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Potential of electric carsharing in urban and rural areas

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Abstract

Electromobility can help to contribute to a more sustainable, climate and environmentally friendly mobility. However, in terms of electric operated cars it has not spread to the full extent of its potential. From the user´s perspective there are two major barriers in buying an electric car: It costs more than a car with an internal combustion engine and also, it has in general a limited range compared to a conventional vehicle. Intermodal concepts, relying on electric shared vehicles can be one promising solution as the total costs of ownership of the electric vehicles can be spread among many users and as a part of the public transport system it can also offer a complement for local and long-distance travel. To evaluate whether successful schemes known from urban contexts might work in rural areas as well, this paper presents results of two studies evaluating the potential of station-based electric carsharing in the city of Berlin and the smaller city of Garmisch-Partenkirchen. Overall, the results show that residents living in a rural area seem to be as open towards e-carsharing as people living in an urban context. However, this group alone cannot contribute to the full economic viability of the system.

1. Introduction

Electric vehicles (EVs) are believed to be a key factor for a sustainable, climate and environmentally friendly future mobility and by that help resolving problems such as peak oil or global warming. Due to their higher efficiency and

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lower average energy consumption EVs have lower CO_2-emissions than cars with an internal combustion engine (ICE) and can thus contribute to a sustainable mobility. However, most people are still in favour of traditional cars with an ICE. The concept of the so-called "fast, long-range sedan" with a higher driving range due to a larger "energy reserve" compared to EVs is still firmly embedded in the minds of many people (Canzler and Knie, 2011). In addition, from the user´s perspective there are two major obstacles in buying an electric car: First of all, an EV costs more than a current car with an ICE and secondly, electric cars have in general a limited range of about 100 km compared to a conventional car with a range of approximately 800 km (each depending on the vehicle type). Furthermore, even if the ecological impact of EVs "well to wheel" can be much better if renewable energies are used to charge the batteries, the eco-friendliness of most private cars can be doubted as too many non-renewable resources are needed for production and operation as well as disposal. To tackle these issues integrated electric mobility services including carsharing with EVs can be one promising solution.

As the name suggests carsharing in general allows the use of public vehicles on demand. The advantages of integrating EVs in carsharing fleets are obvious: The total costs of ownership can be spread among many users and as a part of the public transport system it can offer a complement for local and long-distance travel by bus or train. This double integration can compensate the high costs of ownership and the limited range and therefore provide new green mobility options in an intermodal trip chain. With this approach, private car use and ownership could be reduced to a certain degree.

Carsharing itself has been practiced on a private level long before the first commercial organisations were established. The first documented carsharing organisation started in Switzerland in 1948. In the 1970s, there were several attempts in Europe to establish carsharing systems but it took until the 1990s before it gained worldwide popularity. Today, carsharing companies operate in about 1,100 cities, 27 nations and on five continents (as of August 2012) (Shaheen and Cohen, 2013). As a member of a carsharing organisation, individuals or businesses can rent a car without having the costs or responsibilities of ownership (Schäfers, 2013). Carsharing is most common in urban areas where public transportation is easily accessible and space is rare.

Research suggests the positive effects of carsharing in general. One major impact is the reduction in car ownership as some members sell their car after joining a carsharing organisation, avoid or postpone a vehicle purchase. Also, some studies indicate that members drive less after joining a carsharing organisation, thereby reducing the vehicle-kilometres travelled. Both, reduced vehicle ownership and vehicle-kilometres travelled contribute for example to lower greenhouse gas emissions, less congestion, better air quality and more public spaces. Furthermore, carsharing has also beneficial effects in terms of social inclusion: Households with no car can gain or maintain vehicle access without bearing the full costs of car ownership (Steininger et al., 1996; Burkhardt and Millard-Ball, 2006; Martin et al., 2010; Firnkorn and Müller, 2011; Shaheen and Cohen, 2013; bcs, 2014).

In recent years more and more carsharing operators have supplemented EVs to their carsharing fleets or have started out with merely electric cars (Canzler and Knie, 2009; Canzler and Knie, 2011; bcs, 2014). However, this is not a new development: Already since the beginnings of the 1990s EVs have been tested in carsharing fleets (Shaheen et al., 2012). Especially in Japan, many of the initial shared used vehicle systems used EVs exclusively such as the "Second Car System" in the City of Inagi (Fukuda et al., 2003) or the "Minato-Mirai 21" project in Yokohama (Barth et al., 2007). In contrast to Japan, many of the early European and North American schemes had fewer EVs and used more conventional cars (Barth et al., 2007). The first carsharing scheme in Europe with solely EVs was already introduced in 1999 in the French City of La Rochelle (Communauté d'Agglomération de La Rochelle, 2014).

Research also underlines the positive assessment of carsharing schemes including EVs. Expecially users highly appreciate factors like driving comfort, the service and system itself or the availability of cars and most of them would recommend carsharing with EVs to relatives or friends (CSA 2012; Communauté d'Agglomération de La Rochelle, 2014; Ville de Nice, 2014). In addition, studies show that electric specific vehicle features like limited rage usually do not cause any problems as often assumed because average trip lengths are comparably low (Prem Kumar and Bierlaire, 2012; Wappelhorst et al., 2013; Communauté d'Agglomération de La Rochelle, 2014).

