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How to increase the charging network for EV drivers? A Community-based Charging solution for EV drivers.

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Summary

One of the biggest issues of EV roll-out and mass-adoption for EV drivers is the limited availability of a large charging network when traveling. This paper outlines the key results and feedback of an online survey contacted in 2016 by the author about the idea and concept of using private charging stations from EV drivers at home for public use. Based on the results of the survey, the second part of the paper will present an innovative approach of a community-based model to increase the charging network for EV drivers.

Keywords: digitalization, intelligent, IoT, smart charging, smart grid

1 The Challenges

The vehicle of the future will be connected, electric and offer autonomous driving features. Important to mention is the fact that the EV needs to be charged with renewable energy and be integrated with the Smart Home and Smart Grid. Another important requirement for mass-adoption of EVs is the charging network available for end-users, EV drivers. One of the biggest issues of EV rollout and mass-adoption for EV drivers is the limited availability of a large charging network when traveling. In large cities, there is already a very dense charging network installed or being planned or built within the next years. However, in urban areas and towns there are very limited possibilities for re-charging when traveling abroad.

Nearly 85% of charging events in Germany are be performed by EV drivers in residential areas, such at home or at work [1]. Based on this fact the idea and concept of using private charging stations from EV drivers at home for public use arise and has been investigated by an online survey. The next chapter will outline the market trends and key results with feedback from the online survey contacted in 2016 by the author.

1.1 Market Trends

Various market trends support and promote the development of an integrated and innovative eCharge solution to expand the public charging stations network.

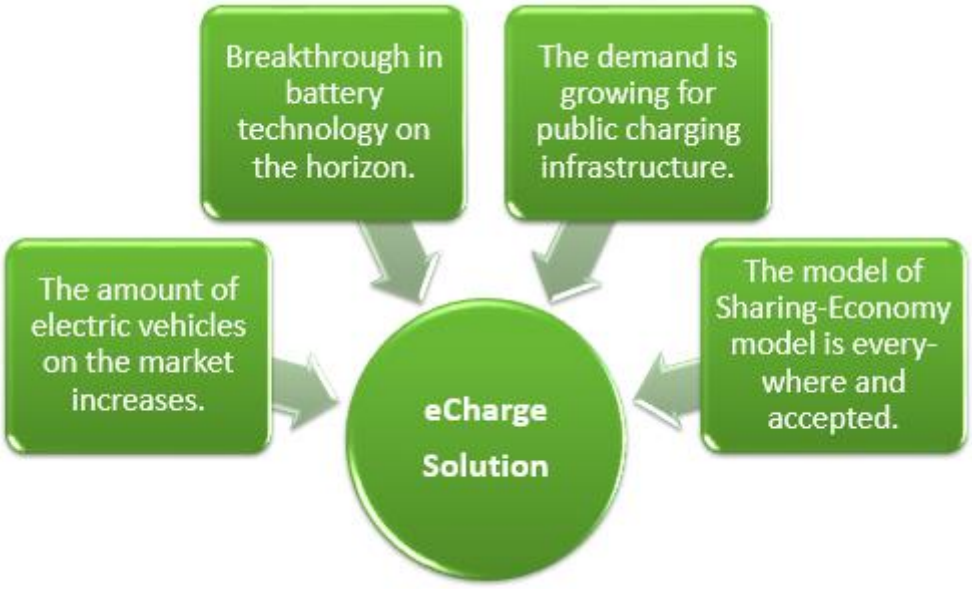

Figure 1: Market Trends

2 Survey about public use of private charging stations

An online survey was contacted end of 2016 with the goal to investigate and analyse the idea of using private charging stations for public use. Potential concerns from EV drivers where asked and the feedback collected.

The survey's purpose was to analyse the general attitude of users towards electromobility and the necessity of a charging infrastructure going along with. This survey is the framework for a paper written for the Cooperative State University Stuttgart (DHBW) and occurred in collaboration with IBM. The focus was to extract the attitude towards a charging infrastructure consisting of private suppliers. Moreover, the survey examined the general attitude towards an eCharge-Community model and furthermore, which requirements of usability are set and expected by the participants.

