

Needs, requirements and attitudes of specific commercial sectors in Denmark, Austria and Germany with respect to the use of electric vehicles in commercial transport

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Abstract

The significant share of commercially induced movements in urban transport and the amount of air pollution and noise produced by the commercial transport – these are issues of rising attention. Various actors search for sustainable solutions for urban commercial transport. Due to their usually short distances, and very often homogenous daily trip patterns, commercial trips make for an excellent use case for electrification. Test fleets are often dedicated to private car ownership or to limited areas.

The aim of this paper is to present results from empirical analysis in commercial transport in Austria, Denmark and Germany with special emphasis to attitudes and preferences of companies of different commercial sectors towards electric mobility. The research was conducted in the project “Suitable Electromobility for Commercial Transport” (SELECT).

A web-based survey was conducted in Austria, Denmark and Germany to reveal the requirements of companies concerning their commercial transport and mobility needs. Furthermore, survey participant were asked to state their attitudes towards electric mobility. Out of 50,000 contacted companies 1,200 responses were gained.

The paper will show that more than half of the participating companies report average tour length of less than fifty kilometres. There is a big share of companies reporting that all tours conducted are shorter than 100 kilometres. Among all participants a high acceptance of electric mobility in commercial transport could be seen.

The analysis of the survey results reveals areas of relevance for the development of recommendations to raise the use of electric mobility in commercial transport. It will be shown that connecting the needs of companies open to deploying electric vehicles with the positive attitudes of decision makers is a central element in fostering the use of electric mobility in urban commercial transport.

Keywords: commercial transport, electric mobility, user needs

1 Introduction

Commercial transport represents a significant share of urban transport (e.g. one third within Berlin) [1]. It is responsible for a substantial amount of air pollution and noise. Commercial transport is not simply the transport of goods but also comprises trips of service providers such as craftsmen or social services. These urban commercial trips are usually short and daily mileage per vehicle rarely exceeds 100 km [2]. Also, these trips are often planned in advance. Given short distances and early planning, urban commercial transport makes for an excellent use case for the electrification of commercial transport.

Due to its diversity, the share of commercial transport is generally difficult to describe in detail. Even though mileage can be measured, there is a lack of knowledge on transport purposes (passengers, goods, service) and especially usage patterns.

In recent years, several test fleets have been established to demonstrate the operability of EV (for Germany e.g. e-mobility Berlin / Daimler, RWE; Mini E Berlin / BMW, RWE, Fleet test TwinDRIVE / VW, E.ON; E-City-Logistics / DHL, M&M in Germany, in Denmark ProV1Elbil, Bright Green Island, Test an Elbil, run by CLEVER A/S with 300 EVs tested by 8 families over 3 months each). In Austria, several pilot regions and technological flagship projects are currently in progress (e.g. VLOTTE; ElectroDrive, Salzburg; e-mobility on demand, Vienna). Some of the fleets are composed of commercial vehicles such as local maintenance and delivery vehicles. A few are electric vans and small lorries, but most are passenger vehicles. Almost all of these projects were limited to small areas, thus reflecting local conditions of EV use.

Several rather sophisticated (modelling) approaches were made to develop scenarios addressing in particular *private* car usage and ownership. The relevant assumptions were based on the plausible deduction of behaviours, opportunities and constraints to estimate market potentials for different segments of private vehicle users and uses [3, 4, 5]. Usage patterns, costs and the availability of charging infrastructure are considered as the most important aspects for private car users. It has been shown that a great potential might exist for vans and small lorries up to 12 tons in total weight, as a high share of these vehicles have a

daily mileage of less than 100-150 km [4]. So far no detailed research has been carried out in regards to EVs for commercial transport, though.

The project “Suitable electromobility for commercial transport” (SELECT), supported by national funding in Austria, Denmark and Germany as well as European funding, investigates how electric vehicles could contribute to an environmentally sustainable alternative to current patterns of urban commercial transport.

One central objective of the project is to understand the needs, requirements and attitudes of selected commercial sectors with respect to the use of electric vehicles to fulfil their transportation needs. Results of this investigation will be used to develop recommendations considering different areas and levels of action, as well as the stakeholders in question.

In order to achieve its objectives SELECT runs empirical research trials among different companies and sectors in Austria, Denmark and Germany based on detailed surveys and questionnaires, and develops recommendations for vehicle manufacturers, governmental organisations as well as commercial transport organisations.