Research and practical experience generally concentrate on urban contexts where the positive outcomes of carsharing and e-carsharing have been evaluated intensively. However, less attention has been paid to the comparison and potential of carsharing in rural areas facing different transport problems such as inadequate public transportation. Therefore, the key research question to be answered in the study presented here is if integrated electric mobility services like e-carsharing that work in urban contexts can be transferred to rural contexts.

To answer this question the following two sub-questions are analysed:

1. How do expectations, use intentions and attitudes towards innovative mobility offers such as e-carsharing differ between people living in urban or rural areas?
2. Are there certain groups that are more open towards new mobility services and how different is their proportional share between the two regions?

To address these questions, the article compares the potential of station-based e-carsharing in an urban and a rural context exemplified by "e-Flinkster", the electric carsharing of Deutsche Bahn. The analyses only focus on local people with no or little experience with (electric) carsharing in order to figure out the potential amongst residents and their contribution to the economic viability of the system. For that, results of two projects in Germany are analysed: The project BeMobility in Berlin and e-GAP intermodal in Garmisch-Partenkirchen. In both cases, a fleet of shared e-cars was/is tested in a given time-span including interviews of (potential) users. To answer the second question, a typology was identified and compared to the results of a representative study in Germany.

In the following a short overview about carsharing in Germany is given, followed by the description of the two projects that are focused in this article. On this basis methods to answer the research questions are introduced, followed by results and concluding ideas giving indications and recommendations for the successful introduction or modification of (electric) carsharing in rural areas, targeting local, regional and national research bodies as well as decision makers in the transport sector.

2. Carsharing in Germany

Carsharing in Germany has a long tradition. Since the first carsharing organisation started in Berlin in the year 1988, the carsharing market has been continuously growing, especially in the last few years. By January 2014, there were 757,000 people registered for carsharing in Germany (an increase of +67.1% compared to 2013) with a focus on larger cities (bcs, 2014).

The largest carsharing network in Germany is provided by Deutsche Bahn who operates in more than 140 cities in Germany. Initially, the station-based system started with conventional vehicles, today known under the brand name "Flinkster". In summer 2010 the first EVs where added to the fleets in Berlin, Frankfurt and Saarbrücken, branded "e-Flinkster". Nowadays, there are about 100 Battery-EVs and EVs with range extender in 27 larger and smaller cities at 54 stations available for the public in Germany. In order to use the system, customers first have to become a member of Flinkster. Booking needs to be done in advance, billing is done per hour and per kilometre.

2.1. The project Berlin elektroMobil 1.0 (BeMobility 1.0)

In 2001 Flinkster was introduced in Berlin consisting of merely conventional vehicles. The introduction of e-Flinkster in Berlin in 2010 was part of the project Berlin elektroMobil 1.0 (short "BeMobility 1.0") which focused on the intelligent networking of electric shared vehicles and public transport (project duration 2009-2011) to contribute to the reduction of car traffic and CO2-emissions. One aim of the project was the integration of e-cars in the conventional station-based Flinkster fleet and to link it with Berlin's public transport system. The accompanying research consisted of several surveys evaluating the potential of station-based e-carsharing and identifying new user groups. The research was carried out by the Innovation Centre for Mobility and Societal Change (InnoZ). The project was funded by the by the German Federal Ministry of Transport, Building and Urban Development (Hinkeldein et al., 2012).

Within the project context 50 EVs were placed at stations within the Berlin S-Bahn circle. The area covered the city center of Berlin with an area of about 88 km² (Berlin 892 km²) where about 1 million of the 3,5 million citizens of Berlin live.

2.2. The project e-GAP intermodal

In 2010, Garmisch-Partenkirchen was selected as a "model community electric mobility" (e-GAP) by the Bavarian Ministry of Economy and Media, Energy and Technology. As a rural, highly touristic site with about 26,000 inhabitants and almost 395,000 visitors and more than 1,3 million overnight-stays (LfStaD, 2012; Garmisch-Partenkirchen Tourismus, 2014) the municipality is faced with serious traffic problems: Due to its rural settlement structure commuter traffic and motorised private transport is strongly dominated by the automobile. The problem of high car ownership rates are superseded by touristic traffic which is also dominated by car use. In 2012, the majority of the guest came by private car (77%), only 26% by train (benchmark:services, 2012).

Against this backdrop, the project e-GAP aims at testing different innovative technologies such as electromobility as part of an integrated mobility concept. One module is the project "e-GAP intermodal" (duration 2013-2015) which focuses on the integration of the electric carsharing system e-Flinkster into the public transport system to reduce car traffic and car dependency. Residents, businesses and tourists are targeted equally.

In July 2013 Deutsche Bahn introduced e-Flinkster in Garmisch-Partenkirchen with a station located at the main station with five vehicles (Figure 1).

Fig. 1. e-Flinkster at the main station in Garmisch-Partenkirchen (Photo: S. Wappelhorst).

3. Methodology

To evaluate the potential of e-carsharing in an urban and a rural context from the user's perspective prior to its first use, quantitative and qualitative methods were used. In addition, the booking data of actual users of Deutsche Bahn were analysed.

