging infrastructure, since the aim of Appel Transport was to introduce electric vehicles at large scale. Other privileges that were in prospect were for instance the possibility to use bus lanes and privileged parking.

Impacts of the project
The test period was short. The driving behaviour of the electric vehicle was positively judged by the drivers.

Key results and achievements of the project
The vehicle has been used very limited so far. Points of concern that were raised by the transport service provider (Peter Appel Transport) were:

- Operating range and loading capacity too limited. The aim was to realise two distribution trips per day (similar to a diesel vehicle), but to have sufficient buffers (also in winter time when operating range is already shorter) actually the required operating range should have been 150 km instead of 100 km. The claimed pay load of 1.500 kg could not be realised (just 1.200 kg), which was too limited for transporting grocery products. The tested vehicle was dimensioned at a gross vehicle weight of 4.5 tonnes, but due to the heavy batteries only 1.200 kg maximum could be loaded;

- Lack of appropriate vehicles. Large truck producing companies do not strongly invest in electric trucks yet. Companies that are involved in the construction of electric trucks are often not substantial companies and therefore they have difficulties to deliver high-quality (technically reliable) trucks;
- Heavy batteries raise the total vehicle weight to exceed 3.500 kg, and then the vehicle must be equipped with a tachograph (and there are associated obligations). However, if a vehicle is only used in short-distance trips a tachograph is not useful;
- If the vehicle weight exceeds 3.500 kg a higher grade driver licence (C) is obliged. However, the Dutch Ministry of Transport can grant an exemption.

Moreover, the retailer (Albert Heijn) is reconsidering its business strategy regarding the use of electric vehicles.

Since the test period of Appel Transport has been very short, the company has given back its subsidy to the Ministry of Transport. However, Appel Transport is intending to start a new test with a larger (heavier) vehicle (12 tonne). This pilot is planned to be performed with a wholesaler (Sligro).

4.7 Technische Unie

Status: In operation (January 2011)

Involved city: Amsterdam

Participants
Technische Unie (wholesale company in technical installation equipment), All Green Vehicle (vehicle manufacturer), MAN (chassis) and municipality of Amsterdam

Figure 64: Electric Man truck from Technische Unie

Project description
Products are distributed by an electric truck from the premises of Technische Unie to customers in the urban region of Amsterdam. The focus is on using this vehicle for deliveries in the city centre (in the environmental zone). However, also customers outside the city centre may be served.

Goals
Technische Unie has set the goal of reducing its CO_2 emission with 10% by 2015. Moreover, this initiative fits to the importance that Technische Unie attaches to sustainable entrepreneurship. Sustainable transport is part of this philosophy, but for instance also reducing the use of package material and informing customers about the 'green' alternatives for installation equipment. Technische Unie believes that transformation to electric trucks is a good strategy to comply with stricter environmental regulation in future. For the municipality of Amsterdam it is important that it contributes to improving the air quality.

Project scope
Delivery of installation equipment to house-building, the utility sector, industry, government and retailers in the urban region of Amsterdam.

Support
Financial: the municipality of Amsterdam gave a subsidy for purchasing the electric truck

Policy: except for the permission to drive in the environmental zone of the city centre no other privileges have been granted.

Impacts of the project
People: The opinions of drivers are diverse. Some drivers miss the typical sound of the diesel engine, and hence, have less affinity with the vehicle, while other drivers are delighted to experience such a new type of vehicle.

Planet: a reduction of CO_2 emissions and particulate matters that otherwise would be generated by a diesel truck

Profit: the truck is not profitable so far. Savings in diesel fuel costs do not pay off the much higher purchase price. However, the vehicle has a great promotional value (e.g. at commercial fairs). Such a value is according to Technische Unie hard to monetize.

Key results and achievements of the project
Technische Unie has experienced that electric vehicles are not ‘proven technology’ yet. Technische Unie suffered from growing pains, which revealed themselves by breakdowns and stoppages. The bankruptcy of AGV (the truck converting company) also caused a lack in support, although MAN is doing their best to support in maintenance and solving disturbances and repairs.

It remains to be seen if Technische Unie will extend its fleet with electric vehicles. The current initiative is aimed at getting experience with this alternative type of propulsion. In addition, Technische Unie is now also involved in some other pilots with dual fuel (diesel/gas) and hybrid (diesel/electric) vehicles.

Customers of Technische Unie notice that Technische Unie invests in environmental-friendly distribution concepts and appreciate this.

4.8 Removal truck

Status: In operation (since October 2011)

Involved city: Amsterdam

Participants
Aad de Wit Verhuizingen, Green Choice, stichting Doen and the municipality of Amsterdam

Project description
An electric truck is used for removal services in the urban region of Amsterdam.

Figure 65: Converted MAN removal truck

Goals
Aad de Wit Verhuizingen: the ambition of the company is to offer climate-neutral removals. Since 2008 this was already possible by compensating the carbon footprint. The implementation of the electric removal truck enables now really CO_2-neutral removals.

Municipality Amsterdam: the initiative of an electric removal truck fits to the goal of improving the air quality and reducing noise in the city.

Project scope
Furniture and household goods

Support
Financial: the municipality provided a subsidy of € 40.000 for the purchase costs. Green Choice offers a discount on the delivery of electricity.

Policy: the municipality granted an exemption to the regulation that vehicles heavier than 7.500 kg (own weight plus pay load) may not drive in the innercity of Amsterdam. In view of enhancing its own sustainable behaviour the housing department of the municipality has been one of the customers.

Impacts of the project
People: the opinion of the drivers is somewhat diverse. Although some drivers miss the typical engine noise of a diesel truck they are in general positive. Drivers also notice a very positive attitude from the general public.

Planet: the expectation is to have about 240 removals in the city on an annual base, and hence this would bring about a CO_2 reduction equivalent to 240 diesel truck trips. In addition to CO_2 reduction, the absence of particulate matters is considered as a major advantage, because removal trucks usually operate in residential areas.

Profit: the exploitation costs of the vehicle are higher than the costs of a standard vehicle at least in the short term. However, removal trucks have a long life time (up to 21 years). The expectation is that on long term the benefits will reveal, because it is very likely that the current fossil-fuelled trucks will be restricted in their operations as they will be banished from the cities.

Key results and achievements of the project
Aad de Wit Verhuizingen is satisfied with the performance of their electric truck and did not have any downtimes so far. A reliable performance is of major interest for Aad de Wit Verhuizingen, because the company is small (operating just 5 trucks), so the electric truck represents 20% of the companies transport capacity.

Together with Stichting Doen Aad de Wit Verhuizingen is now carrying out a detailed measurement regarding the business-economic feasibility of the truck. The aim is to convince the removal industry to follow the lead of Aad de Wit.

4.9 Package delivery / urban distribution (UPS)

Status: Start-up phase (operations started in October/November 2012)

Involved city: Amsterdam

Participants
UPS (transport company) and ElectroFahrzeuge Schwaben GmbH (converting company)


Figure 66: UPS truck in operation

Project description
UPS is planning to operate 6 electric trucks for package deliveries and pick-ups in the urban region of Amsterdam, the innercity in particular. The pilot will initially start with one truck, but in very short terms all 6 trucks should be implemented. The trucks will drive between the distribution centre of UPS and the innercity (distance < 10 km) to deliver packages in the morning and pick up packages in the afternoon. The covered distance of these tours are about 80 km at most.

Goals
UPS is one of the largest transport companies worldwide and aims to have a leading position in the transition to sustainable transport worldwide. UPS is involved in testing several types of fuel and propulsion systems. At the moment about 2.500 vehicles in the worldwide fleet of UPS can already be considered as alternative vehicles (e.g. LNG and hybrid).

The aim of being involved in several experiments is to explore which fuel or propulsion fits best to the different markets of UPS (e.g. urban versus non-urban, short versus long distance transport). Through involvement in testing new fuels and propulsion systems in an early stage of development, UPS obtains knowledge and experience that supports their ambition to play a leading role in sustainable transport.

Project scope
Delivery and pick up of packages

Considering the types of goods for which UPS uses the electric truck the payload in terms of space is more important than the pay load in terms of weight. Operating a smaller vehicle is considered as undesirable.

Support

Financial: a subsidy was received from the Dutch Ministry of Transport in the framework of the program ‘Proeftuin Hybride en Elektrisch Rijden’ which is aimed at supporting practical experiences with electric driving. These practical experiences are intended to contribute to the roll out of electric driving in The Netherlands

Policy: the municipality welcomes any initiative on electric transport and will support the pilot by promotional activities.

Impacts of the project

The pilot will be performed by converting an existing UPS vehicle which is at the end of life yet. In this way, when emissions are measured ‘well to wheel’ it will give a positive contribution to the sustainability performance of the pilot. The ‘right side door’ of the vehicle, which UPS intends to introduce as a standard feature of electric vehicles, is aimed at improving the convenience and safety of the truck driver.

Key results and achievements of the project

A similar electric type of vehicle has been successfully tested by UPS in Germany for about two years. Hence UPS has much confidence in the pilot. The plan to start almost immediately with 6 vehicles endorses these positive expectations.

4.10 Binkey: Garbage truck

Status: In operation (since 2009)

Involved city: Rotterdam (2009), The Hague (2011), Amsterdam, including Schiphol (2011), Groningen, Zutphen, Breda and Tilburg (2011) and Utrecht (and abroad: Brussels Airport)

Participants

Van Gansewinkel Groep, Spijkstaal and Roteb (responsible for maintenance during the pilot that started in Rotterdam), municipality of Rotterdam

Project description

An electric garbage truck is used to collect business garbage in innercity areas and at business areas in different regions. The garbage is transported to a garbage power station where it is transformed into electricity.

Figure 67: Binkey Garbage truck

Since garbage collection is a transport activity characterised by low speed, short distances and many stops it is believed to be very suited for electric transport. Fully charged the truck can make 3 tours per day, which corresponds to a complete working day (8 hours). The E-garbage truck is smaller than a conventional garbage truck, and as result has better manoeuvrability characteristics, which is an advantage in the urban environment.

Goals

The initiatives fit into the ambition of Van Gansewinkel to be a sustainable-oriented company. Van Gansewinkel stresses the closed loop of the energy chain: the electricity that is generated from the collected garbage is used to run the E-garbage truck. Van Gansewinkel believes that this concept anticipates on ever increasing fuel costs and increasing difficulties in acquiring drivers with a truck driver license.

Project scope

The trucks are used for garbage collection in areas that are sensitive to noise and emissions (reductions)

Support

Financial: the pilot project (lasting one year) which took place in Rotterdam received a subsidy from the municipality of Rotterdam (in the framework of their subsidy program Clean Air). For six of the other initiatives (that can be considered as a roll out of the project in Rotterdam) Van Gansewinkel got a subsidy from the Dutch Ministry of Transport in the framework of the program 'Proeftuin Hybride en Elektrisch Rijden' which is aimed at supporting practical experiences with electric driving. These practical experiences are intended to contribute to the roll out of electric driving in the Netherlands.

Policy: the municipality of Rotterdam helped Van Gansewinkel in elaborating the social dimension of the project: offering young people, having difficulties in finding a regular job, new job opportunities (see ‘Impacts of the project: People).

Impacts of the project

People: since the maximum speed of the truck is 40 km/h, drivers do not need a driver’s license for trucks. Van Gansewinkel applies the master-fellow principle to the E-truck: an experienced driver brings in a new colleague by starting to work on this truck. To acquire new drivers Van Gansewinkel cooperates with provision of work agencies, which help unemployment young people that face difficulties to find a job. Due to the design of the truck the driver has a good range of vision on walking public, which supports to safe operations.

Planet: the estimated CO_2-reduction per truck is about 6 to 10 tonne on an annual base. Since it is typical for garbage trucks to run a lot stationary and have a lot of small accelerations the E-garbage truck also significantly saves on emissions of particulate matter and NO_X.

Profit: the investment costs were about the same as for a conventional truck (180.000 Euro), but the E-truck is a smaller vehicle. It is believed that the exploitation can be profitable, and more favourable than the exploitation of a regular truck. It depends on the relative costs of diesel and electricity and the labour costs (labour costs for a regular truck driver are higher than for the Binkey). Other beneficial conditions for Binkey are the use of smaller tyres that are much cheaper than for a regular truck. During the pilot year in 2009 it proved that the vehicle had no maintenance costs at all.

Key results and achievements of the project

The first experiments took place in Rotterdam (in 2009) and the results gave cause to expand the project to applications in other cities. Currently (September 2012) nine trucks are in operation. The cities of Breda and Tilburg are located nearby each other and share one garbage truck. If both cities would have their own truck the workload for the garbage truck would be too limited to have a sufficient utilisation rate.

Van Gansewinkel is positive about the implementation of electric trucks, but was faced with some problems regarding the range of the trucks. Solutions are found in operating another type of vehicle and/or installing a press cracker. In addition, the utilization of the vehicles could be increased if the time windows for operation in the city centre could be extended. This issue is for instance faced in The Hague: the time window is from 7:00 to 10:00 hours. Extension of the time window is now under discussion with the municipality.

Originally the plan was to have at least 12 trucks in operation by the end of 2012. However, due to the economic crisis (and consequently also a fall in the volume of garbage flows), the investment plans are tempered. Despite this current situation there is the intention to roll out the use of the electric garbage truck to other cities, their centres in particular. The truck is still not suitable to operate in low dense neighbourhoods, i.e. rural settings.

4.11 CityShopper: urban grocery delivery service

Status: Tested (since March 2010).

Involved city: Nijmegen

Participants
Cornelissen (transport company), Albert Heijn, Gall & Gall and Etos (retailers)

Project description
Grocery products of Albert Heijn (AH), Gall & Gall and Etos are being transported by regular trucks to the distribution centre of Cornelissen at the border of the city of Nijmegen. Products that are ordered via Internet (Albert.nl) are delivered at home by an electric truck. The vehicle performs two roundtrips per day and this corresponds to a total distance of about 100 – 120 km.

Figure 68: Smith Newton truck of CityShopper

Goals
The ambition is to develop a complete sustainable transport chain from the supplier to the final delivery at home. This ambition is part of the business philosophy of AH and Cornelissen regarding sustainable entrepreneurship. Originally the goal of Cornelissen was to have 7 vehicles in operation by the end of 2011 and to expand its electric truck fleet to 25 vehicles.

Project scope
Delivery of grocery products to people at home

Support
Financial: a subsidy was received from the Dutch Ministry of Transport in the framework of the program 'Proeftuin Hybride en Elektrisch Rijden' which is aimed at supporting practical experiences with electric driving. These practical experiences are intended to contribute to the roll out of electric driving in The Netherlands. In the start-up phase (2010) also a small subsidy was received from Stadsregio Arnhem/Nijmegen (a co-operation between the two municipalities).

Policy: the municipality permits to operate the vehicle in an additional time window in the evening for deliveries the pedestrian zone in the city centre. The regular time window is from 6:00 to 12:00 hours and vehicles complying with environmental regulation (such as electric trucks) may also deliver between 18:00 to 23:00 hours.

Impacts of the project
People: the experiences of the drivers are in general positive. However, several drivers had to overcome some fear about getting in a situation in which the remaining operating range would be too small to return home.

Planet: the vehicle could generate a CO_2 reduction of 26 tonnes on annual base. Taking into account the utilisation rate of the vehicle savings are estimated at 18 tonne.

Profit: Cornelissen Transport believes that in operating the existing type of vehicles it is not possible to have profitable services.

Key results and achievements of the project

The operating range and payload of the vehicle were perceived as too limited. Other perceived disadvantages are the large weight of the batteries that leads to a total gross weight over 3.500 kg, and as a result a tachograph is required and a driver license C. In addition, the reliability of the vehicle operations is lacking. In general, the costs of electric delivery transport were considered as too high to be competitive.

Next to the Smith Newton that is now still in operation also a Ford Transit and a Renault Maxity (48 Kwh, later on 67 Kwh) have been tested shortly. The Renault Maxity had a too limited pay load (960 kg) and too limited operating range (< 150 km).

Cornelissen Transport is still looking for a vehicle that can satisfy their needs. A major requirement is an operating range > 200 km. It is believed that such an operating range is required, because the battery performance decreases over time (4-5% per year) and hence the operating range decreases by about 25% in five years' time. As a result, this limits the employability of the vehicle over time, and it may endanger a safe distance margin in planning trips (to be assured that the vehicle can return to the distribution centre). Consequently, such conditions have a negative impact on the profitability of operating such a vehicle.

4.12 Delta Stadsdistributie

Status: In operation (since October 2009)

Involved city: Zutphen

Participants
Delta (job creation company and initiator), the municipality Zutphen and transport operators (Middelkoop, Transmission, Van Opzeeland, Nabuurs, DPD, Centraal Boekhuis and Intres)

Project description

In this initiative packages and goods are transported by conventional vehicles to a distribution centre in Zutphen. From here electric vehicles are used to deliver in the city centre and to a neighbouring business area in Zutphen. Very special in this initiative is that the deliveries with the electric vehicle are being performed by employees of a job creation company (Delta) and this gives this project an unique and social dimension. Goods that are delivered by transport companies before 9:30 hours at the distribution will the delivered the same day. Since September 2010 also a larger vehicle (truck-trailer) is being operated. This second vehicle is equipped with solar cells, and enables to transport pallets.

Figure 69 Mini-truck by Electrocar in Zutphen

Goals
- Reductions of the number of transport trips in the city;
- Improving the sustainability of urban freight distribution (noise reduction, cleaner air);
- Offering job opportunities to people which have a weak position in the labour market.

Project scope
All kind of products are transported, but predominantly packages. The number of pallets transported is still limited (they are usually only partially loaded). The goods are mainly delivered to the city centre (shops) and companies at a business area nearby the site of Delta. In addition, clean waste and retour deliveries are transported from the city centre back to the Delta site. So fare these different transport activities are separated processes: goods are delivered in the morning hours and retour deliveries are picked up in the afternoon. The Delta site is on short distance from the city centre (about 5 minutes driving).

The operating range of both vehicles is adequate: the vehicles make many stops and therefore the daily number of kilometres is limited (maximum is about 40 km per day, but usually much less than 40 km).

Support
Financial: the mini-truck was sponsored by Rabobank, Delta has purchased the truck-trailer with own resources.

Policy: the project fits to the policy of the municipality of Zutphen to encourage energy efficiency and the efficiency of urban freight distribution (bundling of flows of goods). The municipality has granted permission to deliver outside the time windows for deliveries (between 7:00 and 10:30 h. and 18:00 and 19:00 h.).

Impacts of the project
People: drivers are positive about driving the electric vehicles and they experience positive attitudes at the general public. Drivers do not need a driver's licence since the vehicles are classified as 'slow traffic'. Nevertheless, drivers do get a driver training, e.g. to increase the safety of driving (without noise) in pedestrian areas. The fact that driving these vehicles does not require a driving licence enables people that have difficulties in finding a regular job to become 'truck driver'. This fits perfectly to the core business of Delta, i.e. job creation.

Planet: Delta does not have estimations yet regarding the contribution of their vehicles to reductions of emissions.

Profit: The services of Delta are not profitable yet. Since Delta is a job creation company the labour costs of the transport operations are subsidized. The loading degree of the trucks is overall still too low to enable profitable services. However, the initiators of the Delta delivery services believe that also social benefits should be incorporated in the assessment e.g. cost savings in road maintenance due to the substitution of heavy-trucks by light-weight trucks and the fact that unemployed people are activated through the set-up.

Delta also offers warehouse space to the shops they deliver to, so that shops can increase their selling space, but so far no shops have taken advantage of this service. According to Delta, the shops are positive about the fact that they now receive their goods (bundled shipments) at the same time.

The advantage for the transport companies is that when they can drop all their shipments at Delta they have only one stop, and moreover, they do not have to bother about catching a time window: they can drop their shipments at Delta the whole day. This gives these transport companies more flexibility in their planning and hence they can improve their efficiency.

Key results and achievements of the project
The concept of Delta anticipates on an expected future shortage of manpower in the logistical sector, and truck drivers in particular. In addition, it meets needs for more sustainable transport and efficiency improvements in goods deliveries (through bundling of shipments).

Major factors for a successful continuation and development of the project are:
1) To increase the transport volume: if the number of shipments increases operations can become more profitable;

2) Transport companies should become aware of the benefits that the concept can offer them: time savings that result from outsourcing ‘the last mile of the delivery’ can pay off, in particular since deliveries with regular trucks in the historic centre of Zutphen are difficult and time-consuming. Furthermore, the transport companies should gain more confidence and be convinced about the good performance (e.g. reliability) of the delivery services of Delta;

3) The fact that Delta is not a transport company and hence should not be considered as a competitor to the transport companies that have deliveries in Zutphen may raise their willingness to outsource the last mile of the delivery;

4) Improvement of the information exchange between Delta and its partners regarding the status of shipments (e.g. tracking and tracing) that has to be established by coupling their information systems. Although the electric truck is equipped with a GPS device the transport companies can trace the vehicle and may know when their shipment is delivered, but the status information still needs to be processed manually.

The aim is to further unroll the use of the vehicles for deliveries to the city centre and the business area. In addition, home deliveries are considered as a potential new growth market for the concept. Nowadays couriers usually can only deliver their goods to customers in small time windows (often in the evening only, as people are at work at daytime). Moreover, couriers are often in a rush and this can cause dangerous situations in residential areas. Packages of couriers could be delivered at Delta and picked up at Delta by customers or alternatively Delta could deliver the packages with their electric vehicles at home of the customers.

A major partner in the project, the transport company Middelkoop, is exploring the opportunity to establish similar partnerships with job creation companies in the cities of Arnhem and Doetinchem.

4.13 COMS (TNT Express Benelux)

Status: Test (started in April 2012) has been discontinued.

Involved city: The Hague

Participants:
TNT Express and Louwman Groep (import company of innovative and sustainable cars)

Project description:
An electric vehicle was used to transport (small) shipments to the city centre of The Hague. Since the vehicle is allowed to use bicycle tracks it was considered as promising and useful for urban freight transport. This initiative was a follow up of a similar test that was started in the city centre of Brussels in December 2010.

Figure 70: TNT delivery vehicle (classified as a moped)

Goals
TNT has a strong ambition in fighting against climate change. Their goal is to have a share of 60% electric vehicles in the fleet by 2020 and their strategy to obtain this goal consists of five pillars:

- Network optimization (reducing kilometres and optimising load factors),
- Driving behaviour (training drivers in fuel efficient and safe driving),
- Technology (use fuel efficient technologies),
- Alternative fuels (use alternative transport fuels) and
- Subcontractors (partnering to jointly reduce CO_2 emissions).

The test with COMS fits within these general sustainability goals and moreover COMS is aimed at improving the delivery performance: deliveries to the innercity are expected to be faster (and cleaner).

Project scope
Post and package delivery in the city centre

Support
Financial: TNT did not get any subsidy in purchasing the COMS vehicle.

Policy: TNT did not get any specific support from the municipality of The Hague.

Impacts of the project
The test period has been so short that the impacts on sustainability, profitability and social aspects have not been evaluated.

Key results and achievements of the project
The main reasons for discontinuing the test with COMS were twofold. The reliability of the battery was poor due to its vulnerability to bad weather conditions: especially during cold weather the battery failed or the operating range significantly reduced. The pay

load (in terms of weight and volume) of the vehicle was insufficient. It worked well for deliveries of documents, but not well for the parcel business. Actually the performance of COMS could not compete with the tricycles (electric bikes) that are also being used by TNT in terms of reliability, payload and operating range, while the purchase price of the COMS is rather similar to the price of tricycle.

Engagement of TNT in electric transport is part of their business goals, as it could contribute significantly to their aim of reducing CO_2 emission and being aware that other measures (such as fuel savings by improving driving behaviour) will be insufficient to achieve significant CO_2-reductions. However, their experiences with electric transport so far are rather disappointing.

In addition to the trials with COMS, TNT has had a pilot with a van and a truck (Smith), but the performances of the vehicles were unsatisfactory. The operating range was too small, considering that the depots of TNT are situated some distance from the cities. Furthermore, the vehicles had frequently failures, which endangered the reliability of TNT services and induced TNT to keep other vehicles in operation to set off these failures. Moreover, the engine power was inadequate in view of the type of cargo to be transported (i.e. palletised transport). Lack of engine power now and then forced drivers to drive at unacceptable (dangerous) low speed. The rebuilding of the truck is underway and TNT restarted its pilot later in 2012. The results of that new pilot will play an important role in defining their future policy regarding electric transport.

5 Summary and Conclusions

Based on the review of experiences with urban freight electric mobility, policy and market developments in the Netherlands the following strengths, opportunities and challenges can be distinguished:

Drivers (strengths)

- The ambition of companies to have sustainable operations (i.e. to have a green image) is a strong driver for getting involved in electric transport. The outstanding environmental performance of electric vehicles (silent and non-polluting) therefore is a strong trigger for companies to choose electric vehicles for their operations.

