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Turning municipalities into focal points for electric mobility – the 6SEK-model

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Summary

Electric mobility appears to be a challenge for local authorities, as they are expected by both, citizenship and federal government, to develop significant basic conditions (e. g. charging infrastructure) for a broad market expansion. However, electric mobility includes a variety of complex topic areas, which are not specifically determined in local municipalities yet, even though the German federal government views them as a key part of their electric mobility concept. Since the emergence of electric mobility as a module of a more sustainable mobility in the near future, some municipalities have achieved electric mobility into their range of tasks, while many others have not. Additionally, some municipalities want to wait longer before investing a lot of money into electric mobility because of acceptance uncertainties in the population while others want to encourage electric mobility without knowing how to. Having worked in several research projects (e.g. EMiS - Elektromobilität im Stauferland, and namos - Nachhaltig mobiler Sonnenhügel) addressing that task, we present a model to help municipalities shaping their future mobility actively thus leading to positive effects in the field of sustainability in six steps. The 6SEK-model ("6 Stufen zur elektromobilen Kommune") comprises of an interdisciplinary approach utilizing social, spatial and natural sciences to develop a successful municipal strategy. We will discuss the six different components, the deliberations behind them and their starting points.

Keywords: municipal government, provincial government, mobility concepts, strategy

1 Introduction

Electric mobility promises to contribute to the achievement of a more sustainable transport system, mainly by reducing energy consumption and local emissions (CO_2, pollutants, and noise). The German government set the goal to release one million electric cars on German streets by 2020. To reach this goal,

the government set up a funding program for municipalities. Municipalities have to elaborate electric mobility concepts to acquire funding. The main problem for municipalities in this scenario combines the lack of persons in charge in their own administrations who are responsible for the field of electric mobility and the need to acquire the required knowledge in the dynamic and still developing field of electric mobility. The local development of electric mobility resides on the point of intersection of social, spatial and natural sciences. Therefore, we present a strategy formation for municipalities to set up successful urban mobility concepts based on knowledge gathered throughout a variety of research projects over the course of recent years [1-6]: the 6SEK-model – "In 6 Stufen zur elektromobilen Kommune".

2 Methodology

Mobility comprises different sciences and perspectives, which are most successful when looked at in a comprehensive way. Users of mobility services choose different traffic modes for certain ways (e.g. their way to work or recreation).

The mode choice relates on individual circumstances, such as personal preferences or the amount of available money (social sciences). The sum of individual mode choices leads to consequences for the spatial development of urban areas and thus requires the consideration of different scales (spatial sciences). People's residences are the origin of traffic, their respective destinations (workplaces, shops, gyms etc.) lead to the manifestation of traffic based on mobility needs; leading to transport mode choice related energy demands and emissions (natural sciences & economics). Utilizing electric mobility promotes the municipality's image as being up-to-date and innovative, this holds the chance of connecting other traffic related key parts of urban mobility concepts (e.g. inter- and multimodality, bike- and pedestrian traffic).

The organization of German municipalities rests upon precisely defined responsibilities. To be able to reach the million electric car goal within four remaining years, the addition of clearly defined competences for electric mobility needs to be a priority in German municipalities. We present the 6SEK-model as a possible solution to unburden local municipalities and enhance their administrative performance towards electric mobility. Political support from e.g. the municipalities' major within the local municipalities is indispensable for the success of electric mobility.

The presented results belong to the following projects:

- EMiS – Elektromobilität im Stauferland (in the cities of Göppingen and Schwäbisch Gmünd) - *finsihed*
- namos – Nachhaltig mobiler Sonnenhügel (in the city of Schwäbisch Gmünd) – *on-going*
- FleetFloating - Elektromobilitätskonzept für Unternehmens-, Verwaltungs- und Pendlermobilität im Ilm-Kreis - *finished*

The authors of this paper consider the coupling of electric mobility and diversification within all fields of research and the following components as inevitable (e.g. while the one-to-one substitution of ICV with BEV would solve a few environmental problems, it does not solve spatial problems based on space requirements of cars). Thus, a recurring part of the presented components affects the problem awareness for sustainability within the current mobility system.