The key questions and results of the online survey included:

1. Duration of the survey – 3 months: From October to December 2016
2. Number participants of the online survey – 204 in Germany
3. Participants distribution – Age, Gender
4. Living environment – Home, apartments, flat, others
5. Home, apartment and parking – Ownership
6. General opinion about eMobility and EVs
7. Which mode of driving (electric, plug-in-electric, gas, combustion, others) will they consider in the future?
8. EV ownership – Yes, no, purchase planned
9. How do participants rate the available charging infrastructure?
10. Under which conditions they would buy an EV?
11. Where do the participants see the main problems of eMobility?
12. How satisfied are participants with their EVs?
13. What is the main feature they like most of their EV?
14. Besides the EV they own, do they own another vehicle?
15. Do the participants have already a "private" charging station at home?
16. Do they share their private charging stations already with others?
17. Under which conditions EV driver would share their private charging station with others?
18. Would EV drivers like the concept of sharing and using private charging stations with others?

19. What would be the main obstacles for EV drivers to share their charging station?
20. What kind of business model for an eCharge solution they would prefer to use?
21. What cost elements the price for using private charging stations should include?
22. What should be the key features of such a eCharge solution include?
23. Which kind of financial incentive an eCharge solution should include?

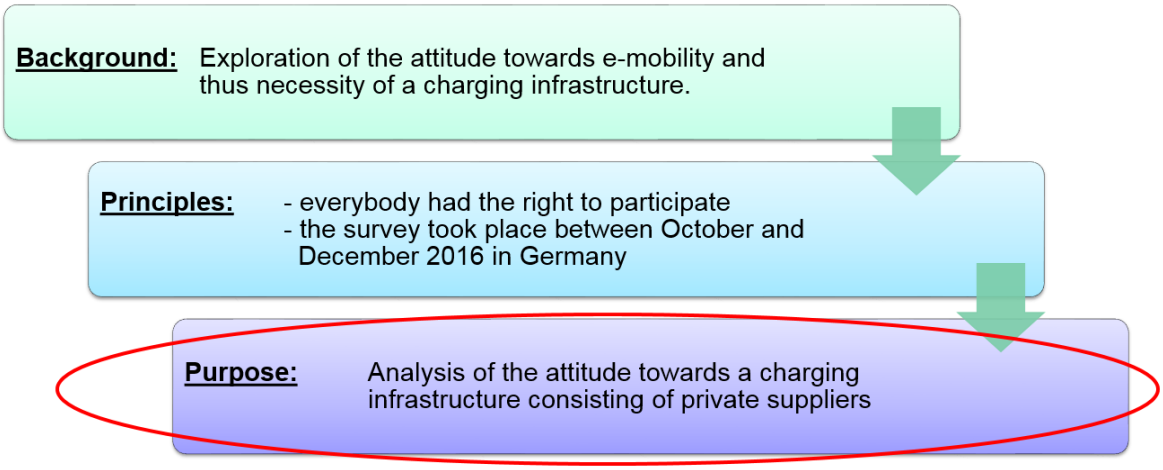

Figure 2 Background and purpose of the survey

2.1 General survey findings

The underlying survey regarding the attitude towards electromobility and thus the necessity of a good charging infrastructure allows to draw conclusions how further approaches should look like to make electromobility more attractive and more comfortable soon.

In principle, a positive attitude towards electromobility is prevalent. Remarkable is, especially, that 46% of the participants intend to purchase an electric vehicle and 33% already own an electric car, either hybrid, fuel cell or battery-powered.