- Many initiatives are driven by expectations of companies that regulations regarding less environmental-friendly vehicles become more restrictive in future, and as such companies are anticipating future policy through getting involved in electric vehicles experiments.

- Most electric freight vehicles are operated in the 'last miles' of the total distribution chain, i.e. from a distribution or urban consolidation centre to the customers. Bundling flows of goods in this last miles operation is important for the efficiency, and hence, competitiveness of such a distribution concept. The use of electric vehicles fits to this distribution concept in which customers get their goods delivered from a local distribution or urban consolidation centre (e.g. at the border of the city or city centre), since these deliveries take place over short distances. As such the use of electric trucks gives incentives to improve the bundling of goods: making urban freight distribution more efficient. As a result of an increased focus on bundling of goods, receivers can benefit from the possibility that their goods can arrive in one (daily) shipment. For instance, unloading goods into shops can therefore be less disturbing to selling activities.

- Citizens (including shop owners and the public) have in general a positive attitude towards electric freight vehicles, since the vehicle can drive without causing noise and smells.

- In several initiatives the electric vehicles are classified as slow traffic, and consequently a driver licence is not needed. The requirements to become a driver on an electric vehicle are therefore lower. In some of these initiatives there is a focus on employing people that have difficulties in finding a regular job or on offering a trainee post to motivate people to start a career in the logistical sector.

- The lower requirements regarding the qualifications of truck drivers for slow electric vehicles is considered as a way to anticipate on an expected future shortage in the labour force in the logistical sector, and a shortage of truck drivers in particular.

- Truck drivers predominantly appraise driving on an electric truck positively. The high comfort of driving (silence and accelerating performance) is appreciated as well as the positive attitude of the public and customers towards their work.

- In general the electric freight vehicle contributes to an upgrade of the image and working conditions of a truck driver.

- In view of an unabated increase of the fuel costs of diesel trucks the relative low fuel costs of an electric truck is one of the drivers of companies to get involved in electric transport.

- In some electric freight vehicle initiatives vehicles are used that are classified as slow traffic, where less qualified drivers (i.e. without driver licence obligation) can be employed. As a result, the electric freight vehicle initiative can benefit from lower labour costs.

- Charging takes places exclusively at companies' premises, generally without problems. In this way the process is simple and companies are not dependent of third parties, i.e. the companies have control over their charging facility and timing to charge (always during the night).

Opportunities (enablers)

- The possibility to get a subsidy (from the national government and/or local government) to purchase an electric freight vehicle lowers the threshold for willingness to invest in electric vehicles. Almost all electric vehicle projects have been initiated with subsidies (one of the exceptions is the Cargohopper-project, although it received resources by winning awards).

- Although companies state that the electric vehicle operations are not cost competitive to the regular vehicle operations yet, they believe that an electric vehicle has a strong promotional value, which is difficult to monetize, but may pay off by attracting new customers that highly appreciate sustainable transport solutions. Hence, the electric vehicle is a mode to generate additional attention about the businesses operating them.

- The outstanding performance of electric vehicles in terms of emissions and noise is a strong trigger to focus on applications of electric freight vehicles where local air quality and noise production are perceived most problematic, i.e. in shopping areas in city centres. However, because of the good environmental performances of electric vehicles their application in residential areas, such as garbage collection and home delivery of packages, are other emerging markets for electric freight vehicles.

- The trend of an increasing role of small vehicle (vans) in city freight transport may support the use of electric vehicles, since the transformation to electric vans is much easier to accomplish than the transformation to electric heavy trucks (because their performance compared to standard trucks is still rather poor).

- As a result of the privilege of electric vehicles to deliver outside the standard time windows of deliveries, companies that use electric vehicles have more flexibility in planning their distribution trips. Moreover, transport companies can also avoid the rigidity of the time windows for deliveries if they avoid the trips to the innercity by dropping their goods at a distribution or urban consolidation centre for the last mile delivery. Avoiding these innercity trips may save time and hence costs and since the dropping of goods at the distribution or urban consolidation centre is not committed to time windows these companies will also have more flexibility in planning their trips.

- The introduction of environmental zones in cities acts as a stimulus to use electric vehicles, since in these zones vehicles are only allowed when they meet higher requirements regarding emissions and noise production.

- Rolling out supporting local policies to other municipalities will make it more interesting and beneficial for transport service providers to get involved in electric transport.

- The permission (an exempting rule created by the national government) to drive an electric vehicle up to 7.500 kg GWT with a driver licence B, which improves the cost competitiveness of an electric vehicles compared to a standard (diesel) vehicle. Due to heavy batteries electric vehicles have a high own weight and their total gross weight may easily exceed 3.500 kg GWT. Since a gross weight over 3.500 kg would otherwise require a driving licence C this would imply higher labour cost. However, employing drivers with a licence C is not competitive in urban freight transport.

Challenges (barriers to overcome)

- Appropriate vehicles are hardly available yet (vehicles have too limited loading capacity or operating range). This holds for the heavy truck market segment in particular. A breakthrough is needed in the performance of electric vehicles in the heavy truck market segment.

- The weight of the batteries should be reduced to limit loss of payload.

- In general the technical reliability of an electric truck is still insufficient. The vehicles are sensitive to failures (converted vehicles in particular) and there is a lack of quality in aftersales services: limited know-how on repairs and limited availability of spare parts. These problems relate to the fact that the substantial truck manufacturers are not yet strongly involved in the development of electric trucks.

- The purchase price is generally perceived high, mainly caused by the high costs of batteries. The total costs of ownership seem not well known yet (e.g. because the rest value/depreciation rate is still unknown), but most companies believe that the business case is still very doubtful. The high purchase price is a major determinant. Production of vehicles at larger scale could reduce the purchase price.

- Basically the assessment of electric vehicles is focussed on the total costs of ownership. However, if social benefits would be incorporated in the assessment (e.g. costs savings in road maintenance due to substitution of heavy trucks by light-weight electric trucks) then a more favourable financial appraisal of electric trucks would result.

- Most companies consider their involvement in pilots with electric vehicles as a way to explore (and get experiences) with electric transport, and to get a frontrunner position in the transport sector regarding sustainability. However, they also keep the option of using other types of clean vehicles in future open. Although the environmental performance of electric vehicles in terms of emissions and noise production is outstanding, it is definitely not the only criterion for companies to consider clean vehicles. Consequently, other types of clean vehicles remain serious competitors to electric vehicles.

- The limited operating range of an electric truck may sometimes cause less flexibility in planning trips, and hence cause less efficient operations.

- ICT has not been mentioned as a relevant issue when introducing electric vehicles. In only one initiative (Delta Stadsdistributie) the introduction of an electric vehicle has resulted in some less optimal information processes due to the fact that the long distance transport (by regular truck) and short distance transport (by electric truck) were no longer in one pair of hands, i.e. the short distance transport with an electric vehicle was outsourced.

- The obligation to equip a vehicle over 3.500 kg GWT with a tachograph (and to fulfil other obligations) is redundant when the vehicle is only used in short trips (e.g. urban distribution). This obligation increases the operating costs of a heavy electric vehicle and makes the electric vehicle less competitive to conventional vehicles.

The Netherlands belongs to the frontrunner countries regarding the development and implementation of electric freight vehicles. Since 2009, when the first initiatives started, now more than 20 freight trucks (> 3.500 kg GWT) are being in operation and new initiatives are underway or planned. Including the market segment of vans (< 3.500 kg GWT) the fleet of electric freight vehicles exceeds 300 vehicles.

Initiatives to operate electric freight vehicles have been taken so far mostly in the largest cities of The Netherlands, where local air quality problems are most severe and the efficiency of urban freight distribution is most endangered. Amsterdam is by far the frontrunner city regarding the number of initiatives in The Netherlands, but also Utrecht, Rotterdam as well as some middle-sized and smaller cities are involved.

The presence of a dense network of canals in the innercity of Amsterdam and Utrecht makes urban freight distribution with vessels an attractive and successful concept. Electrification of the vessels has proven to be successful to further enhance the sustainability performance of this distribution concept. Furthermore, non-conventional electric truck concepts have been introduced in the city of Utrecht (Cargohopper) and Zutphen (Delta Stadsdistributie). The design of these truck concepts were inspired by the need for sustainable and efficient distribution in cities having narrow streets and pedestrian zones (i.e. historical centres). The concepts are functioning well and are envisaging a wider application, i.e. in other cities, but also in other markets (i.e. home delivery of packages). As the experiences with electric trucks exceeding 3.500 kg GWT is concerned the results and opinions of their users are less unambiguous. Most companies are excited, pleased and satisfied about operating an electric vehicle, but some companies remain conservative because of negative experiences.

The ambition of companies to have sustainable operations (i.e. to have a green image) is a strong driver for getting involved in electric transport. The outstanding environmental performance of electric vehicles (silent and not polluting) therefore is a strong trigger for companies to choose for electric transport. In addition, there is a strong believe that future policy regarding less environmental-friendly vehicles (diesel trucks) will become more restrictive. As such, companies consider their involvement in pilots with electric vehicles as a way to explore (and get experiences) with electric transport, i.e. to be prepared for future policy and to get a frontrunner position in the transport sector regarding sustainability.

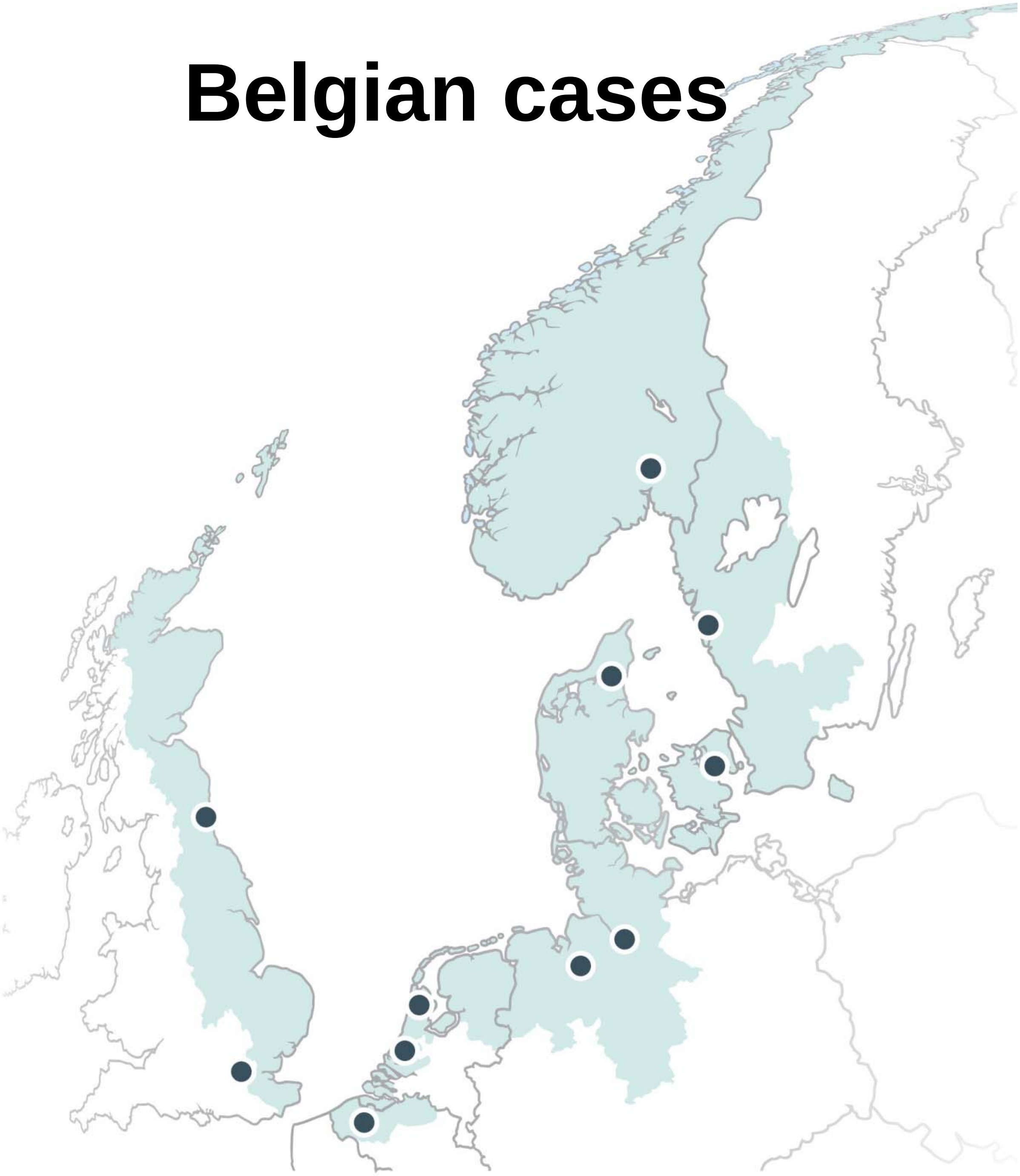
This suggests that their involvement is based on a long term policy and this is supported by the fact that operating an electric freight vehicle is not profitable yet. To some extent operating an electric vehicle can be considered as a show case to demonstrate sustainable ambitions and hence to attract new customers or at least to reinforce its current market position.

In many cases the negative experiences with electric vehicles consist of a too limited operating range and payload of the vehicle, due to the heavy weight of the batteries. The operating range and payload do not meet the requirements for which the vehicle was intended to be used. This is often caused by too optimistic performance claims of the vehicle producer. However, applications in short distance transport in general show satisfying experiences.

Besides some positive exceptions many companies have faced a lack of technical reliability of electric vehicles. The vehicles are sensitive to failures (converted vehicles in particular) and there is a lack of quality in aftersales services: limited know-how on repairs and limited availability of spare parts. These problems relate to the fact that the substantial truck manufacturers are not strongly involved in the development of electric trucks yet. Especially in the market segment of larger and hence heavier trucks there is still a challenge to achieve a significant improvement of the performance of electric trucks, mainly in achieving a satisfactory operational range. The availability of subsidies to invest in electric vehicles as well as the privileges that are granted to these vehicles e.g. exemption of time window delivery restrictions and access to environmental zones, are major incentives to support and start new initiatives. As long as the development of electric freight vehicles is in its infancy such support is of great importance.

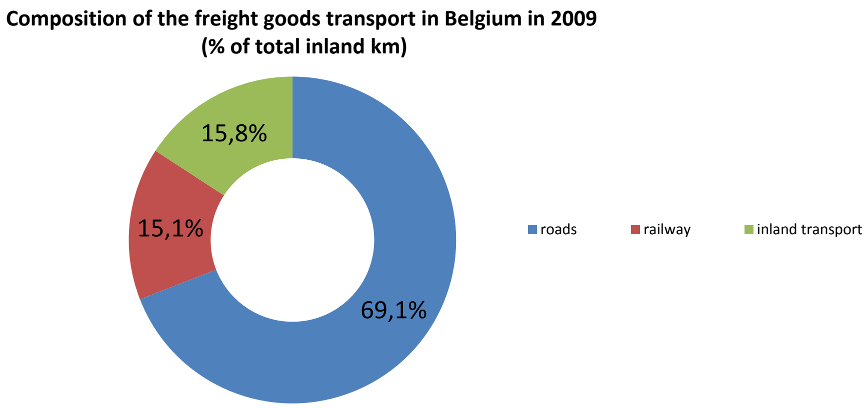
e-mobility NSR

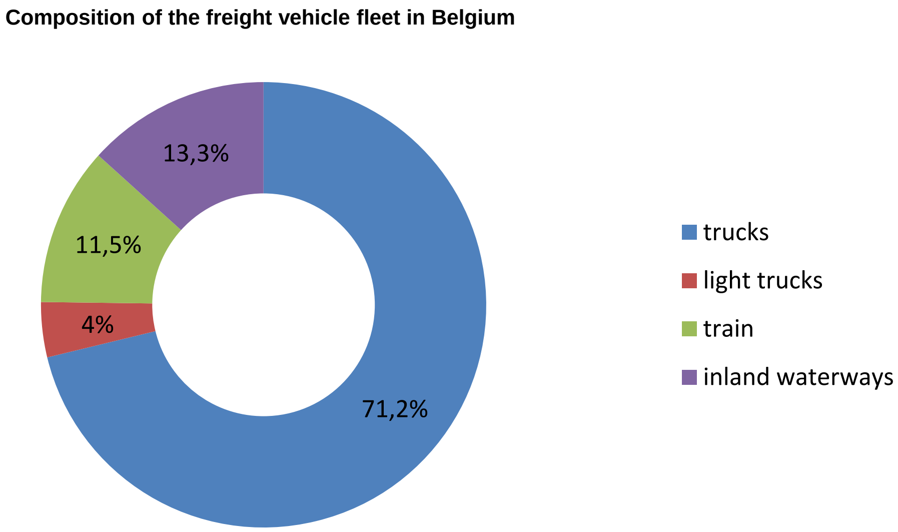
Belgian cases



1 An overview of the freight transport sector

The composition of the Belgium transport sector reflects the large bulk loading point of the Port of Antwerp, thus giving focus to large trucks and inland waterway transport. Regarding road transport, 95.947.000 tonnes of goods were transported. Chemicals and synthetic fibres, rubber or plastic and nuclear industry products constituted the highest share of goods transported on roads 13.865.000 tonnes. Listing the second largest groups of goods transported these are: foods, beverages and tobacco 11.942.000 tonnes, metal ores and other mining and quarrying products 10.836.000 tonnes and base metals, fabricated metal products, except machinery and equipment 10.064.000 tonnes. The composition of the freight goods transport fleet in Belgium is presented below:





Belgium CO_2 emission share for sectors in 2010

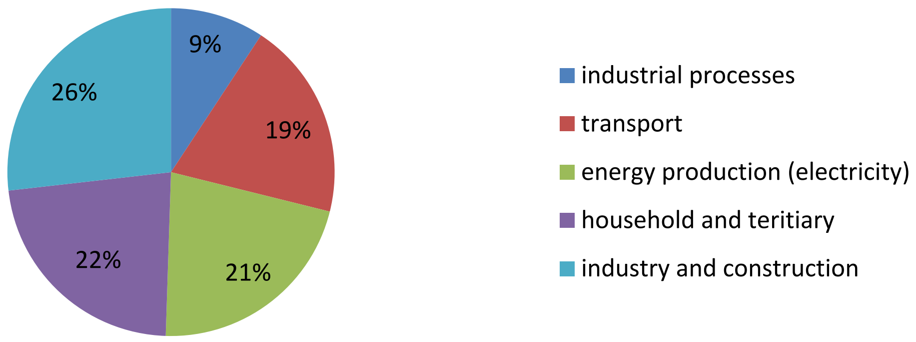


Figure 71: Data on the composition of the freight transport sector in Belgium.

The stock of vehicles in Belgium was accounted for 6.092 million units in 2009. Trucks constituted the main share of vehicles (71,2%) of the whole freight vehicle fleet.

Aim

The aim of this report is to describe progress in electric urban freight logistics systems in Belgium, namely in the use of electric vehicles for goods distribution. Provided with this knowledge, possible impacts of the conducted projects will be assessed, and elaboration on the experienced barriers connected with electric freight vehicles utilisation will be provided.

Below is found a map presenting the location of initiatives on electric mobility in Belgium. As can be observed on the map most of the electric mobility initiatives are located in Flanders,

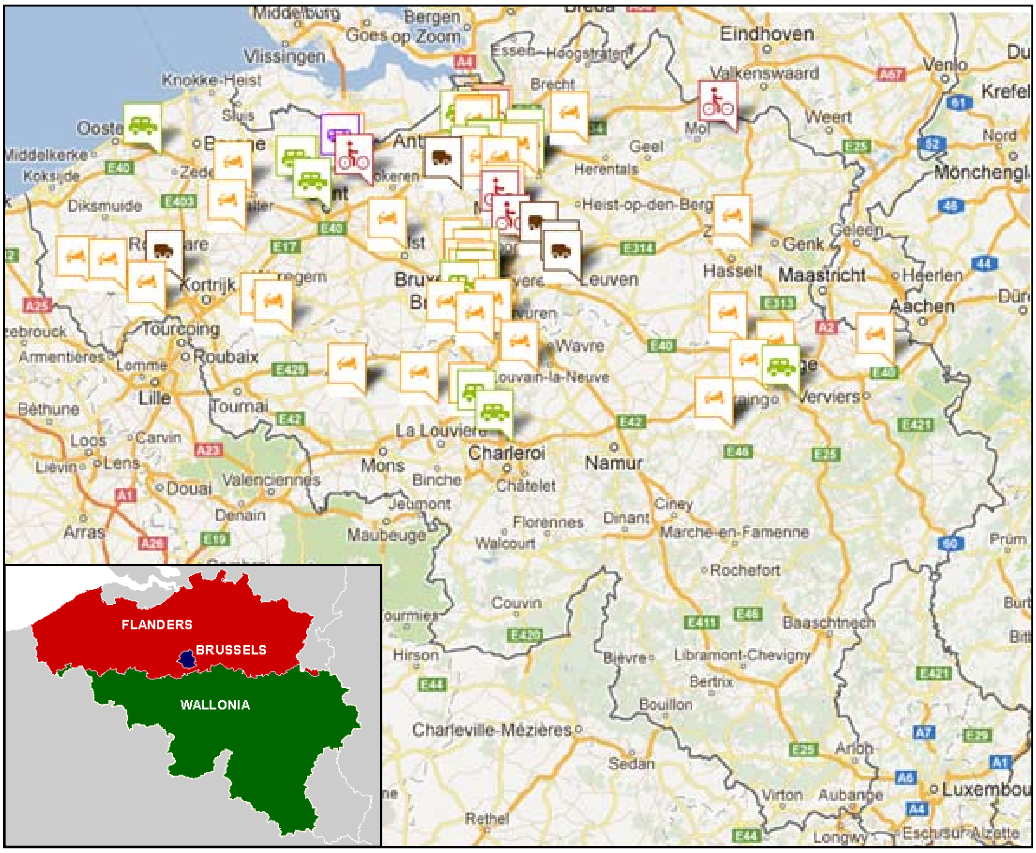


Figure 72 Spatial distribution of electric vehicles in Belgium,
Source: http://www.asbe.be/nl/EV's

Legend:

Personal electric cars — **Buses**

Truck N2, N3, O - GVW> 3.5 tonnes — **Quadricycles**

Vans - GVW <3.5 tonnes — **Bicycles**

In Belgium the share of electric and hybrid vehicles is still below 0.5% of the total amount of vehicles. There are around 1.545 electric vehicles in Belgium and most of these vehicles are forklifts and golfing carts. The second largest group of electric vehicles is electric light duty vehicles. In addition Belgium has a limited number of electric motorcycles (tricycles and quadricycles) with 117 items. Trucks and vans make up together 71 items.

Fuel type	Year	Personal vehicles	Buses	Commercial vehicles					
				Trucks, vans	Tractors	Agricultural tractors	Special vehicles	Motor-cycles	Total number
Electrified	2007	8	19	48	3	5	937	10	1.030
	2008	10	19	53	3	9	995	20	1.109
	2009	10	19	59	3	12	1.087	39	1.229
	2010	36	3 (?)	65	3	13	1.104	71	1.295
	2011	263	3 (?)	71	3	15	1.174	117	1.545

Figure 73 Electric vehicles fleet in Belgium 2007-2011,
source:http://statbel.fgov.be/nl/modules/publications/statistiques/verkeer_vervoer/evolution_du_parc_de_vehicules_2011.jsp and www.ieahev.org

2 Policies and legislation concerning electric vehicles

The annual Belgium CO_2 emissions are around 125 million tons. The Belgium government has plans to reduce this by 15% till 2030. This is, among others, planned to be achieved through an increased share of renewable sources in energy consumption. The federal Belgium target is to attain a 13% share by 2020.

The following account on policies and legislation in Belgium is divided according to the countries three main regions: Flanders Region, Wallonia Region and Brussels Capital Region. Therefore, initiatives undertaken on electric freight vehicles differ between them. However, concerning legislation on electric vehicles Belgium is seen as one administrative unit, though with sometimes differing opportunities for subsidies[3].

Belgium:

- Private owners market: those who purchase a passenger car that is powered exclusively by an electric motor receive a personal income tax reduction of 30% of the purchase price (with a maximum of 9.510 €).
- Business market: The deductibility rate for expenses related to the purchase and use of company cars is 120% for zero emissions vehicles.
- All electric vehicle owners pay the lowest rate of tax under the annual circulation tax which is 73,79 €.