2.1 The 6SEK-model

The 6SEK-model consists of six different components (see Fig. 1):

- Coordination and knowledge building (social sciences)
- User activation and motivation (social sciences)
- Integrated urban- and traffic planning (spatial sciences)
- New mobility (natural sciences & economics)
- Charging infrastructure (natural sciences & economics)
- Municipal and commercial fleets (natural sciences & economics)

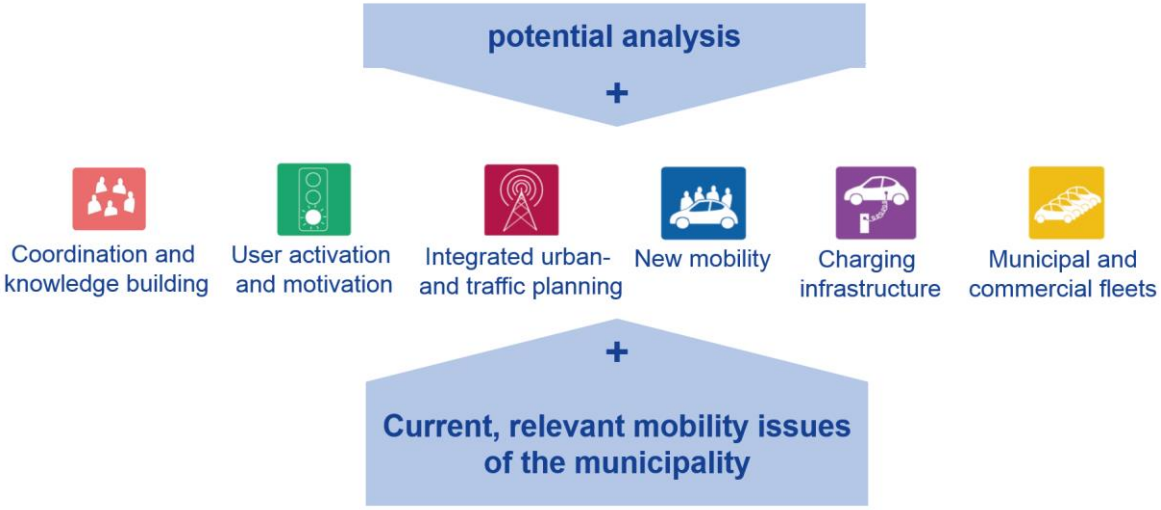

Figure 1: Different components of the 6SEK-model (own representation)

The model's main goal is to make electric mobility available to municipalities in a comprehensible, but scalable way. Each component performs a certain task on the way to an electrified municipality. We take current, relevant mobility issues of the municipalities into account and address specific potentials.

2.1.1 Coordination and knowledge building

In all three projects, the centralization of responsibilities for electric mobility occurs in certain municipality departments. The coordination in EMiS and namos happens in the economic promotion department of the respective cities of Göppingen and Schwäbisch Gmünd. FleetFloating, however, is a project coordinated on the rural district level. Thus, the coordination occurs in the administrative district office and is in the hands of the district's climate protection manager. First, the coordinators have to build up knowledge in the field of electric mobility. There are several ways to achieve this: by working through literature, e.g. [1-4], by contacting external consultants who specialize in the field of electric mobility or by collecting their own experience with electric mobility, with electric cars and their respective charging infrastructure in particular. Typically, a combination of all mentioned methods is most promising.

After building up knowledge, the next important step for the coordinators is to identify all relevant internal and external stakeholders (s. Fig 2.). Since electric mobility does not have clearly defined competences in local or district administrations yet, the most important step for the coordinator is to establish a network in his municipality to be able to implement the following components of the 6SEK-model, which relate to different departments within the municipality or even sub-state players, e.g. electricity suppliers or regional associations.