Conducting successive steps in the work plan, the SELECT project analyses the commercial transport sector in different levels of detail. First, publicly available state-of-the-art data regarding commercial transport is analysed and evaluated in depth. Following this, large-scale empirical research is conducted, providing for detailed data by means of questionnaires and GPS tracking. For this, on the one hand, a wider scope is applied, which addresses different firms in different branches to get a wide view of preferences for and use of electric commercial transport means. On the other hand, there is a focus on the specific conditions within particular branches, whereas the final decision for specific branches results from the first project steps.

In the first steps of the SELECT project, branches were identified that can be considered as potential (early) adopters of electric mobility in the next decade. This was based on the description of commercial transport in Austria, Denmark and Germany, whereas economic sectors were analysed on the level of 21 NACE (Statistical Classification of Economic Activities in the European Community, Rev. 2) sections. One finding of the earlier project steps was that economic sectors must be analysed on a more detailed level, the economic sectors were thus further disaggregated in the progress of the project. The following branches offered the most potential

for electric mobility in commercial transport: In Austria the production sector, the trading sector (including parcel delivery services) and health services are investigated. In Denmark the focus will be on vans in general, the construction sector and the wholesale and retail trade sector. For Germany, the wholesale and retail trade sector (including pharmaceutical logistics), the transportation and storage sector (including Courier-Express-Parcel-Services) as well as the human health sector (including home care services) are studied with respect to their potential of being early adopters of electric mobility.

2 Aim

The aim of this paper is to present results from empirical analysis in commercial transport in Austria, Denmark and Germany with special emphasis to attitudes and preferences of companies of different commercial sectors towards electric mobility. In detail, we aim to identify the attitudes and preferences of decision makers concerning vehicle selection and procurement (e.g. CEO or vehicle fleet manager). Our goal is to connect the attitudes and preferences to the needs and requirements given by the structure and size of the company concerning vehicle fleet and driving patterns. We will analyse this in regard to different economic sectors and the different countries examined. With regard to the attitudes and preferences, we want to identify the general engagement towards the use of electric mobility, the motivational criteria and barriers, and the position of the corporate and regional environment towards the use of electric vehicles.

The results of this analysis will lead to a discussion of relevant areas for the promotion of electric mobility in commercial transport. The recommendations will consider different levels of action as well as the actors in question.

3 Method

In order to reveal the attitudes and preferences of decision makers for the selection and procurement of commercial vehicles, mixed quantitative and qualitative methods were applied. One part of this was a standardised questionnaire. It was followed by guided qualitative interviews. Specialised focus groups were arranged to discuss particular issues in detail.

In this paper, we will show the results of the quantitative survey conducted in the three countries analysed. Survey preparation includes the conceptual development of all survey parts as well as the respective technical implementation of survey instruments. Survey instruments include questionnaires allowing a deeper analysis of selected firms and interview guidelines for each sector under investigation. As the analysis is carried out in different countries, survey documents were developed in German as well as Danish.

The survey was addressed to selected companies according to the branches mentioned above. Due to practical reasons, occasionally a broader range of companies from different economic sectors were addressed. If possible, fleets should comprise some EV to allow for comparative analysis. Companies were contacted either by conventional mail or by email. For each sector, the survey was organised more or less simultaneously. Within each sector, the different survey parts were carried out subsequently based on a detailed time schedule.

Table 1 shows the number of contacted companies in Austria (AT), Denmark (DK) and Germany (DE) as well as the numbers of responses.

Table 1: Contacted companies and responses

	Targeted Business Sectors	Contacted Enterprises	Resp. n	Resp. %
AT	All	21,300	206	1.0
DK	All	25,000	677	2.7
DE	Nursing	4,800	330	6.9

Altogether more than 50,000 companies were contacted by e-mail. Whereas in Germany the focus of the survey was on companies in the field of nursing in home care, in Austria and Denmark a broad range of companies were contacted. This was due to differences in the focus of further analyses. Overall more than 1,200 responses could be gathered. We could see that the more focused addressing of companies in Germany lead to a higher response rate than the more general contact in Austria and Denmark.

