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MONITORING THE SET UP AND USE OF ELECTRIC CARS AND CHARGING POINTS IN SZEGED

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Abstract: In our wider and narrower environment, due to the significant developments in the automotive industry, increasing attention is trending towards electric powered vehicles. Trams and trolley buses have been running in Szeged for many decades, and recent years in self–propelling version. At the same time the population's buying activity of electric powered cars is increasing, which on the one hand causes favorable environmental effects in the city, however it sets out new challenges to promote their decent operation. Does it mean changing or complementing traditional filling points or creating a totally new system of energy supply? With our survey we will measure the population's knowledge of this, we will ask their opinion and we will search answers to the emerging challenge. Our investigation is a part of a project (H2020) run for several years, which is to reveal opportunities for public transport and personal transport to become electric.
Keywords: electric cars, electric charging, Szeged, environment protection

INTRODUCTION

The University of Szeged, Faculty of Engineering (together with the Szeged Transport Company) participate in a HORIZON2020 tender called „ELIPTIC" (Electrification of Public Transport in Cities) research–development project, which started on 1 June 2015 and ends on 31 May 2018.

The tender programme has the object to test the battery–driven trolley buses in battery mode and to extend the trolley bus lines of trolley–wire without configuration, taking advantage of the possibility of self–propelling mode. With the use of self–propelling, namely both trolley–wire and battery–driven trolley buses more districts of Szeged can be covered, where cannot get by public transport at night. (1) For the self–propelling mode in Szeged Transport Company's 13 IKARUS–SKODA type trolley buses 575 kg weight Li–based batteries provide the energy, which charge up on the trolley–wire section, but when braking they are able to save the kinetic energy, so the vehicle's propellant consumption decreases. (2)

The driving and braking of the trolley buses are insured by a 248 kW (337 horsepower) asynchronous electric motor. The modern drive system transforms the 600V direct current trolley–wire voltage for the electric motor into triphase alternating current and it charges the direct current batteries. The self–propelling mode – among others – made the spectacular use of 'overhead connectors' necessary for automatic connection of pantographs (to the trolley–wire), which were applied succesfully and for the first time in the Szeged network.

The driver can control the disconnection of the pneumaticly operated pantographs with the press of a button (at the end of the trolley–wire section), after that the pantograph will be pulled down and fixed in a few seconds.

The batteries need one hour to be fully recharged and the vehicles can go in battery mode more than 7 km at full weight. However, the trolley buses could reach the double of this distance in an optimum case. The average consumption of trolley buses is 200 – 250 kWh/100km, which greatly depends on the demand of heating and air conditioning. This number is significantly more favourable for diesel buses (The diesel fuel costs are 30–40% of the electric cost). The modern trolley buses with lower propellant consumption produce less noise pollution than diesel buses, and they naturally do not encumber the urban air with harmful emissions. The 13 IKARUS–SKODA self–propelling trolley buses will redeem the burning of 400,000 liters of gasoline in the city in one year, so this will significantly contribute to clean air, and through this keeping our health. (3)

One of the main aims of the Eliptic project is to explore what kind of extra services the hybrid trolleybuses can provide in Szeged, and how they can contribute sustainable public transport, thereby shaping and developing the attitude of the population in this area.

Connected to the application's topic,with our survey we measured what the population know about electric vehicles and the filling points, asked their opinion, and searched for an answer to the reveled challeges.

In September 2017 University of Szeged, Faculty of Engineering cooperated with university's students and they did the questionnaire survey among the population. The survey's aim was to explore the travel habits, as well as the general awareness and expectations about electric cars and filling points, furthermore the experiences, and the public support of electric transport.

To sum up, the most important influential factors in the use of electric vehicles according to theoretical research:

» Demographic attributes: (4), (5)
  — sex,
  — age,
  — place of residence.
  — number of vehicles per haushold.
» Traffic attributes:
  — number of vehicles per haushold,
  — average daily distance,
  — proportion of long distance travel,
  — parking attributes.
» Service attributes:
  — range of available services,
  — wait–in–line time.

