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## **Fostering small electric vehicles on a municipal level**

Amelie Ewert<sup>1</sup>, Mascha Brost<sup>2</sup>, Stephan Schmid<sup>2</sup>

<sup>12</sup>*German Aerospace Center (DLR), Institute of Vehicle Concepts, Wankelstraße. 5, 70563 Stuttgart, Germany,  
Amelie.Ewert@dlr.de*

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### **Summary**

Pressing problems such as ever-growing urban populations and mass motorization leave municipalities to take action in order to attain sustainable urban quality. Fostering small electric vehicles could help reduce land consumption and improve air quality. However, there are several obstacles that have to be overcome on local, national and international levels. For policy makers there is an array of measures available. Combining infrastructural changes, financial incentives, policies and soft measures could help the process of a market take-off immensely. The paper presents the outcomes of expert interviews and an online survey with an outline of the current situation.

*Keywords: SEV (small electric vehicles), light vehicle, mobility concepts, policy, market development*

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### **1 Introduction**

Looking at cities around the world today, the progress of congested and cramped landscapes is amplified by ever-growing urban populations and ongoing mass motorization. Land consumption of stationary and flowing traffic is at its limit of capacity and thus reflects in poor urban quality. Further environmental problems such as air pollution are increasingly urgent and are now being addressed in many parts of the world [1]. A number of strategies already exist to promote the substitution of vehicles with internal combustion engines (ICE) for those with electric motors. Nevertheless, a low occupancy rate, especially in passenger transport, indicates that there is a need for new vehicle concepts in urban traffic. In this way, it would be possible to make better use of the limited space available in cities. Effects such as high energy efficiency and low consumption contribute to the fact that small electric vehicles (SEV) offer a good alternative to oversized cars.

Over the past years, the market for electric cars has grown substantially. Since 2011 many SEV concept cars were shown over the years (e.g. Opel RAK e, VW NILS, Honda New Electric Urban Vehicle). Observing the whole market for SEV, there are well-known models such as the Renault Twizy, but overall only few models are available. Nevertheless, sales figures in Europe and the USA show hardly any significant increases. Including Asia, the market structures and the regulatory framework reveal a fragmented landscape.

Different classifications into categories vary substantially and thereby become non-transparent. Nevertheless, SEV offer a variety of strong advantages for urban areas and could partially contribute to tackling environmental problems [2] – [3].

Because of the international divergences in definitions and regulations, for the analysis the term SEV refers to three- and four-wheeled vehicles with an all-electric drive limited to a length  $\leq 3.5$  m, a maximum drive

power of 55 kW and an unloaded weight  $\leq 1,200$  kg. According to the European Union (EU) Regulation 168/2013 [4] this includes L-category vehicles (L2e, L5e, L6e and L7e) and micro- and subcompact electric vehicles (M1).

The aim of the study is to discover prospects for SEV and obstacles in the expansion of the market. During the analysis to find out which actors have which scope for action and effectiveness, cities in particular turned out to be very influential. Their goals as well as actions determine significantly how mobility is formed and thus create the quality of the urban environment. In the analysis, the question of what policy makers can achieve and what scope for action they have is explored.

The study was realized against the background of the Task 32 in the framework of the International Energy Agency (IEA) which operates a “Hybrid and Electric Vehicle Technology Collaboration Programme” (HEV TCP). The Task is an international working group including members from Europe and Asia on the promotion of SEV headed by the German Aerospace Center (DLR) to advance better market perspectives due to a change in surrounding conditions such as regulations, transport policies and mobility concepts.

## 2 Methodology and limitations

To lay down the groundwork for the main analysis secondary data and literature was gathered for the regions considered. This way the current status of the international markets and applications as well as use cases or measures in favour of SEV could be identified.

For the second part quantitative as well as qualitative empirical social research was used in a concurrent triangulation to create primary data. The approach of a mixed-method-design was applied. Therefore, expert interviews were conducted to gain exclusive knowledge and experience gained from practical application. With the same research questions a standardized online survey was simultaneously carried out. By comparing the different methods divergences as well as additional information can be drawn to ensure higher validity. Gaining results from both methods, meta-inferences can be formed by comparing the outcomes. Ultimately together with the desk-based study an outline of different views and prospects for urban mobility today as well as in the near future can be drawn.

As a result 32 interviews were conducted and 90 participants contributed to the online survey including experts from municipalities, consultants, research institutes, manufacturers and associations. Questions were divided into three topics: “Knowledge about SEV”, “Target group and utilization concepts” and “Obstacles and chances”. Within the obstacles and chances a large part was dedicated to different measures and their effectiveness.