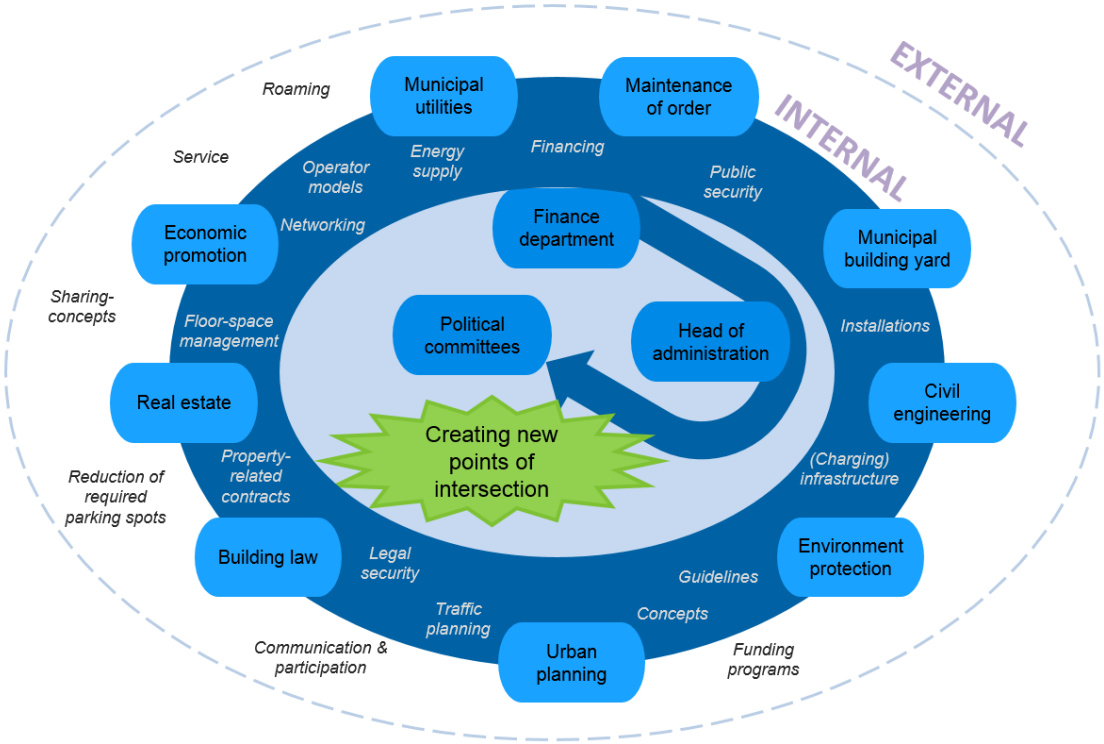

Figure 2: Stakeholder within the field of electric mobility (own representation)

2.1.2 User activation and motivation

The acceptance of mobility-services, and, in consequence, their profitability affects the duration of the service's offering. Thus, the activation of people is of special importance. This includes several aspects: The creation of problem awareness, participation in developing the strategy and information about the possibilities provided by electric mobility are important parts of acceptance-strategies. Thus, municipalities need to include people actively in the process of creating affordable and tailored solutions (e.g. promote electric mobility as a special lifestyle coupled with testing state-of-the-art vehicles).

Within the EMiS-project [2], in a housing complex called "StadtGarten" in the city of Göppingen, the building management provided an E-Carsharing (one Renault Zoe) for the inhabitants. To utilize the E-Carsharing, the inhabitants had to register as a Carsharing-user and to sign a certificate of participation of the building management. The certificate of participation includes information about the usage-fee, as well as insurance protection. In 2013, a kick-off meeting for the implementing of the E-Carsharing took place, where all inhabitants of the housing complex were invited. During an enjoyable atmosphere, representatives of the car dealership as well as the wall-box fabricator elucidated and demonstrated the charging process and the differences of BEV compared to ICV. During this meeting, all inhabitants of the housing complex were able to take a test drive with the BEV and fill the registration papers, thus lowering the additional expenditure to sign up for the E-Carsharing. Feedback from the participants was downright positive. In addition, local press released a positive news article leading to increased awareness in the city of Göppingen and its surroundings.

To provide a low-threshold access to the E-Carsharing for the inhabitants, it was completely free of charge within the project duration. This allows the inhabitants to gather knowledge about sharing-concepts and electric mobility and to experience the advantages of driving an electric car. Additionally, it allows the inhabitants to integrate the E-Carsharing into their daily mobility habits. After a successful integration into their daily mobility habits, we expect inhabitants to utilize the E-Carsharing beyond the project duration. Building management handled the accounting process for the E-Carsharing, thus preventing individual persons to utilize the car permanently allowing anyone interested to utilize it.

To provide information about the E-Carsharing and possible applications, we developed a mobility leaflet (based on new-citizen marketing) and distributed it in the housing complex. The leaflet includes information

about additional mobility services in the near surroundings of the “StadtGarten” outlining the advantages of each traffic mode and the possibilities of the integration of E-Carsharing into a multimodal mobility strategy. Additionally, the leaflet includes a map of local amenities and culture, leisure and sports offerings. The overall goal of the leaflet is to encourage sustainable mobility habits in the “StadtGarten”.

In the first part of the leaflet release, only half of the inhabitants received the leaflet. We conducted surveys with the inhabitants before and after they received the leaflet. First results indicate an increased state of knowledge based on the mobility leaflet [2]. The inhabitants also provided positive feedback about the content and the design of the leaflet [2].