For the quantitative survey, a questionnaire covering the following aspects was developed: For company size, the number of establishments and the number of employees were compiled. Furthermore, the companies were asked whether they operate as a subcontractor of other logistics services operators. In relation to the vehicle fleet, the participants were asked about the number of company-owned and sub-contracted vehicles. A

determination was made in relation to the propulsion of the vehicles and the vehicle category. The percentage of pool or personalised company cars was surveyed as well. Concerning the driving patterns we asked for the characteristics of the tours driven per day (number of tours, tour duration in hours, number of pick-up/drop-off/rest stops) as well as the length of the tours in kilometres. The duration of vehicle stops could be of interest for the employment of electric vehicles. We therefore asked for the share of vehicles with stops for 30 minutes or more during their daily routine.

The attitudes and preferences towards electric mobility were collected from the personal view of the participants, from the point of view of the company as well as from the perspective of their surrounding environment. We asked about their interest in the topic of electric mobility and their assessment of the potential of electric vehicles. Motivational factors and barriers were enquired into in item batteries with a five-level Likert scale. Last but not least, socio-demographic characteristics of the participant were recorded. In Denmark, we had to skip parts of the survey due to country-specific reasons. All details reported in this paper were included in the surveys in all countries examined.

The following sections will explain the findings of the quantitative survey. Differences will be analysed by countries as well as by branches. The areas for recommendations will be deducted from the analysis.

4 Results

The companies responding to our survey are distributed by size as shown in Table 2.

Table 2: Size of companies by employees

Employees	AT	DK	DE
0	2	0	0
1-9	134	531	43
10-49	44	94	177
50-99	7	19	46
100-249	8	15	41
250-499	4	5	15
500-999	2	5	4
1.000 and more	5	8	4
Sum	206	677	330

In Austria and Denmark, the share of very small companies (1-9 employees) is much higher than in Germany. On the other hand, the share of

small companies (10-49 employees) is much higher in Germany.

Similar differences could be seen in the size of the vehicle fleet of owned vehicles. Results on this are shown in Table 3.

Table 3: Size of vehicle fleet

Own vehicles	AT	DK	DE
0	3	171	2
1-4	134	417	61
5-9	35	42	100
10-19	16	19	90
20-49	11	9	61
50-99	4	8	11
100 and more	3	11	2
Sum	206	677	330

What is noticeable is the high share of companies without their own vehicles in Denmark. Some of them state using vehicles of subcontracting companies but far from all of them. To analyse this will be a task for further work. Apart from this, it can be seen that the fleet size of the companies taking part in the survey in Germany is higher than in Austria and Denmark.

Figures concerning the use of electric vehicles among the participants are an important result of the survey. In addition, figures about the length of tours are shown.

As we see from Table 4, the highest rate of dispersion of electric vehicles among the participating companies can be observed in Austria, where the 206 participants report 58 used electric vehicles.

Table 4: Vehicles per respondent

	Resp.	Electric vehic. per resp.	Hybrid vehic. per resp.	Conv. vehic. per resp.	Total vehic. per resp.
AT	206	0.28	0.03	12.10	12.42
DK	677	0.13	0.05	9.42	9.60
DE	330	0.18	0.19	13.58	13.95

Altogether the 1,213 respondents report on 13,660 vehicles they are in charge of for fleet selection and procurement. The share of electric vehicles in the fleets is, with 58 electric vehicles out of 2,558 vehicles, the highest in Austria on average (2.2 %), whereas in Denmark and Germany this share is about 1.3 % (DK: 85 out of 6,498 vehicles, DE: 61 out of 4,604 vehicles). In Austria and Denmark, the share of hybrid vehicles is lower than the share of electric vehicles. In Germany the share of hybrid vehicles is as high as the share of electric

vehicles. The overall fleet size is, with 12 to 13 vehicles, on average higher in Austria and in Germany than in Denmark, with about 10 vehicles.

Figure 1 shows the average length of the tours among the participating companies in the countries examined.



Figure 1: Survey results on average length of tours

We can see that, in all three countries, more than half of the tours on average are shorter than 50 kilometres per day. In Germany, where we focused on companies nursing in home care, about 64 % of the tours are shorter than 50 kilometres. A similar pattern can be seen for tours between 50 and 99 kilometres long, where the share in Germany, at 27 %, is the highest. This means more than 90 % of the tours in nursing companies for home care in Germany are shorter than 100 kilometres on average, which is very propitious for the use of electric vehicles. In Austria and Denmark, where we contacted a broader range of companies, the share of tours shorter than 100 kilometres is not that high (AT: 75 %, DK: 70 %), but still shows that there is a substantial potential for the use of electric vehicles. In the majority of the participating companies, one tour per day is conducted per vehicle.