Wallonia region

- Private persons, who purchase a passenger car that is powered exclusively by an electric motor, pay the lowest rate of **tax under the registration tax** (61,50 €) in Wallonia region.
- Vehicles that do not qualify for the 30% **income tax reduction** may benefit from the Eco-bonus in Wallonia. Grant varying from 500 € to 3.500 € can be appointed for cars emitting less than 80 g/km.
- The government of the Wallonia region has also given subsidies for the purchase of electric vehicles by **municipalities**. Maximum subsidy depends on the type of vehicle purchased, but the grant cannot exceed 75% of the purchase cost. Electric vehicles which can get financial assistance are: electrically bicycles (up to 1.000 €), electric scooters/electric mopeds (up to 1.500 €), electric motorcycles (up to 5.000 €), electric cars (up to 15.000 €) and electric commercial vehicles (up to 25.000 €). The goal of the subsidy program is to encourage utilization of less pollutant and more energy efficient means of transport.

[3] All information included in this part of the report is cited from the website: http://www.acea.be/images/uploads/files/Electric_vehicles_overview.pdf.

Flanders region

- Electric vehicles are exempted from registration tax in Flanders.

Brussels Capital Region

- Private persons, who purchase a passenger car that is powered exclusively by an electric motor, pay the lowest rate of tax under the registration tax (€ 61,50) in Brussels Capital Region.

3 Initiatives on urban freight transport with electric vehicles

Legislation regarding electric vehicles can vary from region to region, as described in the previous section. The same situation is applicable when it comes to policies conducted and initiatives undertaken. Those in Flanders differ from those undertaken in Wallonia and in Brussels Capital Region. Below is presented a short description of policies and projects concerning electric freight vehicles divided into: Flanders, Wallonia and Brussels Capital Region.

Based on initiatives like subsidies / tax deduction / exemptions provided for electric vehicles purchase, Flanders region seems to be the most developed with regard to improving the conditions for employing electric vehicles. This is because the region not only provided financial support, but also created complex programs, aiming at the physical tests of electric vehicles.

Flanders region

The Flemish government, on initiative of the Minister of Innovation - Ingrid Lieten, launched the Living Lab Electric Vehicles program to facilitate and accelerate the innovation and adoption of electric vehicles in the Flanders region. There have been established 5 platforms within the Flemish Living Lab Electric Vehicles. These are: EVA (Electric Vehicles in Action), EVTecLab, iMOVE, Olympus and Volt-Air. The 3 first programs include issues concerning electric freight vehicles. Namely, EVA and iMove use vans delivered from companies cooperating within the EVTecLab platform. Private and public partners (municipalities) are co-financing the initiative. In total, more than 70 companies, organizations and research partners are working together. The subsidies come from the regional authority (IWT - Flemish Agency for Innovation by Science and Technology). In total 16,25 million EUR is subsidized and about 10 million is co-funded by the partners (http://www.livinglab-ev.be/). Besides of this comprehensive program, there were also found other initiatives in Flanders region:

- **EVA –** Electric Vehicles in Action; utilized 5 electric light duty trucks and 25 electric vans,
- **iMove –** utilized 2 electric trucks (transport of furniture) and 15 electric vans (technical service of electricity distribution company),
- **EV Teclab** – specialized in the development of electric drivetrains for heavy duty vehicles, vans and busses
- **Electric truck and electric cargo bicycles serving Antwerp City Depot** (delivery of retail outlets and garbage collection),
- **Goupil electric light freight truck utilized by Antwerp city** (municipal technical services),
- **Goupil electric light freight truck used by private institution in Antwerp city** (food internal transport),
- **Binkey truck in the Malines region** (garbage collection),

Wallonia region

- **Subsidized purchase of electric light freight trucks**. One big initiative was undertaken concerning, among others, electric light freight vehicles. Smaller schemes were not found.

Brussels Capital Region

Brussels Capital Region aims to achieve 5.000 registered electric vehicles by 2015. Ten actions were defined for this purpose:

- Installation of 4.000 charging points (public) by 2015;
- Introduction of a 'écoprime' to purchase a vehicle contributing to low CO_2 emissions;
- Opening of lanes reserved for buses and taxis to electric vehicles;
- Parking free or reduced price for electric vehicles, in public locations reserved with a charging station;
- At least 10% of electric vehicles in the park of the Brussels-Capital and municipal institutions by 2015;
- 5% of electric taxis by 2015 and 10% of electric vehicles for car sharing;
- Introduction of larger delivery schedules for electric vans;
- In collaboration with STIB, setting up a pilot electric buses;
- Creating a point of contact and electric vehicles as coordinator of a VE;
- Setting up the appropriate framework to ensure the rapid deployment of a network of public stations of natural gas distribution.

Besides of this plan, the following initiatives have been undertaken in Brussels Capital Region:

- Binkey truck at the Brussels' airport (garbage collection),
- SITAIR truck at the Brussels airport (garbage collection),
- Goupil electric light freight truck in Brussels (municipal technical services)
- Goupil electric light freight truck in Brussels by Ecopostale and TNT (green post deliveries)

3.1 EVA – Electric Vehicles in Action

Status: in operation/ pilot project (July 2011- June 2013)

Location: Many municipalities across the region of Flanders

Figure 74 EVA program logo

Participants:

a) Core partners among companies involved: Eandis (electricity distributor), FederAuto (Belgian association for car industry companies), Telenet (telecommunication), Blue Corner (charging stations), 4iS (consulting).
b) Public institutions:
   - Flanders Government , Flanders Living Lab initiative ("Vlaamse Proeftuin Elektrische Voertuigen") and municipalities within Flanders region: Aalst - Blankenberge - Brasschaat - Brecht - Bredene - Brugge - De Haan -De Panne - Dendermonde - Edegem - Geel - Gent - Grimbergen - Halle -Heist-op-den-Berg - Hoeilaart - Hove – Ieper - Kapellen - Knokke - Koksijde - Kortrijk - Leuven - Lier - Maldegem - Mechelen - Mortsel - Nieuwpoort - Ninove - Oostende -Oudenaarde - Overijse - Poperinge - Provincie Antwerpen - Provincie Oost-Vlaanderen - Provincie West-Vlaanderen - Roeselare - Sint-Niklaas - Turnhout - Vilvoorde - Waregem -ZulteFlanders Living Lab initiative ("Vlaamse Proeftuin Elektrische Voertuigen").

c) Researchers: Vrije University Brussels, Gent University.
d) Testing companies and advisor partners:

   - Artexis - ASBE - BeCharged - Bpost - Cofely Services - Ecological Innovation - Educam -Electrabel - eNovates – ESRI - Flanders Smart HUB - GGE Ghistelinck - groep VAB - IBBT - Ikea- Ineltra Systems - Manus - Sowepo - Total - VIM - Volvo Logistics[4]

Project description

EVA is one of 5 initiatives covered by Flanders Living Lab, an innovation programme focusing on electric vehicles set up by the Flemish Government and confined to the Flemish Region. The remaining initiatives are: EvTecLab, iMove, Olympus, Volt-Air. Project's investment is 2.244.000 € and operating budget is 1.100.000 €.

Tests sites are located across the Flanders region in numerous municipalities. Charging stations examined within this project are located in public spots and semi-public spaces such as supermarkets or privately owned toll parking. All charging spots are planned to be established by September 2012. The test fleet includes a wide range of more than 20 different brands and types of electric vehicles including vans, buses, scooters and quadricycles. Private users, governmental workers and transport industry staff are the groups taking part in this project. Hence, tests include vehicles used in public and business field. One of the test scenarios that a partner (VAB Group) is testing is a vehicle that can service electric vehicles that have a breakdown on the road.

As for now, 5 electric light duty trucks are used by Eandis, a company working with electricity distribution. It is mainly their service personnel who utilize them. 25 electric vans are used by Eandis (also utilized by service personnel) and the Flemish municipalities. Municipalities utilize e-vans for technical services, which are conducted by technical workers and green workers.

Project scope

EVA Project encompasses:

- Full instalment of 220 charging points that are being clustered on 71 “charging islands” in about 80% of Flemish municipalities – charging points for electric cars/vans and e-bikes across Flemish municipalities.
- 89 electric vehicles will be tested by ordinary users. 5 light duty trucks and 25 electric vans included in this number.
- The test fleet includes a wide range of more than 20 different brands.

Goals:

- Government’s initiatives to encourage electric driving.
- The development of new products and services in the domain of electric vehicles for employment creation**.**

Technical specification:

The vehicles used are Renault Kangoo Z.E, Mia Box Van and Goupil Electrotruck G3, G5 E Van and G5 E Pick-up.

Figure 75 Test van of EVA in Blankenberge at the Belgian Coast

Support from public authorities or other companies:
Financial and legal: The Flemish Government supports financially with 3,3 million EUR of which 2/3 for the investment cost of charging infrastructure and vehicles. Cost of the remaining will be covered by the project consortium.

Results:
The project is not finished yet; therefore no results are yet available. Planned deliverables are:

- A real-life information on the charging and travelling behaviour, that can be used for different kind of research projects, e.g. to learn about charging points' and electric vehicles' usage pattern or in order to calculate the exact number of necessary charging stations and the best locations for installing them (in terms of geographical coverage and charging behaviour).
- Information on the impact on the grid

Comments: The core focus of this program is on charging solutions, thus urban freight logistics is not a core field of EVA investigation. Even though, electric vans are used in this project for goods transport and services and the results of the project will therefore be interesting to follow.

3.2 iMove and Ev TecLab – a large scale testing initiative in electric vehicles

Status: In operation (July 2011- June 2014)/ pilot project

Location: Many municipalities across Flanders region

Participants:
The consortium consist of 18 companies and research institutions: Belgacom/ Mobile For, Delhaize, EDF Luminus, Ernst & Young, Flanders' DRIVE, Fleet&DriverCare, Gemeenterlijk Autonoom Parkeerbedrijf Antwerpen (GAPA), Hendriks Groep, Infrax, Interparking, Janssen Pharmaceutica, P&V Elektrotechniek, Punch Powertrain, REstore, ThePluginCompany, Umicore (world producer of cathode materials for rechargeable batteries in electric and hybrid vehicles) and Vrije University Brussels.

Figure 76: iMove programe logo

Figure 77: EV TecLab programme logo

Project description
iMove is one of 5 initiatives covered by Flanders Living Lab, an organization focusing on electric vehicles, settled by the Flemish Government and confined to the Flemish Region. The goal of Living Lab is to facilitate and accelerate the innovation in the domain of electric vehicles. The project's investment is 3.078.000 € and operating budget is 1.000.000 €. Total investment of consortium partners is 10.000.000 €.

iMove is an initiative of 17 Flemish energy, vehicle industry companies and research institutions. In the project a few thousand people are given the chance to try out driving electric vehicles. Test groups consist of individuals and employees, who use EV's for professional reasons. Cars will be charged at 300 new charging spots, produced for the usage of renewable electricity sources. iMove uses electric cars and vans that were retrofitted by Punch Powertrain (as part of the EV TECLAB platform). The retrofitted vehicles will mainly be tested by professional drivers. Vans will be used by Infrax company (electricity distribution), for service personnel.

An E-truck utilized by the City of Lommel will be used for conferences' supply: chairs, tables etc. Who will use the second E-truck has not been decided yet. Typical applications for this E-truck, as conceived by the producer (E-truckseurope) are among others: garbage collection, inner cities logistics and container transport. They see the E-truck as ideal for city garbage collection: "*A garbage truck drives an average of 157 km per day, perfectly within the range of our electric truck",* says André Beukers,E-truckseurope.
(http://www.transportmanagement.be/1896/e-truck-is-klaar-voor homologatie).

Project scope:
A large scale test of electric vehicles by ordinary users: 175 electric cars, including 2 electric trucks and 15 electric vans are currently on the roads. 30 more were retrofitted by the end of 2012 (for both Eva and iMove project). In addition a total of 300 charging points have been established. EV Teclab will develop various prototypes that will be tested by in real life e.g. by a public transport company in Flanders "De Lijn" in the city of Bruges. The vehicles that will be developed are:

- 30 electric vans (Ford Connect with ICE that are converted to full electric)
- 3 electric busses (developed by Van Hool)
- 2 electric trucks

Goals:
The objective is to use the monitoring data for innovation and research purposes. The consortium aims at a rapid introduction of electric vehicles and sustainable mobility in Flanders.

Figure 78 E-truck performing in iMove project
http://i3.ytimg.com/vi/2bGPROgAfuc/mqdefault.jpg, http://i3.ytimg.com/vi/2bGPROgAfuc/mqdefault.jpg

Support from public authorities or other companies:
Private and public partners (municipalities) are co-financing the iMove initiative. The subsidies come from the regional authorities and IWT (Flemish Agency for Innovation by Science and Technology). In total 4 million € is subsidized of which 3 million € for investments in charging infrastructure and vehicles.

The EV Teclab programme is supported with 3.817.000 € from the Flemish government.

Results:

- The consumption and range of electric vehicles in different driving styles, weather and road conditions (flat and hilly routes);
- The interaction between electric vehicles and smart grid;
- The suitability of charging infrastructure for all electric vehicles and the invoicing of its use independent of the selected energy supplier.

Impact:
"The scale of this pilot project, one of the largest in Europe, and the close involvement of the car producers and suppliers contribute to the depth of the research. Also, various actors in the electricity market represented by which we include are able to demonstrate that electric cars contribute to increased and efficient use of renewable energy", said Jan Flies coordinator iMOVE project, in a press release from Electrawinds.

3.3 Electric truck and electric cargo bicycles serving Antwerp City **Depot**

Status: In operation since 2011

Location: Hasselt City

Participants:
City of Hasselt, Grope H. Essers (logistics expertises), Unizo Hasselt (Union of Independent Entrepreneurs), Veloexpress (biking courier services), VHCH (local merchant association), Ethias (insurance company), Logistra (local logistics partner), Flanders in Action Pact 2020 (Flemish Government initiative), Agentschab Ondemem (Flemish public authority for entrepreneurs' assistance), VVSG (social services), Fietsbasis (biking services; social economy company).

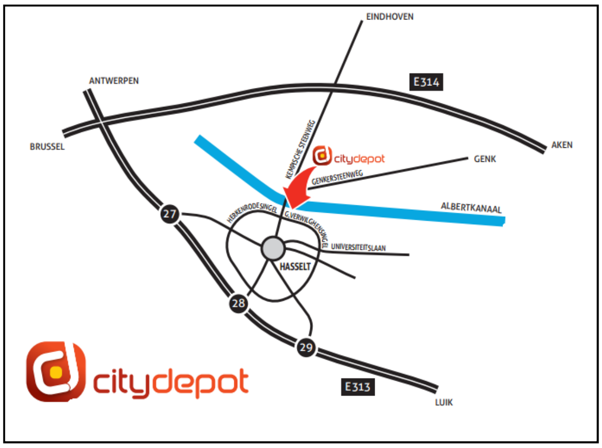


Figure 79: Hasselt City Depot location. Source: http://www.citydepot.be/sites/default/files/images/contact/ligging_CityDepot.pdf

Project description:
A number of shops in the Hasselt's inner city are growing. The disadvantage is that there are more trucks needed in the city to perform the delivery for the retailers. Therefore the City Depot concept for Hasselt was developed and implemented. Goods are bundled at the City Depot located in the city's outskirts, from where they are transported to the city centre. Deliveries are carried out with an electric truck and electrically supported bicycles. The main mean of transport is an electric truck, while electric bikes are used for urgently requested deliveries ("just-in-time"). The electric truck departs from the City Depot twice a day and circulates between the shops in the inner city. Such a limited number of trips are possible because the deliveries for different shops are combined. Moreover, when the goods are delivered to the specific shop, the garbage produced by them is also collected (paper, wood, plastic and cardboard) and stored temporarily in the City Depot. When the just-in-time service is required by the retailer they call City Depot and get the required goods within half an hour. It is possible to transport up to 1 cubic meter this way. In the longer term it is planned that customers, who find it more suitable, will be able to pick up large products at the City Depot, which they purchased in the city centre.

Project scope:
- One electric truck providing deliveries to the inner city,
- Electrically supported bicycles.

Goals:

- Development of a sustainable city logistics concept (green, efficient and flexible),
- A more liveable and pleasant city, thanks to decreased traffic and number of parked vehicles in the inner city.

Support from public authorities or other companies:
Flemish Government has supported City Depot in Hasselt with a 311.000 € grant.

Results:

- For suppliers and for traders: bigger flexibility, as suppliers can navigate with their delivery times (between 7 and 18).
- For the city and inhabitants: fewer trucks (1.140 large trucks less), less traffic (433,15km) due to optimised routes, less noise and less pollution (182.346 kg CO_2). Decreased number not only of trucks delivering products, but also of those collecting garbage.

Figure 80 An electric truck and electric bicycle utilized by Hasselt City Depot. Source : http://www.citydepot.be/home

3.4 SITAIR – garbage collection at the Brussels Airport

Status: In operation since March 2012

Location: Brussels airport in Zavantem

Participants:
Private initiative: Aviapartner and SITA. Aviapartner is one of the leading independent providers of ground handling services across 35 airports in 5 European countries. SITA is the biggest player on the Belgian waste management market. Having 50 branches it provides services for whole of Belgium. It employs 2.500 persons and possesses a fleet of 1.100 vehicles. It collects waste from 50.000 companies and areas with 3.8 million inhabitants.


Figure 81 SITAIR truck

Project description:
Garbage is collected from 20 places at the airport and then transported to the recycling centre, also located at the airport. SITAIR developed this truck in order to navigate in narrow airport's corridors quietly and with no emission.

Project scope:
CO_2 free garbage collection at Brussels Airport using one SITAIR electric truck.

Goals:
- Environmental friendly garbage collection and transport at the airport,
- Reduced noise and emission at the narrow airport's passages.

Support from public authorities or other companies:
The project was not subsidized.

Results:
CO_2 emission amounting to 130 tons per truck per year is avoided.

Comments:
AVIAPARTNER aims to launch electric trucks in all the 35 airports it serves.

3.5 Garbage collecting truck "Binkey" in the Malines region and at the Brussels airport

Status: In operation since July 2011/ in operation from August 2012

Location: Malines region/ Brussels airport

Participants:
Van Gansewinkel waste management company

Project description:
Binkey is an electric garbage transport. It not only ensures quiet and clean garbage collection, but it can also be recharged with the material gathered. Once the waste is collected, it is converted into fuel, which enables electricity production at the waste treatment site. This electricity is then used for charging the electric truck – Binkeys. The scheme works the same in the Malines region as at the Brussels airport. However, the role of Binkeys is reduced at the latter to emptying of FOD (Foreign Object Debris) containers. It is because there is already operating another electric truck, SITAIR (described previously). At the airport's waste residual, fraction is converted into electricity and the truck can be recharged.

Project scope:
Two electric trucks

Figure 83: Binkey electric trucks at work,
source:http://www.truck-business.com/van_gansewinkel_introduceert_binkey__53588-nl-158-185380.html

Goals:
As Legal Environmental and Legal Affairs Director for the Brussels airport states: "*This new product is not only environmentally friendly, it also has an important symbolic value for the 260 other companies that are active at the airport, and our passengers.*"

Support from public authorities or other companies:
The project was not subsidized.

Results:
Driving this electric garbage truck will benefit air quality in the city as the vehicle emits no CO_2 during driving; an emission of 10 tonnes of CO_2 is avoided.

Special features:
The vehicle is made of fully recyclable steel.

3.6 Goupil “Antverpia” light freight truck: Municipal technical services within Antwerp city

Status: In operation (Vehicles delivered between December 2007 and October 2009)

Location: Antwerp City

Participants:
Antwerp City municipality

Project description:
Goupils purchased by the City of Antwerp are used in the cemeteries and the green areas of the city. It is used for emptying bins, sweeping services, gardening, spraying and ground works.

Figure 84 Goupil in use in Antwerp city. Source: http://www.electrocar.eu/nl/nieuwsitem/18-stad-antwerpen-kiest-voor-goupil.htm

Project scope:
To test eight Goupil light freight electric trucks

Support from public authorities or other companies:
The project was not subsidized.

Results:
The cars have been registered, so they can be used all over the city of Antwerp and not only within the cemeteries and the green areas, but also on public roads.

3.7 Goupil electric light freight truck: food transport

Figure 85 Goupil G3-1S "Borgerstein"

Status: In operation since June 2011

Location: Antwerp city

Participants:
Borgerstein Institute Hospital

Project description:
The vehicle used is a modified version of Goupil G3-1S. In addition to the aluminium cargo box, there is also an integrated ramp and lift system to easily load 350 kg food-carts in the rear compartment. Vehicles are used for internal transportation (within the hospital property) of conditioned food cars and linen containers.

Project scope:
5 Goupil light freight electric trucks in use

Support from public authorities or other companies:
The project was not subsidized.

Results:
No results of the project are available.

3.8 Goupil electric light freight truck: Manus company technical neighborhood services within Antwerp and Brussels

Status: Goupil G3-1S in operation since April 2008 and Goupil G3-2L Van in operation since July 2011

Location: Antwerp city and Brussels City

Participants:
Manus

Figure 86 Goupil G3-2L
source: http://www.evalbum.com/3868

Figure 87 Goupil G3-1S
source: http://www.evalbum.com/2247

Project description:
Manus is a neighbourhood management company providing specific services to residents, government, businesses, associations and social housing, where low-skilled residents as employees are deployed.
Antwerp: The Goupil models utilized by Manus company are intended to work in neighbourhood management/city management field, what implies: green maintenance, cleaning, garbage collection and (soft) renovation.
Brussels: Two Goupils in operation from 2010, next two from 2011 and the newest two from 2012. They are used for start-stop utility tasks like emptying garbage bins, loading leaves and branches, carrying light machines like lawnmowers. In general, they are used for all the tasks requiring frequent stops and short distances. Goupils are utilised in the city itself and in the cemetery.

Project scope:
4 Goupil light freight electric trucks in use: 2 items of 2008 Goupils G3-1S and 2 items of 2011 Goupil G3-2L Van

Goals:
One of the pillars of Manus company's mission is to work as environment friendly as possible.

Support from public authorities or other companies:
There are no subsidies available for this kind of investment in the Brussels Area. The vehicles were completely financed by the green area service.

Results:
No results of the project are available

3.9 Green post deliveries within Brussels city by Ecopostale and TNT

Figure 88 Electric light freight truck utilised by Ecopostale, Source: http://ymlp.com/ztx854

Status: Goupil electric light freight truck in operation from the middle of 2011

Location: Brussels City

Participants: Ecopostale and TNT

Project description:
Ecopostale is a courier company founded in 2010 and operating in the city of Brussels. Their services are carried out only with the use of electric vehicles. Urgent orders are carried out with “express couriers” – bicycles, while the regular activities are conducted with electric tricycles and a Goupil truck. Tricycles are electrically supported ones. Each of them has its own, constant route and they make around 35-40 km per day. Five out of eight electric tricycles are used by Ecopostale and three of them are used for the TNT Express clients. Their Goupil truck was purchased in order to deliver packages and mails over longer distances. Therefore it is also used outside the city centre of Brussels. The Goupil truck makes only one route per day from Ecopostale depot to their clients. This is possible, because all packages and mails needed to be delivered during this day are packed into this truck. The electric truck of Ecopostale can drive up to 80 km per day.

Project scope:
- 4 bicycles,
- 8 electric tricycles,
- 1 Goupil light freight electric truck.

Goals:
- The general goal of Ecopostale company while launching electric vehicles’ based courier services was to ensure more punctual (able to avoid traffic) and more environmental friendly deliveries. Ecopostale is building their advantage over competitors in the courier services on the basis of electric mean of transport.
- The reason for start using an electric truck was to serve clients located in the whole “Big Brussels” area with the use of environmental friendly vehicles. It was not possible to serve such a big area with the use of electric tricycles.

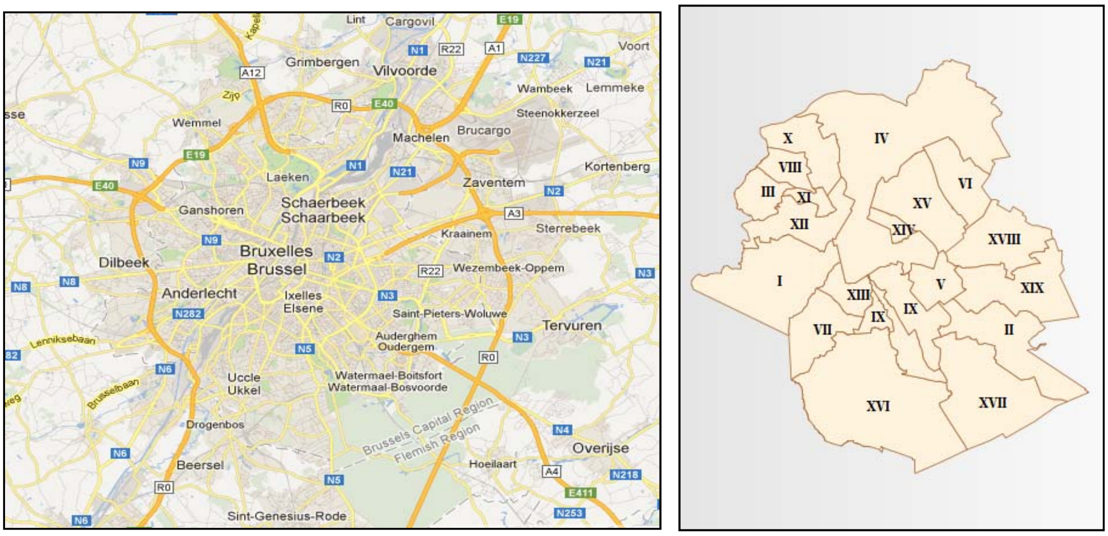


Figure 89 Brussels city map. Sources: http://maps.google.dk, http://en.wikipedia.org/wiki/Brussels

Support from public authorities or other companies:
The purchase of the E-truck was subsidised with 5.000 €.

