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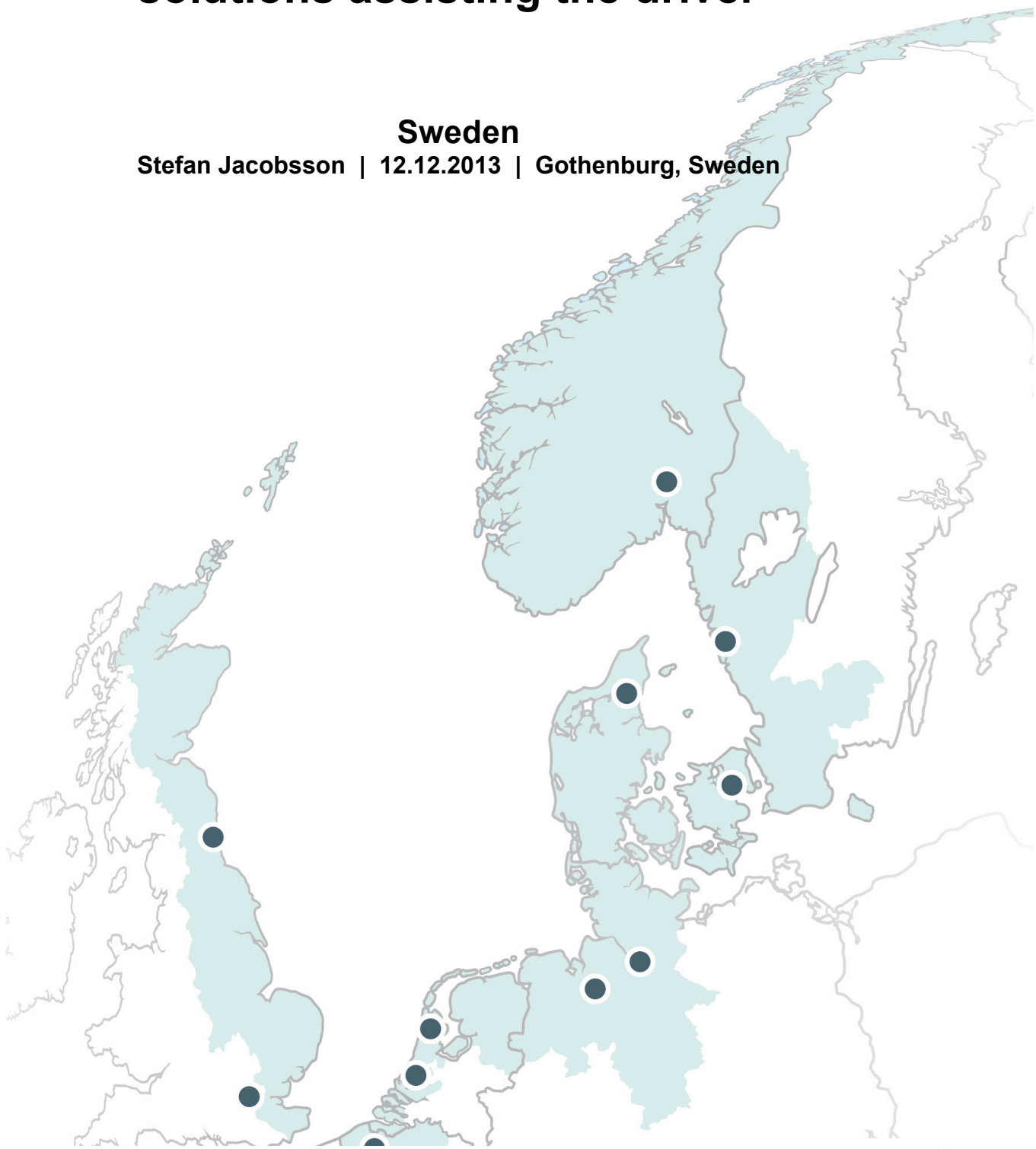
e-mobility NSR

WP 7.5 “Analysis of user needs for ICT solutions assisting the driver”



Sweden

Stefan Jacobsson | 12.12.2013 | Gothenburg, Sweden

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1 Introduction

Activity 7.5 has looked into the use of ICT solutions for electrified urban transport. The goal was to provide a state of the art overview of existing technology solutions and standards as well as insights on the potential for certain technology applications. Also, future ideas and work has been elaborated.