Apart from the analysis of the average length of tours, we analysed our data concerning the maximum length of tours in the companies as well. The reason for this is that a low *average* length of tours does not mean an electric vehicle (especially BEV) could serve the transport needs of every single trip and thereby replace a conventional vehicle completely. The results of our analysis concerning the maximum length of tours can be seen in Figure 2.

In the German sample, 35 % of all companies stated that all tours conducted are below 50 kilometres. Moreover, 72 % stated that all tours are below 100 kilometres. This means that more than 70 % of the transport requirements of the

nursing companies in Germany could be covered by electric vehicles. For Austria and Denmark, the picture is slightly different. The reason for this is probably the broader range of companies that were contacted in Austria and Denmark. But 16 % of the companies in Austria and 22 % of those in Denmark still state that all tours are below 50 kilometres. About one third of the companies in Austria and Denmark stated that all tours are shorter than 100 kilometres, which is much smaller than in Germany. Altogether, this is a very good basis for the use of electric vehicles.

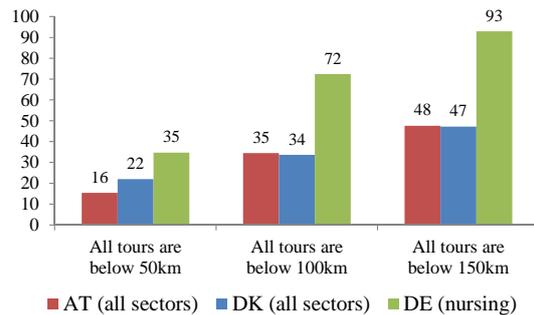


Figure 2: Survey results on maximum daily trip length

Following our aim to analyse the needs and requirements of the companies on the one hand, and the attitudes on the other, the participants were asked about their general view on electric vehicles. This was done by five-level Likert items. For the survey conducted in Austria and Germany, the participants could state the answer “Don’t know” for each item. In Denmark this was not possible. Concerning the question “EVs are generally cool and pleasant to drive” 32 % of the participants in Germany and 24 % in Austria answered “Don’t know”. To get a clear view of the attitudes of participants on electric vehicles negative, positive and neutral items were formulated. Figure 3 shows the results of this survey part. The following aspects appear to be particularly interesting:

(1) In general, there is a positive picture of electric mobility in all three countries examined. Even when considering the fact that, in Germany, only one specific branch was addressed, there are no big differences in attitudes between firms in Austria, Denmark and Germany.

(2) Overall, a high share of participants disagree that electric vehicles are a temporary trend. Only about 10 % agree with this. There are no differences in the three countries on this.

(3) Concerning the emotions connected with electric vehicles, differences can be seen between Austria, Denmark and Germany. In Denmark only