Results:
While conducting 10.849 deliveries:

- 2.071.960 gram of CO_2 were avoided,
- 975 litters of fuel use were avoided.

According to Ecopostale general manager, Nicolas Entienne: "*We are very satisfied with this vehicle. We are convinced it represents a good compromise for our needs regarding the deliveries in the city centres: maximal speed, range, width, length and load capacity. Until now we haven't encountered any problem (compared with other vehicles we have tried: sudden loss of power, loss of range). Our conclusion is that this kind of vehicle is perfect for intra-urban logistic and deliveries, but shows its limits for long distances or higher speed (on speedways for example)".*

3.10 Subsidized purchase of electric light freight trucks in Wallonia

Status: In operation since 2011

Location: Wallonia region

Participants:
11 municipalities of the Wallonia region

Project description:
The project was established by the Wallonia region government and supported financially by this authority. Electric vehicles, which can get a financial assistance are: supported electrically bicycles (up to 1.000 €), electric scooters/electric mopeds (up to 1.500 €), electric motorcycles (up to 5.000 €), electric cars (up to 15.000 €) and electric commercial vehicles (up to 25.000 €).

Figure 90 Logo put on EV's subsidized by government of Wallonia region

Walloon municipalities' got 2 choices: to buy either Cityfort E1 vehicle or Ecomille Jolly 1200 vehicle. In 2009, 84 Walloon municipalities got the subsidy for electric vehicles' purchase. However, not all of them finally decided for a purchase. All the municipalities, which purchased an electric freight vehicle, got the maximum 75% subsidy. Each municipality decided to purchase either one Jolly 1200 or one CityFort E1 electric light freight truck. Only Cityfort E1 is already in use as there is being experienced delay with Jolly 1200's deliveries. Some municipalities started to use Cityfort E1 in 2011, others in 2012. They are used for a big variety of technical services: green services (including cemeteries), street cleaning, transport of goods and garbage collection in the city centres. Some of them are also used for transporting employees.

Project scope:

- 11 Jolly 1200 light freight electric trucks purchased by 11 Walloon municipalities
- 30 CityFort E1 light freight electric trucks purchased by 30 Walloon municipalities

Goals:

- Encouraging utilization of less polluting and more energy efficient means of transport
- For municipalities: an economic gain, as there was available subsidies from the Wallonia region government for electric vehicles purchase.

Support from public authorities or other companies:
81 municipalities where awarded with the Wallonia region government grant. Subsidy was accounted for maximum 75 % of the value of the electric vehicle (VAT included). The rest of the purchase cost was covered by the municipalities own costs.

Results:

According to the municipalities, the most important problem with the Cityfort E1 vehicles is the reduced autonomy. Some other are not satisfied with the vehicle's performance while driving during bad weather conditions (snow, ice, rain). Additionally, they complain about the limited speed.

Figure 91 Cityfort E1 and Jolly 1200
Source: http://www.greenwaco.be/nl/jolly1200.php, http://www.greencarsite.co.uk/vannews/CityFort-electric-vans.htm

4 Summary and conclusions

Main functions of freight EV's within city distribution

a) Most often used by municipalities for technical services (ground works, streets' cleaning), garbage collection from the city centre and green areas maintenance
b) For garbage collection within the whole city's area
c) For inner cities logistics (as an element of city depot concept)
d) For packages and mails deliveries within the whole city's area
e) For bins emptying at the airport
f) For conditioned food and linen containers transport within the hospital area
g) For technical services, used by electricity distribution companies

Impacts

a) A real-life information on the charging and travelling behaviour, that can be used for different kind of research projects is being gathered, e.g. to learn about charging points' and electric vehicles' usage pattern or in order to calculate the exact number of necessary charging stations and the best locations for installing them (in terms of geographical coverage and charging behaviour).
b) Real-life information on the consumption and range of electric vehicles in different driving styles, weather and road conditions (flat and hilly routes) is being gathered.
c) Information on the impact on the grid is being gathered.
d) Development of a sustainable city logistics concept: green, efficient and flexible (city depots with deliveries performed by EV's.
e) A more liveable and pleasant city: less noise and less pollution.

Drivers

- Technical factors
  - The range of an electric truck used is well suited for garbage transport needs within urban areas.
  - Feasible for airports, as EV's can navigate quietly and with no emission within its narrow corridors.
  - Electric bicycles did not have sufficient capacity, therefore an electric light truck was purchased; moreover it's more efficient than electric bicycles as less travels are needed.
  - There are already produced electric trucks with technical specification feasible for city distribution: range: 250 km, maximum speed: 90 km/h, payload: 22 tons
  - Garbage collecting trucks can be recharged with the material gathered.
  - EV's are feasible for works requiring frequent stops and short distances.
  - Light electric trucks are feasible for city distribution. Clients were satisfied with the maximal speed, range, width, length and load capacity.

- Financial factors
  - Public charging infrastructure establishment notably supported financially by public authorities: the biggest project is subsidized with 16,25 million € (60% of the project budget)
  - There were created big consortiums of companies financing long term testing of EV's.

- Energy supply and infrastructure factors
  - 300 public charging points and 71 "charging islands" (with 220 charging points) were installed within conducted test projects in about 80% of Flemish municipalities.

- Environmental factors
  - 300 new charging spots will charge with renewable energy sources.
  - Some of EV's are made of fully recyclable steel.

- Process and logistics factors
  - EV's play an important role in the successful city depot concept implementation; light electric trucks can enter city centres, they are green and efficient.
  - EV's attain higher flexibility of supplies to the city centre, as they can enter the city centre between 7am - 6 pm, unlike ICE vehicles.

- Regulatory factors
  - Tax incentives for EV's' purchases are present 120% deductibility for a business market
  - 30% of the purchase price with a maximum of 9.190 EUR
  - Government of Wallonia region has also given subsidies for the purchase of electric vehicles by municipalities (grant cannot exceed 75% of the purchase cost)

- Human factors
  - None identified

Challenges

- Technical factors
  - Small range
  - Low max speed
  - Sudden loss of power, loss of range while driving during bad weather conditions (snow, ice, rain).

Opportunities

- Technical factors
  - 20 different brands and types of electric vehicles including vans, buses, scooters and quadricycles were tested.
  - ICE cars retrofitted with an electric engine are taking part in pilot projects.

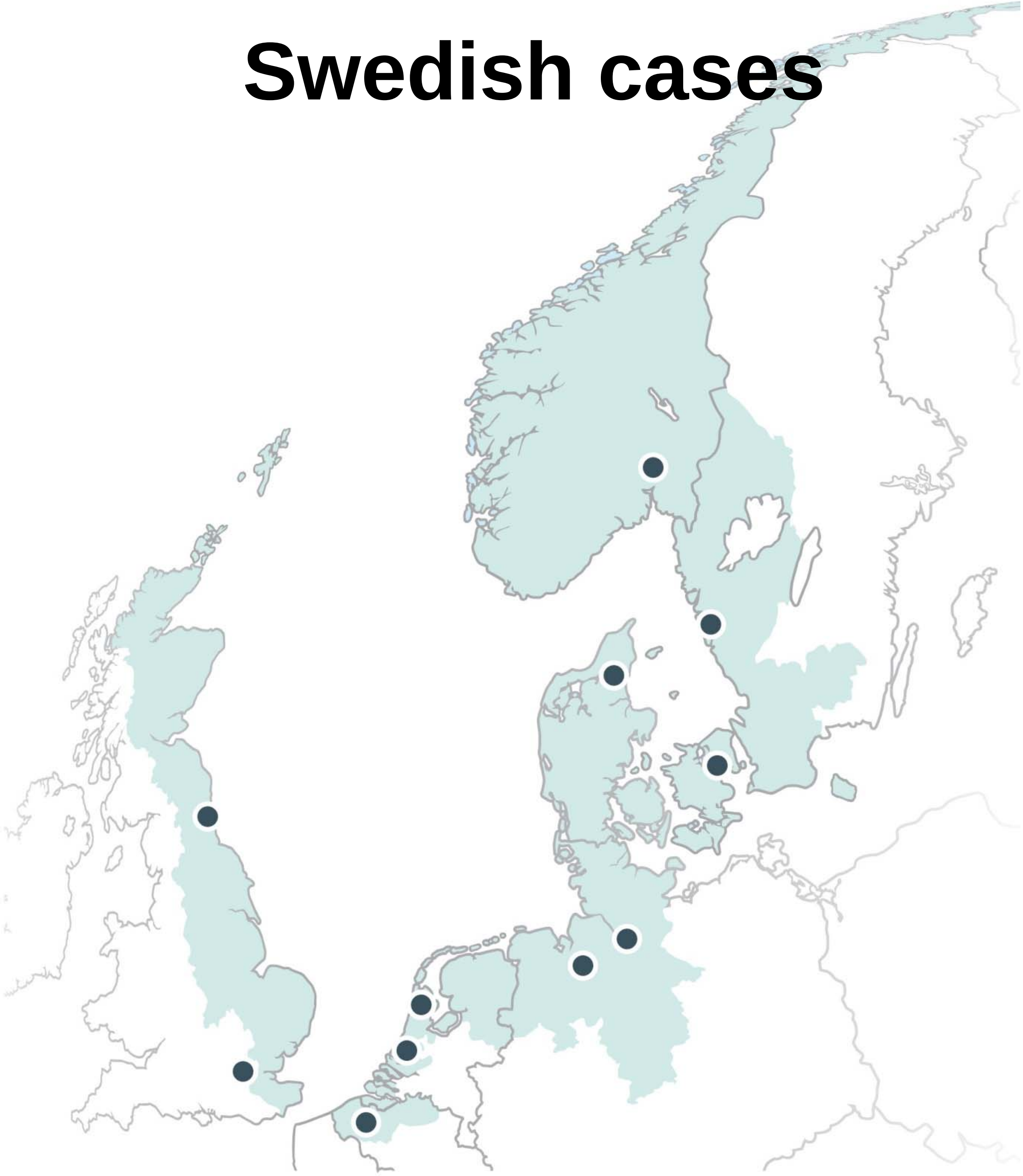
- Environmental factors
    - A more liveable and pleasant city, thanks to decreased noise and pollution.

- Process and logistics factors
    - Tests of technical assistance vehicles which can serve (fix) electric vehicles on the road.

- Human factors
    - A few thousand people are given the chance to try driving electrical vehicles. (A big share of them is professional users.)

e-mobility NSR

Swedish cases



1 Introduction

This report aims at presenting what happens in Sweden within the area of urban freight transport and distribution regarding electric vehicles. The report comprises national as well as local initiatives and projects where electric vehicles are or have been used. This part contains reflections on advantages and disadvantages that the various initiatives have experienced in using electric vehicles. Moreover, the report provides a state of the art overview of existing and future ICT (Information and Communications Technologies) solutions designed for electrified urban freight transport.

2 Case study Sweden

2.1 Roadmap for electric mobility

In Sweden, a roadmap for electric mobility has been put together by a consortium of industry partners; Roadmap Sweden represents more than 80 organisations from suppliers to end users of electric vehicles. The aim of the roadmap is to contribute to a strategy for electrification of road transports in a way that stimulates Swedish economy (Roadmap Sweden, 2013). The roadmap was handed over to the Swedish Minister for Enterprise and Energy, Annie Lööf, on 2013-03-27.

The roadmap concludes e.g. that (Roadmap Sweden, 2013):

- *Light commercial vehicles* (gross vehicle weight of not more than 3.5 tonnes) belong to a market segment that already today would be attractive and economically viable to convert to the use of electric power. This is due to:
  - High activity and short driving distances in cities
  - Regular and high utilisation resulting in that investments are spread over many hours of operation
  - The driving patterns of these vehicles which are relatively predictable. This results in that charging can be planned both from an infrastructure perspective as well as operationally.
  - Possibility of route planning
  - Access to charging stations
- For *large goods vehicles* (gross vehicle weight of over 3.5 tonnes) on main roads, battery power is difficult due to weight and limited reach. Instead electrification of roads is discussed and demonstrated.
- The access of charging infrastructure, especially high speed charging, is important as well as establishing secure salvage values and a stable second-hand market.
- A well-functioning service and after market is achieved through access to competence at independent workshops.
- A higher purchase price for electric vehicles is negative at comparison to other alternatives. Like many other countries, Sweden has a subsidy for green cars, a.k.a. “supermiljöbilspremien”.
  - It is important to secure that subsisides are valid for commercial business and public services as these markets have a higher turnover of the fleet and can therefore make a faster transfer to electric vehicles.

3 Initiatives and projects within urban freight electric mobility

3.1 TGM, Transport AB Göteborg-Marstrand

Overview:

Start of test:	02.05.2013
End of test:	08.05.2013
Involved city:	Gothenburg
Participants:	TGM
Goods type:	Parcel delivery
Type of vehicle:	1Renaul Maxity with lithium battery
Ownership of vehicle:	Rented from AB Volvo
Budget:	2.900 € for renting the truck
Public subsidies:	Yes

Company description:
TGM is one of the largest hauliers in the Gothenburg region. The company has since it was founded in 1957 been contracted by DB Schenker to carry out transports in western Sweden. TGM has a modern transport management system including communication to all vehicles.

Since the 1990's, TGM is in the forefront when it comes to testing and evaluating vehicles with new drivelines. Today TGM has a fleet of 200 trucks out of which 7-8 are environmentally friendly vehicles of different kind. The company expresses a clear commitment to eco-friendliness and sustainability in spite of the fact that the customers often are unwilling to pay for it.

Project description:
TGM's test of a Renault Maxity is part of the project SendSmart.

The project SendSmart started in September 2012 and will end in September 2014 (SendSmart, 2013). The purpose is to develop sustainable freight transport in urban areas that reduce the transports' impact on climate, noise levels and the health of those living in the city. The focus is on clean, energy efficient and quiet vehicles together with logistics for increased consolidation of flows.

The project has three focus areas:

- Goods distribution
- Building and construction deliveries
- Waste management and recycling

Partners in SendSmart are among others TGM, Lindholmen Science Park, the City of Gothenburg, Volvo Group, Chalmers University of Technology, Schenker Consulting, Renova and NCC.

The cost to rent the Renault Maxity from AB Volvo for one week's usage was 25,000 SEK (about € 2,900). The financial support came from the project SendSmart as well as from the City of Gothenburg.

Goals:
TGM as a company shares goals with DB Schenker of which the environmental goals are (TGM, 2013):

- To reduce the environmental effects from our vehicles
- To continuously improve the business from an environmental perspective
- To prevent pollution

The goal with the project SendSmart is to achieve a more attractive and competitive city as well as to create commercially viable logistic solutions (SendSmart, 2013).

Another important stakeholder is the city of Gothenburg who has the goal to achieve an attractive city environment where the different traffic types (public transport, bicycles, freight, and pedestrians) are integrated. More specifically, the goals are:

- Reduced noise
- Reduced congestion
- Reduced emissions which leads to improved air quality
- Increased traffic safety
- Promoting the use of electric vehicles in the city centre

Results:
Operational; During one week in May 2013 TGM, through two drivers, tested a Renault Maxity powered by a lithium battery. The vehicle was used in TGM's regular business for parcel deliveries from the DB Schenker terminal in Bäckebol, just outside Gothenburg, and Gothenburg city. A normal work load for a truck in operation would be 40-50 drops during 6-7 hours in the city. The test runs differed from the normal work as only 20 drops were made during 3 hours (N.B. the reason for this is unclear, the load capacity based on weight was sufficient). On the other hand, the drivers registered the consumption and estimated that the battery power would be sufficient for another 3 hours of operation. After each work day the truck was charged during the entire night.

TGM experienced that the energy consumption was high on highways and on uphill slopes. On the other hand the truck was very smooth to operate in city traffic. The project concludes that this limits the usage of the truck to city distribution, i.e. with the majority of the time spent in Gothenburg's city centre. The truck is not well suited for delivery service outside the cities as stops are often not as well-planned, which can results in longer distances, or transports on ring roads to e.g. Frölunda.

The truck was equipped with a diesel driven cab heater which is needed to maintain a good working environment during winter time in the Swedish climate. At the same time a diesel driven heater saves battery power well needed for the optimal range of the truck. The comprehension within the project is that the differences in energy consumption between summer and winter conditions are decreasing as the batteries develop, with the result that extra battery power is not considered to be needed.

Technical: The gross vehicle weight was 5 metric tons with a load capacity of 2 metric tons. The load capacity was satisfactory to TGM as they need 1.2 metric tons for this kind of operation. However, this specific configuration, a normal chassis where the truck's load space was opened from the back with semi-trailer doors, did not suit the operational needs of TGM from a working environment perspective since the driver during parcel delivery has to enter and exit the load space many times a day. Roger Nilsson at TGM means that a lift gate would not be optimal either as it would consume battery power. The best solution might be a lowered step into the load space achieved through a chassis with integrated wheel houses in the body. Furthermore, this has to be matched with a correct classification of the truck.

The tractor unit was well suited for TGM's needs with easy access to the cab and high comfort with a good view from the driver's seat. The drivers experienced that they quickly learnt how to operate the truck smoothly e.g. when accelerating or decelerating.

Customer attitude

Advantages with an electric vehicle:

- Optimal vehicle for city distribution
- Satisfactory from an operational perspective regarding:
    - Range of driving time, at current conditions
    - Range of distance, at current conditions
    - Load capacity for parcel delivery
- Vehicle performance:
    - Good turning radius
    - Impressive acceleration
    - Good top speed
    - Automatic gearbox with smooth gear changes
    - Silent operation
    - Engine braking instead of active braking
    - Perfect in the test conditions (nice weather, not cold)
- Working environment:
    - Easy access to the cab
    - Good view from driver's seat on the same level as the pedestrians
    - Diesel driven cab heater
    - The driving behaviour is easily adapted to the conditions posed by an electric driveline

Disadvantages with an electric vehicle:

- The price
- Limited operational usage; only city distribution
    - Otherwise access to high speed charging is necessary at critical points

- The specific configuration with a normal truck chassis
  - Ergonomically unfitting as the load space is too high to enter and exit

ICT solutions

TGM does not see a need for ICT solutions to support the business today or in the future. E.g. TGM does not have a need for route planning since the company operates the same streets every time, it is already optimised. Route planning could potentially be used for delivery service (which they don't operate), but on the other hand the kilometre range of electric vehicles might be the limiting factor instead. In that case access to high speed charging is required.

Conclusions

Enablers

- Electric vehicles are considered operationally suitable for urban transport.
- Daily operational costs are substantially lower than fuel costs

Barriers

- Total cost of ownership
  - A hybrid has a 5 times higher purchase price than a diesel truck
  - The largest contributor is the battery cost
- The high battery cost eliminates the possibility to have two set-ups of battery when the range is insufficient

Opportunities

- Pro-active municipality and traffic administration in Gothenburg
  - Driving force behind Göteborg Eco Area and Stadsleveransen.
  - Local legislation, e.g.:
    - Depending on current vehicle configuration; extended delivery time window in the city centre for vehicles of less than 10 metres in length. Otherwise it is restricted between 6 AM and 8 AM.
    - Access to the city centre solely for electric vehicles which could be enforced through automatic pollards
  - Means of control and incentives that are decided on a local level:
    - Reduced road toll fees for electric vehicles
    - Access to public transport lanes
- Subsidy
  - National subsidies on purchase of electric vehicles
  - Subsidies on the purchase price through the project SendSmart
- The OEM Renault are specialised in smaller trucks
- New business models for financing purchase and ownership of an electric vehicle, e.g. leasing of the battery

Risks

- Differentiated truck configurations for different segments, which leads to smaller markets for each OEM with higher risk and vulnerability
    - Electric vehicles are suitable for up to 4 metric tons
    - Electric hybrids are suitable for parcel delivery and smaller distribution trucks
    - Etc.
- For an increased usability within a wider range of operations there is a need for a large charging infrastructure
- Competition and market forces are disturbed by municipality-driven activities like Stadsleveransen

3.2 PostNord

Overview:

Status:	On-going	
Participants:	PostNord	
Goods type:	Mail delivery	
Vehicles:	About 4.500 vehicles of different types; cars, club cars, electric mopeds, and electric bicycles	
Ownership of vehicles:	PostNord	
Budget:	N/A	
Public subsidies:	None	

Company and market description

PostNord is the mail operator for all of Sweden and Denmark with 40.000 employees who handles and distributes about 27 million mail items every day. The company is also a leading operator in logistic services to, from, and within the Nordic region (PostNord, 2013).

PostNord has Scandinavia's largest fleet of electric vehicles which is also one of the largest among mail operators in Europe. The fleet consists of about 20.000 vehicles out of which 5.050 are electric vehicles; of these about 4.500 are operated in Sweden. The electric fleet is mainly made up of bicycles, mopeds and club cars (Roadmap, 2013). PostNord is also testing electric cars and vans for mail distribution where they evaluate range, starts and stops and performance in winter time conditions.

PostNord is determined to increase the amount of electric vehicles in order to achieve the high aim in their environmental goals, but every investment decision has to be based on profitability.

PostNord is part of Roadmap Sweden and the national initiative on electric mobility. PostNord are also interested in, besides electric vehicles, the electrification of roads. They consider it to be an alternative to the railway which is not available everywhere. In the project for electrification of road transports there are on-going discussions of setting up a test track for these purposes.

Goals

The main environmental goal at PostNord is clear; to reduce the emissions of carbon dioxide with 40 % between the years 2009 and 2020. Up to 2012 PostNord had decreased the emissions with 11 %.

The means for achieving the goals are:

- Energy efficiency
- Purchase of green electricity
- Construction of a terminal network to be able to operate larger volumes by rail
  - However, with the demand of delivery overnight some packages need to be flown
- Vehicles with increased energy efficiency
- A fleet consisting of electric vehicles
- Introduction of mix-ins in the diesel

Results
PostNord's overall experience from using electric vehicles is:

- Vehicle performance differs due to season
- Some vehicles are small and can legally be operated on cycle lanes (like mopeds) which shortens the route
- Good user experience
- Good working environment
  - The vehicles have diesel driven cab heaters installed to save battery power
- Good functionality

The range used to be a worry for PostNord, but they have learnt where the different vehicles are appropriate to be used, e.g. some trips and routes in the country side require longer range than an electric vehicle can deliver. Moreover, PostNord notices a decrease in their volumes of handled mail, which eventually leads to decreased density in their distribution. A result is longer trips and a need for vehicles with longer range. These are conditions that electric vehicles of today cannot meet. To be able to meet these needs PostNord is not willing to compromise on the working environment.

ICT solutions
PostNord does not see a need for ICT solutions to support the use of electric vehicles today or in the future.

Conclusions

Enablers

- Electric vehicles are considered operationally suitable, at the tested conditions
  - No worries about electric vehicles' range - they know where they are suitable
- Some electric vehicles can use cycle lanes as alternative roads, which increases the operational efficiency
- Operational costs are lower than fuel costs
- Service and maintenance is mostly cheaper

Barriers

- High purchase price
- Overall solution with batteries and the exchange of them which is expensive
- Lack of business solutions on the Swedish market to change the cost structure. E.g. in Denmark batteries can be leased and subsidies are available.
- Limitations in range, which can be solved through:
  - Faster charging than what is available today,
  - An easy exchange of batteries, or
  - Increased range for the batteries
- Decreasing volumes of mail, which requires vehicles with longer range, a range that is not suitable for the use of electric vehicles.
- Not willing to compromise on the working environment

Opportunities

- Diversified supply of green vehicles that are tested and specified for certain operational conditions, which makes it easier to select and invest

Risks

- Diversified supply of green vehicles for certain operational conditions results in smaller market shares and increased risk and vulnerability for the supplier

3.3 Stadsleveransen

Project overview:

Start of operations:	01.11.2012
Status:	On-going
Involved city:	Gothenburg
Participants:	Innerstaden Göteborg, Securitas and about 180 goods receivers
Goods type:	Parcel delivery
Type of vehicle:	Melex 391 with special-designed trailer
Ownership of vehicle:	Innerstaden Göteborg
Budget for 3 years:	300,000 €
Public subsidies:	Yes

Project description:
The project Stadsleveransen started in 2012 and is based on the concept of last mile delivery in the city centre of Gothenburg with consolidation of parcels at a micro terminal and delivery using electric vehicles. As there are no grocery stores in the city centre, Stadsleveransen does not operate a refrigerated unit.