Activity 7.5 has been divided into four sub-activities: Sub-Activity 7.5.1 "**Comparative Analysis of European Examples of Schemes for Freight Electric Vehicles (EVs) in Sweden**", Sub-Activity 7.5.2 "**Information and Communications Technologies (ICT) solutions**", Sub-Activity 7.5.3 "**Workshop on ICT solutions for electric urban distribution vehicles**" and Sub-Activity 7.5.4 "**Proposals for future pilots**". Sub-Activity 7.5.1 is further described in Appendix A "**Case Study Sweden**".

Supplementary activity 7.5 has added to the report in Activity 7.3 with information on schemes for freight electric vehicles (EVs) in Sweden. Moreover, within Activity 7.5 a state of the art overview of existing and future ICT (Information and Communications Technologies) solutions designed for electrified urban freight transport has been provided.

The workshop "**ICT solutions for electric urban distribution vehicles**" was held on the 26th September 2013 at Lindholmen Science Park in close cooperation with FDT. The results of the workshop have been used as an input for proposals for future pilots within Sub-Activity 7.5.4.

2 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 is defined by Wikipedia (2013) as:

> ICT is often used as an extended synonym for information technology (IT), but is a more specific term that 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 urbanization, 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).

2.1 Solutions on the market

The aim of several of these solutions is to overcome current deficiencies in the infrastructure when using EVs.

2.1.1 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 include:

- Environmental zones with specific rules for the vehicle in question, e.g. maximum vehicle length of 10 meters or only for EVs
- 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, cafeterias, etc.

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Layers that would be of extra interest when using EVs:

- 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

2.1.2 Intelligent route planning

Route planning is made at the transport office in order to take all stops of a truck on one day 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 reports on each vehicle, trips and/or business line and more. The aim is to reduce mileage, optimize the routes and use in an incentive system.

Limited reach of an EV 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.

2.1.3 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 roadblock 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,
- An electronic device placed in the window of a vehicle which is read at long range,
- Automatic license plate recognition, and
- Other types of recognition solutions such as face, finger print, and finger vein

2.1.4 Carbon footprint calculator and report

Carbon/ecological footprint refers 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 of internal use and/or for improvements 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.

2.2 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.

2.2.1 Booking support of parking slot and/or charging post

It is a widely available service to book online or by using the 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 optimized 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 maximize 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. How much is it worth to the hauler to have an available parking slot when the driver arrives?

2.2.2 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 what is known as cooperative systems within ITS (Intelligent Transport Systems and Services).

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 (Viktoria Swedish ICT, 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).

2.3 Advantages and winnings with ICT solutions

The European Commission (2007) means 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 an urgent need for ICT solutions, neither today or 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. Especially when it comes to 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 EVs a business case can be calculated and evaluated.

3 Workshop on ICT solutions for electrified urban distribution vehicles

Lindholmen Science Park and FDT organized a transnational full day workshop on the 26th of September 2013 in Gothenburg, Sweden. The target was networking and information exchange between companies using electric freight vehicles in their business, having a focus on ICT solutions for e-mobility in urban freight.

WP 7.5 leader Stefan Jacobsson from Lindholmen Science Park introduces the workshop.

The representing countries were Norway, Denmark, Germany, Belgium, the Netherlands and Sweden. The participating organizations were Zero, FDT, DB Schenker, Copenhagen Electric, HAW, TNT Express, Fraunhofer IVI, Vehco, Stadsleveransen and Lindholmen Science Park.