The goal of the on-going namos project is to establish a sustainably mobile neighbourhood. We are currently working on three different activation and motivation topics:

- Information, e.g. about future construction zones and the plans for road constructions in the neighbourhood. We inform the residents via press releases, leaflets and information booths on action days within the neighbourhood.
- Sensitisation/Experiencing, e.g. coupons for the utilization of Pedelec- or Carsharing. Both offerings already exist in the neighbourhood, thus methods to encourage the residents to utilize these offerings are key in this part. So far, try-out zones on action days within the neighbourhood appear to be the most effective.
- Co-design, developing methods together with the residents. First ideas from the residents include the implementation of reduced-traffic areas, no-parking zones and a small market to encourage local amenities, thus reducing the amount of necessary traffic. In addition, the residents participate in the design process of a mobility-hub within the neighbourhood.

We will derive methods for the next steps within the project based on the results of a survey [7], which utilized lifestyle typologies for the evaluation [8].

2.1.3 Integrated urban- and traffic planning

Urban- and traffic planning are dynamic and long-term processes. The development of certain strategies therefore is essential. This component takes into account the goals and the potentials of the municipality, as set in urban development plans or climate concepts, and views electric mobility as a tool, e.g. to reduce emissions by the new technology or to stint parking space requirements in neighbourhoods by establishing electric Carsharing. Potential approaches to make these processes visible for municipalities are back-casting or dynamic master plans.

In the on-going namos project, we are utilizing a dynamic master plan to visualize every single step containing project-relevant actions in the field of urban- and traffic planning. Fig. 3 & 4 show these steps from project start in spring 2016 until spring 2017 (y-axis). We differ three types of participants, who have to be addressed for the respective project steps: the city administration, the citizens’ community and the research team, which, in our case, are the authors (x-axis). Additionally, we distinguish four different types of actions: information, accompanying research, co-design and consultation. These types differ in their amount of participation with the residents. Other relevant stakeholder, e.g. the municipality’s administration, might influence the amount of participation for each action. Because dynamic master plans visualize a project’s progress, we also minute stopped project steps, e.g. the scheduling of the parking day in the neighbourhood. We are working closely together with the residents in several round-tables and town meetings and conduct surveys for certain interrogations, e.g. residents prefer a different route planning for a bicycle way because of their daily utilization insight. We are constantly extending the dynamic master plan according to newly happened or planned events.

Fundamentally, dynamic master plans couple steps from urban- and traffic planning. Each stakeholder is able to reconstruct a project’s process. While this component might not have a direct impact on electric mobility, it encourages and raises awareness of sustainable mobility, thus potentially leading to the purchase of electric vehicles, if needed. The more direct influence of dynamic master plans are the strengthening of pedestrian and bicycle traffic (e.g. route guidance and internal development within the neighbourhood). Another important aspect is the inclusion of the targeted steps of the dynamic master plan into already existing plans, e.g. urban development concepts.

