Chapter 8
Potentials of e-Mobility for Companies in Urban Areas

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8.1 Introduction

8.1.1 Survey on e-Mobility for SME Companies in Graz

In 2013, a 22 month research project on urban logistics called “Urbane E-Lieferservices” (Modellregion für Elektromobilität Graz, Austria) was started. The project included a survey on requirements for e-based logistics in urban areas. Within the survey, two subjects were defined: firstly, the current situation of transport and delivery logistics at urban companies had to be determined; secondly, the companies’ technical, logistical and operational requirements and needs for comprehensive electric city logistics were investigated. The survey consisted of 50 individual questions and was implemented by using an online platform. The Styrian Chamber of Commerce supported the project.

Twenty-one companies from Graz participated in the survey during the period from November 2013 to February 2014. When selecting the participating companies, a balanced mixture was considered, company size and commercial sector being decisive criteria in determining the test partners. Only small and medium-sized companies doing their main business in and round Graz were invited to participate in the survey. Additional criteria included the companies’ general interest in alternative concepts in the field of urban logistics. These companies were contacted personally via phone or email.

The twenty-one participating companies can be assigned to four different commercial segments:

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U. Clausen et al. (eds.), *Commercial Transport*,
Lecture Notes in Logistics, DOI 10.1007/978-3-319-21266-1_8

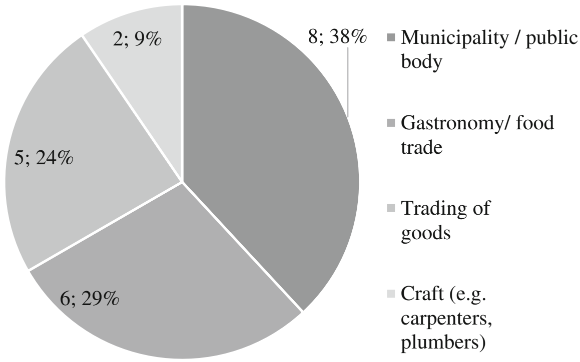


Fig. 8.1 21 participating companies (=100 %) within the survey, classified according to commercial segments

1. Municipalities/public body: 8 participating companies (=38 %)
2. Gastronomy/food trade: 6 participating companies (=29 %)
3. Trade of goods: 5 participating companies (=24 %)
4. Craft (e.g. carpenters, plumbers): 2 participating companies (=9 %)

The "municipalities/public body" segment was the group with the highest company participation, followed by the "gastronomy/food trade" group (Fig. 8.1).

The companies' logistic terminals are located in and around the City of Graz. While 16 companies have their registered location directly in the City of Graz (equivalent to approximately 76 % of participants), five companies are based in the area surrounding Graz (equivalent to approximately 24 % of participants).

8.1.2 Testing Campaign for SME Companies in Graz

During the testing campaign, nine participating companies were invited to test their logistic performance on electro-mobility ability. The testing was carried out with an e-mobility tracking app in which the driving performance was recorded and analyzed afterwards with respect to different best-case and worst-case scenarios. A resulting report informed the participants under which conditions the operation of electric vehicles in their company seemed reasonable from a technical and economic point of view.

8.2 Survey—Main Results

8.2.1 Current Situation of Freight Logistics in Urban Areas

The first part of the survey dealt with the current situation of freight logistics in urban areas from companies' perspectives. Within the survey, the following results were determined:

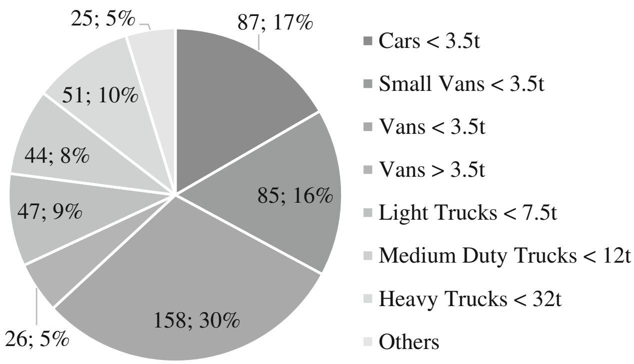


Fig. 8.2 Number of vehicles in use at the companies, classified according to vehicle types