3.1. Study design of BeMobility 1.0

Within the project BeMobility 1.0 a computer-assisted web interviewing (CAWI) was carried out from November until December 2010 (T0) to evaluate the new e-Flinkster system in Berlin. The survey included questions about socio-demographics, mobility behaviour as well as expectations and use intentions in regard to e-carsharing. Survey

participants were recruited via various media of Deutsche Bahn and the local media. Altogether, 311 persons answered the questionnaire.

As the article focuses on the potential of e-carsharing from the perspective of local people with no or little experience with this offer, all other target groups (like existing Flinkster customers from elsewhere) are excluded from the following analyses. Thus, the presented results for the Berlin sample focus on the remaining 25 cases.

3.2. Study design of e-GAP intermodal

In Garmisch-Partenkirchen also an online survey (CAWI) was conducted starting from July 2013 over a period of four months targeting tourists as well as local people and businesses. This first survey (T0) included questions about mobility behaviour, experience, assessment, expectations and use intensions in regard to (electric) carsharing, about environmental attitudes, affinity to technology as well as socio-demographics. Local people were approached via local media and a local business mailing list. Members of Flinkster from all over Germany were contacted via e-Mail. Altogether 280 respondents were recruited. In the following, the focus is laid on the 23 locals who answered the questionnaire.

In addition to the online survey, personal short interviews were conducted at the train station in Garmisch-Partenkirchen to validate and specify the quantitative results and to provide justifications for single findings. The interviews were carried out at two days in August and September 2013. The interviewed persons were addressed randomly. Among the 19 participants were 5 locals. The guided interviews focused on the following topics: Information about the interviewee, transport use and affinity, openness towards intermodal services such as (electric) carsharing, and attractiveness of the new carsharing service in Garmisch-Partenkirchen.

3.3. Claim on generalisability

The statistic generalisability of the findings is limited in several respects: For both surveys no controlled random sample could be drawn due to reasons including organisational considerations. In addition, the sample sizes are rather small. Therefore, no inductive statistics are used in order to generate statements on the whole population of Berlin and Garmisch-Partenkirchen or even generalise to German or middle European urban and rural cities in a statistical sense.

However, the following results can be understood as valuable indications of trends since participants in the surveys can be assumed to have a particular interest in new mobility offers. By comparing the survey data with the representative study "MiD" and a representative InnoZ-study about attitudes towards mobility offers in German cities, the authors claim to draw conclusions about the specific characteristics of a group of people in the two different structured regions whose interest in e-carsharing is above-average. However, this claim is limited since both regions have very specific features. Berlin is extraordinary large in size and attractive to young professionals who are very open minded towards new technology and services in general while car ownership is comparably low. On the contrary, Garmisch-Partenkirchen is more attractive to elderly people and special not only because of its strong tourism but also because of the comparably good train connection to the prospering metropolitan region of Munich. Taking all these interfering factors into account, still some statements can be made and these statements are validated through qualitative methods which also illustrate what is important. With this multi-method-approach, suggestions for further development of mobility offers in touristicly attractive rural areas can be made that are methodologically profound.

4. Sample description and results

The following analyses concentrate on the CAWI samples covering 25 cases in the Berlin project and 23 cases of residents who responded in Garmisch-Partenkirchen.

The analysis of the socio-demographic features gives indications whether people who are interested in integrated electric mobility services such as carsharing with EVs differ from the German average.

The results for the Berlin sample show that the majority of the respondents is male (96%), middle-aged and has a higher education (88%). Almost all of them are fully employed and over 1/3 have a monthly household net-income over 4,000 Euro. The average household size is larger (2.9) compared to the German average (MiD = 2.1) (Table 1).

Table 1. Socio-demographic features. (Own Elaboration)

	BeMobility 1.0 T0-survey (n=25)	e-GAP intermodal T0-survey (n=23)	MiD 2008 (n=60,713)
gender	male 96%	male 68%	male 49%
	female 4%	female 32%	female 51%
age (mean value)	43 years	42 years	43 years
education	88% higher education, 64% university degree	65% higher education, 39% university degree	26% higher education, 36% university degree
labour situation	96% full-time employed	85% full-time employed	30% full-time employed
income	38% with a monthly household netgross-income over 4,000 €	34% with a monthly household netgross-income over 4,000 €	12% with a monthly household netgross-income over 4,000 €
average household size	2.9 persons	2.8 persons	2.1 persons

In Garmisch-Partenkirchen the socio-demographics of the sample group is similar to the Berlin sample in regard to the labour situation, income and average household size. Even though the gender relation is also dominated by male, the proportion is lower compared to the Berlin sample but still higher than of MiD. The same applies for the indicator education even though the rate of people with a higher education is still above average.

Comparing the data with MiD the results show that these samples are highly biased. As in other research projects evaluating the use of intermodal services, certain groups are over-represented with only slight differences between people living in an urban compared to those living in a rural context.

These results indicate that certain groups are over-represented regardless their living environment.