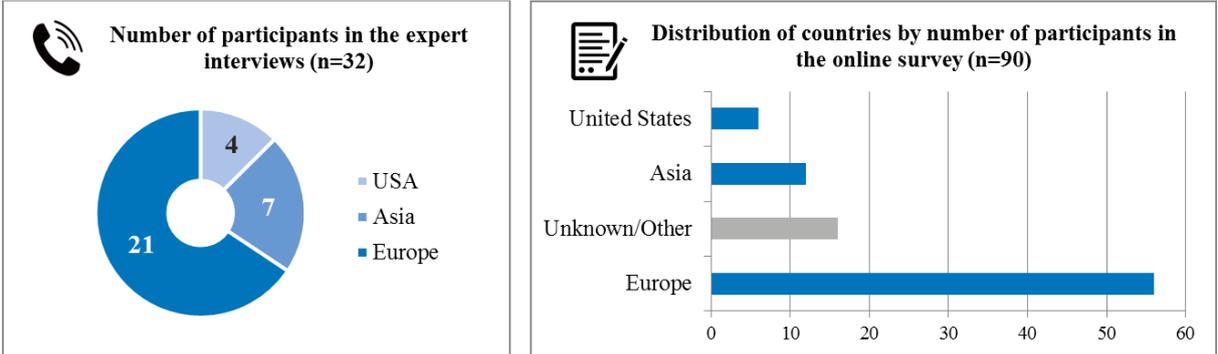


Figure 1: Response to the expert interview and the online survey

For both methods, the results are not representative due to the limited number of experts and thus the answers from the respective countries. The results should only give a general overview of the current situation. The scope of the analysis is furthermore limited to passenger transport within urban surroundings. The focus is on municipalities and excludes other actions carried out by different stakeholders.

### 3 Biggest barrier: Missing knowledge about SEV

The most important aspects according to the participants comprise efficient use of space and better air quality (see figure 2) and therefore transform urban areas into one of the most relevant playgrounds for this type of vehicle. Other prospects that are seen as effective and directly linked to the city are noise reduction and increased urban and life quality. The comprehensive feedback makes it clear that the municipalities themselves are influential actors and could initiate many measures to overcome obstacles that stand in the way of a market breakthrough.

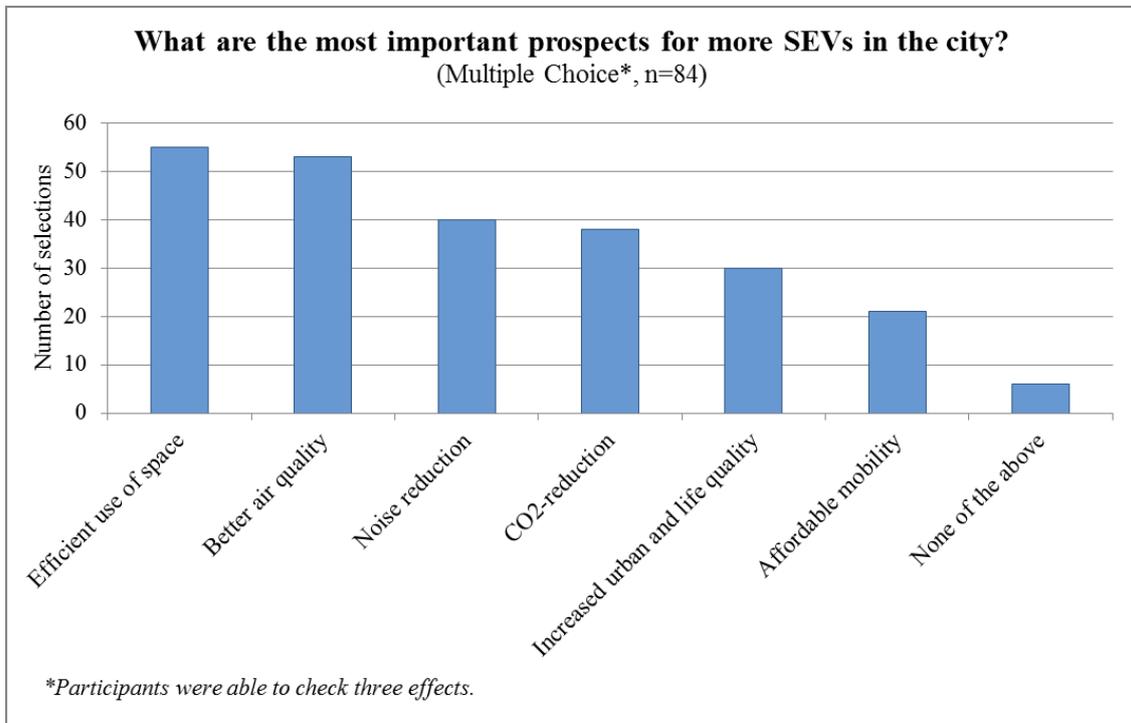


Figure 2: Prospects for more SEVs in the city

Although there would be many positive impacts, SEV are not very much known among the urban population nor the municipal administration themselves. These vehicles are commonly not considered as an option for sustainable transport and are classified as too unsafe or unattractive. For this reason, getting the concept of the vehicles closer to the cities is a first step. In this context, the benefits that can result from the use should be highlighted specifically.