Stadsleveransen is a spin-off of Göteborg Eco Area, a micro terminal in the Lindholmen area of Gothenburg. Göteborg Eco Area started in 2008 as a project, which has grown to serve 15 businesses, mainly within education, with parcel delivery but also with waste management. Since 2011 the terminal is commercially viable with incomes covering all the costs.

The background is that to improve the city environment, the City of Gothenburg has put regulations on how goods transports can operate in the city centre. Any vehicle can enter the city centre between 6 AM and 8 AM, outside these hours there is a vehicle length limit of maximum 10 metres. Parts of the city centre have been made into low speed areas where it is allowed to drive at walking pace, but parking is forbidden. Moreover, pedestrian streets have been introduced where vehicles are prohibited. This is enforced by pollards in the street, which can be lowered so permitted vehicles can pass. Today Stadsleveransen is the only transporter that has an exemption to traffic Korsgatan and Kungsgatan (central Gothenburg)

Logistics service providers that re-route their parcels via Stadsleveransen are PostNord, DB Schenker, DHL, Bring and various smaller transporters. When goods arrive to the micro terminal Securitas' trained personnel controls and registers all parcels in the in-house developed IT system. The parcels are consolidated and loaded on the special-designed trailer for delivery to the shops or smaller companies in the city centre. At the moment 180 shops and smaller companies are affiliated with Stadsleveransen. There are a few shops that have re-routed all their goods to go through Stadsleveransen.

The project is planned in three phases with a pilot phase during one year. Year 2 and 3 function as a transition phase, so that Stadsleveransen will be self-financing after 3-4 years.

Project goals:
The project goal is to contribute to reducing the number of transports into the city centre as well as to improve the urban environment. At the end of the project the goal for Stadsleveransen is to be profitable and to continue to run the business solely based on market conditions.

The City of Gothenburg, who has been the driving force behind Stadsleveransen, has the goal to achieve an attractive city environment where the different traffic types (public transport, bicycles, freight and pedestrians) are integrated. More specifically, the goals are:

- Reduced noise
- Reduced congestion
- Reduced emissions which leads to improved air quality
- Increased traffic safety
- Promoting the use of electric vehicles in the city centre

Project budget and financing:
The total project budget for three years is 2.7 million SEK (about 300.000 €). The budget for the first year is 900.000 SEK split on 70 % for staffing and 30 % for investments. The coming years will not see a reduction in budgeted costs, but there will be a shift towards a larger part of operational costs for staffing and premises. The plan for year 2 and 3 is that investments will not be significant; the costs are rather related to depreciation on current assets.

As the business will grow there are uncertainties if costs for the terminal respectively costs for staffing might increase. It might result in a need to change premises for the terminal.

The financial support of the projects is divided as follows:

- City of Gothenburg finances 35 % in the pilot phase (year 1) and expects to reduce its subsidies as the business grows
- Real estate owners finance 15-20 %
- Innerstaden Göteborg finances 10 %
- Region Västra Götaland finances 10 %
- Göteborg Energi finances 8-10 %
- Advertising revenues stand for 15 % (with a prognosis to increase to 30 %)

Notable is that shops and smaller companies that use the service of Stadsleveransen as well as transport companies that re-route their goods to Stadsleveransen instead of delivering on their own don’t pay anything. At this stage Stadsleveransen offers some free services, e.g. if the shop wishes the delivery can also be speeded up or postponed one day.

Results:

Operational: The progress of the project is very good, as the pilot phase is finished after about 6 months compared to the plan of 1 year.

The vehicle's range is 70-80 km, which is reduced during winter time. Nonetheless, it is not a limitation for the operations, as the catchment area is rather dense. The charging is done overnight and takes 7-8 hours. The vehicle is equipped with a diesel driven cab heater, which is needed to maintain a good working environment during winter time. At the same time a diesel driven heater saves battery power well needed for the optimal range of the vehicle.

There is a need to increase the load capacity of the vehicle to decrease the number of trips. With regards to the length limitation in the city centre of maximum 10 metres there is still a possibility to have a larger trailer. The traction force of the vehicle is sufficient; however, a vehicle that is too long will not blend in as well as this one.

Technical: The vehicle is equipped with a clear indicator of the battery level and there has not been any problem with the battery. The only technical problem that has been registered is regarding the construction of the trailer and load space, nothing related to the electric driveline.

Customer attitude: Advantages with an electric vehicle and a new logistic solution:

- There is nothing that speaks against an electric vehicle (under these conditions)
- The vehicle is reliable:
    - Well-functioning and easy to handle
    - The vehicle's range is not a worry in the dense city centre
- Good working environment with diesel driven cab heater
- Reduced energy consumption
- Important to have a neutral part responsible for the project
- Positive reaction on the concept, but there are disagreements regarding who should run it

Disadvantages with an electric vehicle and a new logistic solution:

- The load capacity need to be increased
- Adjustment time is needed in order to change goods and information flows
- Difficult challenge to create a business model that works

ICT solutions:

Stadsleveransen uses an IT system that has been developed in-house. It is used to register goods by scanning the parcel's ID and the waybill. The system collects all parcels for each delivery point and produces a new waybill.

Stadsleveransen is not using any other ICT solutions as the routes are short and the number of vehicles is low. With a larger business, higher complexity and/or more vehicles there would be a need for ICT solutions. That the fleet consists of electric vehicles is of no significant matter.

The project manager Christoffer Widegren does not consider technology and ICT solutions to be the challenge in this project, but rather the business model and the new way of working.

Conclusions:

Enablers

- Electric vehicles are considered operationally suitable
- Reduced energy consumption
- Positive attitude towards the concept of a micro terminal
- Logistic service providers and transport companies are relieved of the problem with last mile delivery
- Profitability through development of the business model so that the customers and right stakeholders contribute, e.g. goods receivers and transport companies

Barriers

- The business model is not functioning
  - The business model needs to be developed so that the customers and right stakeholders contribute, e.g. goods receivers and transport companies
  - The business is not self-financing which might be difficult to achieve as an existing offer needs to be changed
- Difficult to engage goods receivers, i.e. shops and smaller companies
- Disagreements on who should run the micro terminal which might lead to that Stadsleveransen loses the support from some stakeholders

Opportunities

- Pro-active municipality and traffic administration in Gothenburg that puts regulations and restricts access to certain areas of the city centre
- Achieve profitability in a micro terminal

Risks

- Competition and market forces are disturbed by subsidised activities like this
- A competitive micro terminal is set up operating electric vehicles with access to the same catchment area
- Initiatives with micro terminals have failed before

Information and Communications Technologies (ICT) solutions

The following section presents ICT solutions for electrified urban freight transport and distribution. Focus has been on identifying technologies that assist the driver and that may have an impact on the introduction of electrified vehicles to be used in urban areas.

ICT stands for “Information and Communication Technology“ and stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information.

A report by Trafikanalys (2012) states that the increased demand for effective flows of goods in growing urban areas is the result of urbanisation, as well as the increased environmental focus from a political perspective. Pick-up and delivery of goods in urban areas, a.k.a. city logistics, has a large impact on the economy, availability, life quality, and attractiveness of a city.

Information can be used as a mean to improve city logistics; improved information systems can reduce the trip time and thereby release capacity in the system (Trafikanalys, 2012).

3.4 Solutions on the market

The aim of several of these solutions is to overcome current deficiencies in the infrastructure when using electric vehicles.

Navigation support

Navigation support is widely available today from suppliers like Garmin, TomTom and Magellan as well as by the vehicle OEMs (Original Equipment Manufacturer). The difference in offer can generally be traced to the graphical user interface and the layers of information that is provided. Some layers of information are basic features while others are offered at an extra cost.

Several of the layers are dependent on municipalities’ and/or government’s instruments of control. They might also be revoked at any time. Nonetheless, if available it is in the interest of the haulier to make use of them.

Layers that are useful for urban freight transport and distribution are:

- Environmental zones with specific rules for the vehicle in question, e.g. maximum vehicle length of 10 metres or only electric vehicles
- Information of access to public transport lanes for certain vehicles

- Slots with free or reduced fee for parking for certain vehicles
- Points of interest like lunch restaurants etc.

Layers that would be of extra interest when using electric vehicles are:

- Charging stations that are publically available, especially those that have high speed charging
    - Charging stations with flexible payment solutions
- Points of interest in connection to a charging station like the driver's favourite lunch restaurant
- Competent workshops for maintenance and repair
- Information on remaining route length before charging is needed

Intelligent route planning

Route planning is made at the transport office in order to take all stops of a truck on one day of operation into consideration together with regulations on driving times and rest periods etc. The planned route is updated continuously; e.g. if one delivery with specific delivery times is removed, the whole route might change due to the fact that the stop with most constraints is gone. Updating the route is important to make the trip as economical as possible for the haulier.

Route planning can be done supported by software that often is integrated with the haulier's fleet management system. The combination of the software gives a possibility to track vehicles, compile advanced report on each vehicle, trip and/or business line and more. The aim is to reduce mileage, optimise the routes, and use in an incentive system.

Limited reach of an electric vehicle increases the need for route planning as well as it restricts the possibilities of operation and usage areas. Intelligent route planning for city distribution needs to take regulations on driving times and rest periods into particular consideration as a rest period might be combined with charging of the vehicle. Therefore access to a charging station needs to be considered. The intelligent route planning should also consider regulations and environmental zones that are applied to the specific vehicle.

Solutions for accessing restricted areas

There are areas that have restricted access for different reasons, e.g. terminals, secure parking lots, and environmental zones in city centres. Infrastructural solutions to manage the access vary; gates, pollards, tire killers, and other types of road block devices. The technological solutions for a vehicle and driver to access these areas differ based on cost, efficiency, and security. Access solutions that can be used are:

- A chip that is presented at short range to a reader, e.g. through the window, e.g. a RFID (Radio Frequency Identification) tag
- An electronic device placed in the window of a vehicle which is read at long range, e.g. DSRC (Digital Short Range Communication)
- Automatic license plate recognition, and
- Other types of recognition solutions such as face, finger print, and finger vein

Carbon footprint calculator and report

Carbon/ecological footprint refer to the total greenhouse gas emissions that are caused by a vehicle. Calculating the carbon footprint exactly is difficult, but there is on-going development of standards defining how to measure and calculate.

The purpose of calculating the carbon footprint can be internal use and improvements or to be offered to the customer. The customer might be the end-user of a transported product or the logistics service provider to follow-up, improve, and/or to verify the impact of a business. The market of this kind of ICT solution is based on the customer's willingness to pay.

3.5 Future solutions

These solutions are currently not available. They have not been specified as of when they might be available, as some of the solutions are a matter of research, while others are close to market launch.

Booking support of parking slot and/or charging post

It is a widely available service to book online or by using a mobile phone. The booking is often connected to the actual usage of the service where verification, and sometimes authentication, is performed e.g. by providing a pin code. Booking of e.g. a parking slot or a charging post directly from the vehicle is not available today. The actual booking can be handled, but there is no support or infrastructure to verify and authenticate the booking.

Advantages for the driver and haulier are more efficient use of the vehicle and an optimised trip by securing access to a certain parking slot or charging post exactly when the vehicle is planned to be there. This might diverge from the infrastructural perspective where the aim is to maximise the service, i.e. the supply of parking lots. A question to sort out is how a vehicle that has exceeded its parking time is handled when the upcoming slot is booked. Another question is if the service should cost anything including some sort of advanced payment. How much is it worth to the haulier to have an available parking slot when the driver arrives?

ELVIIS, Electric Vehicle Intelligent Infrastructure

ELVIIS is a concept where the intelligence is in how the communication between vehicles and the electrical grid is working. The concept is based on a cooperative system within the ITS field (Intelligent Transport Systems and Services), while the solution is based on an on-board computer in the vehicle that keeps track of the battery's power level. The on-board computer sends the information over the mobile telecom network to the electrical grid to coordinate the charging of vehicles. The system plans for optimal charging, e.g. outside peak hours, based on lowest cost and demand, making it a so-called smart grid. Then the owner of the vehicle is charged for the cost, not the owner of the outlet (Viktoriainstitutet, 2013). The advantage with the concept is that large amounts can be saved if smart charging posts don't have to be installed, but instead existing infrastructure can be used. The connection to the mobile network provides possibilities of watching the charging status and make changes over the mobile phone (Roadmap Sweden, 2013).

4 Advantages and winnings with ICT solutions

The European Commission (2007) signify that the efficiency of urban freight distribution can be increased with the help of ITS, in particular through better timing of operations, higher load factors and more efficient use of vehicles. It requires integrated systems that combine route planning, driver assistance systems, intelligent vehicles and interaction with infrastructures.

Even so, the market for urban freight transport and distribution does not express a need for ICT solutions, neither today nor tomorrow, based on the cases studied. On the other hand, many times it shows that thinking beyond what is available today and on the market is difficult, so a latent usefulness for ICT solutions might be present, if the benefits are communicated correctly. Especially when it comes to new ICT solutions as the innovation rate is high and the solutions often are beyond the users' imagination when introduced to the market. With clear concepts and solutions applied on the use of electric vehicles a business case can be calculated and evaluated.

5 Conclusions

Many times cities and regions, instead of countries, are suited to be forerunners in the development of city logistics. They have the power to put regulations regarding environmental zones, to offer reduced taxes or fees for road tolls or to provide financial subsidies to promote purchasing of electric vehicles (the latter is also regularly done on national level). In a city's own businesses they are important users of vehicles. Moreover, there are often plans made on the municipal level that fixes transport needs for a long time as well as potential solutions (Roadmap Sweden, 2013).

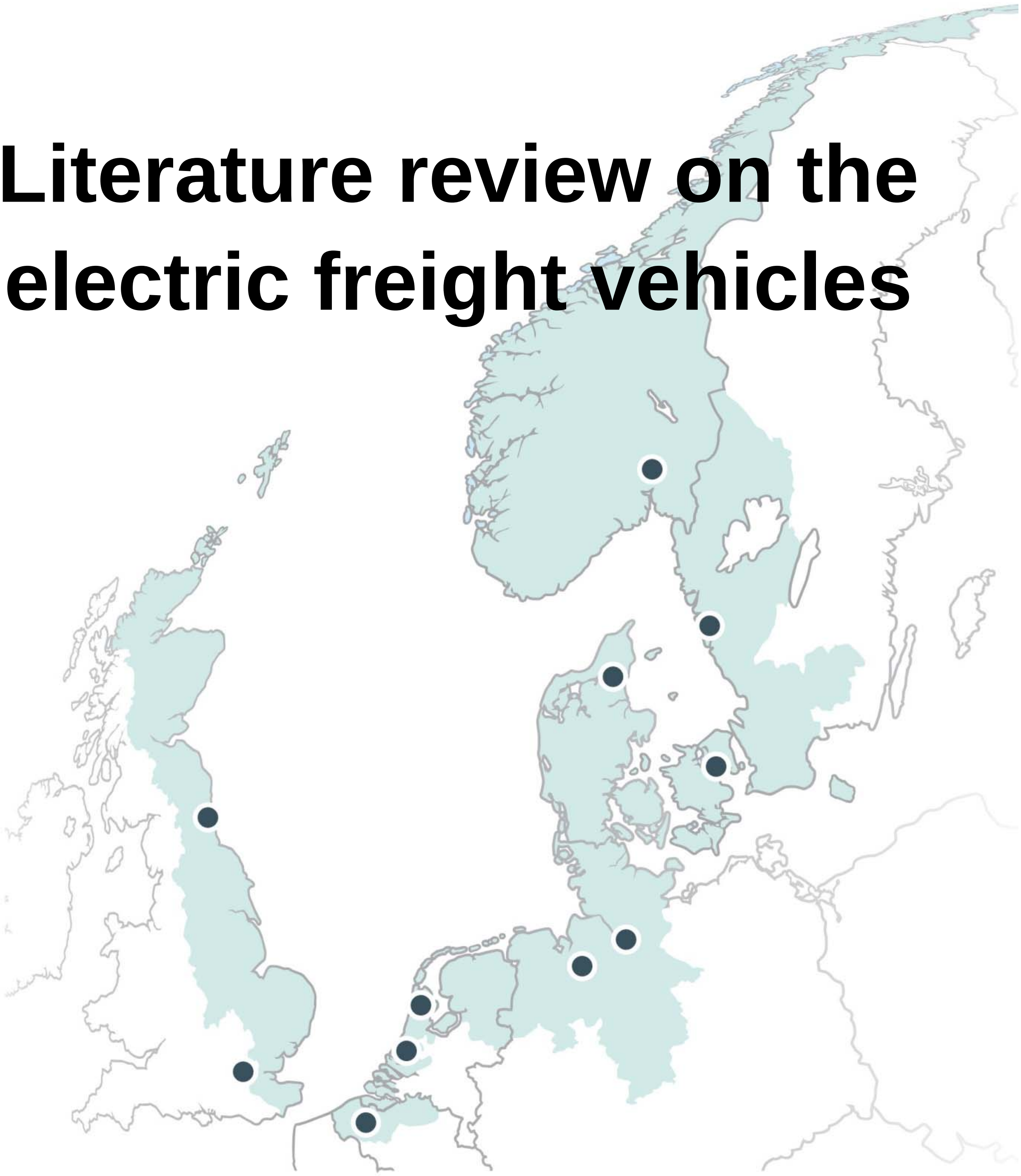
The transport business runs under severe competition, in order to achieve legitimacy in measures it is vital that solutions are neutral from competition, e.g. consolidation centres must secure free competition and integrity (Trafikanalys, 2012). To improve chances of success it is therefore important that they are managed by a single neutral body, which enable equal access for multiple transport companies.

The battery cost of an electric vehicle is still a large barrier. However, the users have found a specific segment for the use of electric vehicles and have accepted the limitations in range. Hauliers that are not interested in being forerunners or cannot find enough incentives to invest in electric vehicles, might consider the fact of losing customers if the competitors act faster or if local rules and regulations change quickly.

The conclusion is that considering the advantages and disadvantages of electric vehicles, city logistics is the segment that today is best suited for a wider introduction and use of electric vehicles.

e-mobility NSR

Literature review on the electric freight vehicles



Literature review on the electric freight vehicles

E-mobility is a hot topic, both in the public policy area as well as in business and scientific communities. While there is abundant literature on E-mobility, the attention is focussed on passenger cars. Literature on electric freight transport is still scarce, reflecting the fact that electric freight transport development is more in an infancy phase. However, urban freight transport is considered as one of the most promising fields of applications of electrification. This section bundles and categorises the main findings that have been reported in literature up to now on electrified urban freight transport.

TECHNICAL FACTORS

According to University of Duisburg-Essen, CEP and pharmaceutics services deliver with vans and smaller trucks in regionally limited areas. Their daily kilometrage is typically below 140 km. Therefore, EV's can potentially replace CVs in delivery services (University of Duisburg-Essen 2011, p. 12).

According to University of Duisburg-Essen, companies:

- Desire a higher kilometre range on one charge,
- Have concerns to test non-serial technologies,
- Would not buy EV's while TCO is more expensive than conventional vehicles,
- Value emission free transportation (University of Duisburg-Essen 2011, p. 12).

According to the literature the following challenges within the technical field exist:

- Drivers want to dynamically adapt recuperation gradient (Fraunhofer IAO 2011, p. 10).
- Finding of and navigation to public charging station is not available yet (Fraunhofer IAO 2011, p. 11).
- The displayed distance left should adapt dynamically to the topography of the planned route, the weight of the freight loaded and other electrical consumers (Fraunhofer IAO 2011, p. 10).
- Flexible tour planning is limited by the maximal kilometre range (Wunderlin 2011, p. 5 and Schönewolf 2011, p, 14).The Kilometre range is influenced by drive style, weather and electrical consumers like heating (Wunderlin 2011, p. 6)

According to the literature, the following actions, within the technical upgrades field, can help to open up the way for EV's market uptake:

- Supply of the realistic information about EV kilometrage performance by the EV's' manufacturers (UDE 2011, p. 12).
- Enable testing of EV's for commercial users (University of Duisburg-Essen 2011, p. 12).
- Develop a training for EV drivers to increase energy efficiency and enhance kilometre range (Wunderlin 2011, p. 6)
- Evaluation of tours suitable for EV's are necessary (Wunderlin 2011, p. 5, Schönewolf 2011, p. 14)

- The displayed distance left should adapt dynamically to the topography of the planned route, the weight of the freight loaded, and other electrical consumers (Fraunhofer IAO 2011, p. 10).
- Develop an interface for the driver to adapt recuperation gradient (Fraunhofer IAO 2011, p. 10).
- Create Smartphone App to choose individual settings like mirrors, recuperation gradient, gauge design (Fraunhofer IAO 2011, p. 11).
- Create Smartphone App to find and navigate to charging stations (FraunhoferIAO 2011, p. 11).

FINANCIAL FACTORS

The cost competitiveness of electric trucks to conventional trucks is in the long term one of the most critical aspects to achieve a large-scale implementation of electric transport. Davis and Figliozzi (2013) did a study in the U.S. with three types of the latest generation of electric delivery trucks (Navistar E-Star, Smith Newton and Isuzu N-Series) to examine their competitiveness to conventional trucks under varying scenarios. They found that electric trucks can be competitive if the cost savings from the reduced operational cost are sufficient to overcome the significantly higher initial purchase costs. The DELIVER-project (2012) also addresses this issue. Due to increasing fuel prices the disadvantage of high purchase costs will mitigate and light trucks could have a competing TCO from 2017. In an exemplarily model calculation, University of Duisburg-Essen (2011, p. 128 – 129) show that the TCO of E-transporters can become positive after 4 years due to low energy costs and good energy efficiency. Moreover, usage of EV's in multi-shifts would improve amortization (Wunderlin 2011, p. 10. Schönewolf 2011, p. 16). According to Jüchter, costs for charging infrastructure in companies are significant (Jüchter 2011, p.4).

Electric vehicles are not competitive if routing constraints lead to the purchase of additional vehicles above and beyond the required number of conventional vehicles. The key factors that determine the competitiveness of electric trucks are the **purchase price, fuel price, projections about battery costs and lifetimes and the vehicle utilization.** Rising energy costs and falling battery costs will create an environment where EV's can prevail, although EV's are currently a more expensive option in most situations. To become a viable alternative in the current environment for electric trucks, some combination of the following factors must be present:

- Daily distances travelled are high, approaching the electric trucks maximum range of 100 miles (but the battery energy constraint is not binding);
- Low speeds or congestion and traffic jams are prevalent in the area of the route;
- Customers stops are frequent and numerous, and a conventional truck would typically idle during these stops;
- Since the electric engine is more energy efficient, grades or other factors exist which cause increased expenditures of energy;
- The purchase price is reduced by tax incentives;
- Increase on taxes for CVs (yearly vehicle tax, purchase tax, mineral oil tax);
- EV's may depreciate fast due to technological development. Therefore counteractions are required such as: financing of upgrades into newer

technology and guarantees of battery runtime (University of Duisburg-Essen 2011, p. 6, 14, 15).
- The planning horizon is extended beyond ten years.
- Regulatory support by non-monetary incentives like unlimited and free entrance into restricted zones, free parking and others.

Additionally, the following actions can be helpful:

- EV configurator in development to compare TCO of commercial electric vehicles. www.ev-configurator.de (Fraunhofer IAO 2011, p. 12).
- In a recent study of Nijland et al. (2012) the financial impacts of operating an electric truck are considered from the total logistical chain perspective. Their conclusion is that the costs for logistical companies will possibly increase, because the vehicle operating costs and additional costs for extra transhipment will rise. The estimated effect on the total costs is, however, limited (+4%). This observation may suggest that some additional measures that lead to an increase of the costs of conventional urban freight transport (UFT) are desirable to boost the implementation of electrified UFT.
- New business models have to be developed (Fraunhofer IAO 2011, p. 12; Ernst & Young and Urgenda, 2012).

The cost of battery deterioration, which is related to the lifetime of the battery and its cost of replacement, is a key issue in the economic performance of electric trucks. Knipe et al. (2005) have found very good lifetimes from earlier generations of batteries (e.g. as used in the Toyota Rav4) with the batteries still functioning well (though measurably weaker) after the vehicle surpassed the 100.000 mark. The Elektrification Coalition (2010) reported a similar lifespan anticipating a battery lifespan equivalent to about 150.000 miles. Internal research conducted by Smith Electric Vehicle (2010), however, found that the lithium ion batteries used to power their trucks retained 80% of their initial capacity on average after 3000 cycles of fully discharging and recharging the battery. This means a lifespan of more than 11 years at 260 operational days per year. Other sources (e.g. CE, 2011, ElementEnergy, 2011) report a battery lifetime ranging from 4 to 10 years. It is known that the speed of recharging also effects the lifetime (CE, 2011).