Taking the spatial context into account, the question arises if the mobility behaviour of people varies. Table 2 shows that all respondents of the two samples have a driving licence. People without were obviously not interested in taking part in a study about carsharing. However, the difference in car availability proves the dominance of the car in rural contexts: While in Berlin only 52% of the interviewees can use a car "(almost) at any time", the percentage rises to 91% for the Garmisch-Partenkirchen sample. In general, car availability promotes its use and thereby contributes to traffic problems with the accompanying negative effects.

Table 2. Mobility features compared to MID (Own Elaboration)

	BeMobility 1.0 T0-survey (n=25)	e-GAP intermodal T0-survey (n=23)	MiD 2008 (n=60,713)
driving license	100%	100%	87%
car availability	52% (almost) at any time	91% (almost) at any time	74% (almost) at any time

Having a deeper look at the mode choice, the results underline that people living in Garmisch-Partenkirchen show a strong affinity to the automobile: 78% drive a car (almost) daily. By contrast, only 12% of the Berlin sample uses the car on a daily basis. Going with someone in a car plays a minor role in both samples (Fig. 2).
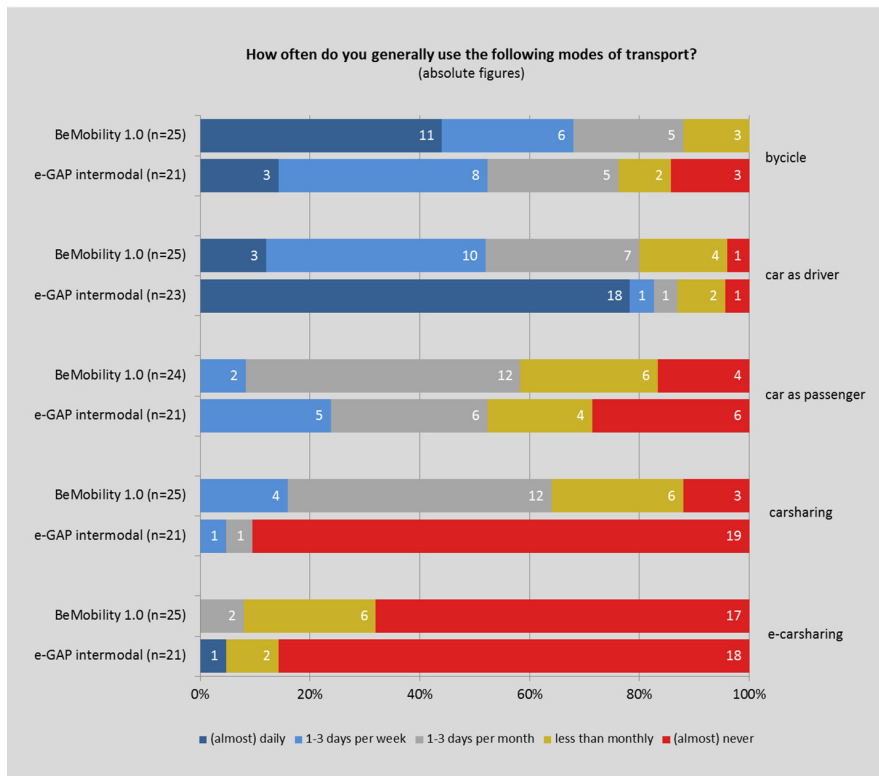
Fig. 2. Mode choice in terms of individual mobility (Own Elaboration)

Carsharing in general is not an option for most people in Garmisch-Partenkirchen which is not surprising as there were no carsharing organisations in the municipality prior to project start. While the survey was conducted, it was barely known within the community. In contrast, 64% of the respondents in Berlin use carsharing at least on a monthly basis. This is not surprising, taking into account that the first carsharing scheme in Berlin was introduced in 1988. However, electric carsharing is not of high interest for most people in both samples.

Cycling is a common mode of transportation in both samples. More than 50% in Garmisch-Partenkirchen und almost 70% in Berlin use their bike at least once a week. Also, people living in Berlin's urban environment show a higher public transport affinity than people living in the rural context of Garmisch-Partenkirchen (Fig. 3). Only one person in Garmisch-Partenkirchen states that he uses public transport on a daily basis, the rest goes less than monthly or (almost) never. In Berlin, 72% use public transport at least monthly. There is a similar picture for public transport for longer distances. People living in Garmisch-Partenkirchen use it less than monthly and in Berlin 44% of the respondents use it at least monthly. Carpooling plays only a minor role in both samples.