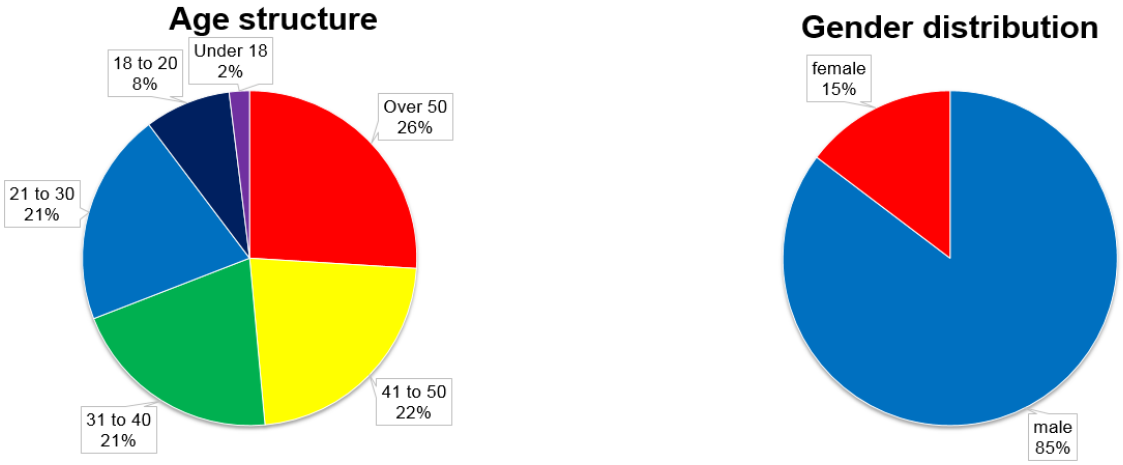

Figure 3: Age structure and gender distribution

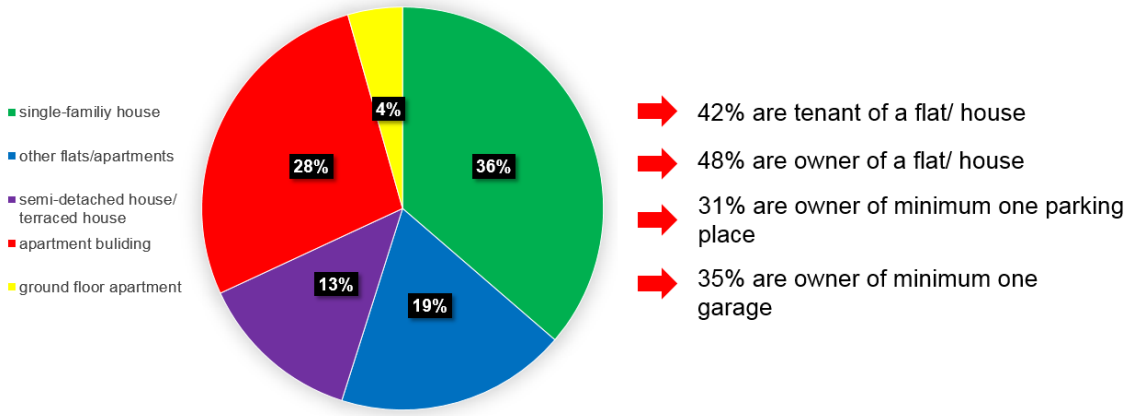

Figure 4: Housing situation

The share of participants who own an electric vehicle now or owned one in the past, however, is compared with official using figures, proportionally high.