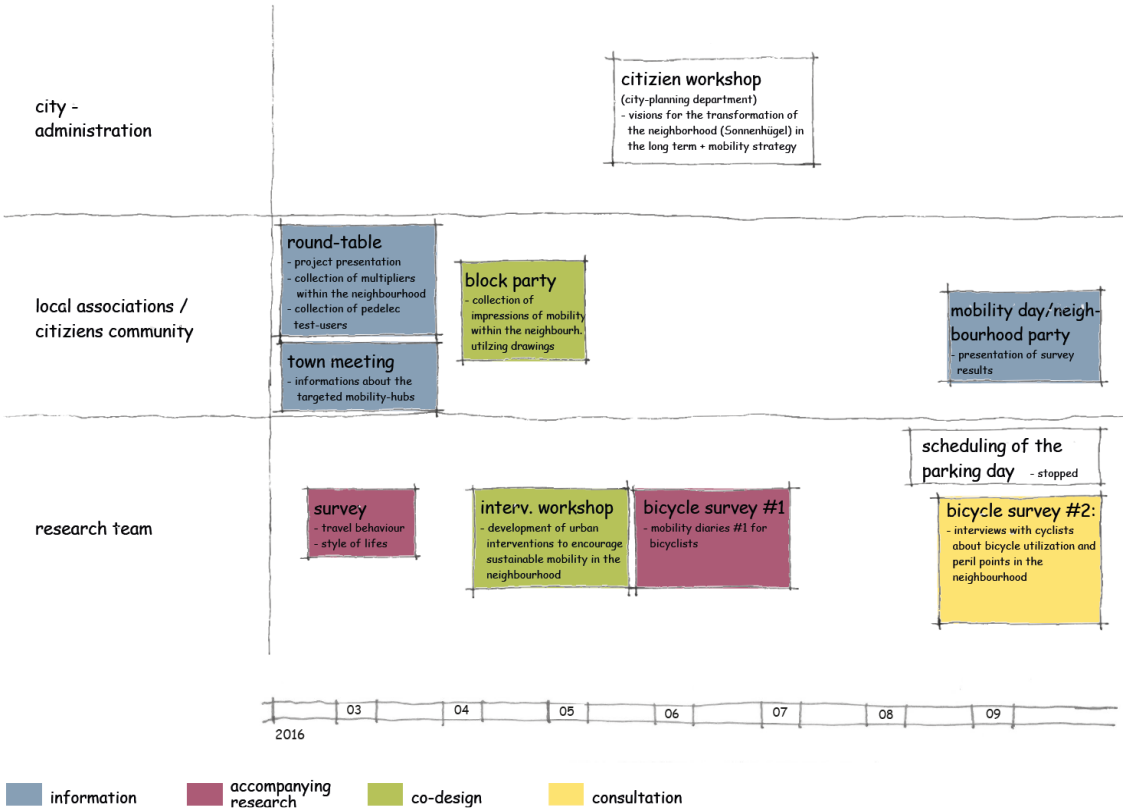

Figure 3: Dynamic master plan within the namos project – part 1 (own representation)

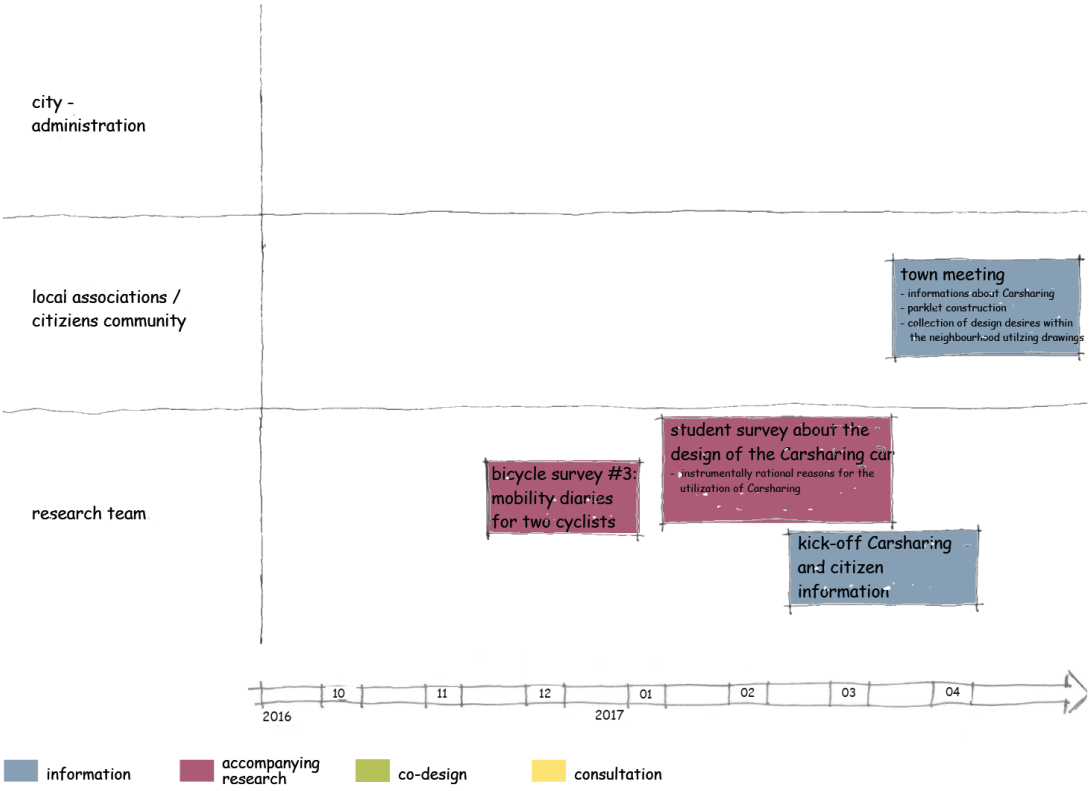

Figure 4: Dynamic master plan within the namos project – part 2 (own representation)

2.1.4 New mobility

Shared mobility concepts are key for this component. Unfortunately as of today, the operating efficiency of most such concepts is not given. Thus, the utilization of tailored solutions for municipalities considering additional use-case scenarios to increase the average utilization of shared mobility concepts is inevitable, for example by reducing the municipal car pool (saving costs) and - in return - constantly chartering electric Carsharing during office hours [1-3]. Additionally, public transport has to play a (perhaps different) role within future mobility concepts, thus we include it in our model.