The results reflect the different mobility behaviour of people living in the two differently structured areas with a high car affinity and dependency in rural contexts, not least because of quantitative and less differentiated mobility services compared to urban areas.
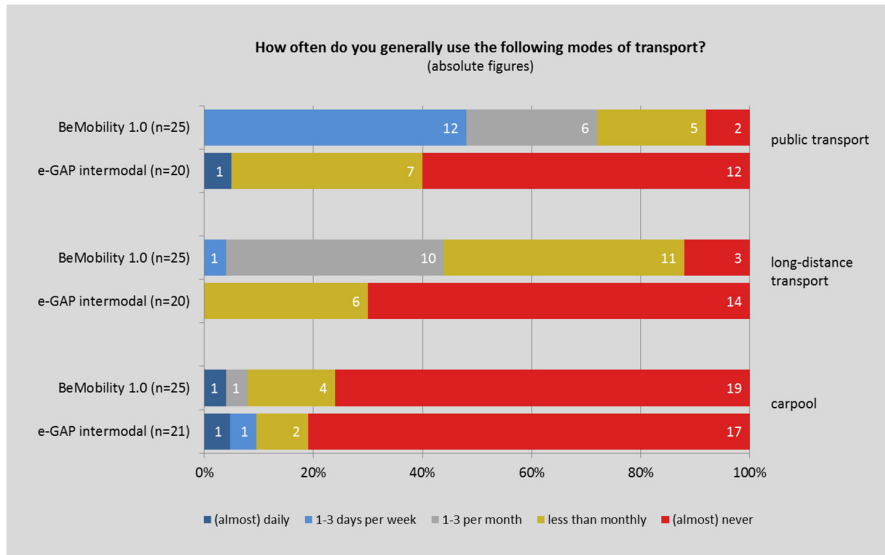
Fig. 3. Mode choice in terms of collective mobility (Own Elaboration)

4.1. Attitudes towards e-carsharing

To answer the question whether expectations, use intentions and attitudes towards innovative mobility offers such as e-carsharing differ between people living in urban or rural areas and if this might have consequences for the acceptance of the system people were asked if they would generally use an EV in the carsharing fleet of Flinkster.

For Berlin, the majority of the respondents agree in a positive way (Fig. 4). By contrast, residents of Garmisch-Partenkirchen are more reluctant. Only 25% agree to the statement that they will probably use e-carsharing in the municipality. When personally interviewed, answers are more positive though limitations are stated.

The specific electric components of the vehicle fleets do not seem to play a major role as it is often assumed. In Garmisch-Partenkirchen almost 90% think that the range will be sufficient for their trip purposes, analogical to 80% of the respondents in Berlin. These results underline the outcomes of similar research projects (Wappelhorst et al., 2013).
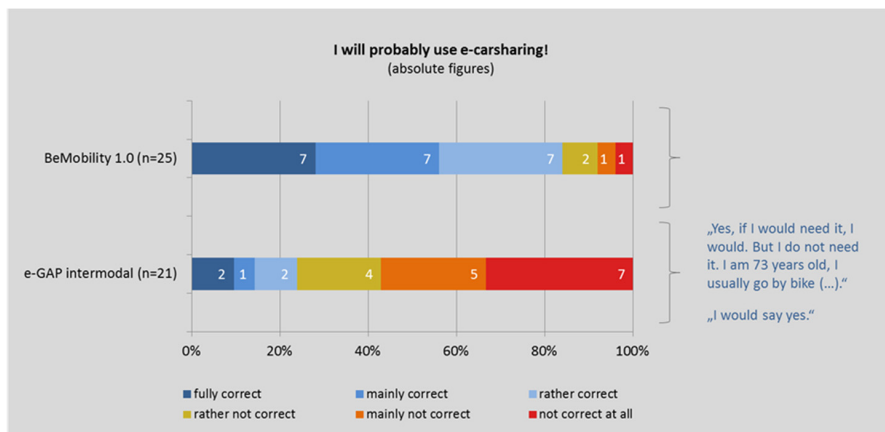

Fig. 4. Use intention of e-carsharing (Own Elaboration).

In Berlin people were also asked if the combination of e-carsharing and public transport was a good possibility for their daily mobility. Over 90% of the respondents agree (Fig. 5). By contrast, only 2 persons of the Garmisch-Partenkirchen sample think that public transport will become more attractive for them through the introduction of e-carsharing. Positive statements regarding the integration include the combination of different modes or the flexibility. In Garmisch-Partenkirchen the qualitative answers are also positive. However, reasons for the higher attractiveness of public transport in combination with carsharing are not obvious and remain on the surface.
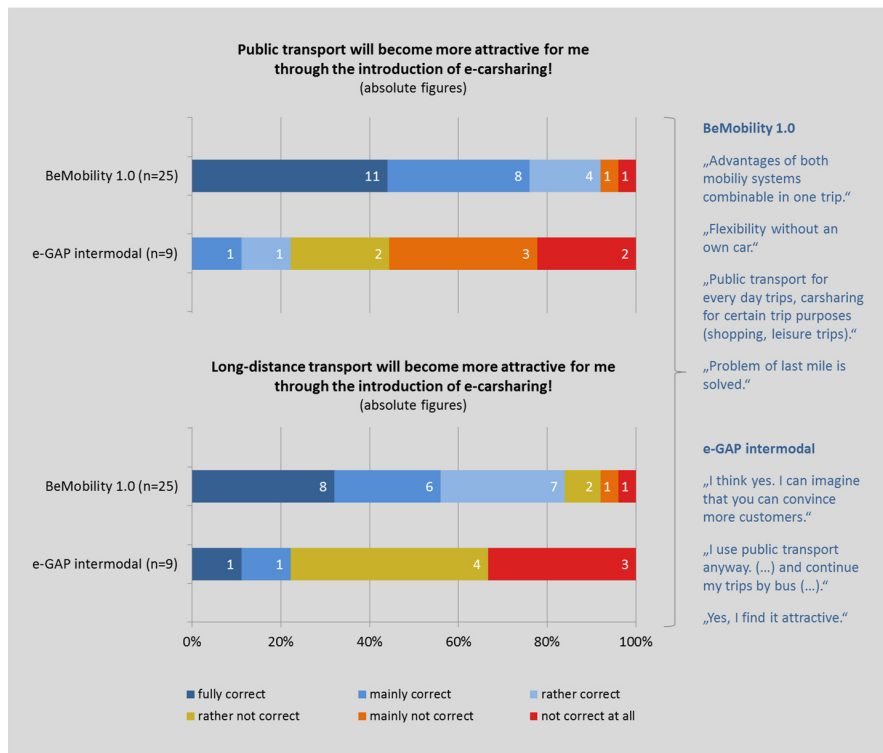