3.1 Content of the workshop

During the morning session there were presentation held on different European examples of schemes for Freight EVs focusing on ICT solutions. There were also presentations held from a number of producers of EV ICT solutions as mentioned above.

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Johan Stråkander from Vehco explains different ICT solutions from a producer's perspective.

The emphasis of the afternoon session was group discussions on EV and ICT solutions organized by a moderator. The discussions were divided into two different areas with their corresponding solutions:

- Internal efficiency for the haulier
  - Navigation support
  - Intelligent route planning with fleet management system (FMS)
  - Booking support of parking slot and/or charging post
- External efficiency for city/haulier/other actors
  - Intelligent access program – access management for restricted areas (incentive based discussion)

Some of the questions that were addressed:

- What are the advantages and disadvantages of the ICT solutions described in chapter 2?
- Is there any information that is crucial for the ICT solutions to be used for EVs?
- Can you see any information that is missing that might be useful? Especially for urban freight transport and/or the use of EVs?
- How do the ICT solutions meet the consumer demands?
- Are there any barriers that might hinder full implementation and usage? Which are they?
- What are the future perspectives for different kinds of ICT solutions, with a main focus on

EV integration in relation to route planning and navigation support?

- What are the needs for further development of ICT solutions for EVs in city logistics?
- Can ICT foster the use of EVs in city logistics?
- On which commercial market segments can EV's be used most optimally?

The aim was to make a small and efficient workshop where there was time for both small presentations, round table discussions, new ideas and networking.

Moderator Camilla Nyquist explains the aim of the afternoon session.

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3.2 Results of the workshop

As mentioned above there were group discussions during the afternoon session. The following subsections contain the outcomes of the discussions. The strategy was to go through each of the ICT solutions one by one.

Afternoon session and round table discussions about different ICT solutions from an EV perspective.

3.2.1 Navigation Support

Discussions:

- The need for navigation support depends on how good the driver knows the route.
- Test from a Swiss web site: How many passengers? How loaded is the EV? Which topography is on the way? The Navigation Support web site should be able and taking account the following data:
- Unit price
- Often the subcontractors have their own systems
- Navigation Support should be combined with Dynamic Route Planning
- Navigation Support is on the wish list, but not a basic need

Advantages:

- Can estimate how long the EV should be charged to be able to cover the planned distance.
- Knowing the specific arrival time
- Knowing about traffic jams, more efficient route planner
- Can take away the range anxiety

Disadvantages:

- Cost is crucial

Missing information that would be useful?

- Recharging points location (It is more useful for the driver than the system)
- Routes that contain less hills that reduces the energy consumption
- Charging points with flexible payment solutions
- Status of the charging points; up-and-running, available or defect
- Information for different countries
- Fast re-chargers using induction
- Component workshops or repair shops/service centres
- Non-occupied charging points (homepages show already real time info, but is not included in the driver's on board unit
- Good to know which charging points that are private and which ones are public
- Charging points at the delivery place to charge during loading/unloading
- Manufacturers should specify the development to bring it to the market as fast as possible and on feasible terms

Crucial information for this ICT solution

- See the ICT solution document

3.2.2 Dynamic Route Planning

Discussions:

- Volume and range are important factors
- Used in express deliveries
- Communication to and from the EVs is very important to calculate routes. Info about the range, how empty the batteries are
- Updates and improvements for the dynamic route planning systems should be located on a server that can provide systems easier with the newest software

Advantages:

- Construct the routes so they fit the cars minimum range, especially for EVs because of their limited range
- The more efficient the wider range
- The system should always calculate the most dynamic route
- Smart and dynamic system to switch cars when necessary
- Driving behaviour impacts the energy consumption

- Climate impact (i.e. summer, winter)
- Weight of the pallets
    - Heavy pallets → diesel
    - Light pallets → EV

Disadvantages:

- Space
- Weight of the pallets. Too heavy goods cannot be delivered by EVs.