In chapter 2.1.2, we already presented the Carsharing of the EMiS-project. The "StadtGarten" housing complex consists of 127 flats; roughly 50% registered as Carsharing users according to the building management. In the namos-project, the setup of a Carsharing proposition (ICV and BEV) finished. The operator of the Carsharing breaks even for the BEV with an occupancy rate of 20%. As of today, we do not know any numbers about the utilization of the Carsharing proposition. The setup of a Pedelecsharing is one of the next upcoming tasks within the project. We are currently working on the topics from chapter 2.1.2 to extend the user-group for the sharing propositions.

FleetFloating is a conceptual project. Our role within this project was to investigate and outline an electric mobility concept for the rural district *Ilm-Kreis*. First, we identified the potential stakeholders in the *Ilm-Kreis* according to chapter 2.1.1 and supported the setup of network structures that convene at the district's climate protection manager. During the project, we completed two surveys about the potentials of electric mobility in a sharing context, both car and pedelec, with employees of the rural district administration and employees of several companies located in an industrial park (Erfurter Kreuz) within the rural district. Based on the survey's results (n = 417), 66% of the respondents could imagine utilizing Carsharing in a pooling context. For the case of Pedelecs, the numbers are 25% (and 36% for utilizing a Pedelec in a recreational context) (Article in press). As soon as the employers would organize Carsharing as pooling, almost 80% would utilize the proposition. Additionally, [4] conducted that reservations towards the utilization of electric mobility are far smaller when people already gathered experience in the field of electric mobility. Both results disembogue in our conclusion to install trial operations for both sharing modes within the rural district, before setting up a pooling concept for the long haul. In both cases, we recommend anchor tenants for the sharing vehicles and an extension of the user groups to increase the operating efficiency. We expect a better operating efficiency for Carsharing concepts in rural districts due to the spatial parameters.

Fundamentally, shared mobility concepts "extend" local public transport and municipalities and governments should treat them in this way. Additionally, connector propositions to the utilization of public transport exist, e.g. rolling transport services (taxi-on-call, citizens' busses) and they add nicely, regardless of being an ICV or BEV, to public transport. The coupling of the promotion of the utilization of public transport with measures to enhance sharing (e.g. registered public transport users receive a few anytime minutes for sharing propositions) and with results of the other components of our model are highly recommended. On a final note, the consideration of promoting of electric mobility for certain industries or use-cases (e.g. freight transport in cities or taxis) is an important part as well.

2.1.5 Charging infrastructure

The goal of this component is the demand-actuated installation of public charging infrastructure within the municipality. Throughout several queries of our research projects, the respondents stated that constantly unutilized charging infrastructure is worst publicity for a municipality trying to develop electric mobility. In addition, the charging infrastructure's longevity is important for the success of a strategy formation for electric mobility. We present and utilize the "Elektromobile Quartierstypologie" for the positioning of charging infrastructure, combining aims like cost efficiency, multi-use case-scenarios, accessibility, visibility, scalability and approvability [2, 5, 6]