Fig. 5. Attitude towards combination of different services (Own Elaboration).

Altogether, the results show a high importance of the integration of e-carsharing in the public transportation system especially in urban areas. For rural areas it can be assumed that a higher density in the station- and charging-network might raise the acceptance of e-carsharing for multimodal trip chains.

4.2. Attitude-based mobility typology

To evaluate the customer potential for mobility services like e-carsharing a differentiation of target groups can be a good tool. In earlier studies, an attitude-based typology was developed that proved well for evaluating the potential use of intermodal services (Maertins, 2006). Significant differences in terms of mobility behaviour and CO2-balance could be identified within this approach. Therefore, the concept was then used in different field studies (Hoffmann et al., 2012). The typology was developed by means of cluster analysis (Ward´s method, on the basis of scales for mobility attitudes).

In 2012, a representative survey was conducted in the cities of Berlin, Hamburg, Munich and Frankfurt among persons over 18 years old based on 30-minute telephone interviews. Using a factor analysis altogether 12 scales out of 62 variables were extracted followed by several hierarchical cluster analyses which allowed to describe six attitude-based mobility typologies and their distribution (Table 3):

1. **Traditional car-lovers** valuate the car as the one and only true mode of transportation. All other modes are strongly rejected – especially public transport. This mobility type represents the "traditional" use of automobiles in Germany. Their mobility related attitudes towards the environment is below average and their potential as innovators is lowest among all mobility types. They prefer living in green areas outside cities and have the lowest score of innovativeness.
2. **Flexible car-lovers** also focus on the car but do not generally reject other modes of transport: Being rather neutral towards public transport, they show certain openness towards bike use and the use of long distance trains. They take a skeptical view of mobility services. Their mobility related attitudes towards the environment and innovativeness are below average. They prefer living outside urban areas.
3. **Urban-oriented public transport-lovers** strongly prefer public transport to other modes of transport. They reject cars and bikes and are neutral towards the use of long distance trains. They are neither technological pioneer nor open to mobility services. Also their attitudes towards the environment and innovativeness are below average. They prefer living in urban areas or urban residential areas.
4. **Conventional bike-lovers** focus on the bicycle as their preferred mode of transport. They are open to public transport and strongly reject the car. They are neither open to mobility services nor innovators or technological pioneers. They have a slightly sensibility towards the environment.
5. **Ecological public transport and bike-lovers** reject cars and reject enjoying car driving. They prefer riding a bike and using public transit on short and long distances. Their favored place of residence is within cities and they have a high affinity towards mobility services contrasting a low technology affinity. On the innovator scale they score positively.
6. **Innovative technology-loving multioptionals** are open to all modes of transport. They are innovative, environmentally sensible and very open to new mobility services.

Especially the last two target groups show a particular high potential for integrated mobility services such as e-carsharing.

Table 3. Attitude-based mobility typology (Own Elaboration).

typology	preferred living space	mobility attitude	affinity towards information and communication technology
traditional car-lovers	outside cites	preference of car, rejection of other transport modes	
flexible car-lovers	outskirts of cities	preference of car, no general rejection of other transport modes	
urban-oriented public transport-lovers	within cities	preference of public transport, rejection of cars and bikes	low
conventional bike-lovers	urban space	preference of cycling and neutral towards public transport	not high
ecological public transport and bike-lovers	urban space	preference of public transport and cycling equally, rejection of cars	small
innovative technology-loving multioptionals	not clear	positive towards carsharing and generally all modes of transportation	high

Comparing the distribution of these groups in Garmisch-Partenkirchen with big cities, the results show that the sample differs especially in terms of car orientation (Fig. 6). However, more than 25% of the questioned persons in Garmisch-Partenkirchen belong to the group of the innovative technology loving multioptionals who are particularly open to new mobility services. Thus, there seems to be a potential for these offers for certain user groups, also in rural areas.

Analysing the use intention depending on the mobility typology, the results for Garmisch-Partenkirchen (on a scale from 1 - no use intention, 6 - high use intension) show a value of 1.2 for traditional car-lovers, a value of 2.75 for flexible car-lovers and a value of 4.2 for innovative technology loving mulitoptionals. The lower values in regard to use intention of car lovers indicate that e-carsharing does not seem to fit their current preferences.