QUESTIONNAIRE SURVEY METHOD

We did a personal questionnaire survey during our research to explore the habits of current and potential, in the future electric car users in connection with traffic and charging, demands and preferences related to electro–mobility.
The current vehicles users and the potential electric car customers belong to the questionnaire's focus group.
Questions of the questionnaire covered the following topics (7):

  — Personal data (sex, age, place of residence).
  — Current vehicle traffic customs.
  — Willingness to buy electric cars.
  — Charging requirements (e.g.: services, charging time).

The designation of the topics was made based on the international and national professional literature and the own experience. We asked 20 questions in the questionnaire, because the reliability of the answers probably deteriorates over 25 questions [6]. 311 people (182 men and 129 women) participated in the questionnaire survey, and the survey was done in a shopping mall in Szeged. The questions included simple choice questions with two or multiple possibilities and the respondents could give answers evaluable on a scale. Apart from closed questions, open questions assured additional useful rematch.

DATA PROCESSING BASED ON QUESTIONNAIRE

The great majority of responders are middle–aged, graduated (48%) living in shire–towns.
Among vehicle usage habits the first to be asked in the survey was a car usage (Diagram 1).
Predominantly (72%) of the responders used car for daily commuting (at most 10 km) while (26%) used it for commuting (at most 100 km) and only a few times yearly they cover more than 600 km daily .
Following this we wanted to know how much kilometers do the motorists cover on daily basis.
Based on this survey 31% of the responders cover only a few times more than 150 kilometers daily on yearly bases, 29% of them cover this range only a few times monthly respectively while 2% of them cover this range daily.

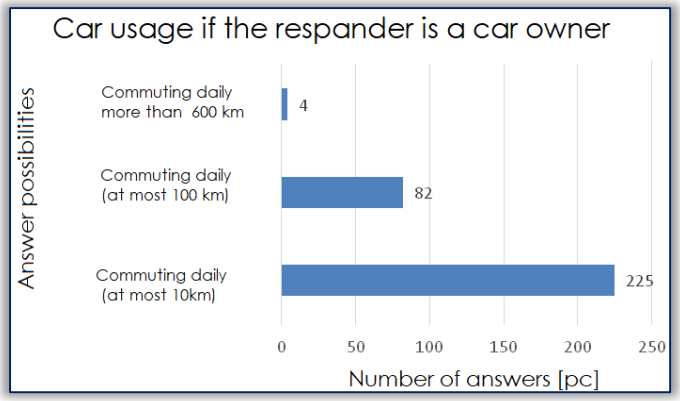

Diagram 1: Car usage habits
Source: Eliptic according to survey, 2017

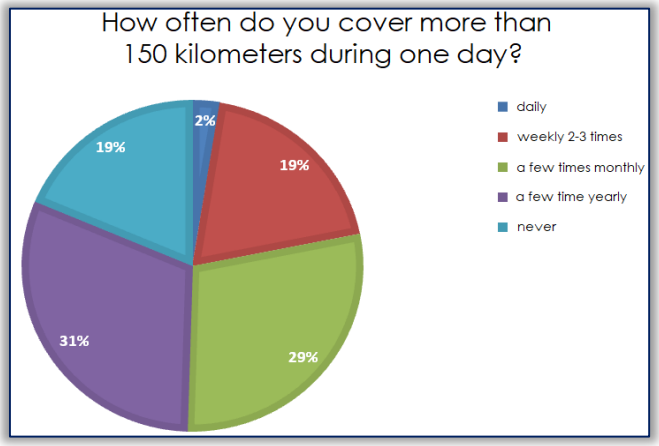

Diagram 2: Daily covered ranges
Source: Eliptic according to survey, 2017

In diagram 3 we were interested in consumer awareness of different engine propellants.
A bit unexpectedly the responders are better informed of electric propellant (90%) than biodiesel (73%), bioethanol (50%) respectively, or the LPG (63%), CNG (42%) respectively.