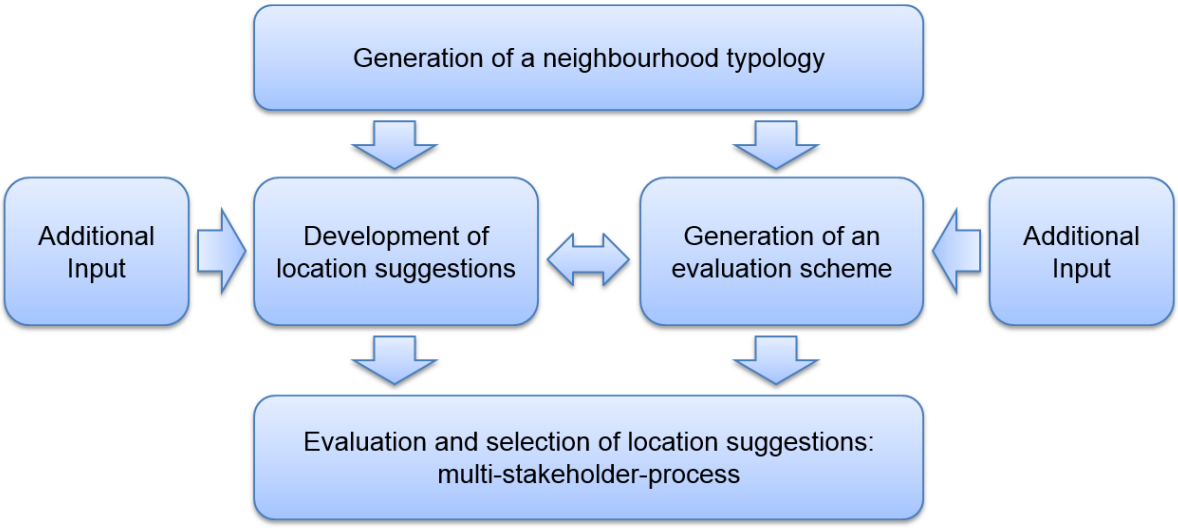

Figure 5: Scheme of the "Elektromobile Quartierstypologie" (own representation)

The scheme consists of four different parts, with two additional input parts, which are not essential for the overall success of the scheme (see Fig.5). Based on the results of the neighbourhood typology, we develop location suggestions for charging infrastructure. Simultaneously, we generate an evaluation scheme that comprises the criteria utilized for the location suggestions. The last step is the evaluation and selection of the location suggestions within a multi-stakeholder-process.

1. The neighbourhood typology enables an assessment of the potentials and requirements from electric mobility. We define four different neighbourhood types (classified on city block level) utilizing easy accessible variables e.g. the amount of residential housing in a city block, distance to the city centre and building capacity [2, 5, 6]. For each neighbourhood type we define raw values of required charging infrastructure (e.g. the need for public charging infrastructure in single-family houses neighbourhoods is slim, because of a relatively high number of private garages or parking areas having the potential for wallboxes or other private charging infrastructure)
2. The development of location suggestions consists of information like Points of Interests (POIs), extending the results of the neighbourhood typology. These POIs include e.g. hospitals or venues within the city. The chosen POIs correspond to the results of a survey asking the interviewed people about their preferred use-case scenarios where they could imagine utilizing a charging infrastructure [2]. Local stakeholders, e.g. from the coordinators of electric mobility within the municipality, might have additional input at this point.
3. The focal point of the evaluation scheme is the definition of the underlying criteria. In the EMiS-Project, the main aspect is the potential occupancy rate of the charging infrastructure. The occupancy rate varies based on the charging use-case scenarios for e.g. residents (charging at home), employees (charging at work) or visitors (charging at POIs). Additional criteria are the interference of public space due to charging infrastructure and the public visibility of potential locations.
4. The final evaluation and prioritization of the location suggestions takes place in a multi-stakeholder-process (s. Fig 2 for the relevant stakeholder). In this step, the implementation of local knowledge about certain location suggestions into the scheme takes place. Independently of their amount of input, all stakeholders welcomed the possibility to express their opinion about the location suggestions. The result of this step is the choice of location suggestions in the macro-level. The planning of the exact location in the micro-level will take place within the municipality and includes at least one on-site visit and addresses topics like e.g. the energy supply and civil engineering costs of the charging infrastructure, property ownership of the sophisticated location, and monument protection.

We utilized this scheme within the EMiS-project. The feedback from the stakeholders was positive, because of the inclusion of all relevant stakeholders for electric mobility overall, thus leading to a high acceptance for the designated location suggestions. Additionally, this concept makes discussions within the municipality

about location suggestions obsolete, which could be time-consuming. The utilization of this scheme within the municipality for other use-cases (e.g. when a private citizen applies for the installation of a charging station) is another advantage. Furthermore, this process leads to a comprehensible ranking of possible charging sites allowing the municipality to utilize the results as charging-infrastructure-planning guide for the near future. Disadvantages, however, are the overall time-consuming process with the participation of all stakeholders and city or traffic planning obstacles leading to obsolete location suggestions. Throughout the process, we will establish the stakeholder network for operational services of the charging infrastructure. In our case, the municipal utilities worked closely together with the municipal administration.

2.1.6 Municipal and commercial fleets

Electrifying municipal and commercial fleets requires different concepts and incentives, but the potential, on the short term in particular, is immense. It is easier to start with the electrification of the municipal fleet and thus lead by example and start with the user activation at the same time. The establishment of fleet management processes and the diversification of the fleets are important. Furthermore, we recommend the active incorporation of local companies to set up local boundary conditions for electric cars in commercial fleets and a basic framework for the exchange of experiences [4].