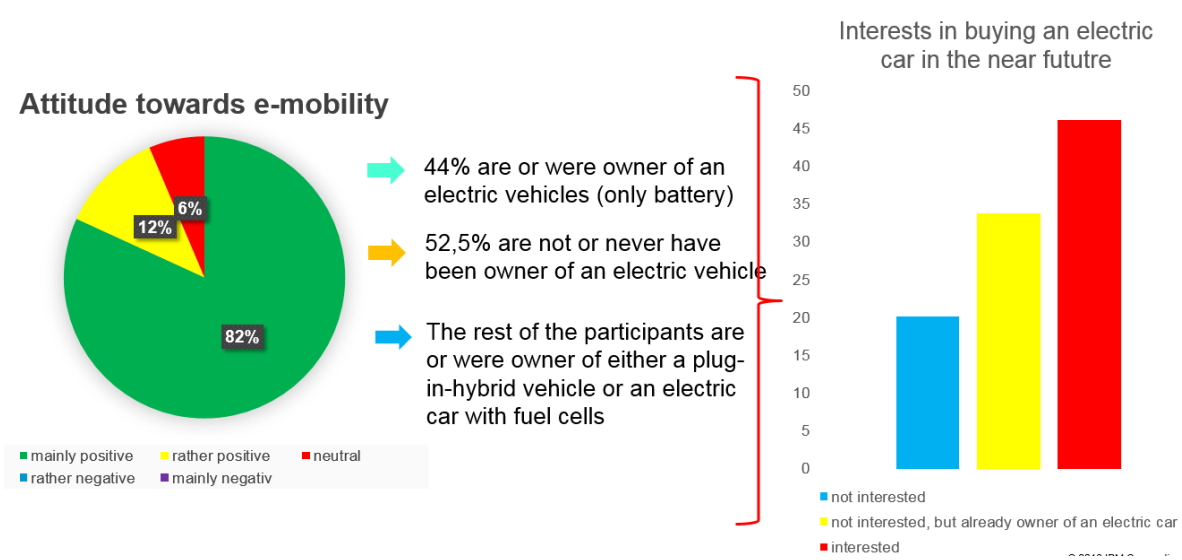

Figure 5: Attitude towards electromobility

Nevertheless, the battery-powered locomotion is traded as the automotive drive form of the future. This point of view is shared by 80% of the participants, in other words, not only those who are interested in purchasing an electric vehicle soon, but also with approximately 1/3 those who are part of the "not interested in buying such a vehicle" group. Consequently, a scepticism towards the dependence on fossil fuel, as well as the need for action in environment and resource protection exists. These points were positive properties of electromobility, independent from the attitude towards the interest in purchasing such a vehicle.

The survey, however, has also shown the deficits of this new technology. The low and insufficient battery capacity, as well as the lack of charging stations and a wide-ranging charging infrastructure are disadvantages of electromobility compared with combustion engines. Here, urgent need of action is necessary to maintain the positive basic attitude on the one hand and specially to increase the interest in purchasing an electric car on the other hand.

	Not interested in purchasing an e-car	Interested in acquiring an e-car	Already owner of an e-car
Main advantage of e-mobility	✖	- Environmental protection (41,5%)	- Independence of fossil fuel(40%)
Main problem of e-mobility	- Insufficient battery capacity(44%) - Lack of charging stations/ infrastructure(24,4%)	- Lack of charging stations/ infrastructure(39%) - Insufficient battery capacity(21%)	- Lack of charging stations/ infrastructure(52%)
Drive technology of cars in the future	- Battery (34,1%) - Hybrid-drive (29,3%)	- Battery (80%)	✖
Valuation of the charging infrastructure(1-10*)	Between 2 and 4 (totally 61%)	Mainly 3 and 4 (totally 43,6%)	Mainly 3 and 4 (totally 40,5%)
Valuation of the amount of charging stations(1-10)**	Between 2 and 4 (totally73%)	Between 2 and 5 (totally 78,6%)	Mainly 3 (30,4 %)

*here 10 is the highest and 1 the lowest possible valuation

➡ 55% own an electric car **and** a combustion engine

Figure 6: Valuation of electromobility

2.2 Evaluation of the solution approach: Sharing private charging stations

One solution approach to improve the charging infrastructure could be the introduction of a network consisting of private charging station providers. The survey shows that 82% of the participants would welcome such a network and that more than 64% would generally agree to share their private charging station. However, the survey did not differ between participants with an electric vehicle and those without. This approach, nevertheless, has potential and could be promoted by further incentives, for instance through payments and other financial support or through additional features.

*the given percentages refer to all participants, irrespectively whether they are in possession of an electric vehicle or not

Figure 7: General attitude towards a private charging station network

Financial incentives could be government support or benefits on the one hand and user fees on the other hand. Additional features that improve the customer's and supplier's benefit might be apps which simplify the payment process, have integrated maps that show free charging stations and offer further comfort.