Barriers that might hinder full implementation and usage

- Data availability
- Different systems for EVs than for the other vehicles. Should be suitable or same system
- Tracking of in-house and/or subcontractors works differently in different countries
- Implementation cost (service providers for Telematics/FMS)

3.2.3 Booking Support of Parking Slot and/or Charging Post

Discussions:

- There should be fast charging posts or induction charging spots at the delivery places so the EVs can recharge during loading and unloading. Public charging spots between the destinations will probably not be used since the delivery time then will be increased.

Advantages:

- Good when combined with lunch breaks and fast charging
- Route dependence
- Free parking for EVs
- For the future: Parking slots with charging posts

Disadvantages:

- No parking slots for deliveries of goods in the city centres
- From a commercial point of view it is not useful for the public charging posts, but for the customers' charging posts when delivering goods in the middle of city centres.

Barriers that might hinder full implementation and usage

- The government should be in charge and specify where the fast charging posts should be located and on how they can be booked, so many different charging posts with different systems and standards will be avoided.

3.2.4 Intelligent Access Program

Discussions:

- Better to use a central delivery spot and from there everything will be distributed to the city centre

- EU rules 2013: It should be good for the logistics organizations to be in the front line, so they are prepared when the rules in the cities changes, meaning that only EVs and other clean vehicles are allowed in the city centres.
- Noise reduction

Advantages:

- If there are Traffic zones available where only EVs are allowed
- From a governmental point of view to decrease carbon foot printing and live up to the EU environmental goals of CO_2 free cities
- Benefits if you get more customers than your competitors since the company gets more environmental friendly by using IAP.
- Benefits if you can get smoother into the city by using IAP.

Disadvantages:

- For logistics business point of view it is just more effort and more costs. No customers want to pay for it

Are today's solutions attractive:

- Automatic controls are an advantage and can be run with lower costs and are more efficient. And the manpower can be reduced.
- If you can get a system where you get the "right" vehicles with the "right" technologies it would be very attractive and solve a lot of issues and would be easier to control who should be able to move around in the cities and who should not.
- The good thing with electronics devices is that they minimize the need for enforcement and for checking. They could offer a cheap solution, at least in the pedestrian areas. The electronic devices could make it easier to enforce regulations.
- Minimize the checking and cheating.
- The on-board unit in the trucks prevent from cheating as well.

Required Incentives to make the ICT solution attractive

- Secured parking slots/areas for heavy trucks i.e. well-lighted during night, fence around the parking slots and crossing gates that only can be opened by privileged vehicles.
- Creating a designated area for EV's makes it more attractive to use EVs and stimulates the use (i.e. bus lanes, specific area in the city just allowed for EVs).
- Better delivery times during daytime for EVs within cities.
- By using EVs you should get more benefits than when using a regular vehicle.

3.3 Summary of the workshop

The biggest problem with EVs except that they often are more expensive than regular vehicles is the range anxiety. With the discussed ICT solutions above this range anxiety could be decreased in different ways. But nevertheless the help of these ICT solutions EVs are most suitable for city logistics.

Today, 6% of all fleet operations could be done by EVs, because these routes are less than 150 km. And most of these routes are within city centres.

The volume and weight of the goods are important factors. The usage of EVs should be concentrated to lighter goods transportations.

The information about the charging posts is of interest. Such information could be the locations of the charging posts, the availability of the charging posts, and if they are private, public, fast, normal or induction chargers. Other good information is where component workshops or repair shops/service centres are located.

Some representatives at the workshop believe it is better to use a central delivery spot and from there distributed everything to city centre. To reach the EU goals of CO_2 free cities in 2030 the transports from a central delivery spot should only be done by EVs.

WP7 leader Michael Stie Laugesen is summarizing the workshop.