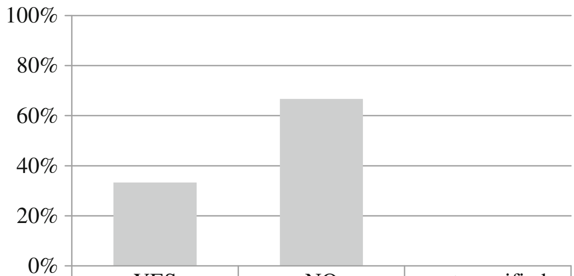
Current truck fleet at the companies

Depending on their scope and responsibilities for business goods logistics, the companies' truck fleet has a specific structure. In total, 523 vehicles used at the companies were counted. This corresponds to an average of about 25 vehicles per company. These vehicles were mainly light trucks under 3.5 tons, amounting to about 30 % of the vehicles, followed by about 17 % passenger cars under 3.5 tons and vans under 3.5 tons, amounting to about 16 % of the vehicles listed.

The number of vehicles under 3.5 tons gross vehicle weight thus comprise about 63 % of vehicles listed (Fig. 8.2). Specifically, this segment of electric commercial vehicles is covered well by the market.

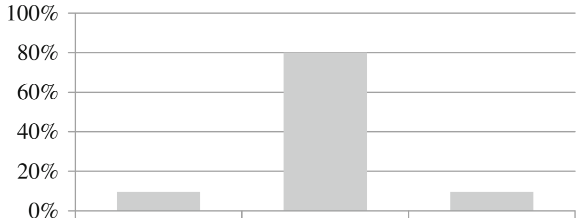
Current usage of electric vehicles in urban areas

Approximately 33 % of participating companies within the survey (=7 companies) already use electric commercial vehicles (Fig. 8.3). As already mentioned, especially companies that showed interest in electric mobility were addressed in the survey. A company with its own electric vehicles tends to show a higher affinity for these topics than other companies. This partly explains the high proportion of companies with electric vehicles within the survey.



	YES	NO	not specified
counts	7	14	0
percent	33%	67%	0%

Fig. 8.3 Number of companies with electric commercial vehicles in use



	maximum permissible weight	cargo volume	not specified
counts	2	17	2
percent	10%	80%	10%

Fig. 8.4 Criteria for vehicle selection

In total, 81 electric vehicles were named. However, the distribution of active vehicles in each company has a high spreading: minimum is one electric vehicle; maximum is equal to 67 electric vehicles for one participating company (company from the segment of public body). Overall, this result emphasizes the trend towards electric mobility for enterprises in urban areas (Projekt CycleLogistics 2014).

Shipping volume of vehicles

Available cargo space or maximum permissible weight are important criteria for selecting commercial vehicles. Loading capacity and maximum permissible weight are often reduced in electric vehicles (due to the large volume or weight of battery systems), compared to conventional vehicles. The total vehicle weight in turn has a significant impact on energy consumption and range of electric vehicles.

Approximately 81 % of the participants see transport volume as a decisive factor for choosing the vehicle. Therefore, only 10 % of respondents see maximum permissible weight as a limiting factor when choosing commercial vehicles (Fig. 8.4). Further investigations show that the use of maximum cargo space volume is taken for about 58 % of logistic trips. In comparison, the use of maximum allowable transport weight is needed only for 33 % of trips.

The result shows that maximum permissible transport weight is not claimed in the majority of the performed transportation and delivery operations. This allows a higher operating distance of electric commercial vehicles in daily use (BVL Österreich 2014).