The evaluation result can be categorized into five dimensions: structure and kind of payment system, reliability, availability, simplicity of the services and additional features.

Many of the participants hopes for a transparent and fair billing system that is standardized and accessible everywhere. The payment process should be implementable through established services like credit card, EC card, PayPal or online banking.

Reliability has a high importance to the respondents. That, consequently means that the members of such a community model would like to rely on its functionality and actuality.

Besides the previous points, availability has an enormous primacy caused by the demand for a well-developed and structured charging network in both nationwide and pan-European and which additionally is always and without any restrictions available and usable. Moreover, the participants ask for a comprehensive supply in urban and especially in rural areas.

Furthermore, the simplicity of the usability has a high priority caused by the fact that an eCharge-Community should be clearly includable into the everyday life without causing any application-oriented or technical problems or challenges.

Finally, requests for additional features integrated in an app were identifiable. This app may imply further information concerning the charging station, the kind of plugs or the location. Data security, however, has the absolute priority.

Given the fact that this part of the survey dealt with the general attitude towards an eCharge-Community, however also critical voices were raised. Some respondents do not understand the holistic advantage. In their opinion offering private charging stations against payments is a commercial activity which must be taxed. Therefore, critics point to the possibility of intentional tax evasion what could establish an increasingly negative response of electromobility.

Moreover, another critical point is that the private charging network is inevitable a competitor of established energy suppliers. Therefore, the expansion of the charging infrastructure through those suppliers is inhibited because in their opinion there is no necessity of investing in an own network.

3 The eCharge Solution

The motivation of an eCharge solution (charge sharing) is primarily to expand the public charging network by including private charging stations is outlined in the following figure.

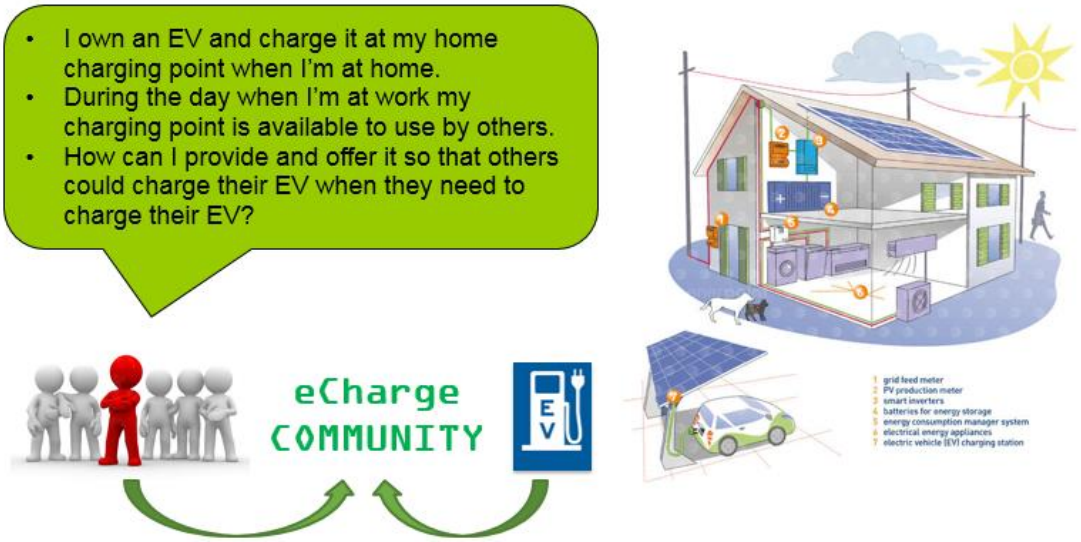

Figure 8: Motivation for eCharge-Community members

The persona of an eCharge-Community member includes:

1. He likes the "community" idea: From „eMobilist" to „eMobilist" („Birds of a Feather")
2. He wants his private charging station offer others for public use.
3. He wants to use private charging stations from other eCharge community member when traveling.
4. He does not have any private charging station, but wants to use private charging station of other EV owners.
5. He prefers to see the live status of charging stations (available, in-use).
6. He requires easy to use payment solution (no extra registration, ad-hoc).
7. He likes to make a reservation request for private charging stations in case „availability" could be an issue while traveling.