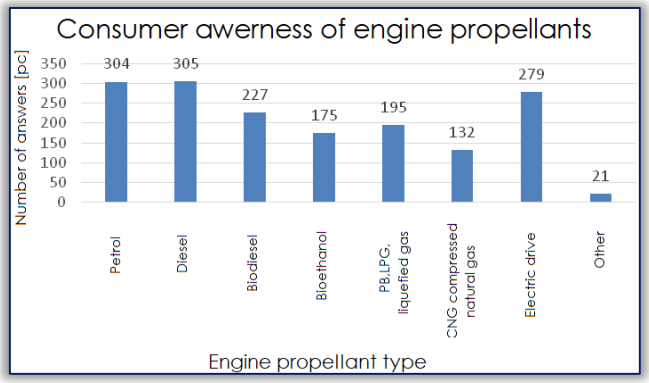

Diagram 3: Consumer awerness of certain engine propellants
Source: Eliptic according to survey, 2017

Following this in our survey in diagram 4 we were curious about consumer awareness of certain electric car brands. It is not a mere coincidence that the most well–known electric car brand is Tesla (34%), followed by Japanese brands such as Nissan (20%), Toyota (17%), Lexus (8%) and then the German brands BMW (28%), VW (9%), Mercedes Benz (4%) according to our survey.

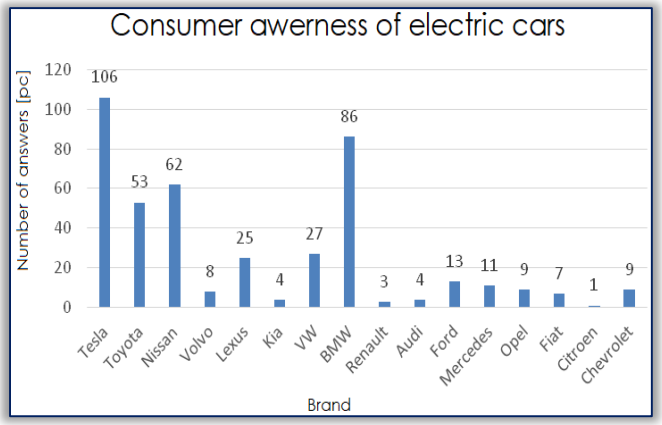

Diagram 4: Consumer awerness of electric car brands
Source: Eliptic according to survey, 2017

In diagram 5 you can see the driving possibilities of electric cars. The great majority of people taking part of in our survey (63%) have never driven an electric car, however, the participants would be glad to do so, while (18%) rules out such a possibilities. Among those who have already driven an electric car (20%) there are four times more participants who liked it than those who did not.

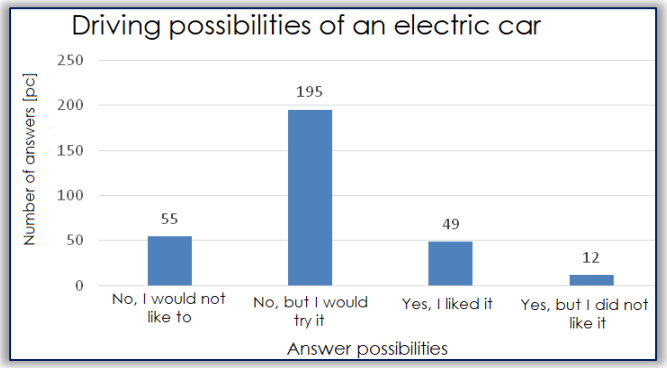

Diagram 5: Driving possibilities of an electric car
Source: Eliptic according to survey, 2017

In our survey we asked the participants of their willingness to buy an electric car. Predominantly the participants do not intend to buy an electric car within three years and majority of them (47%) is willing to pay for an electric car at most 4 million Forints. (Diagram 6) According to this they would rather buy an used electric car than buy a new one. In connection with this, a question may come up if the potential buyers are aware of the necessary service cost that can be rather high. It is to be noticed that the brand new, purely electric car is some 3 million Forints more expensive than a traditional principal based car, having the same technical parameters.

Nowadays, among electric cars we can find more types that are capable of covering 250 kilometers with a single charge but the range of above 150 kilometers can be regarded as usual. At the same time the range depends on the car load, nature of usage, speed and weather conditions. According to diagram 7 the half of the interviewed people expected an average range of 150–200 that is in consonance with range of today's purely electric cars.