Mileage per day

The studies of commercial vehicle mileage in Graz show:

- 82 % of mileage is covered within the inner City of Graz
- 18 % of mileage is covered within surrounding local areas

Further detailed results show the distribution of mileage in Graz (inner city and surroundings). The average mean distance traveled by single commercial vehicles per day is about 80 km (AM), whereby 75 % of all vehicles do more than 30 km/day (IQR_Min) and 75 % do less than 100 km/day (IQR_Max). However,

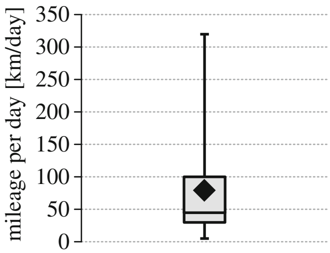


Fig. 8.5 Distribution of companies' mileage per day

the distribution of the length of the route has a high spreading: minimum (Min) is 1 km a day; maximum (Max) is equal to 320 km a day and the median is 45 km a day (Med) (Fig. 8.5).

Commercial electric vehicles up to 3.5 tons gross vehicle weight that are currently available on the market have an average range of about 100 km with one single battery charge (according to the manufacturer specifications). Comparing these values with the survey results, it appears that a majority of daily delivery trips can be easily handled by electric vehicles. Advantages for usage of electric vehicles in the field of last mile logistics can be seen (small transport volumes, short distances, high stop-and-go content working on energy recovery, etc.), especially in urban areas (Leonardi et al. 2010).

Available charging time

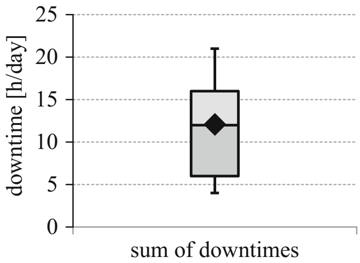
Vehicle downtimes within the daily use of electric commercial vehicles may be used for battery charging. According to the survey, the total vehicle downtime is about 12.1 h/day on average mean (AM). 75 % of responses give a total downtime of vehicles longer than 6 h/day (IQR_Min), 50 % giving a total stop time longer than 12 h/day (Med) and 75 % with a total downtime shorter than 16 h/day (IQR_Max). Minimum (Min) is 4 h a day and maximum (Max) is equal to 21 h of total downtime a day (Fig. 8.6). Currently available commercial vehicles up to 3.5 tons gross vehicle weight require an average battery charging time of about 5 to 10 h (according to the manufacturer specifications). Comparing these values with the survey results, most of the daily transport routines provide sufficient load time for vehicle battery loading.

Current problems in central urban areas

Specific traffic and loading time regulations provide municipalities opportunities to control and support sustainable city logistics (Emission-free last mile delivery service 2014). From the companies' perspective, main problems within actual transport and delivery services in urban areas are:

- Insufficient loading zone areas
- Difficulties traveling from bypass roads to city centers

Fig. 8.6 Vehicle downtime per day



Min 4, Max 21,
IQR_Min 6, IQR_Max 16,
Med 12, AM 12.1

- Restricted access times and duration
- Parking taxes.

8.2.2 Requirements for Successful Future e-Based City Logistics

Further results within the survey illustrate current and/or future requirements for e-based logistics in urban areas, from the companies' point of view:

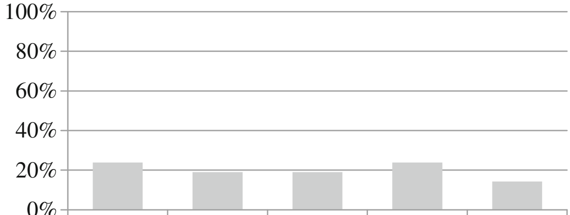
Restrictions of electric vehicles
Companies have specific requirements in electric vehicles for future developments (descending ranking according to the number of mentions):

- Short battery loading times
- Sufficient maximum load (cargo space)
- Low additional costs incurred
- Sufficient typical range

Therefore, demand for vehicle performance is of minor importance. The result thus makes clear that companies are currently worrying about challenges in fields of battery technology and occurring costs by switching to e-based logistics. Further developments in these fields are expected.

43 % of companies need a maximum distance up to 100 km per battery charge (Fig. 8.7). Nowadays, most electric commercial vehicles under 3.5 tons are available with a range of 100 km (according to manufacturers' specifications). Therefore, the use of electric commercial vehicles for many companies seems possible.