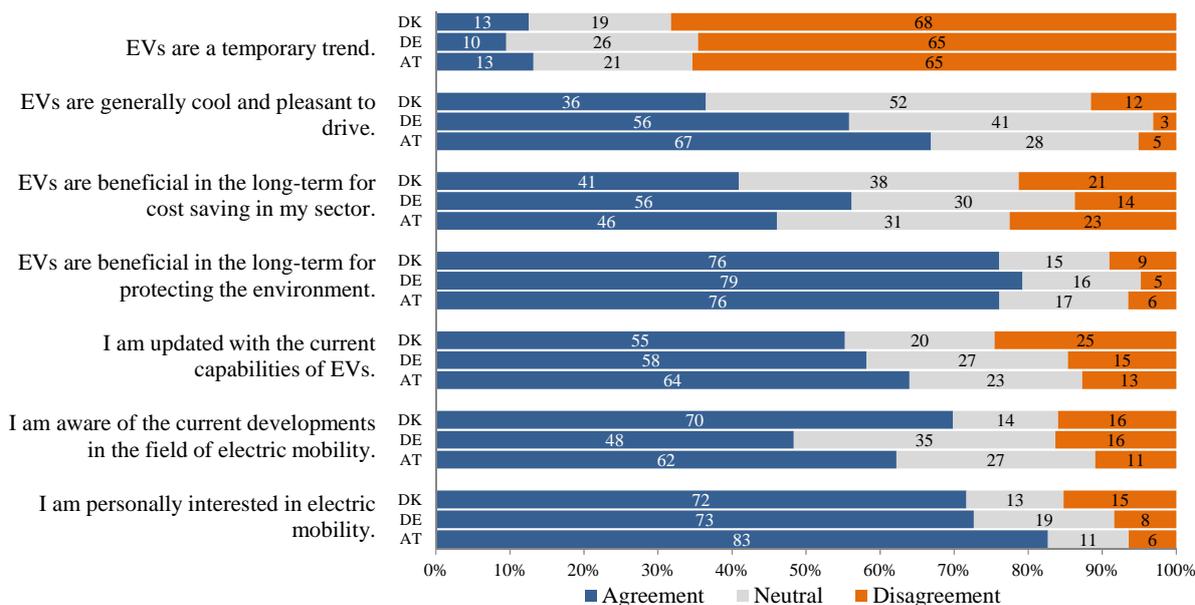


Figure 3: Survey results on attitudes towards electric mobility

36 % agree that electric vehicles are generally cool and pleasant to drive. This share is markedly higher in Austria and Germany.

(4) Regarding the economic benefits of electric vehicles, considerable sections of the participants have a positive picture. In Germany more than half of them agree that electric vehicles are beneficial in the long-term for cost saving. In Austria and Denmark the shares are a bit lower. Many more participants see the environmental benefits of electric vehicles, more than three quarters in each country.

(5) In all countries, more than half of the participants agree that they are aware of the capabilities of electric vehicles. Obviously there is good knowledge of electric vehicles. Taking into account that the survey targeted those who are responsible for the selection and procurement of vehicles in companies, this may be interpreted that the right persons have the relevant information. The same picture can be drawn when asking about the awareness of current developments. Through it can be seen that the shares of participants stating they are up-to-date with the capabilities of electric vehicles differ from the share of participants stating they are aware of the developments in the field of electric mobility. The reasons for this must be part of deeper analyses.

Altogether, there is a very high interest in electric mobility among the survey participants.

Summing up the results of the survey it can be concluded, firstly the participants transport needs and requirements allow the deployment of electric vehicles to a high degree. Secondly the participants show very positive attitudes towards electric vehicles and electro mobility in general. Differences can be seen in the needs for the focused analysis of nursing companies in Germany compared to the more general approach of the targeted companies in Austria and Denmark. But these differences in the needs and requirements do not impact on the attitudes.

5 Discussion

Comparing the survey results with results of previous steps in the project, we could see that commercial transport makes up very well for electrification. This could be fostered by the use of the positive attitudes among decision makers for the selection and procurement of commercial vehicle fleets.

In relation to general vehicle registration statistics it can be noticed that the share of electric vehicles among the participants of the survey is higher than in the countries overall, when taking the registration of all passenger cars (including private car usage) in 2013 into account. In Austria out of 4.6 million passenger cars, 2,070 are registered as electric vehicles, which make 0.04 % [6]. In the survey the share of electric vehicles amounts to 2.2 %. In Denmark out of 2.2 million passenger cars,

1,243 are vehicles registered as electric vehicles (0.06 %) [7]. In our survey the share of electric vehicles amounts to 1.3 %. In Germany 7,114 passenger cars (0.02 %) out of 43.4 million are registered as electric vehicles [8]. In the survey the share of electric vehicles in Germany amounts to 1.3 %, as in Denmark. Taking the numbers shown into account, it can be concluded that companies contributing to the survey deploy electric vehicles to a higher share than on a representative average. This could be true as well for the people interested in electric vehicles and electric mobility. To some extent this could influence our survey results.

Analysing transport and vehicle statistics in Austria, Denmark and Germany in earlier project steps, we saw a high potential for the deployment of electric vehicles. There, the mean transportation distance according to the transport statistics in Austria in 2012 is 44.2 kilometres. The analysis of statistical data in Denmark showed that, except for the transport sector, the distance range of 40 to 60 % (depending in the vehicle type) of all vehicles is well within the 100 kilometres mark and thus may allow for a shift to electric vehicles. In Germany 67 % of all passenger cars and 54 % of all lorries under 3.5 tons payload drive less than 50 kilometres per day on average. The analysis of specific sectors revealed remarkably higher shares. For example, it can be seen that in the human health sectors, which includes nursing and home care, there is a very high share of daily trip length below 50 kilometres.