### 4 Potential utilisation concepts and target groups

In the discussion about viable user concepts particular attention was paid to the demands of cities and the most sustainable solutions possible. The potential utilisation concepts for passenger transport queried in the online survey are displayed in figure 3.

Tourist services are seen as the most promising utilisation concept (89%). In this way, short distances between the sights can be efficiently managed and tourists maintain the flexibility to travel on their own schedule. Fleets such as company or campus fleets (85%) are also seen as promising. According to most of the experts in the interviews but also in the survey (83%) sharing schemes are a good concept and named it the most important model for today's cities in particular operated with SEV.

Private use and commuters in particular are a reasonable target group especially in cities where ownership of a car is still dominant. Although, private ownership is seen as overall *promising* by 72 percent and only 45 percent as *very to fairly promising*, in comparison they are seen as the least promising. Nevertheless, it is important to examine which modes of transport are being replaced.

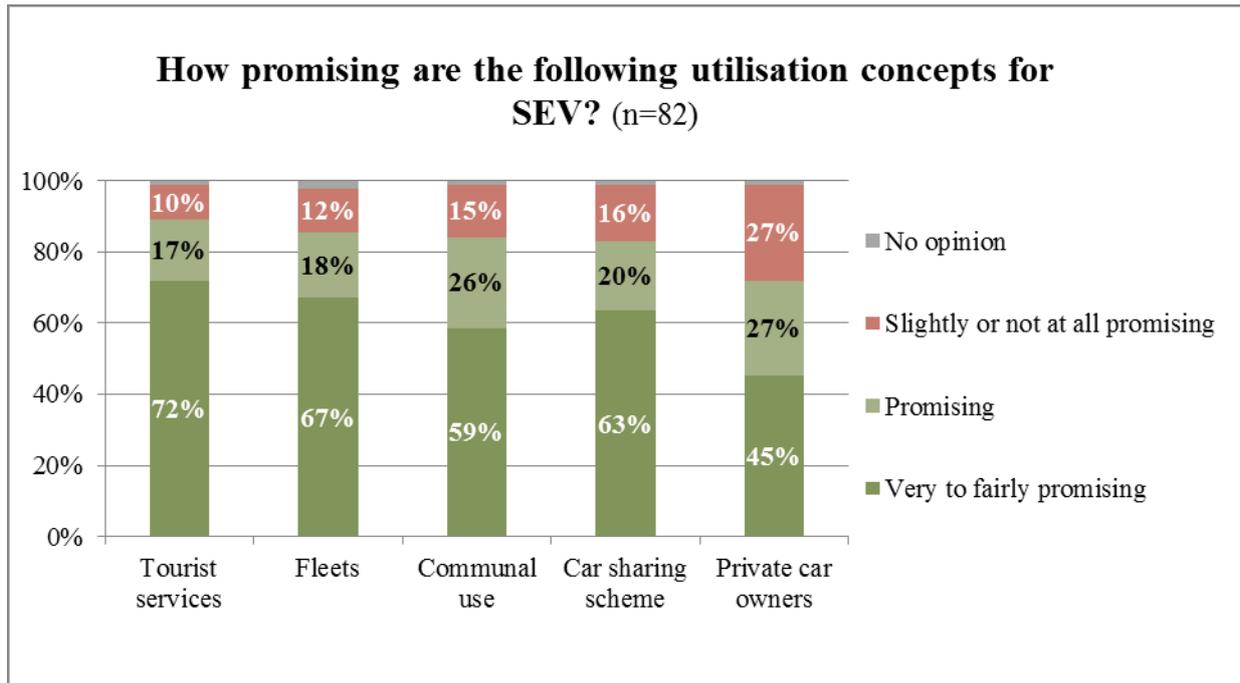


Figure 3: Potential utilisation concepts for SEV

## 5 Measures to promote an uptake of SEV

On the local level there are several measures that could be implemented to promote the use of SEV over cars with ICE including push and pull factors.

### 5.1 Traffic Infrastructure

Changes in transport infrastructure include both moving and stationary traffic and may involve regulations, constructional solutions or reallocation of road space. Although the measures presented below are radical, they are needed at least in part to make a difference.