Subsidies for successful implementations of electric mobility
52 % of companies expressed their interest in funding opportunities for electric vehicles. This result shows the importance of electric mobility for future logistic solutions. Looking at the results in relation to companies already using electric vehicles (about 33 % of the respondents), companies still seem to be reluctant about the topic. When it comes to funding, the majority of the companies (about 67 % of



	less than 50 km	less than 100 km	less then 150 km	more then 150 km	not specified
counts	5	4	4	5	3
percent	24%	19%	19%	24%	14%

Fig. 8.7 Required vehicle range for electric commercial vehicles

the respondents) would prefer a direct subsidy for the purchase of electric vehicles and related infrastructure.

Necessary infrastructure for urban e-based logistics
The following requirements of urban infrastructure for electric city logistics have been defined. The list is ranked according to the number of mentions:

- Demand for standardized battery change systems (expiry of battery durability)
- Establishment of specialist workshops on electric mobility
- Establishment of public e-charging stations
- Easy access to loading/unloading zones for electric commercial vehicles (costs, duration, space)

The results show that companies currently see challenges in the field of technology standardization, creation of infrastructure for battery charging and repair of vehicle fleets. Further developments are expected in these fields. It is possible to operate electric logistic solutions in urban areas by creating appropriate conditions.

8.3 Testing Campaign

8.3.1 Overview

During the campaign, nine participating companies tested their logistic performance on electro-mobility ability.

We recorded the logistic transport routines of the companies using a GPS-tracking app with extension for electric mobility within the testing campaign, as performed by one of the project partners. The participants received an “electric vehicle simulator” within a smart phone application, which they carried during their daily logistic operations in their vans. This application also calculated relevant electric vehicle parameters such as current battery status, remaining range, etc. So, results could be obtained regarding practically relevant statements for the usage of electric commercial vehicles.

The test campaign ran from May to July 2014. Each participant had the opportunity to test up to five working days. We worked out a detailed test report for every participant.

8.3.2 *Results and Reports of the Testing Campaign*

The results of the testing campaign were processed according to the following criteria:

- Qualified data base that gives clear statements about potential benefits, strengths and risks in the implementation of e-logistic concepts for companies
- Usability of electric vehicles within the company based on individual logistic tours (regarding vehicle range, battery charging time, cost savings)

In particular, the following results could be achieved:

Daily tour behavior (Figs. 8.8 and 8.9)

From the resulting GPS-tracking data, we specified the routine on daily tours (including mileage, transport times, vehicle downtimes, etc.).

Investigation scenarios for electric mobility (Fig. 8.10)

Within a specific analysis, we determined the energy consumption for e-based vehicles. In further studies, several worst-case scenarios, supposed different battery loading times and additional energy consumption through heating/air condition were evaluated.

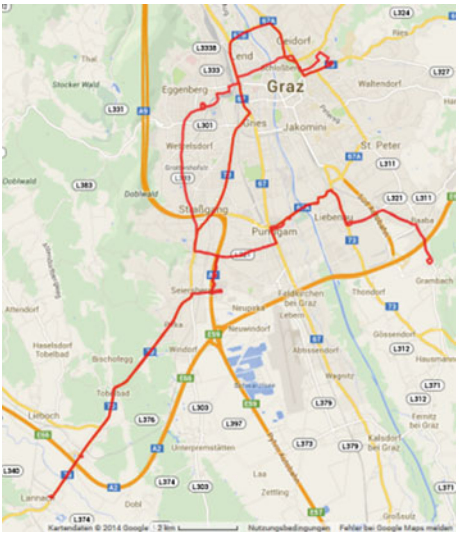


Fig. 8.8 Evaluation of GPS-tour tracking for one specific day

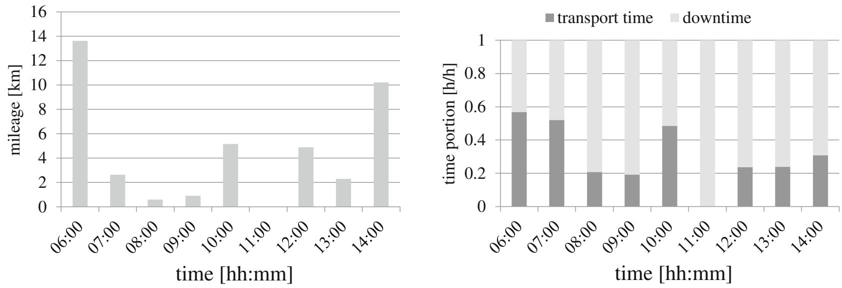


Fig. 8.9 Evaluation of tour distances per hour for one specific day; evaluation of time portions per hour for one specific day