Altogether, the analysis of the mobility behaviour and potential acceptance in general show that the potential of carsharing or e-carsharing in rural areas amongst locals is comparably lower than in urban contexts.
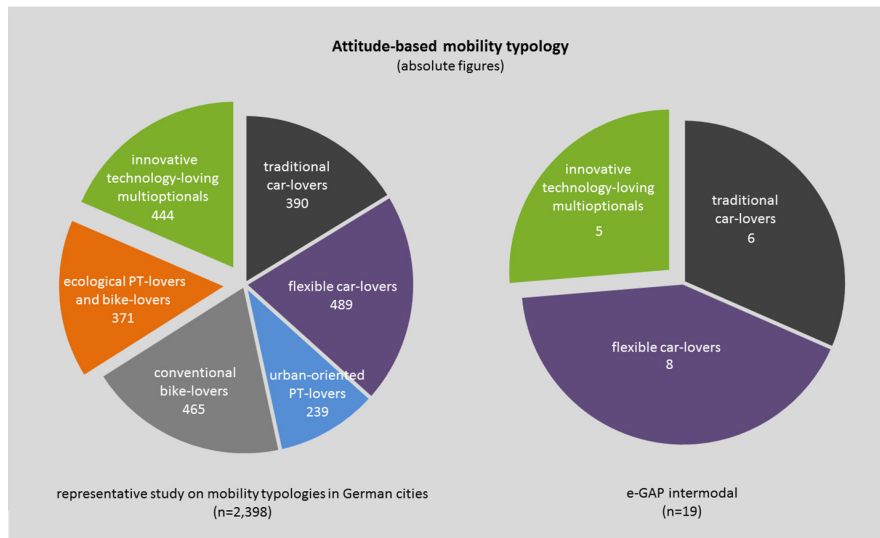

Fig. 6. Attitude-based mobility typology (Own Elaboration).

4.3. Booking behaviour

The analyses presented above evoke the expectation that e-carsharing only works in large cities as the acceptance is much higher and car-ownership lower. However, the example of Garmisch-Partenkirchen proves that the offer is comparatively well-accepted in terms of actual use by people living there. About 59% of the 39 users who had booked a car at the station in Garmisch-Partenkirchen at least once within the last 3 months are local residents. The rest came from various small to large German cities. This may have different reasons. In Garmisch-Partenkirchen, being a "model community electromobilty" since 2012, the public attention is already focussed on electric mobility in general and the e-carsharing offer in particular. Also, the introduction of e-Flinkster in July 2013 was accompanied by various marketing and promotion measures, presented in local press and on websites. In Garmisch-Partenkirchen the public recognition of the product was high compared to other e-Flinkster sites like Berlin or other cities. By surprise, only two customers from Munich had booked an e-car in Garmisch-Partenkirchen, even though the train connection between the two cities is good and fast and e-carsharing could be a perfectly integrated in an the intermodal trip chain of a day-visit.

5. Conclusions

The results indicate that people who are interested in integrated electric mobility services such as carsharing with EVs have certain features in regard to social-demographic features, mobility behaviour, expectations, use intentions and attitudes towards innovative mobility offers which need to be taken into account when implementing innovative mobility services.

Car affinity and car dependency seem to counter new mobility services in rural areas. However, there is a group of locals in Garmisch-Partenkirchen who actively use e-carsharing and represent a demand for intermodal offers also in small cities even if this demand is too low to guarantee the economic viability of a system like e-Flinkster with high costs for running it. Thus, it is important to approach other target groups like commuters or tourists as well. Garmisch-Partenkirchen offers high potential for such an attempt. As a touristic destination, it is visited by millions of guests in summer and winter likewise. Many of these guests live in an urban environment and are open to public transport offers and new mobility services and might already be a member of Flinkster. Addressing these persons before they travel in their own car and stick to that mono-modal mobility plays a crucial role for the commercial viability of e-carsharing in rural areas such as Garmisch-Partenkirchen. However, transferring this attempt to non-touristic rural areas is problematic. There, solutions have to be developed that can be established with considerably lower costs and therefore do not depend on a high demand. With regard to the high costs, EVs must be doubted to be the technology that guarantees profit for service providers in non-touristic areas.

In addition, the results of the attitude-based mobility typology suggest that the different groups should be approached in a more differentiated way. For example, the ecological public transport and bike-lovers in cities like Berlin and Garmisch-Partenkirchen could be addressed by focusing on the ecological and practical advantages of intermodal trips using public transport and e-carsharing. The group of innovative technology-loving multioptionals could be particularly addressed by focusing on the innovative aspects of the service and the offer to try it out.

However, the results only have preliminary character. Richer empirical work is necessary to validate the findings. Therefore, further research will be conducted within the project "e-GAP intermodal" at a time after the first try-outs, especially in terms of the actual use when e-carsharing is possibly integrated in new intermodal mobility routines. Results will as well be compared to an urban context. The main question for further studies will be if and how such an "enhanced" public transportation system will be accepted as alternative to private car-ownership.

Acknowledgements

References

Barth, M., Shaheen, S., Fukuda, T., Fukuda, A. (2007) Carsharing and Station Cars in Asia: An Overview of Japan and Singapore. *Transportation Research Record: Journal of the Transportation Research Board,* No. 1986, Transportation Research Board of the National Academies, Washington, D.C., 2007, pp. 106-115.

bcs Bundesverband CarSharing e.V. (2014) *Carsharing-Boom hält an.* http://www.carsharing.de/presse/pressemitteilungen/carsharing-boom-haelt-an [Accessed: 25 March 2014].

benchmark:services (2012) *Vergleichender Gästemonitor 2012 Garmisch-Partenkirchen.* Halbjahresbericht (Tabellenband), Hofheim am Taunus.