3.3.1 Can ICT help increase the use of EVs in city logistics?

a) It depends on the quality of the vehicles. The accuracy is very low. It is hard to plan in a good way. But if the information is near to the reality it is easier to optimize and utilize the EVs.
b) Yes, but Telematics needs to be improved. To get all information like state of charge, true end prediction and all information from the transport management system and put them all together with a good algorithm to plan the electric routes.
c) User's driving behaviour. It is hard to find the impact without the data from the driver.
d) Reach EUs goals 2030: We need to close the city centres for all vehicles except EVs and similar clean vehicles.

3.3.2 On which commercial market segments can EV's be used most optimally?

Today:

a) Fixed routes with lightweight cargo, fixed goods and fixed routes.
b) No refrigerated goods

Future:

c) Fixed routes disappears
d) EVs have many advantages and possibilities in the cities, but not for longer and heavier transports
e) Different transport modes should be used most optimally. For example, from ports to special terminals only using EVs, or where the transportation distance is not too far and especially within city centres.
f) Utilization of gas driven vehicles for long distance transports

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4 Proposals for future pilots

Several times cities and regions, instead of countries, are better suited to be forerunners in the development of city logistics for EVs. They have the power to put regulations regarding environmental zones, to offer reduced taxes or fees for road tolls or financial subsidies to promote purchasing of EVs. In a city's own businesses they are important users of vehicles. Moreover, it is 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, openness for all users and integrity (Trafikanalys, 2012).

The battery cost of an EV is still a large barrier. However, the users have found a specific segment for the use of EVs and have accepted the limitations in range. Hauliers that are not interested in being forerunners or cannot find enough incentives to invest in EVs might consider the fact of losing customers if the competitors act faster and/or cheaper or if local rules and regulations change quickly.

The government should be in charge for specifying where public charging spots, public fast charging spots and/or public induction charging spots should be located and how they can be booked, so many different charging spots with different systems and standards are avoided. In addition, there should be standardizations of charging handles and plugs that fits all EVs.

The conclusion is that considering the advantages and disadvantages of EVs, city logistics is the segment that today is best suited for a wider introduction and use of EVs.

Further discussion about the integration with the ICT producers would be of interest. Like how the system could have been incorporated for Navigation Support and Dynamic Route Planning? How easy it would be for them to introduce such charging availability should be included to? The system is available but to have it in one PDA, one smart phone or in one application.

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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.

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6 Appendix A: Case study Sweden

This Appendix A: Case study Sweden 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.

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 subsidises 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.

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2 Initiatives and projects within urban freight electric mobility

2.1 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:	1 Renault 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 customer is unwilling to pay for it.

Project description

TGM's test of 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 environment 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 delivery between 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 workday the truck was charged during the entire night.

TGM experienced that the energy consumption was high on highways and in 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 (the stops are not as

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well-planned which often 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 wheelhouses 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, at these conditions
- 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, section 2.2.3
  - 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

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- 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

2.2 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 vehicle:	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 wintertime 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 %.

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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 these 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

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2.3 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 traffic 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 so-called pollards in the street which are lowered so that permitted vehicles can pass. Today Stadsleveransen is the only transporter that has an exemption to traffic Korsgatan and Kungsgatan.

Stadsleveransen is run by Innerstaden Göteborg together with Securitas who operates the terminal. The catchment area for Stadsleveransen's deliveries in Gothenburg's city centre is Korsgatan, Kungsgatan (between Östra and Västra hamngatan) as well as parts of Vallgatan. There are on-going discussions of adding more streets.

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 reduce the number of transports into the city centre as well as to improve the city environment. At the end of the project the goal is for Stadsleveransen to be profitable and to continue to run the business solely based on market conditions.

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 % on 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

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own don't pay anything. At this stage Stadsleveransen offers some free services, e.g. if the shop wishes the delivery can 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 wintertime. Nonetheless, it is no limitation for the operation as the catchment area is rather dense. The charging is done overnight and takes 7-8 hours. The tractor is equipped with a diesel driven cab heater, which is needed to maintain a good working environment during wintertime. 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 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

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