The costs of batteries are high and, due to the large number of batteries needed in an electric truck these costs have a substantial share in the initial purchase costs of an EV. Despite of this, it is believed that these costs of batteries can and will drop. Jaffe (2010) reported that a lithium ion battery pack costs about $1,000 per kilowatt-hour (kWh) in 2010, but can be expected to drop to $ 400 by 2013. On the other hand, the Elektrification Coalition (2010) is much more conservative as it believes that such a reduction of battery costs would still need ten years' time to materialize. The DELIVER-project (2012) forecasts that costs will fall to about € 500/kWh in 2014 and to € 250/kWh in 2020.

ENERGY SUPPLY AND INFRASTRUCTURE FACTORS

The process of recharging electric vehicles is an important issue as it greatly determines the possible use of electric vehicles, both in terms of its availability and flexibility of using EV's. As regards freight transport the charging process ideally may not require to make compromises regarding the logistical processes.

The recharging techniques that get most attention so far are slow charging, fast charging, battery swop stations and inductive charging. Research in this field so far is, however, almost exclusively addressed to applications for passenger cars.

Lack of compatibility of different chargers plugs is one of the biggest problems concerning energy supply for EV's, according to the literature. Worldwide standardization of charging plugs is desirable (Wunderlin 2011, p. 5).

Scarce literature discussing charging infrastructure for UFT indicates that since delivery vehicles tend to follow the same route each day and return to its company premise every night the possibility to recharge slowly during the night is a satisfying solution (Feng and Figliozzi, 2013; Ehrler and Hebes, 2012). The advantage coming with night charging is that public charging infrastructure is not needed then (Schönewolf 2011, p. 7). However, it occurred to be that the installation and operation of inhouse charging infrastructure was technically challenging, thus more costly than planned (Daimler AG 2011, p. 86, Schönewolf 2011 p. 15). Moreover, charging plugs were too damageable and only specially trained staff could handle the plug, which caused problems with replacement drivers and training issues (Wunderlin 2011, p. 5).

If charging was to take place outside the company's premises (public quick charging infrastructure) logistic processes and tour planning would need to be adapted (Schönewolf 2011, p. 7). Further elaborating on public charging solutions, it could be useful in freight delivery, if batteries could be quickly charged without damage (Schönewolf 2011, p.7). Public charging infrastructure is also acceptable by the majority of the public (Schönewolf 2011, p.8). However, critics attempt to ensure that no green or traffic spaces are turned into public charging spots for EV's (Schönewolf 2011, p. 8).

ENVIRONMENTAL FACTORS

It is beyond doubt that urban freight distribution with electric vehicles is beneficial to the environment. Delivery EV's are locally emission-free (FraunhoferIAO 2011, p. 16) and perceived as more silent in operation, although their maximum level of noise is comparable to modern ICE vehicles (Jücher 2011, p. 5, University of Duisburg-Essen 2011, p. 70 - 85).

It remains difficult to assess the total environmental benefits for cities, also due to the fact that much depends on the extent to which conventional UFT can be replaced by electrified UFT. A study of Nijland et al. (2012) estimates a reduction of 1 to 2 megaton CO_2 in 2050 in urban freight transport in The Netherlands if a complete transition to electrified UFT can be achieved. In this study Nijland et al. elaborate the impacts of electrified UFT in a wider perspective. A major observation is that although a significant

CO_2 reductions will be achieved, trips of vans and small trucks will almost triple, because the transition to electrified UFT will involve implementation of small vehicles and much more trips covering small distances (total vehicle-kilometres is expected to increase). This means that transition to electrified UFT is not likely to reduce the congestion problem in cities, on the contrary.

Other impacts that are envisaged by Nijland et al. relate to land use. The limited range of EV's will induce more transhipment in the transport chain. As a result the number of regional distribution and transfer centres will increase. In view of this Nijland et al. argue that logistical companies may get an increasing interest in locations at the border of cities (e.g. to avoid additional logistical costs). The municipality should have a facilitating role by offering space to establish logistical centres and possibilities to cluster logistical activities (since clustering enhances the possibilities for co-operation and co-operation can increase the efficiency of UFT, i.e. increasing the utilisation rate of vehicles). Electrified UFT is a mode to support such kind of efficiency in UFT.

Silent EV's (and modern ICE's) could pose a bigger risk to passengers (University of Duisburg-Essen 2011, p. 70 – 85). Still EV's are perceived as more silent than modern ICE's as they have a different spectrum of sound when approaching (Jücher 2011, p. 5). A warning indication is needed for the marginal group of visibly handicapped passengers. Possibilities described in the literature are:

- Loud road surfaces
- Intelligent warning system for the passenger and the driver (University of Duisburg-Essen 2011, p. 70 – 85).

PROCESS AND LOGISTICS FACTORS

The limited operating rage of EV's is one of the issues that determine its current applications: operations at relatively short distances, i.e. urban freight distribution. The required range will be company-specific (depending on customer density, customer demands, weight of goods, etc.). This suggests that the range requirements may vary according to the specific needs.

Literature provides some indications regarding distances travelled for urban deliveries and how this matches with the possible range of EV's. For the U.S. an average distance of 36 miles per day was found by FHWA (2009, 2010), while a report by FedeX (Barnitt, 2011) came up with a distance of 41,4 miles, as the average distance travelled by delivery trucks, which is significantly lower than the range achieved and claimed by EV manufacturers. EV's in CEP-services travel less than 40 km per day according to scientific literature evaluating a test in the German pilot regions (Schönewolf 2011, p.8).

According to University of Duisburg-Essen, the following commercial traffic holds a potential for the usage of EV's: CEP-Services, forwarding companies, and pharmaceutics, social services, newspaper and flower delivery (University of Duisburg-Essen 2011, p. 201 – 223). Simulation and analysis of different commercial freight transport tasks showed substitution potential with EV's in CEP, postal and public cleaning services (University of Duisburg-Essen 2011, p.226 – 246). Also textile logistics offer a large potential, as the delivery window can be expanded significantly, allowing multi-shift delivery (Schönewolf 2011, p. 8).

Moreover, CEP service providers often work with sub-contractors who own their vehicle and use it privately. Hence all limitations of private EV owner apply: kilometre range might not be sufficient, charging opportunities are missing, purchase price is too high (Daimler AG 2011, p. 69). Furthermore, CEP services potential for delivery window expansion is narrow: two hours earlier in the morning and later in the evening are accepted (Schönewolf 2011, p. 8). In several sources it can be found that City Logistics and e-mobility behave complementary and form an ideal partnership (e.g. University of Duisburg-Essen 2011, p. 225 – 226). On the contrary, some literature sources suggested, city logistics concepts in Germany have not proven economic in the past in general and EV's are too expensive to use in a city logistic concept (University of Duisburg-Essen 2011, p. 225 – 226). One reason is that EV's are heavier than ICE's due to the weight of the batteries and therefore regulations possibly could demand the usage of tachographs and/or higher driver's licenses appears with a shift to EV's (University of Duisburg-Essen 2011, p.226 – 246). Therefore, pilot projects for city logistic projects with EV's are needed (University of Duisburg-Essen 2011, p. 225 – 226); subcontractors need to be included in environmental strategies of large CEP companies (Daimler AG 2011, p. 69).

ICT FACTORS

Following actions required in the field of ICT have been identified in the literature:

- Tour planning and routing for EV's in freight delivery has to be adapted, especially for dynamic tour planning (University of Duisburg-Essen 2011, 226 – 230).
- Add an 'energy coefficient' to all roads, to calculate 'most energy efficient tour' instead of 'shortest tour (University of Duisburg-Essen 2011, 226 – 230).
- Information and communication technology can be used as a mean to improve city logistics; improved information systems can reduce the trip time and thereby release capacity in the system (Trafikanalys, 2012).

REGULATORY FACTORS

In a report of the Fraunhofer Institute, political and regulatory measures to support EV's are analysed (Fraunhofer IAO 2011, p.20). EV's in urban transport need to be supported by regulatory measures, due to the higher purchase costs (FraunhoferIAO 2011, p. 20): for instance, the German Federal Government is discussing goals on how to support e-mobility, i.e. reserved freight loading pits for EV's (Jüchter 2011, p. 5). However, realization of general ideas meets barriers in regional politics (Jüchter 2011, p. 5). A better cooperation between federal and regional politics is needed to reach common goals (Jüchter 2011, p. 5).

Following action (regulation) can further support EV's spread according to the literature reviewed: EV's and CVS performance is measured through the NEDC. Therefore the vehicle manufacturers base the kilometre range of their vehicles on performance measures in the NEDC. Literature indicated that EV’s kilometre range determined by NEDC is halved in realistic drive cycles. In order to create trust into the new EV technology, a specific drive cycle for EV’s is needed, to produce realistic results of EV’s kilometre range (University of Duisburg-Essen 2011, 226 – 230).

HUMAN FACTORS

Human factors relate to the behaviour and attitude of users, mainly the drivers of electric trucks on the one hand and customers served by an electric truck and the general public on the other hand. The perceived performances of EV’s by these actors greatly determine the willingness to accept and use EV’s, hence these human factors are a highly relevant topic for EV implementation.

According to a study of Ehrler and Hebes (2012), that was conducted during pilots with EV’s in Berlin (DHV and Meyer and Meyer), drivers had a very positive attitude and were very keen on testing the vehicles. Also other aspects, such as the easy use of cockpit instruments as well as the space in the drivers’ cabin were considered satisfactory or even positive. Drivers enjoyed the good handling, agile electric motor and reduced noise of the EV (Wunderlin 2011, p. 6). They were also proud to drive an innovative, environmental friendly EV (Wunderlin 2011, p. 6); passengers were interested and astonished and interviewing the frequently drivers, to a point where drivers needed a lot of patience to satisfy the discussion demand of passers-by (Wunderlin 2011, p. 6). The safety risk for pedestrians, because of very little noise production, was considered as marginal.

Recharging facilities in the public space would be welcomed both by drivers and shift managers as it would increase the flexibility of using EV’s, but it was no barrier for the pilot projects that were considered. Drivers were, however, less enthusiastic about the reduced payload of the EV’s caused by the battery size and weight (Jüchter 20911, p.4). Ehrler and Hebes also interviewed customers of deliveries and neighbours to customers of deliveries and found similar positive attitudes (a high appreciation of reduction of emissions and noise in particular). Although the study of Ehrler and Hebes provides evidence favouring EV’s, more extensive research in these human factors would be needed to generalise their conclusions, because their study only covered two companies in one city and a relatively short test period.

The impact of EV’s on the traffic safety is an issue that still lacks convincing evidence, basically because of a lack of empirical data as the number of EV’s in operation is still very limited. Since EV’s produce very little noise it is conceivable that they create dangerous situations, because other road-users and pedestrians may not perceive EV’s very well.

As regards hybrid cars a U.S. study (Hanna, 2009) showed a relative greater involvement of hybrid cars in collisions with cyclists and pedestrians, but such indications have not been found yet for instance in The Netherlands and Japan (Nijland et al., 2012). As regards electrified UFT Nijland et al. address two adverse effects on the safety of urban traffic. Electrified UFT leads to an increase of freight trips in the city, but the number of large trucks driving in the city will decrease. More trips will have a negative impact on traffic safety, but a shift to smaller trucks will on the other hand positively affect traffic safety. However, the final impact is uncertain.

Conclusion on the whole report

This chapter aims to conclude on 290 pages of case studies. The task was undeniably a challenge, as case studies covered all seven North Sea Region countries and more than 60 initiatives on electric freight vehicles. Though, it is also a great strength of the report; with such a large number of cases analysed, that derived conclusion can be treated as a reliable source of information.

By identifying initiatives and early adopters of electric freight vehicles, possible future users can get an important insight into what it means to be a driver of electric freight vehicles; possible strengths, opportunities or challenges. Moreover, the report can be a tool to effectively promote and diffuse electric freight vehicles as the report addresses political, social and technical issues, which needs to be addressed and developed further in the future.

The conclusion endeavours to find the common strengths, opportunities (recommendations) and challenges connected with electric urban freight vehicles implementation identified in each country and for the whole NSR region, on the basis of elaborated country conclusions.

Experienced strengths and opportunities of the electric freight vehicles use for the city distribution

The main identified strengths and opportunities connected with electric freight vehicles deployment for the city distribution are as follows:

a) **A marketing strategy.** A growing number of companies are taking CSR more seriously as they have to compete in an ever more environmentally conscious world where consumers are demanding greener products. Since electric vehicles do not produce pollution (including noise) several of the companies contacted have used the vehicle as a marketing tool promoting a greener image. One company explained that the business relationship with existing customers was strengthened and new customers gained. It seems as though the green image to some extend could compensate for the need of the vehicles to operate economically.

b) **Job satisfaction.** Drivers are proud to be driving a vehicle which does not pollute. They felt that they were driving a special vehicle which contributed to their job satisfaction. The same drivers who have experienced a problematic functionality have at the same time reported to be satisfied with their vehicle. This means low functionality does not always equals low satisfaction as the environmental aspects is valued high and can compensate.

c) **Higher driving comfort** compared to the ICE vehicles**,** including:
   - Reduced noise inside the car
   - Automatic gear-box
   - Faster acceleration

- o High hinge moment of the electric engine, making the vehicle agile even at low speed

d) **Higher manoeuvrability** compared to the ICE vehicles. As the maximum torque at low speeds was higher than of ICE vehicles compared to for several electric freight models, the vehicle has been reported to be very manoeuvrable and easy to drive in the city centre.

e) **Lower operational costs,** compared to the ICE vehicles. It needs to be stressed that this factor is only valid for few companies where they have not experienced many technical errors. Operational costs can become lower if night distribution with electric vehicles is supported legally, as the vehicles will not be stuck in traffic. Implementation of such a law is probable as electric freight vehicles produce much less noise while driving.
The lower operational costs are mainly caused by:
- Higher efficiency of the energy usage, which is especially important for the city distribution. When vehicles are stuck in the traffic jams. This higher efficiency is not only coming from the very structure of the electric engine but also by the reverse energy generation while using brakes.
- Lower number of parts to repair within the electric engine comparing to the ICE.
- Cheaper vehicle's insurance. Broader insurance opportunities for EV's, differentiation between insurance fee for ICE vehicle and EV, as there is less parts to repair.

f) **Potentially lower labour costs** (lower requirements for drivers – possibility of employing people with driving licence category B, thus wider scope of potential employees and lower requirements regarding salary)

g) **Public charging spots already in place.** Several charging spots are already in place within larger cities and therefore some companies would not need to invest in their own charging infrastructure. An advantage mainly for companies requiring higher range than secured with electric vehicles which means flexible routing of deliveries.

Many of the city distribution companies who have adopted electric vehicles have fixed routed for their vehicles and it has worked out for most to use it the vehicle for the intended purpose. As the companies can charge the vehicles on the company's premises, they just have to plan a route in accordance with the battery capacity. Moreover, public charging points create a possibility of taking advantage of parking at the reserved parking lots while delivering to the city centre and charging during dwell time with the use of public charging spots. This is an important advantage for the companies, as the parking places in the city centre are extremely rare.

h) **Potential Low Emission Zones implementation.** In several cities Low Emission Zones are implemented which serves as a huge advantage over competitors using ICE vehicles, since only EV's can enter inner city areas without having expensive particle filters installed.

i) **Potential flexible deliveries.** As the electric vehicle is almost soundless deliveries can be made during the majority of time during the days). However, it also depends on the customers who agree or not agree for changed deliveries' timing. Potentially, the night distribution can also take place if law changes are made.

Experienced barriers of the electric freight vehicles use for the city distribution

Identified barriers concerned almost exclusively technical EV's' specification:

a) While operational costs in a substantial number of cases proved to be lower than of ICE vehicles, **the purchase and charging infrastructure establishment cost** was often found inacceptable without public support

b) **Small size** (therefore they can easier find a parking spot but on the other hand they can carry **a lower payload**)

c) **Small range** (a barrier mostly for companies performing their deliveries on the flexible routes)

d) Fluctuant range in cold temperatures and **imprecise range estimations** in general

e) **Lack of spare parts and repair shops** trained to fix EV's, as this is an emerging market

f) Loss of the payload due to **heavy batteries**. Firstly, it is an important problem as tachographs obligation depends on the vehicle's weight. Secondly, because the entrance of vehicles above a specified payload is restricted or even banned.

g) **Incompatibility of purchased EV's' plugs with public charging infrastructure** can take place, as there is no standard for charging plugs in place. However, this problems concern mainly companies performing their deliveries on the flexible routes, where "on-way" charging can be necessary.

h) Driving EV's need an adaptation of processes - **pre-planning** (additional time & cost).

i) **Sub-contraction is less feasible** with EV'S, since subcontractors often hire self-employed drivers who own their vehicles and usually utilize them after working hours. This must be changed, as EV's must be charged during the nights at the company's premises.

j) **Lacking dispatching system** for EV's

To conclude, electric freight vehicles were found feasible for the city distribution, especially for:

- The last mile deliveries (sufficient range, speed, manoeuvrability in the substantial part of cases studied), which are performed on the fixed routes (small range is not an obstacle for the business reliability in this case, as the travel distance is constant – known in advance)
- The last mile deliveries performed between the distribution centres and final customers (these deliveries take place over short distances, thus EV's range is sufficient). In this way, urban consolidation centres not only improve the economic efficiency of the deliveries, improve land use within the city, but also decrease the freight transport's footprint on the environment.
- The night deliveries (EV's are silent and therefore could be allowed to deliver during the night time)

Concerning country conclusions these are summarized on the basis of the division into the following categories: technical, financial, energy supply, environmental, process and logistics, ICT, regulatory and a human factor and represented in the tables on the following pages.

Conclusion - Drivers

Factor/ NSR country	Denmark	Norway	Germany	London	Netherlands	Belgium	Sweden	Common for NSR countries
Technical	1. Fail safe (few moving parts) 2. Sufficient capacity 3. Fast acceleration 4. Range 5. Manoeuvrable		1.Kilometer range suitable. 2. Relatively fail safe 3. Driving comfort (no pollution and noise)	1. Range.	1. Manoeuvrable	1.Manoeuvrable 2. Range 3. Acceleration 4. Sufficient capacity	1. Suitable for urban transport	**1. Range** **2. Speed** **3. Manoeuvrable** **4. Sufficient capacity**
Financial	1. Low operational cost 2. Marketing 3. Public subsidies	1.Discounts	1. EV's can be profitable. 2. EV's used as marketing measure. 3. New customers gained. 4. Strengthen relations with current clients. 5. Public subsidies in certain projects	1. Cost neutral due to policy benefits Premium of 5 000 £.	1. Low fuel cost 2. Low labour cost (young drivers)	1. Public subsidies available for EV's 2. Large country-wide tests (including private capital)	1. Low operational costs 2. Cheap service and maintenance	**1. Low operation cost, but public subsidies still important** **2. Lower labour costs in some countries**
Energy Supply	1. Several charging points available in cities. 2. Easily deployed	1.Electricity prices are low	1. Expensive public charging spots not necessarily needed for EV's in transport logistics. 2. Public charging infrastructure available.	1. Unified access to charging grid.	1. Need for charging spots located mainly at the company premises (not for public charging spots)	1. Recharged with energy produced from garbage gathered 2. Public subsidies available for infrastructure		**1. Several charging spots already in place within the cities** **2. Need for charging spots located mainly at the company premises (not for public charging spots)**
Environmental	1. No pollution (noise included) 2. Higher efficiency of energy usage	No pollution (noise included)	No pollution (noise included).	1. Slow and limited EV's enforce energy efficient driving style. 2. No pollution (noise included)	1. No pollution (noise included)	1. Eco friendly driving 2. Green CPs' (integrated with Smart Grid)		**1. No pollution (noise included)** **2. Higher efficiency of energy usage**
Process and	1. Suitable for city	Suitable for the	1. Suitable for city	1. Suitable for city	Suitable for the last	1. Suitable for		**1. Suitable for city**

Logistics	distribution	fixed routes	distribution.	distribution.	mile deliveries and goods bundling	garbage transport 2. Suitable for city distribution (night distribution, flexible deliveries) 3. Small size 4. Many stops 5. Feasible for integration with city depots		**distribution**
ICT								
Regulatory	1. Tax exemption 2. Free parking 3. Low Emission Zones	1. Incentives: driving in bus lane, free parking, exempted from charges while entering city centre (congestion toll, tunnels)	1. 10 years tax relief 2. Low Emission Zones	1. Free parking	1. Some companies buying EV's as they anticipate future policies -expect future regulation on Ice vehicles	1. Tax incentives 2. Subsidies for EV's purchases by the municipalities	1. Can use bicycle lanes for transportation	**1. Legal incentives** **2. Low emission zones** **3. Subsidies for purchases and tax exemptions**
Human factor	1.Pride 2. Image/CSR 3. Marketing 4. Comfort		1. Driving comfort (also due to lack of noise) 2. Strengthening relations with customers. 3. Pride. 4. Visibility of EV's. 5. Driving style.	1. Highlight business's sustainability (CSR). 2. Despite of problems connected with adaptation high satisfaction. 3. Positive public reaction.	1.Green image 2. No pollution 3. Image 4. High comfort 5. Better working conditions 6. Lower requirements for drivers – possibility of employment of unemployed people	1. Some clients satisfied with EV's 2. Large tests across the country	1. Positive reactions on the micro terminals	**1. Image** **2. CSR** **3. Pride** **4. Marketing** **5. Comfort**

Table 17. Conclusion on drivers for electric vehicles

Conclusion - Opportunities

Factor/ NSR country	Denmark	Norway	Germany	London	Netherlands	Belgium	Sweden	Common for NSR countries
Technical	1.Range increase 2.Separate heating system	1.Mass production	1. Freight EV's are technically suitable to substitute a considerable amount of ICEs. 2.More precise range estimations 3. Less fluctuant range in cold temperatures.			1.EV technological race 2.ICE vehicles retrofits into EV's	1. Fast charging solutions	**1.Range increase EV technological race 2.ICE vehicles retrofits into EV's 3.Reverse energy g generation while brakes used**
Financial	1. Continued support for EV'S and their testing	1. Mass production	1. Increased financial or non-financial support for EV'S by policy makers to minder TCO gap.	1. Broader insurance opportunities for EV's.	1. Continued support for EV'S		1. National subsidies for purchase of EV's 2. Leasing of the battery would be an options	**1. Continued support for EV'S and their testing 2. Broader insurance opportunities for EV's, differentiation between insurance fee for ICE vehicle and EV.**
Energy Supply	1. Continued support for charging infrastructure 2. More fast charging spots		1. More fast charging spots 2. Smart Grid.					**1. More fast charging spots Smart Grid**
Environmental	1. Increased number and extension of Low Emission Zones 2.Change of the public fleet to EV's		1. EV's can help cities to adhere to their climate goals.	1. Training eco driving.	1.Stronger focus on eco-friendly driving style	1.Liveable cities		**1. Low Emission Zones 2. Highlighting the environmental benefits connected with EV's**
Process and Logistics		1.Useful for a 30% of users, these performing "short trips"	1. Benefits of being a first mover.		1. Focus on small vehicles and vans 2. Night distribution 3. Goods transported from	1. On-the-road repair of EV's		**1.Increase focus on EV's and city depots integration 2. Useful for short trips**

					city depots to the clients (last mile deliveries) with EV's			
ICT			1. More precise range estimations. 2. Dispatching software that implements EV's technical limitations.					**1. Development of dispatching + OBU software for EV's**
Regulatory	1. Continue tax exemptions 2. Implement Low Emission Zones		1. Harmonized regulations regarding EV's special rights for whole the country 2. Extended time windows for deliveries. 3. Dedicated EV zones or Low Emission Zones. 4. Enhance weight limitations for drivers licence. 6. Free parking.	1.Ensuring stable taxation and discount conditions	1. Low Emission Zones 2. Harmonize the regulations regarding EV's for whole the country 3. Drivers licence		1. Pro-active municipal involvement in Swedish cities 2. Reduced toll fees for EV's	**1. Low Emission Zones 2. Driver's license 3. Harmonize the regulations regarding EV's for whole the country**
Human	1. Continue gathering information on users experiences 2. Teaching eco-driving style 3. Marketing (green image)		1. Energy efficient and regardful driving style. 2. EV's are visible in city traffic (marketing)		1. Test and try also for professional drivers 2. Strong promotional value of EV's	1 Larger EV's selection	1. Well received by clients and passers-by.	**1. Marketing 2. Eco-driving style 3. Test & try also for professional drivers (companies)**

Table 18: Conclusion on opportunities for electric vehicles

Conclusion - Challenges

Factor/ NSR country	Denmark	Norway	Germany	London	Netherlands	Belgium	Sweden	Common for NSR countries
Technical	1. Lack of spare parts Driving in winter conditions 2. Lack of repair shops	1. Driving in the winter conditions	1. Loss of range in winter. 2. Loss of payload due to heavy batteries. 3. Loss of range due to batteries ageing. 4. Higher energy demand in urban start-and-stop traffic. 6. Limited freight EV's variety.	1. Range. 2. Lacking spare parts.	1.Repair shops 2.A high battery's weight – decreased payload (insufficient)	1.Range 2.Low speed for EV's on the roads outside the city	1. Only low payload possible 2. Potentials for a broader selection of vehicle models.	**1.Range** **2.Driving in the winter conditions** **3. Expertise (lack of repair shops)** **4. Limited selection and interest** **5. Loss of the payload (heavy batteries)**
Financial	1. Additional running and maintenance expenses (e.g. charging infr.) 2. Additional heating 3. Total cost of EV's	1. Expensive (purchase) 2. High residual value	1. Total cost of ownership in most cases more expensive than ITC. 2. Investments in charging infrastructure	1. Insurance expensive (in one case).	1. Reliability (knowledge about the range in the specific use) 2. High purchase price 3. Depreciation rate unknown (because of 1 and 4)	1. Weather conditions	1. High purchase price	**1 High purchase price** **2. High running cost** **3. Total cost of ownership (especially when charging infrastructure purchase is taken into account)**
Energy Supply	Limited number of charging spots outside the cities Battery swapping is not yet possible for larger vehicles		1. Incompatible plugs and charging equipment.				1. Scarcity in charging infrastructure	**1. Incompatible plugs of different EV's models for charging (also sometimes incompatible plugs for fast charging spots and regular charging spots)**
Environmental	Green and black EV's (with/without use of smart grid)							**1. Other types of clean vehicles remain competitors**
Process and	1. Time needed for	1.Driving EV's need an	1.Sub-contraction is	1.No access to	1. Heavy batteries		1. Hard to create	**1. Heavy batteries cause a**

Logistics	recharging 2.A need of time schedule reconsideration	adaptation of processes - pre-planning (time&cost)	less feasible with EV'S 2. Heavy batteries cause a decreased payload. 3. Adaption of internal processes for using EV's necessary (time & cost).	knowledge within the field 3. Lack of information	cause a decreased payload 2.Limited range		a feasible business model	**decreased payload** **2. Driving EV's need an adaptation of processes - pre-planning (time&cost)** **3. Sub-contraction is less feasible with EV'S**
ICT			1.Dispatching software not available for EV's yet		1.Different systems for long and short routes			**1. Lacking dispatching system for EV's**
Regulatory	1. EV's import regulations (responsibility for repairs) 2.Tax exemption is valid only till 2015	1. Tax exemption is valid only till 2017 2. Insecure market regulations		1. Insecure market regulations	1. Tachographs not feasible for the city		1. Potential distortion of competition	**1. Tachographs not feasible for the city distribution.** **2. Limited time period of tax exemptions**
Human	1. Range anxiety 2.New market/product anxiety 3. Suppliers not ready to tackle problems	1. Time consuming to run and plan	1. Potential EV users disappointed by prototypes.	1. People wait for tested solutions				**1. New product/market anxiety** **2. Readiness of the technology** **3. Time consuming**

Table 19: Conclusion of challenges for electric vehicles.