#### Dedicated traffic infrastructure

Currently in most of the countries worldwide the ownership of cars is still the dominant form of transportation and is reflected in historically evolved auto-centred cities. In most cities, SEV have to share space with all other vehicles on the road. This does not give them any advantages, for example to save travel time by avoiding congestion. Sharing lanes with large vehicles on higher speed roads also leads to greater safety risks. Ultimately, there are no advantages on the road and thus no motivation to switch from a car to a smaller vehicle.

This circumstance is seen as the biggest hurdle to stand in the way of a market uptake. Improving the infrastructure in favour of SEV can increase the demand. They have to be separated from other vehicles to avoid traffic jams and to travel safer on the road. However, many cities are already struggling with cramped space and a high volume of traffic that needs to be satisfied. It would therefore be more reasonable to share lanes with buses and taxis for the medium term. As soon as the number of vehicles increases, however, the lane should again give priority to buses in order not to favour individual traffic. A good example is Norway, which has been sharing bus lanes with electric cars in general since 2005. This, along with many other incentives, has led to an uptake of electric mobility [5].

Another concept that is emerging is shared space. With the upcoming of many different types and sizes of vehicles beginning from personal light electric vehicles (PLEV) up to buses, there is no space for many separated lanes. Setting up shared spaces could increase safety of different road users. Therefore, every road user including people with disabilities needs to be considered in the design process.

To go even further than only priority access to bus lanes or shared spaces bans could be applied to ICE vehicles and are seen as highly effective (by 94%, see figure 5) for their promotion. Furthermore, some streets, especially in inner cities or neighbourhoods, are suitable for a car-free layout with an exception for SEV. In the long term an entire ban of cars from city centres can be realised. One effective measure that is already a common tool is (ultra) low emission zones ((U)LEZ). This way people are pushed towards buying electric vehicles (EV) in order to use individual transport in the city centre. However, EV in general are often preferred to SEV in particular. Therefore, there should be specific advantages for SEV or an addition, that certain vehicle sizes are excluded from the city. In the medium term it is more likely to set up city tolls with reduced tariffs for SEV until setting up an LEZ.

However, the economic activity affected in the areas must always be taken into account. Alternative mobility offers, such as sharing schemes, can make travel choices more attractive.

### Special parking spaces and parking management

Another traffic-related problem is parking in cities. On average, the car remains in a parked position for 95 percent of the day [6]. The increasing motorization rate results in an extensive land use for parking spaces. Parking pressure also leads to increased parking search traffic, resulting in traffic jams and, in the case of vehicles with internal combustion engines, air pollution in particular. A reduction of parking areas would, however, lead to a significant increase in urban quality. SEV are small sized and could therefore e.g. substitute a large parking space with two to four lots depending on their size (see figure 4). However, it is crucial to determine parking regulations and precautions. This will help to avoid problems that may arise, such as those caused by bicycle sharing systems such as ofo or Mobike. In these applications, many cities struggled with congested sidewalks or cycle paths.



Figure 4: Parking space needed for Renault Twizy, Source: Renault, 2017

Through various incentives e.g. special parking spaces, SEV can be favoured over cars. The experts questioned stated that this would be a very powerful tool to be implemented by municipalities (88%, see figure 5). Redesign of smaller parking spaces could be realised in proximity to the workplace, the event location or in residential areas. Furthermore, dead areas can be converted into parking areas, e.g. small street triangles without use. These actions can either come from the municipality alone or be initiated in dialogue by manufacturers wishing to introduce a vehicle to the market.

Regulatory permission can be introduced for transverse parking as many SEV also fit transversely into smaller parking spaces due to their short length. As a third and also very powerful measure seen by 90 percent of the respondents, parking management could take effect by requiring SEV drivers to pay little or no fees for parking. On the contrary costs for ownership of a car need to be increased and can partly be achieved by increasing or introducing parking rates.