BMVBS Bundesministerium für Verkehr Bau und Stadtentwicklung, Institut für angewandte Sozialwissenschaft (infas), Deutsches Zentrum für Luft- und Raumfahrt (DLR) (2008) *Mobilität in Deutschland 2008.* Ergebnisbericht. Struktur - Aufkommen - Emissionen - Trends. Bonn, Berlin

Burkhardt, J., Millard-Ball, A. (2006) Who Is Attracted to Carsharing? *Transportation Research Record: Journal of the Transportation Research Board*, Volume 1986, No. 1, pp. 98-105.

Canzler, W., Knie, A. (2009) Green Solutions to the Auto Crisis - From Auto Makers to Mobility Ser-vice Providers, Strategy Paper, Heinrich Böll Foundation (Editor). *Publication Series on Ecology*, Volume 4, Berlin.

Canzler, W., Knie, A. (2011) *Einfach aufladen. Mit Elektromobilität in eine neue Zukunft.* München.

Canzler, W., Knie, A. (2013) *Schlaue Netze: Wie die Energie- und Verkehrswende gelingt.* München.

Communauté d'Agglomération de La Rochelle (2014) *Yélo.* http://yelo.agglo-larochelle.fr/voiture [Accessed: 15 January 2014].

CSA (2012) *Autolib' étude clientèle réalisée à l'occasion du premier anniversaire.*
    http://www.csa.eu/multimedia/data/sondages/data2012/opi20121205-autolib-des-clients-extremement-satisfaits.pdf [Accessed: 13 January 2014].

Firnkorn, J., Müller, M. (2011) What Will Be the Environmental Effects of New Free-Floating Car-Sharing Systems? The Case of car2go in Ulm, *Ecological Economy 70,* Volume 70, Issue 8, pp. 1519-1528.

Fukuda, T., Kashima, S., Barth, M. (2003) *Evaluating Second Car System, an Electric Vehicle Sharing Experiment in Tama New Town District, Inagi City, Tokyo.* TRB 2003 Annual Meeting.

Garmisch-Partenkirchen Tourismus (2014) *Tourismusbericht für das Jahr 2013 Gästeankünfte und Übernachtungen Inlands- und Auslandszahlen.*

Hinkeldein, D., Hoffmann, C., Schönduwe, R. (2012) *Using Attitude-Based Focus Groups to Analyze the Potential of Electric Vehicles as Part of Integrated Mobility Services, TRB 2012,* 91st Annual Meeting.

Hoffmann, C., Graff, A., Kramer, S., Kuttler, T., Hendzlik, M., Scherf, C., Wolter, F. (2012) *Bewertung integrierter Mobilitätsdienste mit Elektrofahrzeugen aus Nutzerperspektive.* Ergebnisse der Begleitforschung im Projekt BeMobility – Berlin elektroMobil. InnoZ-Baustein 11. Berlin.

LfStaD Bayerisches Landesamt für Statistik und Datenverarbeitung (2012) *Statistik kommunal 2012. Eine Auswahl wichtiger statistischer Daten für den Markt Garmisch-Partenkirchen.* München.

Martin, E., Shaheen, S., Lidicker, J. (2010) The Impact of Carsharing on Household Vehicle Holdings: Results from a North American Shared-use Vehicle Survey. *Transportation Research Record 2143,* pp. 150-158.

Prem Kumar, V., Bierlaire, M. (2012) *Optimizing Locations for Vehicle Sharing System.*
    http://www.strc.ch/conferences/2012/Kumar_Bierlaire.pdf [Accessed: 13 January 2014].

Schäfers, T.: Exploring Carsharing Usage Motives [2013] A Hierarchical Means-End Chain Analysis. *Transportation Research Part A,* 47, pp. 69-77.

Shaheen, S., Cano, L., Camel, M. (2012) *Electric Vehicle Carsharing in a Senior Adult Community in the San Francisco Bay Area.*

Shaheen, S. A., Cohen A. P.: Carsharing and Personal Vehicle Services (2013) Worldwide Market Developments and Emerging Trends. *International Journal of Sustainable Transportation,* 7(1), pp. 5-34.

Steininger, K., Vogl, C., Zettl, R.: Car-Sharing Organizations (1996) The Size of the Market Segment and Revealed Change in Mobility Behavior, *Transport Policy,* 3(4), pp. 177-185.

Ville de Nice (2014) *Autobleue fête ses 1 an.* http://www.nice.fr/Transport/Autobleue/Autobleue-fete-ses-1-an [Accessed: 13 January 2014].

Wappelhorst, Sandra; Dobrzinski, Julia; Graff, Andreas; Steiner, Josephine; Hinkeldein, Daniel (2013) *Flexible carsharing - potential for the diffusion of electric mobility.* Paper presented at the Workshop Future mobility. Markets and policy measures in the evolution of electric mobility. Bremen.