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02.08.2012	Tessa Taefi, Tobias Held	Team E-mobility NSR	Alsterschiff Goldbeck, Hamburg	First Roundtable E-mobility NSR. Information and networking
14.02.2012	Tessa Taefi	Peter Meyer	City Express Hamburg	Initial contact for regional studies in the project e-Mobility NSR
15.02.2012	Tessa Taefi	Herr Hinz	Hermes Logistik Hamburg	Initial contact for regional studies in the project e-Mobility NSR
23.02.2012	Tessa Taefi	Lars Purkarthofer, UPS	Teleconference	Case Studies E-mobility NSR
28.02.2012	Tessa Taefi	Werner Oltmann	Fleet Factory Hamburg	Initial contact for regional studies in the project e-Mobility NSR
15.03.2012	Tessa Taefi	Team E-mobility NSR	HAW Bergedorf	E-mobility NSR: Workshop on Fast Charging
26.03.2012	J. Kreutzfeldt, J. Hinckeldeyn, T. Taefi	Peter Meyer	City Express Hamburg	Interview for regional cases
27.03.2012	Tessa Taefi	Herr Höper	DHL Altona	Interview E-mobility NSR with Manager and Driver.
29.03.2012	T. Taefi	Geoff Allison	Smith Electric Vehicles, Newcastle	Interview and factory tour at Smith Electrical
29-30.03.2012	Tessa Taefi	Team E-Mobility NSR	Newcastle	International Partner Meeting E-mobility NSR
10.04.2012	Tessa Taefi, Tobias Held, Jochen Kreutzfeldt	Peter Lindlahr, hySOULUTIONS	HAW Hamburg	Introduction at hySolutions.

03.05.2012	T. Taefi, A. Renz, J. Kreutzfeldt	Frau Schwarz, Logistikinitiative	Otto Forum, Wandsbeker Strasse 3-7, Hamburg	Logistik meets Science, Presentation e-Mobility NSR Project.
16.05.2012	Tessa Taefi, Tobias Held	Team E-Mobility NSR	Handelskammer Hamburg	Workshop "Fuelling the climate"
22.05.2012	Tessa Taefi, Tobias Held, Jochen Kreutzfeldt	Werner Oltmann	Fleet Factory Hamburg	First Fleet & Electric Day of Fleet Factory and BLG. Presentation of Prof. Held regarding TCO of commercial EV's.
30.05.2012	Tessa Taefi	Anne Südekum	Effenberger Vollkornbäckerei, Rutschbahn 18 20146 Hamburg	Interview Case Studies E-mobility NSR Projekt.
07.06.2012	Tessa Taefi	Mr. Hintze-Schomburg	Teleconference	Chances and Risks of electric mobility Hamburg politics.
14-15.06.2012	Tessa Taefi	Susanne Kernebeck	Haus der Technik Essen	4th German Electric Mobility Congress
27.08.2012	Tessa Taefi, Tobias Held, Jochen Kreutzfeldt	Klaus Bergerfurth, Bundesverband eMobilität e.V.	E-COLLECTiON concept-STORE, Am Sandtorkai 50, in 20457 Hamburg	Roundtable Electric Mobility. Presentation by Mr. Held and Mr. Oltmann about TCO of EV's.
29.08.2012	T. Taefi, T.Held, J. Kreutzfeldt, J. Hinckeldeyn	Peter Lindlahr, hySOULUTIONS	hySOLUTIONS, Steinstrasse 25, Hamburg	Update EV projects in Hamburg
30.08.2012	T. Taefi, T. Held, J. Kreutzfeldt	Logistikinitiative Hamburg	Restaurant Grill and Green, Hamburg	Summer event of the Hamburg Logistikinitiative.

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6. Sef Peeters, Director of Peeters Vervoercentrale, Amsterdam.
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Appendix A: Technical Specifications

This chapter gives an overview about the technical details of full battery electrical vehicles used in commercial transport cases in Germany. The following manufacturers and vehicles will be described:

	Manufacturer	Model 1	Model 2	Model 3	Model 4
1	PSA Citroen	Berlingo			
2	DFM	Chinese Van			
3	e-Wolf	Omega-Cargo Mini	Omega-0.7	Omega-1.3	Omega-1.4
4	Ford	Transit Electric	Transit Connect BEV		
5	German E-Cars	Plantos			
6	Iveco	Daily Electric 35 S	Daily Electric 50 C		
7	Karabag	Fiat Fiorino-E	Doblo-E	Ducato-E	
8	Mercedes	Vito E-cell			
9	Cargohopper	Cargohopper Train			
10	Cargohopper II	Cargohopper II			
11	Mia Electric	Mia U	Mia U Long		
12	Modec / EFA-S	UPS Modec Truck	P80-E conversion	Modec Truck	
13	Renault	Kangoo Z.E.	Kangoo Rapid Maxi Z.E.		
14	Smith Electric	Newton	Edison		
15	MAN	Modified by Peter Skafte ApS.	TGL	Converted	
16	Axiam	Mega Multitruck			
17	Elecscoot	E-Truck			
18	CityFort	E1			
19	ePower Trucks	Alke ATX	Nissan Cobstar		
20	Faam	Ecomile	Jolly2000	Smiley	Jolly1200
21	Goupil	G3			
22	Little Electric Van	Little Electric Van			
23	Peugeot	eBipper	eBoxer	eExpert	ePartner
24	Tata	Ace			
25	Bradshaw Electric	Bradshaw Van			
26	Toyota	iQ			
27	Volkswagen	e-Caddy			
28	Ford	Focus BEV			
29	Xenova	Terryman			
30	Spijkstaal	Ecotruck	Binkey Truck		
31	SITA	SITAIR Truck			
32	Melex	Melex 391			
33	Volkswagen	eT!			
34	Renault	Maxity			
35	Toyota	Coms			
36	e-Trucks Europe	e-Truck			

Table 20: Overview on the electric commercial vans and trucks

1. Citroën

Electric vehicles are a central tenet of the PSA’s strategic commitment to address environmental challenges. PSA Peugeot Citroën claims that one year after being the first to introduce electric vehicles in Europe in late 2010, they are the European leader in the EV market, with a share of nearly 30%. PSA Peugeot Citroën has delivered nearly 4.000 EV’s and booked more than 6.000 orders (PSA, 2012). Currently the following models are available in the market:

- Peugeot Partner Origin and Citroën Berlingo First (Commercial vehicle)
- Peugeot iOn and the Citroën C-ZERO (Urban vehicle)

Within the range, the Citroën Berlingo is of most interest for e-urban transport:

Citroën Berlingo First Electric		
		
Basic Information		
Manufacturer	Citroën	
Model	Berlingo First Electric	
Seats	2	2
Price (excl. VAT)	42.950 (09.2011) / 19.000 (06. 2012)	€
Availability	Late 2010. Berlingo 2 in Fall 2012	
Transport characteristics		
Gross weight	1890	kg
Payload	500	kg l
Load Volume	3000	
Battery		
Type	Natrium - Nickelchlorid (Zebra)	
Capacity	23,5	kWh
Range (NEFZ)	120	km
0 - 100% Charging	6-7	h
	230	V
Motor		
Energy consumption	0,22	kWh/km
Performance	60	kW
Top Speed	80	km/h

Table 21: Technical data of the Citroën Berlingo First Electric (Citroën, 2011).

2. DFM Chinese Vans

The very moderately priced DFM Vans where imported by a German import company on behalf of Mr. Meyer, owner of City Express Hamburg, in 2010. A the time of sourcing, in 2009, not many electric vans where available in Germany and if, they were extremely expensive. Mr. Meyer visited the Chinese workshop, in which with simple methods conventional Chinese vans, delivered without the combustion motor, where converted into electrical vehicles. Even the original gearbox was kept, which is uncommon for an electric vehicle. City Express meanwhile stopped its activities as importer of the vehicles due to the minor quality of the vehicles.

DFM (Chinese Van)

Basic Information		
Manufacturer	DFM (Chinese)	
Model	Van	
Seats	2	
Price (excl. VAT)	below 20.000	¤
Availability	Stopped	
Transport characteristics		
Gross weight		kg
Payload	500	kg l
Load Volume		
Battery		
Type	Lead Gel	
Capacity		kWh
Range	120	km
0 - 100%		h
Charging	230	V
Motor		
Energy consumption		kWh/km
Performance	8	kW
Top Speed	120	km/h

Table 22: Technical data of the DFM Van (CityExpressHamburg, 2010)

3. e-Wolf

e-Wolf is a German developer and manufacturer of EV's. The company is located in Frechen close to Cologne, where the EV's are assembled and a showroom is located. The range of e-Wolf includes three electrical racing cars, one car for personal transport, one bus, four commercial vehicles for transport and three electrical scooters. The following table gives details on the commercial transport e-vehicles of e-Wolf (e Wolf, 2012a).

e-Wolf E-transporter range					
					
Basic Information					
Manufacturer	e-Wolf				
Model	Omega Mini Cargo	Omega 0.7	Omega 1.3	Omega 1.4	
Price(excl. VAT)	21.955,50 (2010)	68.960,50 (2010)	51.765 (2010)	83.276,20 (2010)	€
Availability	Yes	Yes	Yes	Yes	
Transport characteristics					
Payload	325	613	1.300	1.400	kg
Battery					
Type	Lead-acid-gel	Li-ceramic	Li-ion	Li-ceramic	
Capacity	7,2	24,2	19,2	24,2	kWh
Range (NEDC)	65	180	100	150	km
Motor					
Performance (cont./peak)	4 / 8	60 / 90	18/ 31	75/ 140	kW
Top Speed	45	140	80	100	km/h

Table 23: Technical data of the e-Wolf E-transporter range (e-Wolf, 2012b)

4. Ford

Listed in the following table is the technical data of the two Ford EV's used in the model region test colognEmobil. The electrical power train of the Ford Transit BEV has been assembled by Smith Electric Vehicles in England. The vehicle is identical with a Smith Edison, see chapter A.13 on page 130. The electrical power train of the Ford Transit Connect has been assembled by Lotus lightweight Structures Ltd on behalf of Azure Dynamics (who filed for bankruptcy protection in March 2012), in England. Since 2011 the Ford Transit Connect Electric is available in the market at 44.000 ¤with a 52kW engine, consuming 0, 21 kWh/km for fleet customers, since 2012 it is available at car dealers.

Ford Transit BEV and Ford Transit Connect BEV			
			
Basic Information			
Manufacturer Model Seats Price (excl. VAT) Availability	Ford / Smith Electric Transit BEV 2 Available as Smith Edision Globally Non-US	Ford / Azure Dynamics / Transit Connect BEV 2 Prototype Prototype	¤
Transport characteristics			
Gross weight Payload Load Volume	1000	500 3500	Kg kg l
Battery			
Type Capacity Range 0 - 100% Charging	Lithium-Ion 40 165 4-6 380	Lithium-Ion 28 130 6-8 240	kWh km h V
Motor			
Energy consumption Performance Top Speed	90 80	105 120	kWh/km kW km/h

Table 24: Technical data of the Ford Transit BEV and Transit Connect BEV (Ford, 2012a+b)

5. German E-Cars

German E-Cars GmbH is a sister company of the German FRÄGER GmbH with years of ex- pertise in industrial production of transmission and motor systems. In 2009 they launched the Benni, Germany's first mass-produced electric vehicle. In autumn 2012 the Plantos, a light com- mercial vehicle based on the Mercedes Sprinter Chassis will follow. The Plantos will be sold in different variants, 9-seater bus, box or flatbed. Apart from the Plantos, German E-cars offers the Stromos for personal transport.

German E-Cars Pantos		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	German E-Cars Plantos 3 Below 80.000 Autumn 2012	¤
Transport characteristics		
Gross weight Payload Load Volume	3500 1.000 -1400	kg kg l
Battery		
Type Capacity Range 0 - 100% Charging	38,6 80 - 100 12 / 4 230 /400	kWh km h V
Motor		
Energy consumption Performance Top Speed	0,25 - 0,35 75 130	kWh/km kW km/h

Table 25: Technical data of the German E-Cars Plantos (E-Cars, 2012)

6. Iveco

The ECODaily electric is a variant of the new ECODaily range by Iveco. Iveco prides itself that the “ECODAILY Electric is designed by Iveco, constructed by Iveco and sold by Iveco”. The EV is in serial production and available in over 7.000 trim variants, with different wheelbases, as box, combined or flatbed, etc., just as the conventional Iveco. Depending on customers range requirements the models can house 2 - 4 of the ZEBRA batteries, each weighting 200 kilograms (Iveco, 2012).

Iveco ECODaily Electro			
			
Basic Information			
Manufacturer	Iveco		
Model	ECODaily Electric 35S	ECODaily Electric 50C	
Seats	2	2	
Price (excl. VAT)	100.000	140.000	¤
Availability	Serial production		
Transport characteristics			
Gross weight	3.500	5.200	kg
Payload	up to 2.105		kg
Load Volume	7.000	17.200 l	
Battery			
Type	NaNiCl2 (ZEBRA Z5)	NaNiCl2 (ZEBRA Z5)	
Capacity	2 -3 batteries, 21,2	3- 4 batteries, 21,2	kWh km
Range (NEDC)	90	130	h
0 - 100% Charging	8	8	
	400 / 32	V / A	
Motor			
Energy consumption			
Performance (continu-ous / peak)	30/ 60	40/80	kW
Top Speed	70	70	km/h

Table 26: Technical data of the Iveco ECODaily (Iveco, 2012)

7. Karabag

Karabag is a car dealer and workshop of fiat commercial vehicles and mobile homes, located in Hamburg. Starting in 2009 Karabag ventured in the electric mobility market by converting Fiat commercial transporters and the new 500 E in collaborated with the Italian company Mictro- Vett, with TüV Süd being responsible for homologation. Since 2011 Karabag is producing the Fiats at own production sites in Europe. Together with different partners, Karabag developed a wireless charging through an induction system and together with Eberspächer an emission free heating powered by bioethanol. Rating EV registrations in Germany 2010 reveals that Karabag was market leader with a market share of about 20%. Together with STILL (KION Group), renowned for their electrical forklifts, Karabag has established the first nationwide service for electrical vehicles with 800 service points. The service technicians were familiar with an integral part of the EV technology already, since electric engines and power electronics of the Kion group is implemented in the vehicles. (STILL, 2012).

Karabag E-transporter range

Basic Information				
Model Seats Price (excl. VAT) Availability	Fiorino E 2 36.761 - 57.285 End 2012	Doblo Cargo E 2 57.233 - 68.562 End 2012	Ducato E 2 82.687 - 111.605 End 2012	¤
Transport characteristics				
Gross weight Payload Load Volume	500 2.500	475 4.000	933 - 1.370 8.000	kg kg l
Battery				
Type Capacity Range 0 - 100 % (220V) 0 - 100 % (400V)	Li-Polymer 13,8 - 31,3 70 - 140 4 - 8,5 1 - 3	Li-Polymer 22,8 - 33,3 85 - 130 9 3	Li-Polymer 44,4 - 66,6 75 - 155 12 4	kWh km h h
Motor				
Performance Top Speed	26/60 75-115	60 130	60 90	kW km/h

Table 27: Technical data of the Karabag E-transporter range (Karabag, 2012)

8. Mercedes

Mercedes launched a pilot of the Vito E-Cell in mid 2010, producing a pre-series of 100 pieces for tests in Germany. Results of the study where included in a new version which went into a limited serial production in April 2011. Mercedes claims the Vito E-CELL to be the first electric drive van produced by an automaker at its factory rather then converted off-site (Mercedes, 2012). Currently there are three electric vehicles available in the market:

- Mercedes Vito E-Cell (Delivery Professionals)
- Mercedes A Class E-Cell (Family vehicle)
- Smart fourtwo electric drive (Small urban vehicle)

Within the range, the Vito E-CELL is of most interest for e-urban transport.

Mercedes Vito E-CELL		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	Mercedes-Benz Vito E-CELL 1 - 2 22.500 04.2011	€
Transport characteristics		
Gross weight Payload Load Volume	3050 900 5700	kg kg
Battery		
Type Capacity Range (NEFZ) 0 - 100% Charging	Lithium Ion 36 130 10 / 5 230 / 400	kWh km h V
Motor		
Energy consumption Performance Top Speed	0,22 60 80	kWh/km kW km/h

Table 28: Technical data of the Mercedes Vito E-Cell (Mercedes, 2012)

9. Cargohopper

The Cargohopper is an initiative of Hoek Transport in Utrecht. The compact narrow vehicle runs silently and emission-friendly public through the Old Town. It is the perfect alternative to the numerous vans movements otherwise required to supply.

Cargohopper is a vehicle that is able to tow 3 metric tonnes in a linear line by means of a 48 Volt 28 hp electric engine. The three trailers are steered on both axles which gives it a great manoeuvrability. Cargohopper has zero emissions and is allowed in the inner city at any time and any place. It is also narrow: only 1.25 metres wide so it can stop to make a delivery in narrow streets, where most of the other traffic is not able to pass.

Cargohopper		
		
Basic Information		
Manufacturer		
Model		
Seats	2	
Price (excl. VAT)		€
Availability	Now	
Transport characteristics		
Gross weight		kg
Payload	1000	kg
Load Volume		
Battery		
Type	Solar roof panel	
Capacity		kWh km
Range (NEFZ)	75	h
0 - 100% Charging		V
Motor		
Energy consumption		kWh/km
Performance		kW
Top Speed	25	km/h

Table 29 Technical data of the Carhopper

10. Cargohopper 2

Building on the success of Cargohopper I, the transport company Hoek has just launched Cargohopper II, the 2nd generation solar powered electric distribution trailer capable of covering a wider area in and around city of Utrecht. Just as the first Cargohopper the truck is solar-electric propulsed. The use of high output solar cells that are integrated in the roof panels generate 22% more energy per m^2 than the panels applied in the first Cargohopper. The trailer roof measures 11.7 m^2 with solar panels and provides a peak power of 1.9 Kw. Cargohopper 2 has been developed by Hoek Transport in cooperation with Divaco Benelux and Solar Car International.

Cargohopper II

Basic Information		
Manufacturer		
Model		
Seats	2	
Price (excl. VAT)		€
Availability	Now	
Transport characteristics		
Gross weight		kg
Payload	1000-2500	kg
Load Volume		
Battery		
Type	Solar roof panel	
Capacity		kWh km
Range (NEFZ)	150	h
0 - 100% Charging		V
Motor		
Energy consumption		kWh/km
Performance		kW
Top Speed	50	km/h

Table 30 Technical data if the Cargohopper II

11. Mia Electric

Mia Electric is a Franco-German company. Founded in June 2010 the company is based in Western France, where the cars are produced in the factory formerly owned by a French automobile manufacturer. The Mia electric vehicles are designed for urban and suburban driving. All models have sliding doors and are very compact, with a length of only 2.87 or 3.19 meters, depending on the version MiaElectric (2012). Service and maintenance is offered from the dealer or at any of the 360 Pit Stop outlets in Germany. Currently there are three Mia models available in the market:

- Mia U (Commercial Vehicle)
- Mia L (Family vehicle)
- Mia (Small urban vehicle)
- Within the range, the Mia U is of most interest for e-urban transport:

Mia Electric: Mia			Mia Electric: U
			
Basic Information			
Manufacturer Model Seats Price (excl. VAT) Availability	Mia Electric Mia U 1 - 2 22.500 Early 2012	€	Mia U long wheel base 2 26.124 Now
Transport characteristics			
Gross weight Payload Load Volume	1195 430 / 380 1200 / 1500	kg kg	350
Battery			
Type Capacity Range (NEDC) 0 - 100% Charging	Lithium iron phosphate 8 / 12 80 / 125 3 / 5 230	kWh km h V	Lithium Ion 130 5
Motor			
Energy consumption Performance Top Speed	18 100	kWh/km kW km/h	100

Table 31: Technical data of the Mia U (sourcelondon.net, 2012)

12. Modec

Six electrical trucks, built by the British EV constructor Modec (went into administration in 2011). UPS had tested two electric versions for parcel delivery in Germany since 2009:

- One conversion by ElekroFahrzeuge-Schwaben (EFA-S) ElekroFahrzeuge-Schwaben of an
- 15 year old conventional UPS truck, the P80 based on a Mercedes Vario. This vehicle had served 500.000 km already during its life as a conventional vehicle ((EFA-S, 2010)). Six more conversions have been ordered in 2012.

The P80-E has a cost, payload and load volume advantage over the Modec version of the UPS truck. For more details on the project, please refer to chapter A.11 (EFA-S, 2010).