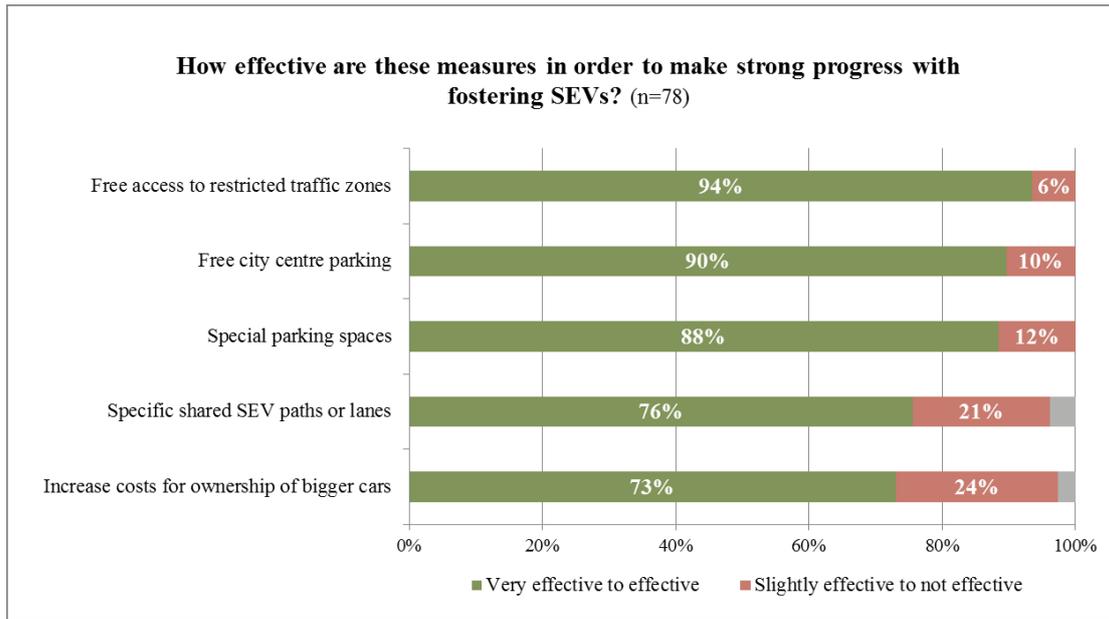


Figure 5: Estimated effectiveness of measures concerning parking

Overall increasing the cost of car ownerships would help to encourage the use of e.g. SEV. Combining these measures provides on the one hand push and on the other hand pull factors, which increases the impact. However, in order to achieve higher scaled effects, such as the reduction of the motorization rate, it is important to set higher transport planning and strategic goals. Instruments can be Clean Air Plans, Traffic Development Plans or parking policies. In addition, it is advisable to gradually extend the measures from individual lighthouse projects towards high area coverage [7].

## 5.2 Charging infrastructure

The limited range of SEV in comparison to normal battery electric vehicles (BEV) is a barrier for many people to buy them. Consequently, the lack of a sufficient charging infrastructure is an obstacle for the market.

In order to have charging security and to take away range anxieties within the urban population, charging infrastructure in cities must be expanded. In this statement it is particularly striking that the municipalities questioned in the interviews attach high importance to this measure. Additionally, the survey revealed this measure to be the second most important, with 91 percent of respondents saying it is effective. To achieve sufficient coverage public bodies themselves should get involved, but can cooperate with private companies and energy suppliers. Providing charging infrastructure, however, can be a problem for municipalities as it means high resource expenditure.

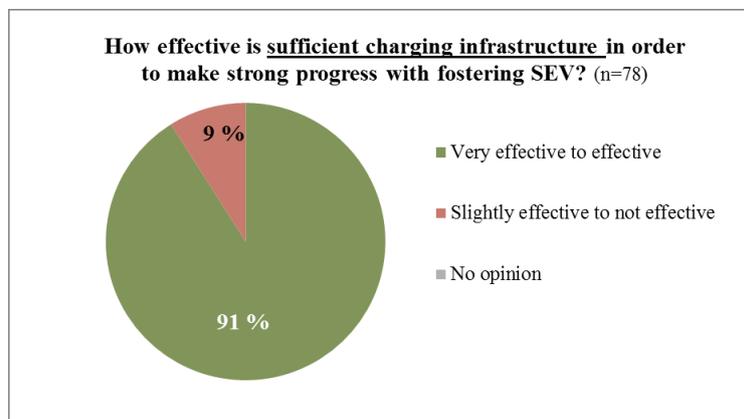


Figure 6: Estimated effectiveness of sufficient charging infrastructure

### 5.3 Adapting traffic codes

In addition to the transport infrastructure measures, municipalities have the possibility to intervene in some aspects through policies or regulations. This does not require large resources but considerable results can be achieved.

Non-adapted or hindering traffic codes are seen in particular in speed limits on the roads. Especially in the United States SEV are hindered to run in mixed-vehicle traffic with the background that they should only cover short distances in planned communities. These regulations can be widened by the states or even local jurisdictions [8]. This reveals a fragmented landscape of different roadway speed limits throughout the country. It would therefore be helpful to develop clear regulations in favour of SEV that are consistent on a larger scale.