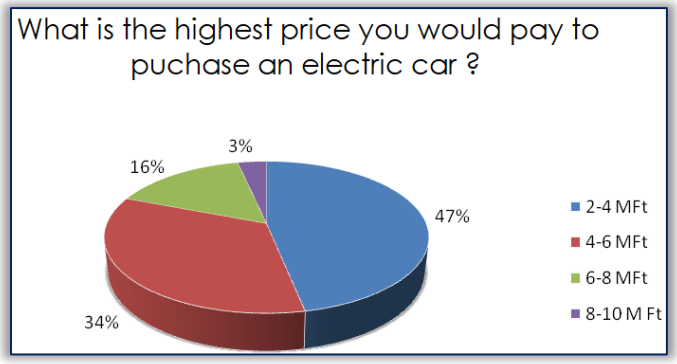

Diagram 6: The willingness of buying an electric car
Source: Eliptic according to survey, 2017

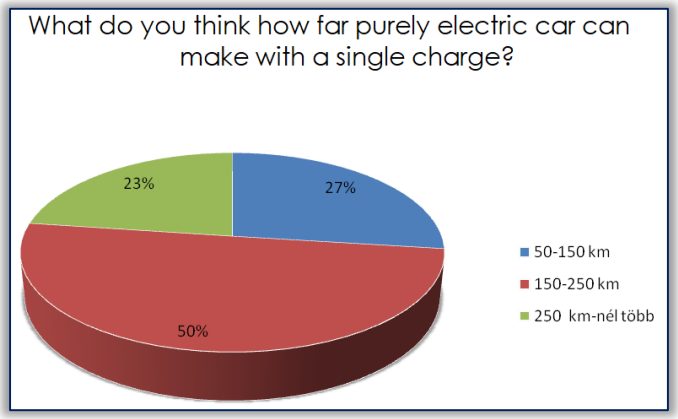

Diagram 7: Range of electric car
Source: Eliptic according to survey, 2017

In our study we regarded as a focal point to ask opinions about installation of electric car recharging pionts, recharging frequency and time.

According to academic literature, users of electric cars predominantely recharge the vehicles at their workplace and park and ride lots and petrol stations. However, recharging points at deparment stores, at public officies and stations' parking lots, as well. (8)(9)

The great majority of interviewed people regards useful installation of the recharging points in the vicinity of the following places: petrol stations (31%), deparmtent stroes, farmers market (25%), park and ride lots (13%) and around stations and turistical destinations, respectively.

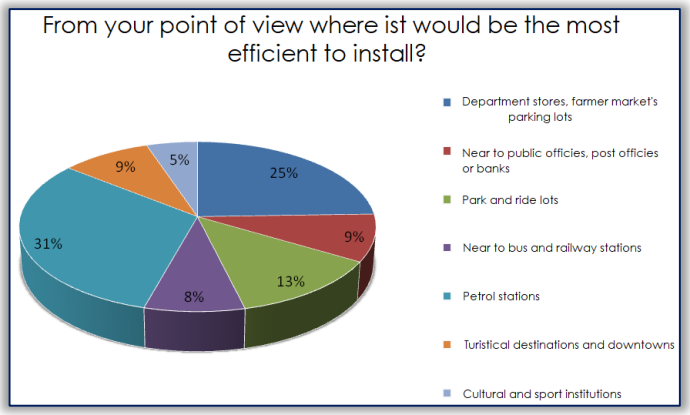

Diagram 8: Possible locations of charge points installment
Source: Eliptic according to survey, 2017

Nowadays the fast charger output is usually 60 kW and in the near future the expected output is 150 kw or even more rapid fast chargers are to be expected. Owing to this fact the recharging time is expected to be reduced, however, this is to be balanced by the even growing capacity of the batteries. It becomes important that the services during recharging time should fit the daily routine activities. In our country an electric vehicle is usually 2.57 times recharged on daily basis. This fits with foreign observations according to which vehicle is being recharged on driver occasions but with shorter intervals. As you can see on diagram 9 according to our survey 51% of the interviewed people use once the charge points while 30% of them used them four times a week.

