15. Symposium Energieinnovation, 14. bis 16. Februar 2018, Technische Universität Graz, www.EnInnov.TUGraz.at
ISBN 978-3-85125-585-0 DOI 10.3217/978-3-85125-584-3

On Economic and Environmental Prospects of Electric Vehicles

Amela AJANOVIC[1], Reinhard HAAS[1]

Introduction

The transport sector is one of the major contributors to oil consumption and greenhouse gas (GHG) emissions. Due to continually increasing GHG emissions and local air pollution interest in alternative automotive technologies is growing worldwide.

Currently, the electrification of mobility is seen as one of the key strategies for heading towards a sustainable transport system. Many governments have set goals to increase number of electric vehicles. According to the Paris Declaration global electric vehicles stock should over 100 million. Different types of electric vehicles are already available on the market. However, all these automotive technologies have some advantages and disadvantages compared to conventional internal combustion engine (ICE) vehicles as well as different electrification level, see Fig. 1

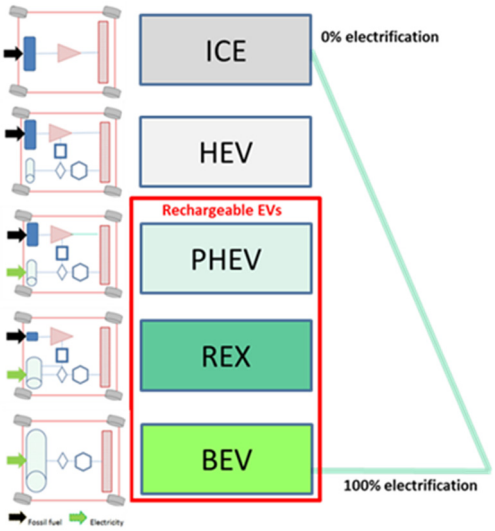

Figure 1: Level of electrification of electric vehicles in comparison to conventional internal combustion engine (ICE) vehicles (based on [1], [2])

The major reasons for their low penetration are still the same as 150 years ago: long charging time and limited infrastructure, low operating range, and high costs. Moreover, environmental benefits of electric vehicles could be very different depending on the primary energy sources used for electricity generation.

The core objective of this paper is to analyze future prospects of electric from an economic and environmental point of view.

Method

Our method of approach is based on calculation of total cost of ownership of electric vehicles in comparison to conventional cars and a life-cycle approach to assess the environmental benefits. The most crucial parameters in this context are kilometers driven per year and depreciation time of the car as well as battery. The analysis of future prospects it is based on technological learning regarding investment costs of batteries. Development of battery costs over the last years is shown in Fig. 2.

[1] Vienna University of Technology, Institute of Energy Systems and Electrical Drives / Energy Economics Group, Gußhausstraße 25, 1040 Vienna, Tel.+ 43 1 58801 370-{364|303}, {ajanovic|haas}@eeg.tuwien.ac.at, www.eeg.tuwien.ac.at

ISBN 978-3-85125-585-0 DOI 10.3217/978-3-85125-584-3

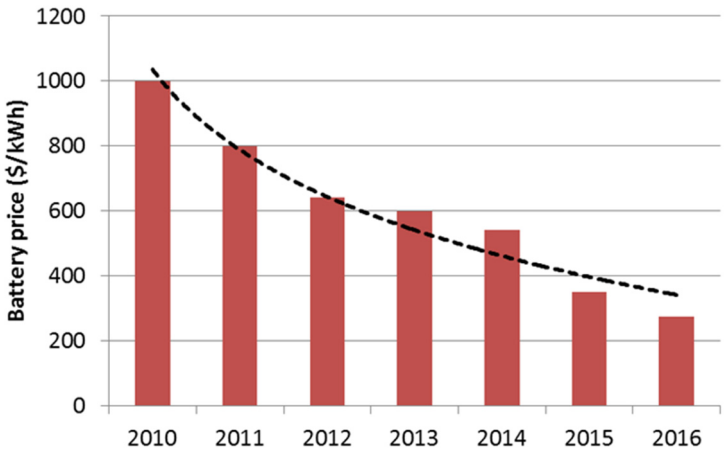

Figure 2: Development of lithium-ion battery price, 2010-2016 [3]

Results

The major disadvantages of battery electric vehicles (BEVs) are the high capital costs, mainly due to the battery, and a low driving range in comparison to conventional vehicles. These problems could be reduced with plug-in hybrids (PHEV) and range extenders (REXs). However, these technologies have lower CO_2-emissions in the whole energy supply chain than conventional vehicles but unlike BEV they are not zero-emission vehicles at the point of use. The number of km driven has a higher impact on total mobility costs than the learning rate. Hence, the use of EVs as taxis and in car-sharing leads to the best economic performance.

The most popular electric vehicles are currently hybrid electric vehicles (HEVs). They have only slightly higher costs and similar operating ranges as conventional vehicles. But since they are dependent on fossil fuels, they can only be seen as energy efficiency measure. However, they can serve as a bridging technology – as long as BEVs and fuel cell vehicle do not gain high popularity – and together with PHEVs and REX contribute to faster technological learning and reduction in battery costs.

To harvest the full environmental benefits of electric vehicles, electricity used in electric vehicles have to be generated from renewable energy sources – otherwise total CO_2-emissions are likely higher than those of conventional cars.

References

[1] Ajanovic A., Haas R.: Dissemination of electric vehicles in urban areas: Major factors for success. Energy 115 (2016) 1451-1458

[2] Ajanovic A.: “The future of electric vehicles: prospects and impediments”, WIREs Energy Environment 2015. doi: 10.1002/wene.160, 2015.

[3] BNEF: “Lithium-ion Battery Costs: Squeezed Margins and New Business Models”. Bloomberg New Energy Finance, July 10, 2017