Furthermore, it is important to address the speed limits in cities in European as well as in cities of the United States. A large obstacle for the urban population to buy an SEV or for municipalities to foster them is the safety aspect and the lack of required crash tests. Reducing top speed limits in urban centres down to 30 km/h would largely increase safety. This hypothesis is demonstrated, among others, by a long-term study in London (1986-2006), which shows the effects of the introduction of 20 mph/h (32 km/h) zones on road safety. According to the study, this led to a 41.9% decline in the number of road accidents, based on the number of road casualties at that time [9].

Another positive aspect is that vehicles with a top speed of 45 km/h or less would not hinder traffic as they would in higher speed limited roads.

### 5.4 Financial incentives

Costs of SEV can be high especially when comparing them to e-scooters or pedelecs. The price range lies between approximately 7,000 and 55,000 EUR. By providing e.g. energy taxation EV and, above all, vehicles that consume less energy, have advantages over conventional ICE vehicles. In addition to subsidies from the state, municipalities can take the initiative, as L-category vehicles are not included in all state subsidies. They can provide discounts on charging facilities for citizens or for using the public transport in the case of an SEV-ownership. Financial aid was perceived as a powerful tool from the experts in the interviews and is verified by 76 percent of the online questionnaire respondents. Financial support for manufacturers is also a measure that could be implemented by municipalities.

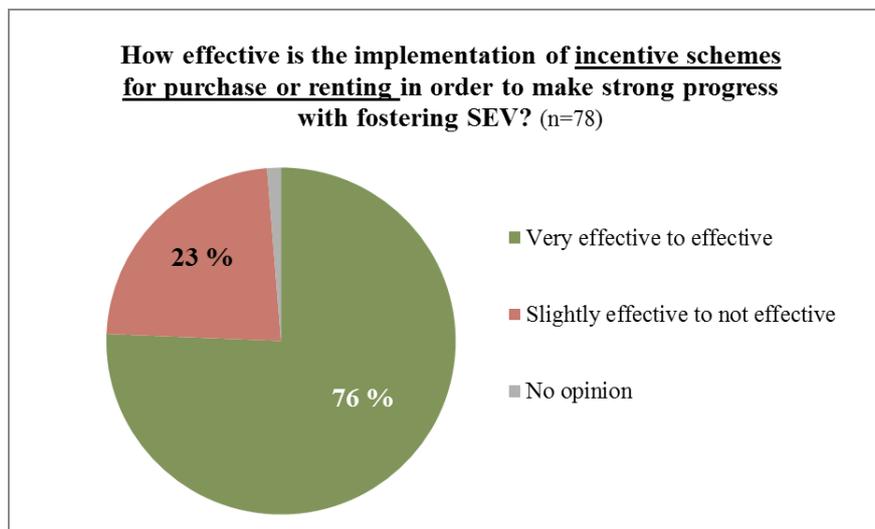


Figure 7: Estimated effectiveness of incentive schemes for purchase or renting

### 5.5 Raise awareness

In addition to the infrastructural and regulatory changes presented, soft measures are a good incentive to encourage potential consumers towards the use of SEV. One large factor holding back widespread use of

SEV is the lack of knowledge about these vehicles among the urban population. There are only a few use cases, not many vehicles on the road and only a few vehicle models on the market compared to cars. The people who are familiar with these vehicles, however, mostly have the image of an unsafe and visually unattractive vehicle for the elderly. These are obstacles that can be tackled by municipalities in order to reach a wider target group. There are several utilisation concepts that can be fostered by actions such as knowledge transfer through municipalities.

### Pilot projects and show cases

An effective way to make SEV visible is to deploy them in various pilot projects or showcases. It is an effective way of testing the impact and mechanisms of action with SEV in operation. In order to set a good example, the public sector can use these vehicles in particular, e.g. for park maintenance. Furthermore, pilot projects can be implemented together with various stakeholders such as companies, transit agencies, universities, manufacturers or NGOs and communal organisations.

### Offer sharing schemes

Potentials are also seen in car sharing within urban areas or for tourist services (by 77 percent of the respondents). There is already a number of sharing systems implemented in Asia and Europe. In many of the European projects such as Citélib by Ha:mo, RUHRAUTO, Re.volt or ENUU the municipalities are involved in different intensities. By offering this type of vehicle in a non-binding way and over a longer period of time this is a good step to introduce the vehicles to citizens.

### Campaigns and activities

A measure that was seen as less effective than other incentives is campaigns and activities by 55 percent. Nevertheless, during the interviews it became clear that the only way to experience this type of mobility is to test the vehicles. An even smaller hurdle than e.g. a registration for a car sharing program is the attendance at various municipal events where these vehicles can be presented. Test drives allow the visitors to experience a first contact and the driving feeling. In this way, citizens can receive information about SEV and their benefits.