This concept is like the project launched in Sweden 2016 by Renault [3]. However, in addition to the ElBnB solution by Renault there are more key important features included which are outlined in the figure on the next page. It includes:

1. Easy to use payment solution
2. Online charging station status (available, in-use, unknown)
3. Smart Home features, such as: PV integration, energy management, etc
4. Smart Grid features, such as: Smart Charging, Energy market integration, etc.

In summary, the eCharge solution of expanding the charging network by private charging stations for public use will increase the possibility to charge in urban areas where there are very limited possibilities today for re-charging when traveling abroad.

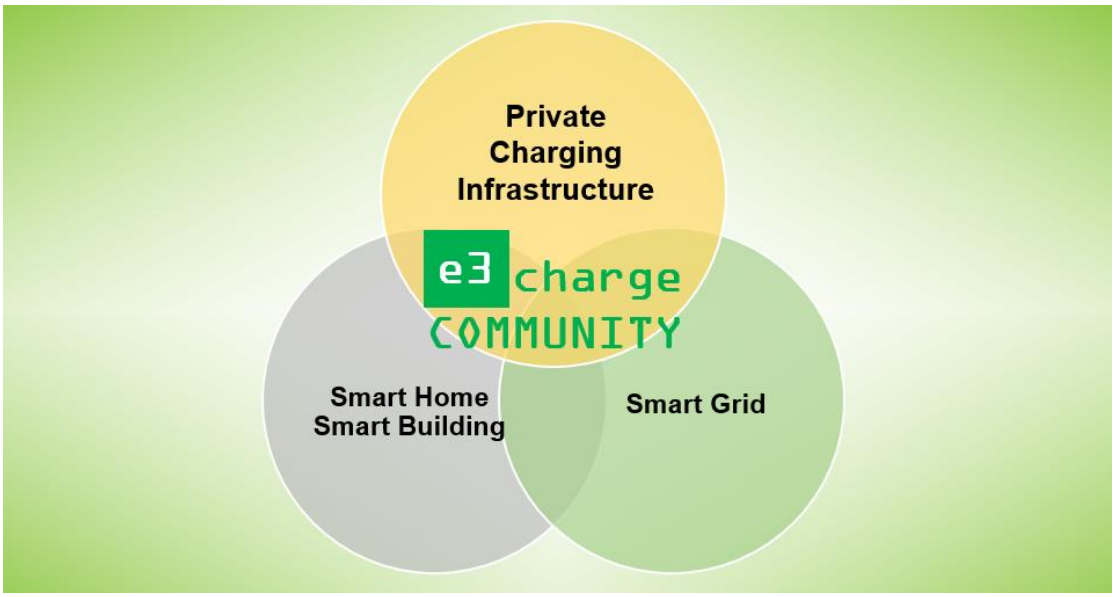

Figure 9: eCharge-Community Features

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[2] German National Platform for Electric Mobility (NPE): Charging Infrastructure for Electric Vehicles in Germany 2015 http://nationale-plattform-elektromobilitaet.de/en/the-npe/publications/

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Authors

Volker Fricke works at IBM Germany as Technical Relations Executive, Europe. He represents IBM in international and national standardization bodies, such as ISO, W3C, DIN, DKE in the domain of „Connected Vehicle, eMobility and Co-operative Intelligent Transport Systems (C-ITS) for autonomous vehicles. He leads IBM involvement in European Horizon 2020 research projects in the domain of electric and green vehicles. He was the Lead IT Architect from IBM in the European Research project „Green eMotion“ and he is the technical lead for the “Green Vehicle” NeMo EU project. He holds various patents and publications in the domain of Internet-Of-Things together with other IBM colleagues. He is contributing and participating at conferences about “Connected Vehicle”.

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