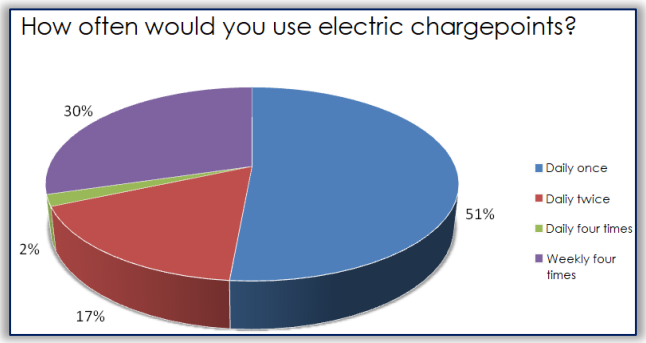

Diagram 9: Usage frequency of charge points
Source: Eliptic according to survey, 2017

We also asked the operators how much time they would spend recharging their electric cars at a petrol station besides a motorway. According to diagram 10, 52% of the interviewed would spend 15 minutes, 27% of them would spend 5 minutes recharging their cars.

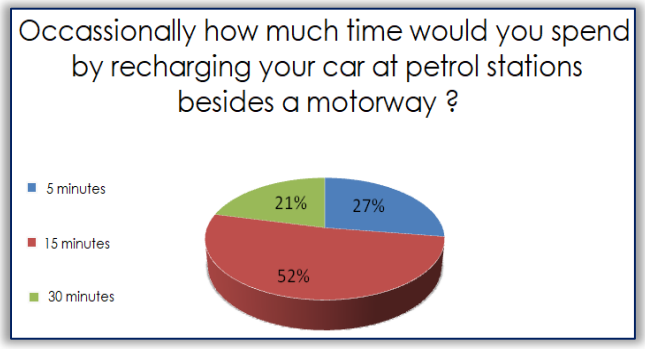

Diagram 10. Charging time willingness
Source: Eliptic according to survey, 2017

In the questionnaire we sought answer to that electric car owners use those for what distance on a daily basis.

As seen on the 11th diagram, the answers state that the users big portion (50%) uses it for a maximum distance of 25 km, 30% of them uses it for 25–50km and only 2% of the respondent uses it for more than 100 km in a day.

Henceforward the respondents could give an answer to that for them, how important is Szeged's air purity? Based on the processing of the 12th diagram, Szeged's population finds it very important (68%) and important (20%) securing the purity of Szeged's air. Naturally we have to place this air pollution issue in a complex social problem circle.

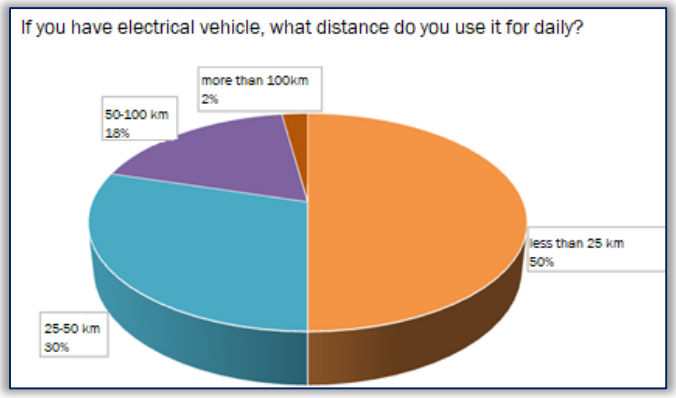

Diagram 11. Electric car daily average range
Source: Based on ELIPTIC survey, 2017

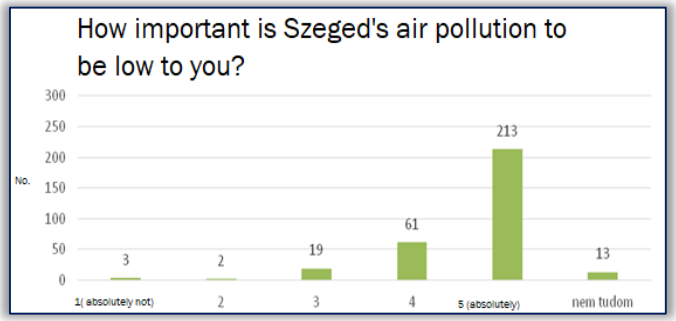

Diagram 12. The importance of air pollution in Szeged
Source: Based on the ELIPTIC questionnaire, 2017

On the apropos of the 13th diagram we asked that the respondents on what degree they agree on planting more charger points. Processing the answers it is clear that comprehensively (87%) they support the expansion of the charger network.