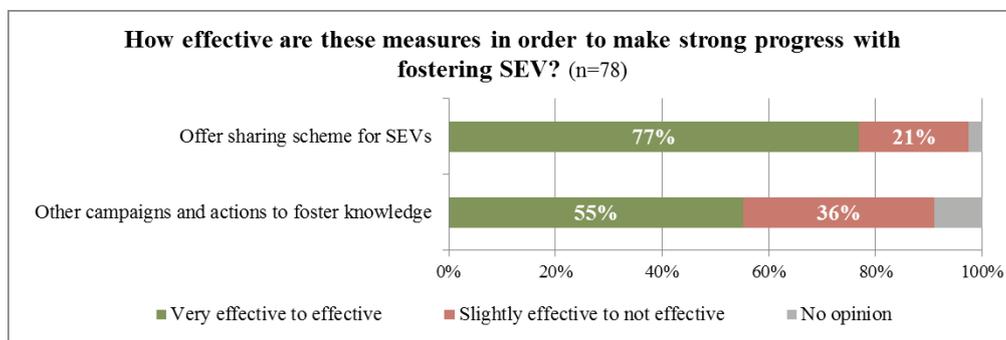


Figure 8: Estimated effectiveness concerning sharing schemes and campaigns to raise awareness

## 6 Discussion

The municipal administration and their motivation to promote SEV play the key role. A direct approach with showcasing of the advantages by different actors is a first step to raise awareness. Once public bodies are eager to promote SEV, various measures can be implemented at the municipal level. Probably the most important element is the transport infrastructure, which has mostly not yet been adapted. Cities need to think about what place SEV can and should occupy and accordingly give access to restricted areas or even special lanes and parking spots. The promotion of SEV is very important on the one hand, but on the other hand obstacles need to be created for driving vehicles with ICE. In this sense, (U)LEZ, which are already being introduced in some cities or higher parking fees, have great potential.

Overall, there is a range of measures that can be applied at different levels. However, incentives need to be bundled together in order to have an impact. Some incentives, e.g. setting up charging infrastructure, are already being implemented for EV whereby synergies can be created.

To know which measures to implement in a specific city it is, however, crucial to consider the local and national requirements, regulations as well as the mind-set of the society. Therefore, when promoting SEV in any kind of way a municipality needs to know about the possibilities it can bring to their city by having their own research. This can, for example, be the calculation of their own official channels when converting fleets. Since cities have many differences it might be possible to create a toolbox with measures as figure 9 shows and to pick out the feasible tools depending on the city in order to achieve a higher market share.