Both, Göppingen and Schwäbisch Gmünd, emphasize climate protection goals and the signal effect as an administration as their main reason to electrify their own fleets. The visibility of the electric cars in the city's daily life arouses curiosity in the local population. We recommend a consistent car wrapping for all municipal electric cars. On one hand, municipal employees might have reservations towards electric mobility. Their incorporation and their participation in workshops for the utilization of electric cars is important, because they will actually utilize the electric cars and play an active role in the success of electric mobility within the municipal and/or commercial fleets. On the other hand, as soon as the employees experience the advantages of electric cars, they are multipliers within the population as well. At start, it is important to identify one person willing to motivate the employees to utilize BEV opposed to an ICV for business trips, e.g. by taking them on test drives. Even though BEV have higher purchasing costs, their running charges are lower; thus, the relevant economic dependent variable is the annual mileage: the higher the annual mileage is the better is the BEV's profitability [2, 4]. From a climate protection point of view, the results of the EMiS-project show that BEV strongly contribute to climate protection when utilizing renewable energies [2], while grid power (German mix) leads to quite low overall emission reductions.

An additional option not yet implemented, is the establishment of a procurement policy within the municipality. The procurement office dares to solely purchase BEV, as long as no special use-case exists which a BEV cannot cover, thus leading to the purchase of an ICV. Leading by example, commercial companies can follow the lead of the municipality and the municipality can guide interested companies through the process of purchasing BEV for commercial fleets, e.g. with additional information for employees (see chapter 2.1.2).

In the FleetFloating project, we conducted surveys with employees in the *Ilm-Kreis* about their interest and the potential of electric shared mobility in commercial fleets (Article in press). During office hours, companies can utilize the electric cars as company vehicles. Employees can utilize them for their commuting ways and outside of office hours. The employees can imagine utilizing BEV in a commuting context, when they receive a guarantee for appropriate charging infrastructure at their respective workplaces.

The daily average utilization length of already existing carpooling within municipal and commercial fleets from our surveys amounts to 50km. Additionally, approximately 80% of the sample of our surveys have commuting distances shorter than 30km for one way – a distance easily covered by electric cars. The employees utilize mobility offerings on weekdays in particular. Thus, the provisioning of BEV or Pedelecs are an appropriate alternative to the utilization of a private car. Because, as mentioned above, the annual mileage is the relevant economic dependent variable for BEV compared to ICV, the employees with private cars, long commuting distances and the willingness to abandon their private cars, are the main target group for the utilization of electric mobility. Additionally, the higher the employees' commuting distance, the higher is the willingness to pay for electric (shared-) mobility. The most important requirements for electric shared mobility in commercial fleets are:

- Charging the BEV during office hours is sufficient, thus employees do not need to charge the BEV at home
- When employees have to charge the BEV at home, they want to receive compensation for charging costs. The charging costs are refundable by the companies, according to German law.
- Electric shared mobility needs to save the employees money

The potential for electric mobility in municipal and commercial fleets exists. At start, the investment will be higher for BEV compared to ICV. Over time, the operating efficiency of BEV will save money for the operators. As of today, BEV cover most of the use-case scenarios of municipal and commercial fleets.

3 Conclusion

The presented 6SEK-model has the potential to help municipalities reach their transport related sustainability goals utilizing electric mobility. Each component is comprehensible for all stakeholders. Additionally, it is possible to address only a few components of the model, even though some of the presented methods solely take full effect coupled with other components. The effectiveness of the model grows together with the amount of components utilized. The utilization of the 6SEK-model initially addresses the identification of potentials and the development of strategies for electric mobility within municipalities. The development of concrete steps takes place within stakeholder processes. After collecting all necessary data and finishing internal and external stakeholder processes, the implementation of concrete steps starts.

Currently, the authors are in the process of collecting the relevant stakeholder, decision processes, operator concepts, legal and fiscal implications for all presented components to derive a toolbox for small- and medium-sized municipalities getting started with electric mobility. The goal is to allow municipalities to choose from a wide range of individual measures for each component helping them addressing a certain task regarding electric mobility. The identification of indispensable measures from each component is part of the toolbox.

We recommend the development of an overall strategy for the breakthrough of electric mobility in municipalities before utilizing tailored measures for each municipality to encourage actively the transition towards a more sustainable mobility. Germany requires urban mobility concepts for municipalities because they have the potential to help reaching the one-million-goal of electric cars by 2020 in Germany. The presented 6SEK-model addresses this task.

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