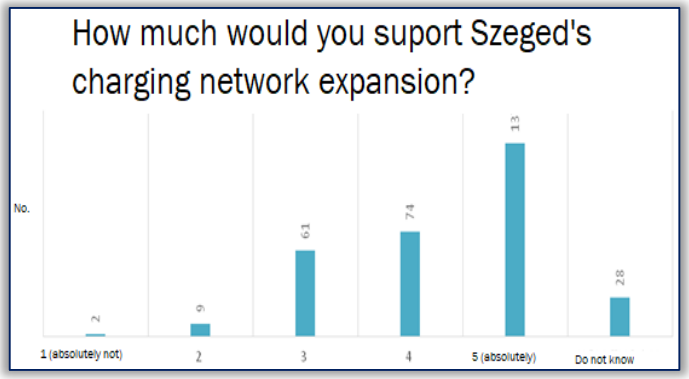

Diagram 13. Charging network expansion support
Source: Based on the ELIPTIC questionnaire, 2017

Nowadays there is a significant number of news and programme attends with the expansion of the electric vehicular instruments and attendant units which enjoy governmental priority. Following this we also asked about that according to the respondents what factors would advance the growth of the number of e–vehicles in our country. (Diagram 14) The answers suggest that they think financially supporting it more (70%), with expanding the charging network significantly (48%) and by expanding the user allowance (31%) the domestic e–driving spreading would be feasible.

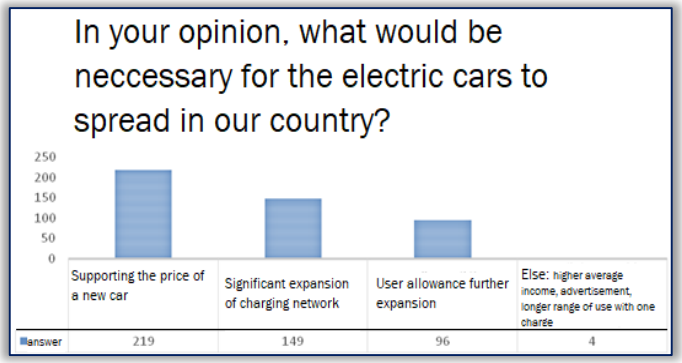

Diagram 14. Electric vehicles spreading conditions
Based on the ELIPTIC questionnaire, 2017

SUMMARY

Szeged's community traffic's examination in the context of ELIPTIC project comes with several staged questionnaire. During the first stage, in 2015 October 10th, in stations and sometimes in vehicles with a 465 participant sample. After a fast evaluation a targeted passenger group examination was configured, where based on experiences the questions were swapped or modified. From the present questionnaire survey's lessons the question group regarding passenger comfort should be highlighted, which can be interpreted for the whole network. Especially important that how much a modern Ikarus–Skoda trolleybus is a present in the passenger, citizen's minds, common sense that is, with all the externals in consideration of environmental protection. Instructive survey outcomes were achieved, which gives an adequate base for further examinations.

Present questionnaire's goal was investigating the travelling habits as well as the general currency and expectations of electric driving and charging points, the ventilation of incidental experiences, and with the estimation of social support of electric travelling.

Examining the travelling habits it can be established that for most of the surveyed, using the electric vehicles could be a real alternative. However, the majority of the respondents are not considering buying new electric vehicles in the near future because of the relatively low range, the few charging points and the high purchase price.

Because of the significant price differential between the new traditional and electric cars, it is more expected that the demand for used hybrid electric cars will grow first and only after that will the demand for purely electric cars grow, since the problem of short range only affects these.

Based on the expected frequency of charging, the most valuable charging points are the gas stations next to highways, supermarkets, market parking's and the P+R parking.

Based on the processing of the answers Szeged's population finds it very important or important protecting the purity of air, and expansively supports the expansion of the charging network in the city.

The study also highlighted that supporting more the price of a new electric car, the relevant expansion of the charging network and the further growth of user discounts, the number of potential buyers of electric cars.

Acknowledgement

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