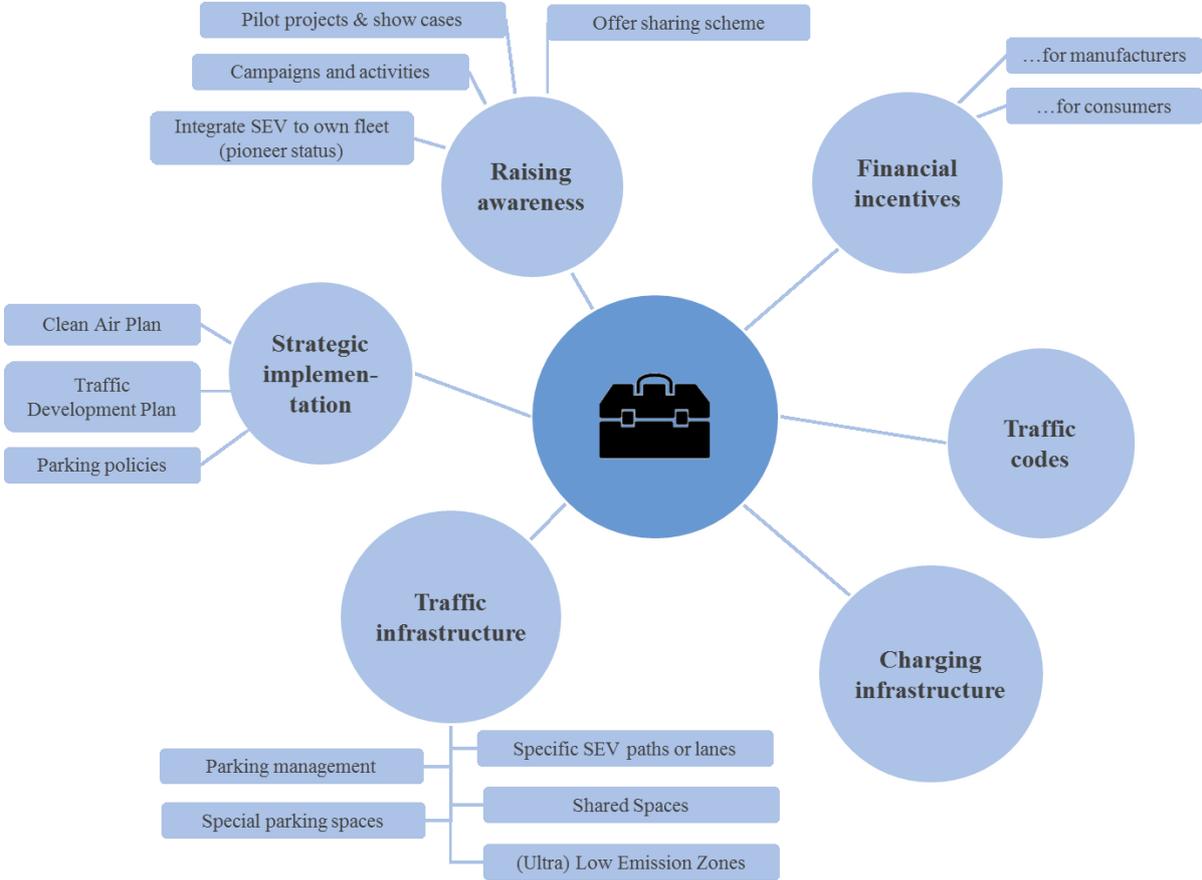


Figure 9: Estimated effectiveness concerning sharing schemes and campaigns to raise awareness

The differences in the regions considered play a major role especially in terms of utilization. Although SEV find their place everywhere in the urban environment, this is interpreted differently in Asian megacities where this applies to the suburbs. Although commuters are a desired group due to the low occupancy rate, they are not a reasonable chance against the background of the change in mobility concepts and the low range. A focus should be laid on first and last mile mobility in the form of collaboration between public transport and sharing alternatives with SEV.

Overall, SEV are likely to remain a niche market in the medium term as there is little encouragement to buy such a vehicle as long as they are not offered significant advantages from cities. Some of the measures require a large amount of resources but for a start it is also possible to begin with e.g. strategic implementation and policies. However, some of the measures are not welcomed by certain interest groups such as large manufacturers. It would therefore also take other manufacturers such as Renault with Twizy to produce these vehicles in order to create an effective lobby for SEV. The vicious circle where the risk for an investment is too high has to be minimized by already implemented measures. Only when the costs for SEV are reduced a major breakthrough can come as the price in the purchase decision is one of the key factors that can be influenced.

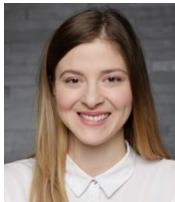
In conclusion SEV are a good sustainable mobility solution and could tackle many problems cities face today. By starting the process of awareness and knowledge an initial impulse is given and getting

municipalities on board could influence the SEV market share substantially. But in order to see a success, infrastructural adjustments have to be made in urban traffic.

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## Authors



**M. Eng., Amelie Ewert** works as a research fellow for the German Aerospace Center (DLR), Institute of Vehicle Concepts in Stuttgart, Germany since 2018. In her field of work she is responsible for user requirements and future perspectives of light vehicle concepts. Prior to her work she wrote her masters' thesis with DLR and gained experiences in the field of sustainable mobility in an international context at the German Development Corporation. She holds a bachelor degree in Geography and a master's degree in environmental management and urban planning in conurbations.



**Dipl.-Ing., M.Des. Mascha Brost** studied mechanical engineering at the University of Stuttgart, Germany. After her studies, she worked for two years in the field of computational fluid dynamics. She complemented her technical education with a Master degree of Integral Design Studies, an international, interdisciplinary program of the Stuttgart State Academy of Art and Design. The combination of technical and artistic product design contributed to the development of a small electric vehicle by a product design company in 2014, where she worked for two years. Since 2015, she is a research associate at the DLR Institute of Vehicle Concepts, where she is also part of the IEA-HEV TCP Taskforce 32 "Small Electric Vehicles".



**Dr. Stephan A. Schmid** is Head of Department 'Vehicle Systems and Technology Assessment' at the Institute of Vehicle Concepts, German Aerospace Center (DLR). He is the National Scientific (Alternate) Delegate of Germany for the IEA Implementing Agreement 'Hybrid and Electric Vehicles' (IEA HEV-TCP). He served from 2011 to 2013 in addition as DLRs Transport Representative in Brussels. Mr. Schmid holds a diploma degree in Mechanical Engineering from the Technical University of Karlsruhe, and received his doctoral degree (Dr.-Ing.) in Engineering from the University of Stuttgart.