The results of the survey confirm the results gained from the analysis of statistics in the first steps of the project. Moreover, the survey reveals that there is not only a high potential when taking a look at average daily trip length and length of tours but also when taking into account the maximum length of tours conducted in companies. A conventional vehicle could not be replaced by an electric vehicle if the vehicle's average daily mileage is well within the electric vehicle's range but single trips during a longer period are outside its range. Thus general statistics on average trip length do not give a clear picture of the suitability of electric vehicles for commercial transport. The survey results indicate that there is a potential for electric vehicles in commercial transport even if the maximum length of tours conducted in companies is taken into account. This is true for the more general approach we applied in Austria and Denmark, but to a much higher extent for the

focused approach on nursing companies we applied in Germany. In Austria and Denmark it can be seen that 16 % and 22 % respectively of our participants stated that all tours are below 50 kilometres. The even higher share (35 %) for nursing companies in Germany shows that a detailed analysis of special branches could be very useful to understand the suitability of electric vehicles in commercial transport. On the other hand, it confirms results of the analysis of official statistics and studies in former project steps.

Altogether, a high potential for electric mobility in commercial transport can be expected. The needs and requirements of companies in Austria, Denmark and Germany would be fulfilled to a good extent by the use of electric vehicles.

Additional to this, the attitudes of decision makers for selection and procurement of vehicle fleets in commercial transport are very positive. The survey results give no doubt that the decision makers who responded in the survey are aware of advantages and capabilities of electric vehicles.

About one third of the participants in Germany did not state on their agreement or otherwise concerning the statement, "EVs are generally cool and pleasant to drive". This leads to the conclusion that there is still a high potential for the development of knowledge on electric vehicles. Measures concerning the use of electric mobility in commercial transport must thus aim to stimulate customer's emotions and charge electric vehicles with emotion.

Comparing the survey results on needs, requirements and attitudes concerning country-specific differences, we saw that there are differences in needs and requirements in Germany compared to Austria and Denmark, but no general differences in attitudes in the three countries analysed. The authors believe that this results from the sector-specific analysis in Germany, whereas in Austria and Denmark the approach in contacting companies was more general. This means that no target-group-specific promotion of the advantages of electric vehicles is necessary. But use cases for electric vehicles must be developed in close connection to the needs and requirements of specific user groups and branches. Due to differences in tour length, and also certainly in trip patterns, there is no unique approach for the use of electric vehicles in commercial transport possible. Altogether, the overall positive picture of electric vehicles our participants have shown should be used for the promotion of electric mobility and electric vehicles in commercial transport.

Main fields of action for recommendations to foster the use of electric mobility could include spreading information to potential users of electric vehicles in commercial transport, and stimulating emotions among customers. As other studies show, the provision of public charging infrastructure is not that important for potential commercial users. The driving range electric vehicles can provide today suits the needs of many companies. Thus the development of the vehicle technology regarding driving range is not that crucial.

6 Conclusion and further outlook

In conclusion, there is a large share of companies whose transport needs and requirements comply with driving ranges of electric vehicles of 50 or, even better, 100 kilometres. This is not only true for the average length of tours but also for a lot of commercial transport companies' maximum tour lengths.

In addition to this, potential electric vehicle users' positive attitudes must be used to develop recommendations to foster the use of electric vehicles in commercial transport.

To contribute to this, the SELECT project will further analyse potential economic sectors which have proved to be suitable for the use of electric vehicles. In further project steps, we will conduct qualitative surveys in specialised branches, focussing on specific user groups. To analyse trip patterns and the length of tours, GPS-based analyses will be conducted in specific companies. This will add further knowledge to previous analyses of statistical data and the quantitative analyses shown in this paper. The GPS-based analysis will be the third step in the process of identifying potential users of electric mobility in commercial transport. Furthermore, the framework for a fleet management system taking into account the specific demands of companies integrating electric vehicles into commercial vehicle fleets will be developed. In the end, the work of the SELECT project should lead to the development and specification of recommendations considering different areas and levels of action as well as the stakeholders involved. The recommendations will be developed for vehicle manufacturers, governmental organisations as well as commercial transport organisations. Results of this work will be made available in further publications [9].

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