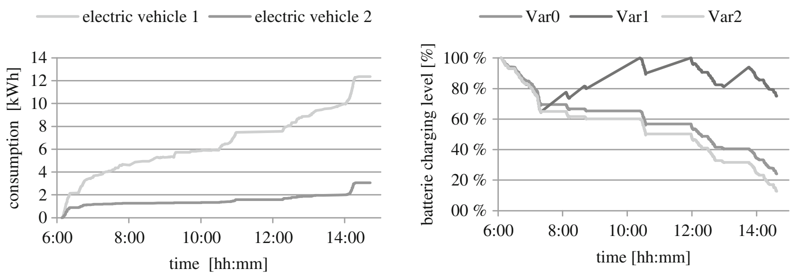


Fig. 8.10 Investigation of energy consumption per day for different reference vehicle scenarios; investigation of battery level per day for different worst-case scenarios

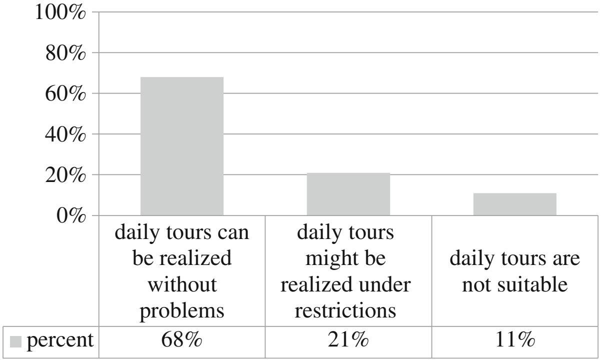


Fig. 8.11 Potential for realization of daily delivery tours by e-based vehicles

Within the test campaign, over 60 records of daily tours from nine companies were evaluated with a total of 4200 driven kilometers. Focusing on specified worst-case scenarios, the analyses yielded the following results. We can see the potential for successful realization of daily tours by e-based vehicles (Fig. 8.11):

- 68 % of daily tours can be realized without problems
- 21 % of daily tours might be realized under restrictions
- 11 % of daily tours are not suitable

8.4 Summary and Outlook

The survey and the following testing campaign within the project "Urbane E-Lieferservices" carried out a detailed overview of companies' logistics tour profiles, transport routines, technical restrictions for vehicles, etc. Furthermore, the requirements to be met for the use of electric vehicles by companies in urban areas were worked out (C-LIEGE 2014).

For many companies, currently available electric commercial vehicles possess adequate technical functions (vehicle range, payload, etc.). For primarily demanded vehicles (especially vans under 3.5 tons gross vehicle weight), numerous electrified vehicle models are available. Battery charging times (especially overnight) are mostly sufficient to fully recharge empty vehicle batteries. Therefore, electric mobility is suitable for usage in sustainable urban logistics (Bretzke 2012).

The executed testing campaign gave companies the possibility to make their own experiences with electric logistic solutions. The results assure benefits of electric mobility for companies (SUGAR 2014). Some companies still show uncertainty about changing to electro mobility. Therefore, the need for better access to specific information is apparent (BESTUFS 2014).

The implementation of an e-based urban logistics solution will be realized within a future project. The project results thus yield essential conclusions for further projects on sustainable electric based logistics for the region of Graz and beyond.

Acknowledgments The authors wish to thank the "Klima- und Energiefond" of the Austrian Ministry of Agriculture and Forestry, Environment and Water and the Austrian Federal Ministry for Transport, Innovation and Technology for their financial support. Additionally, the authors would like to thank the project partners City Government of Graz, e-mobility Graz GmbH, Quintessenz GmbH as well as Symvaro GmbH.

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