UPS electric trucks				
				
Basic Information				
Manufacturer Model Seats Price (excl. VAT) Availability	Modec UPS Truck 2 Double price of conventional UPS Insolvent	EFA-S P80-E conversion 2 Less than conventional UPS Truck price Prototype	Modec 2	¤
Transport characteristics				
Gross weight Payload Load Volume	5.500 1.500	5.500 3.450 23	6020 2300	kg kg m^3
Battery				
Type Capacity Range 0 - 100% Charging	Lithium 51 70 - 100	Li-FeYPO4 62 80 - 100 (130 empty) 8 - 10 400	Litium-ion/ZEBRA 54/82 100/160	kWh km h V
Motor				
Energy consumption Performance Top Speed	 75 80	0,5 90 80	480	kWh/km kW

Table 32:Technical data of the UPS trucks (N24, 2009 and EFA-S, 2012)

13. Renault

Renault aims to become the first full-range car manufacturer to market zero-emission vehicles in use. The Renault-Nissan Alliance is developing a complete range of 100% electric power trains with power ratings of between 15kW and 100kW. Renault is retailing the electrical cars at the same price as equivalent diesel models (without the battery, which is rented). Currently there are four models available in the market:

- Kangoo Z.E. (Delivery Professionals)
- Fluence Z.E. (Family vehicle)
- Twizy (Small tandem urban vehicle)
- ZOE (Commuting to work)

Within the range, the Renault Kangoo Z.E. is of most interest for e-urban transport, available in two sizes, the Reanault Kangoo Z.E. and the Renault Kangoo Rapid Maxi Z.E (Renault, 2012b)

RENAULT KANGOO Z.E.			
			
Basic Information			
Manufacturer	Renault	Renault	
Model	Kangoo Z.E.	Kangoo Rapid Maxi Z.E	
Seats	2	2	
Price (excl. battery and VAT)	19.999	21.190	¤
Price for battery	89,25	89,25	¤/month
Availability	End 2011		
Transport characteristics			
Payload	595	650	kg
Load Volume	3500	4300	l
Battery			
Type	Lithium Ion	Lithium Ion	
Capacity	22	22	kWh km
Range (NEFZ)	170	170	h
0 - 100% Charging	8	8	V
	230	230	
Motor			
Energy consumption	0,17	0,18	kWh/km
Performance	44	44	kW
Top Speed	130	130	km/h

Table 33:Technical data of the Renault Kangoo Z.E (Renault 2012a)

14. Smith Electric Vehicles

Smith Electric Vehicles is a privately held company headquartered in Kansas City, Missouri. Smith currently designs, produces and sells two vehicles, the Smith Newton (based on Czech Avia chassis) and the Smith Edison (based on Ford Transit chassis). Both vehicles can be configured for a range of applications: there are multiple wheel base-, battery size- and weight options, the chassis caps are suitable for different bodies like for example dropside, tipper, box and refrigerated box. Smith has manufacturing facilities in Kansas City, Missouri and outside of Newcastle, UK. In 2011, Smith US purchased the zero-emissions vehicle business from the UK- based parent company, which has been in operation in Europe since the 1920s. In the 1950s and 60s the Smith EV's became famous with the Britain's electric milk float (SmithElectric, 2011a) and (SmithElectric, 2011b).

Smith Electric Edison and Newton			
			
Basic Information			
Manufacturer	Smith Electric Edison	Smith Electric Newton	
Model	Edison	Newton	
Seats	3	3	
Price (excl. VAT)	From 71.000	From 95.000	¤
Availability	Globally Non-US	Globally	
Transport characteristics			
Gross weight	3.500 - 4.600	7.500 - 12.000	kg
Payload	725 - 2.300	2.800 - 7.400	kg
Battery			
Type	Lithium Ion	Lithium Ion	
Capacity	36 - 51	40 - 120	kWh
Range	90 - 180	50 - 240	km
0 - 100% Charging	6-8 / 4	8	h
	230 / 400	230	V
Motor			
Energy consumption	0,3	0,8	kWh/km
Performance	90	120	kW
Top Speed	80	80	km/h

Table 34:Technical data of the Smith Edison and Newton (SmithElectric, 2012)

15. Electric MAN truck

The Danish company Peter Skafte ApS has conducted the rebuilding of a MAN diesel truck to an electric powered truck. Electric truck uses a special designed chassis, where progress happens without shaft by means of electric motors mounted directly on the vehicle's rear wheels. The chassis is the only one on the market that can be lowered down to the street level.

Electric MAN				
				
Basic Information				
Manufacturer Model Price (excl. VAT) Availability	MAN Modified by Peter Skafte ApS 368.753	MAN TGL	MAN Converted	€
Transport characteristics				
Gross weight Payload Volume	16000 9000	12000 3800 200-540	12000 40	kg kg l
Battery				
Type Capacity Range Charging	ZEBRA (NaNiCl2) 36 - 51 160 120-125 7 380 3 Phases /32A	Lithium-Ion 180 8	 130 9	 kWh km h V
Motor				
Energy consumption Performance Top Speed	1.130-1.170 90	 110-184 89	 80	kWh/km kW km/h

Table 35 Technical data of the Electrical MAN trucks

16. Aixam

Company profile AIXAM-MEGA is a manufacturing group located in the Rhône-Alpes region, in Aix-les-Bains (savoie) and Chanas (Isère). Being founded in the French Alps in 1983 AIXAM MEGA produces more than 15000 vehicles each year, with combustion and electric engine, for delivery to France, Europe and North America. The company reports to have sold 1500 electric vehicles to Europe and North America.

From 2003, Mega renewed its range completely to exploit two markets that were undeveloped: the compact ultra-light commercial utility vehicles and electric vehicles.

- Multitruck Compact Commercial Vehicles: available in two motors, diesel with a very low emissions level and a 100% electric motor
- E-Worker Compact Proximity Vehicle: only available in electric versions
- E-City Professional Saloon vehicle: available in an electric version, for professional use.
- E-City 2+2 saloon vehicle: available in an electric version, suited for private customers.

The Multitruck is delivered in several versions, dropside, van, pick-up, tipper, skip-tipper, basic and short (Mega-Vehicles, 2012).

Aixam Mega Multitruck		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	Aixam Mega Multitruck 2 12.300 Now	£
Transport characteristics		
Payload Volume	500 - 655 3000	kg l
Battery		
Type Range 0 - 100% Charging	Lead Acid 60 / 45 8 - 10 230	km h V
Motor		
Energy consumption Performance Top Speed	0,22 4 / 8 45	kWh/km kW km/h

Table 36:Technical data of the Axiam Mega Multitruck (Mega-Vehicles, 2012)

17. Elecscoot

Elecscoot Ltd was established in 2007 and is based in Consett, County Durham. Elecscoot claims to be UK’s leading provider of zero emission, all-electric cars, trucks, scooters and cycles. The company began in 2007 specialising in electric scooters. Having identified the clear demand in the market for affordable and green transport solutions, the company began to develop a range of passenger cars and light commercial vehicles. Apart from the E-Truck described below, the company offers a second commercial vehicle called
E-Pickup (Elecscoot, 2012).

Elecscoot E-Truck		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	Elecscoot E-Truck 2 8.995 Now	£
Transport characteristics		
Payload Volume	400 / 700	kg l
Battery		
Type Range 0 - 100%	Lead gel / lithium poly- mer 180 - 482 6	km h
Motor		
Energy consumption Performance Top Speed	 80	kWh/km kW km/h

Table 37: Technical data of the Elecscoot E-Truck (Elecscoot, 2012)

18. CityFort E1

Electric Powered Solutions is an importer and UK supplier of electric vehicles from some of the leading manufacturers around the world including Zallys, Fort and Metazet.

The company is a subsidiary of Pasquali Tractors UK Ltd - who has provided environmentally friendly solutions to load carrying for land based industries in the UK over many years.

The range includes electric vehicles like wheelbarrows, dumper trucks, burden carriers, tow tractors and ride on vehicles (CityFort, 2012).

CityFort E1 Electric Van		
		
Basic Information		
Manufacturer	Electric Powered Solutions	
Model	CityFort Electric Van	
Seats		
Price (excl. VAT)	21.240	
Availability	Now	£
Transport characteristics		
Payload	530	kg
Volume		l
Battery		
Type	Lead Gel	
Range	120	km h
0 - 100%	8	
Motor		
Energy consumption		kWh/km
Performance		kW
Top Speed	45	km/h

Table 38: Technical data of the CityFort

19. ePower Trucks

ePower Trucks is a trading name for the electric vehicle division of Lift Safe Ltd. Established in 2000, ePowerTrucks supply electric trucks, tow tractors, electric utility vehicles, electric tugs and a wide range of electric powered vehicles to a diverse range of industries (ePowerTrucks, 2012).

Alkè ATX		Nissan Cabstar	
			
Basic Information			
Manufacturer Model Seats Price (excl. VAT) Availability	Alkè ATX 100E / 200E 2 15.000 Now	Nissan Cabstar no price Now	 £
Transport characteristics			
Payload	400 - 600	1000	kg
Battery			
Type Range 0 - 100%	Lead acid 70 8	 72 	 km h
Motor			
Energy consumption Performance Top Speed	 6 30	 40	kWh/km kW km/h

Table 39: Technical data of the ePower Trucks (ePowerTrucks-2012)

20. Faam

Faam is an Italian based company founded in 1974 with a strong research culture. Since 2000 FAAM has been working on Fuel Cell technology applications, both for transport and for station- ary use. In 2008 FAAM has created an innovative system, which is based on the promotion of high-efficiency FAAM traction batteries combined with a high efficiency battery charger. FAAM has created BMS, Energy Management Systems, for lithium batteries. The company sells three different electric vehicle models (FAAM, 2012).

Faam Ecomile, Jolly 2000, Smiley, Jolly 1200					
					
Basic Information					
Manufacturer	Faam	Faam	Faam	Faam	
Model	Ecomile	Jolly 2000	Smiley	Jolly 1200	
Seats	2	3	2	3	
Price (excl. VAT)	35.100	49.950	12.100		£
Availability	Now	Now	Now	Now	
Transport characteristics					
Payload	935	1900	450	1630	kg
Battery					
Type	Lithium Ion	Lithium Ion	Lead Gel 72 V	lead – acid	
Range	80	120	70		
0 - 100%	6	6	6 - 8		h
Motor					
Top Speed	80	100	45	53.3	Km/h

Table 40: Technical data of the Faam electrical trucks (sourcelondon.net. 2012).

21. Goupil

Elecscoot Ltd was established in 2007 and is based in Consett, County Durham. Elecscoot claims to be UK's leading provider of zero emission, all-electric cars, trucks, scooters and cycles. The company began in 2007 specialising in electric scooters. Having identified the clear demand in the market for affordable and green transport solutions, the company began to develop a range of passenger cars and light commercial vehicles. Apart from the E-Truck described below, the company offers a second commercial vehicle called E-Pickup (Elecscoot, 2012).

Goupil G3		
		
Basic Information		
Manufacturer	Goupil	
Model	G3	
Seats	2	
Price (excl. VAT)	15.000-22.000	£
Availability	Now	
Transport characteristics		
Payload	700	kg
Volume		l
Battery		
Type	Lead traction (48)	
Range	130	km h
0 - 100%	7-8	
Motor		
Performance		kW
Top Speed	40	km/h

Table 41:Technical data of the Goupil G3 (sourcelondon.net, 2012)

22. Zerocars Little Electric Van

Zerocars are a Southampton based private limited company with over six years' experience in the motor trade. Zerocars have a range of electric vehicles to appeal to both private buyers looking for a stylish electric car or for business users looking for practical & sustainable transport solutions (Zerocars, 2012).

- The Little Electric Car range of vehicles has a design inspired by the Mini Moke, the legendary icon of motoring freedom from the 1960s, bought bang up to date with twenty first century technology.

- The Piaggio Porter range of electric utility vehicles has sold over five thousand units across Europe to date and includes vans and people carrying options.

Zerocars Little Electric Van		
		
Basic Information		
Manufacturer	Zerocars	
Model	Little Electric Van	
Seats	2	
Price (excl. VAT)	14.000	£
Availability	Now	
Transport characteristics		
Payload	250	kg
Volume		l
Battery		
Type	Lead Gel	
Range	95	km h
0 - 100%	8	
Motor		
Performance	4	kW
Top Speed	50	km/h

Table 42: Technical data of the Little Electric Van (sourcelondon.net, 2012).

23. Peugeot

Allied Electric is a new vehicle manufacturer dedicated to reducing environmental harm by bringing practical and reliable zero emission electric vehicles to market. Allied Electric's products combine the latest in lithium-ion battery technology and electronic management software with a range of reliable vehicles produced by the major vehicle manufacturer Peugeot.

Allied Electric's new range of electric vehicles includes goods vans and passenger vehicles that are ideal for daily working life in busy town centres. Electric vehicles for sale from Allied Electric offer ranges of up to 95 miles and top speeds of up to 62mph, making them suitable for operation in most urban environments (AlliedElecric, 2012).

Allied Electric Peugeot Conversions					
					
Basic Information					
Manufacturer	Allied Electric				
Model	eBipper	eBoxer	eExpert	ePartner	
Seats	2	3	2-3	2	
Price (excl. VAT)	41.000	58.000	51.000	46.000	£
Availability	Now	Now	Now	Now	
Transport characteristics					
Payload	350	895	666	681	kg
Battery					
Type	Lithium Nickel Cobalt Maganese	Lithium Ion	Lithium Ion	Lithium Ion	
Range	100	175	160	110	km
0 - 100% (200V)	8,5	19	14	9	h
0 - 100% (400V)	3	10,5	8,5	5	h
Motor					
Top Speed	100	80	100	100	km/h

Table 43: Technical data of the Allied Electric Peugeot conversions. (sourcelondon.net, 2012)

24. Tata

Internationally, Tata Motors is focused on environment-friendly technologies. In 2005, the com- pany established its European Technical Centre (TMETC) at the University of Warwick in the UK and the brief was clear - develop a clean, battery powered electric mini truck with leading- edge performance which fulfills the expectations of business users (Tata, 2012).

Tata Ace		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	Tata Ace 2 12.500 Now	£
Transport characteristics		
Payload Chassis cab Payload Drop side Payload Box van Payload Tipper	590 500 485 375	kg kg kg kg
Battery		
Type Range 0 - 100%	Lead Acid 50 5 - 8	km h
Motor		
Top Speed	40	km/h

Table 44: Technical data of the Tata Ace (sourcelondon.net, 2012)

25. Bradshaw

Bradshaw has been supplying Industrial Electrical Vehicles to both the UK and the world market since 1975 and is now the largest UK based manufacturer in this sector. The Bradshaw product range includes ride on and pedestrian controlled tow tractors; load carriers; utility vehicles and personnel carriers. Our expert team also designs and manufactures custom and bespoke equipment, so we can tailor specific solutions to your requirements.

Bradshaw		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	Bradshaw Electric N/A	 £
Transport characteristics		
Payload Volume	N/A	kg l
Battery		
Type Range 0 - 100%	N/A	 km h
Motor		
Performance Top Speed	N/A	kW km/h

Table 45 Technical data of the Bradshaw EV; Source: http://www.bradshawelectricvehicles.co.uk/

26. Toyota IQ

Toyota has been working to develop sustainable mobility for many years, driven by their vision of zero emissions and zero waste. It combines compact city car agility with zero emissions and the easy, silent driving of an electric vehicle with a range of up to 105km. The use of a newly developed, flat, highly compact lithium-ion battery pack creates a intelligent packaging solution.

Toyota iQ		
		
Basic Information		
Manufacturer	Toyota	
Model	IQ 1.0	
Seats	4	
Price (excl. VAT)		£
Availability	Now	
Transport characteristics		
Payload		kg
Volume	32	l
Battery		
Type		
Range	780	km h
0 - 100%		
Motor		
Performance		kW
Top Speed	150	km/h

Table 46 Technical data of the Toyota iQ

27. VW e-caddy

The electric Caddy will retain its 140 cubic feet of storage space, since the lithium ion batteries are built right into the floor, and its 85kW electric motor took the high-roofed wagon to a regulated high speed of just under 75mph during testing. The electric Caddy should be able to haul loads of over 1200 lbs. and VW claims it has a range of 68 miles.

VW Electric Caddy		
		
Basic Information		
Manufacturer	VW	
Model	Caddy Electric	
Seats	2	
Price (excl. VAT)		£
Availability		
Transport characteristics		
Payload	748	kg
Volume	4.2	l
Battery		
Type	air-conditioned	
Range	200	km h
0 - 100%		
Motor		
Performance	85	kW
Top Speed	130	km/h

Table 47 Technical data of the VW e-Caddy

28. Ford Focus BEV

The Focus Electric gets all of its power from a state-of-the-art 23 kWh liquid-cooled, lithium-ion battery. It has an EPA-estimated range of 76 gas-free miles on each charge and is engineered to reach a top speed of 84 mph. The all-electric motor is designed to help reduce energy loss and heat generation while reducing the carbon footprint. An interesting fact is that the Focus has three batteries. Two make up the main li-ion pack: one mounted under the car, and one that's mounted directly above, inside the rear hatch area behind the seats A conventional 12V lead-acid car battery is used to control the onboard electronics.

Ford Focus Electric		
		
Basic Information		
Manufacturer	Ford Motor Company	
Model	Ford Focus	
Seats	4	
Price (excl. VAT)		£
Availability	Now	
Transport characteristics		
Payload		kg
Volume		l
Battery		
Type	liquid-cooled lithium-ion	
Range	122	km h
0 - 100%		
Motor		
Performance	23	kW
Top Speed	135	km/h

Table 48 Technical data of the Ford Focus Electric

29. Xenova Prototype - Terryman

Xenova's Terryman is a fully electric powered van which offer an innovative added value in terms of environmental and resource protection. The Terryman has photovoltaic roof that generates approximately 10% of the daily energy itself. Xenova's Terryman's dimensions include a length of 2800mm, a width of 1700mm and a height of 1600mm. It is a completely zero-emission vehicle and can be used as a commercial and delivery purpose.

Xenova Prototype		
		
Basic Information		
Manufacturer	Xenova	
Model	Terryman	
Seats	2-9	
Price (excl. VAT)		£
Availability	Now	
Transport characteristics		
Payload	1090	kg
Volume		l
Battery		
Type		
Range	500	km h
0 - 100%		
Motor		
Performance	60	kW
Top Speed		km/h

Table 49 Technical data of the Xenova Terryman

30. "Binkey" Electric Truck / Spijkstaal Ecotruck

The Ecotruck 7500 is an electric driven chassis/cabin with a high loading capacity of abt. 4000 kg and a very special cabin which is extremely suitable for the many getting in and exiting of the driver and driver's mates. The Ecotruck is now regularly supplied for waste collecting. The Ecotruck can also be supplied with a fixed cargo-box and tail lift. The vehicle is very suitable for the purpose as city distribution also.

Spijkstaal Ecotruck / Binkey			
			
Basic Information			
Manufacturer Model Seats Price (excl. VAT) Availability	Spijkstaal Ecotruck 7500 2	Spijkstaal Ecotruck 7500 2 Now	 £
Transport characteristics			
Payload Volume	4000 25	2000 7	kg l
Battery			
Type Range 0 - 100%	Lithium-ion 100	Lithium-ion 100	 km h
Motor			
Performance Top Speed	 40	 40	kW km/h

Table 50 Technical data of the Spijkstaal Ecotruck; Source: http://www.spijkstaal.com/english/Products/Ecotruck-7500/ecotruck

31. SITAIR Truck

Investment was required in a new generation of household waste collection trucks, and therefore a partnership was set up with PVI, specialised in electrical traction for vehicles, and SEMAT, a company specializing in collection and cleaning equipment, as well as with Li-Ion, a battery manufacturer. After eighteen months of design, SITA's new fully electric truck is ready. In addition to the zero direct emissions of CO_2, the vehicle has extremely low noise levels.

SITAIR Truck		
		
Basic Information		
Manufacturer	Aviapartner and SITA	
Model	SITAIR truck	
Seats	2	
Price (excl. VAT)		£
Availability	Now	
Transport characteristics		
Payload	16	tons
Volume		l
Battery		
Type	switchable lithium-ion	
Range	120	km h
0 - 100%		
Motor		
Performance		kW
Top Speed	100	km/h

Table 51 Technical data of the SITAIR truck; Source: http://www.emag.suez-environnement.com/en/fully-electric-trucks-courbevoie-2921

32. Melex 391

The longest model in Melex 3 Series, Melex 391 has a large carrying capacity. The car is capable of up to 1250 kg of payload, depending on equipment. But because of different registration rules, the model is traffic approved for a load capacity up to 1000 kg.

The body is of 1.85 x 1.31 m wide but as an alternative, Melex also offer a a full 2.05 x 1.31 m body. Electro-hydraulic tipping is optional.

Melex 391		
		
Basic Information		
Manufacturer Model Seats Price (excl. VAT) Availability	Melex 391 2 Now	 £
Transport characteristics		
Payload Volume of cargo	1000 1,25 x 1.69	kg m
Battery		
Type Range 0 - 100%	80	km h
Motor		
Performance Top Speed	5 30	kW km/h

Table 52 Technical data of the Melex 391; Source: http://www.blyss.de/producers/6/p/205

33. VW eT !

The eT! is advancing to become the automotive building block for an innovative, future-oriented logistics concept, which not only drives with zero emissions in urban areas – thanks to its electric wheel hub motors – but also offers maximum freedom in manoeuvering and turning as well as optimal utilisation of the vehicle's interior space. If 'refuelled' with electricity generated from renewable energy sources, the eT! can indeed be operated with zero emissions.

eT! can be operated semiautomatically in certain situations. The car can follow the delivery person from house to house ("Follow me"), or the car can return to the delivery person on command ("Come to me") – driverless! As an alternative, the driver can direct the car's movements via a 'drive stick' from the passenger's side that also offers a standing seat and quick access to the vehicle.

Source: http://www.autoblog.com/2011/11/18/volkswagen-et-electric-delivery-van-is-out-of-this-world/

VW eT!		
		
Basic Information		
Manufacturer	VW	
Model	eT!	
Seats	2	
Price (excl. VAT)		£
Availability		
Transport characteristics		
Payload		kg
Volume	4.1	l
Battery		
Type	lithium-ion	
Range	100	km h
0 - 100%		
Motor		
Performance		kW
Top Speed	110	km/h

Table 53 Technical data of the VW eT!; Source: http://www.saving-volt.de/2012/09/vw-et-das-postauto-der-zukunft/

34. Renault Maxity

A light commercial cab-over-engine vehicle manufactured in accordance with European standards, Renault Maxity is a notable addition to the Renault Trucks delivery range, distinguished by its outstanding performance. Renault Maxity's unique compactness is backed by standard-setting manoeuvrability with latest generation steering gear offering a minimal turning radius of 4.80 m. Renault Maxity makes the most of the cab-overengine concept to offer total mobility and excellent integration into town traffic.

Renault Maxity		
		
Basic Information		
Manufacturer	Nissan	
Model	Renault Maxity	
Seats		
Price (excl. VAT)		£
Availability		
Transport characteristics		
Payload	1,750/2,200	kg
Volume	4.1	l
Battery		
Type	lithium-ion	
Range	100	km h
0 - 100%		
Motor		
Performance	47	kW
Top Speed	90	km/h

Table 54 Technical data of the Renault Maxity; Source: http://www.hessel.dk/media/28019/Maxity_brochurer.pdf

35. Toyota Coms

The COMS has four wheels and a roof, so the driver isn't required to wear a helmet. It does have a mandatory seatbelt, because safety is important and also the COMS doesn't actually have any doors (you can get canvas doors). It also requires the driver to have an actual driver's license, as the vehicle's top speed is 37 mph. The updated motor has a maximum output of 5kW and up to 250Nm of torque. While the inverter was developed in-house, the 6 lead-acid batteries are from Panasonic, and will carry the vehicle for a good 31 miles before needing a 6-hour recharge.

Toyota Coms		
		
Basic Information		
Manufacturer	Toyota	
Model	Coms	
Seats		
Price (excl. VAT)		£
Availability	Now	
Transport characteristics		
Payload	140	kg
Volume		l
Battery		
Type		
Range	50	km h
0 - 100%		
Motor		
Performance		kW
Top Speed	60	km/h

Table 55 Technical data of the Toyota Coms; Source: http://gas2.org/2012/07/06/toyota-coms-makes-a-comeback/

36. E-trucks Europe

The basis of an E-Truck is largely similar to a conventional diesel vehicle.With a big change: the powertrain. The conventional diesel engine has been replaced by one made by E-trucks Europe custom, electric. The electric motor is powered by energy from the battery pack. The battery pack of the vehicle is mounted on the left-and right-hand side of the chassis.

E-Truck		
		
Basic Information		
Manufacturer Model Seats Price (excl.	E-Trucks Europe, Triphasé E-trucks	
Transport characteristics		
Payload Volume	20000	
Battery		
Type Range 0 - 100%	250	
Motor		
Performance	20-40 90	

Table 56 Technical data of the E-truck Europe; Source: http://e-truckseurope.com/nl/projecten/e-trucks-europe

About E-Mobility NSR

The Interreg North Sea Region project North Sea Electric Mobility Network (E-Mobility NSR) will help to create favorable conditions to promote the common development of e-mobility in the North Sea Region. Transnational support structures in the shape of a network and virtual routes are envisaged as part of the project, striving towards improving accessibility and the wider use of e-mobility in the North Sea Region countries.

www.e-mobility-nsr.eu

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