THE FUTURE CHALLENGES FOR ELECTRIC PASSENGER CARS

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Motivation

Electric vehicles are currently seen as a main alternative technology to conventional internal combustion engine vehicles powered by fossil fuels. They have many advantages in comparison to conventional vehicles, e.g., higher energy efficiency, lower noise and pollution level. Due to the fact that battery electric vehicles do not have emissions at the point of use, they are widely supported by different policy measures and targets such as the Sustainable and Smart Mobility Strategy, according to which all vehicles on the European roads should be zero-emission vehicles by 2050. The ban of conventional cars is already announced by many governments. In addition, especially during the COVID crisis, very generous supporting measures are provided to accelerate adoption of electric vehicles. Due to broad portfolio of provided measures the number of electric vehicles is continuously increasing, especially in the last five years. However, with the increasing number of electric vehicles, also some new challenges are becoming more visible.

The core objective of this work is to analyze and evaluate recent developments in the transport sector with the major focus on battery electric vehicles in the EU. Of special interest is sustainability of supply chains as well as development of vehicle size and mobility costs.

Method of approach

Based on the literature research and data collection, an economic analysis of the battery electric vehicles is conducted considering different car size categories, different electricity mixes as well as costs for slow and fast charging. This analysis includes investment costs (IC) of vehicles, corresponding operating and maintenance costs ($C_{O\&M}$), specific number of kilometres driven per car per year (skm), the energy/electricity price (P_f), and specific energy consumption (FI). The formal economic analysis starts with the calculation of the total driving costs (C_{drive}) per for different size segments of electric vehicles:

$$C_{drive_i} = IC_i\alpha + P_f FI_i skm + C_{O\&M_i} \quad [€/car/year] \qquad (1)$$

i…car category

In addition, existing policies are evaluated and recommendation for the future more sustainable development are derived.

Results

As shown in Fig. 1, currently largest number of available electric vehicle models are in category large cars and SUV. The increasing size of vehicles is usually related to longer driving range but also to higher energy consumption as well as higher total driving costs. Moreover, the production of such cars is consuming more energy as well as larger amount of different materials including e.g., lithium and cobalt.

Currently, majority of electric vehicles is charged using slow charging points. However, there are plans to extend charging network and to have also fast charging points especially at the highways. Figure 2 shows total mobility costs for two different charging options: car charging at home as well as car charging using publicly available fast charging points. It can be noticed that the total costs of mobility based on the use of fast charging points is about four time higher in comparison to slow home charging points. Investment cost of electric vehicles are increasing with the battery size and corresponding driving range. Moreover, large battery capacity led to increasing use of raw materials as well as consequently to some environmental and social problems.

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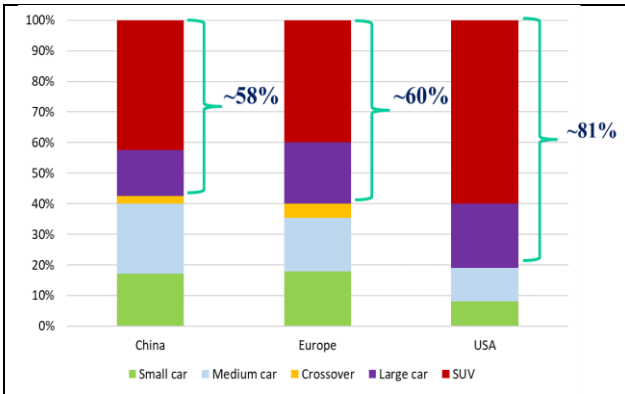

Fig. 1. Available electric vehicle models by vehicle segments in China, the EU and US [1]

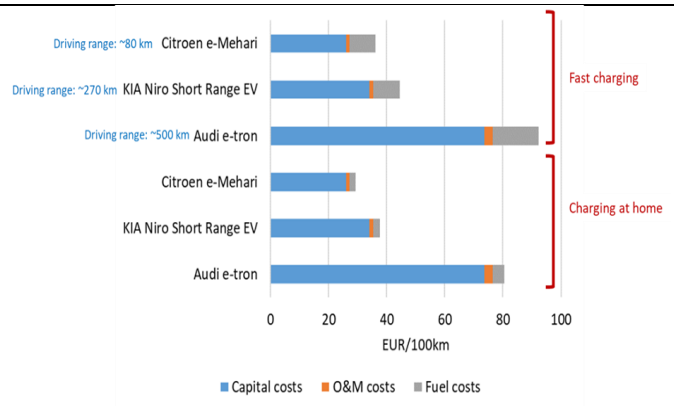

Fig. 2. Total driving costs of selected electric vehicles (Assumption: 15000 km driven per year)

Conclusions

To make electric vehicles competitive with conventional cars it is important to have similar mobility performance as well as similar mobility costs. Currently, electric vehicles have a shorter driving range and/or higher purchase price. Mostly affordable are small electric vehicles which have a short driving range. They are suitable mostly for daily use in urban areas, which should be finally replaced with electrified public transport or active mobility.

The increasing size of electric vehicles is an additional challenge, since there is still huge uncertainty about negative environmental impact of raw material mining which a needed for battery production as well as regarding the environmental impact of battery recycling. However, battery performances are improving and also new battery chemistries could be expected in the future. Currently, electric vehicles are still less convenient for use in comparison to conventional cars, especially in the view on charging time and availability of charging infrastructure.

In the future, electric vehicles could play a significant role in the transport sector. However, major challenges are (i) to implement proper mix of stabile and sustainable supporting policy measures for electric vehicles considering their full environmental benefits through the whole supply chain, (ii) to improve battery performance and reduce their costs, (iii) to limit supporting measure to smaller and medium electric vehicles as well as to car fleets and public transport and (iv) to ensure that the electricity used in electric vehicles is coming from renewable energy sources.

Referenzen

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