State of Road Electromobility in Hungary and Chongqing Region, China

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Abstract: Infrastructure and vehicle manufacturers create standard vehicles all over the world though the characteristic of vehicle use and electromobility system is different in countries and continents. In our research, Chinese and Hungarian characteristics and peculiarities are analysed; special focus is given to the applicability and involvement of renewable energy sources. Considering the limitations of data collection, two regions are selected: Chongqing region of China and Hungary. This paper is part of a long-term project which final aim is the elaboration of methods that maximize the energy efficiency of electric road vehicles during movements and charging. The first step of cooperation is the road electromobility system analysis according to energy production, vehicle stock, charging facility, operational aspects, and incentives. The results are summarized and compared in this paper. It was found that despite the similar size of the areas, the population density, subsidies, and vehicle industry have a significant impact on electromobility. China provides an indirect support through subsidies to the national electric car and battery manufacturers. In Hungary, the main aim is to reduce global emission of road traffic. Accordingly, pure electric vehicles are favoured in Chongqing, and plug-in electric vehicles in Hungary. Another key finding that public charging plays a significantly greater role in Chongqing than in Hungary.

Keywords: electric vehicle (EV), operation, energy system, charging facility, tariff system, incentives, China, Hungary

Introduction

Clean air is essential for high life quality in urban areas around the world. In developed countries, many cities face with the increasing air pollution generated by passenger car traffic. For example, air pollution generated by road transport caused more deaths than traffic accidents in the USA in 2016 [1-2]. Several soft and sustainable travel modes can reduce the total emission of transport. Therefore, policy makers promote cycling, walking as a low-cost, clean, and active transport mode [3-4]. Furthermore, urban planners support the reorganisation of urban areas based on novel approaches, such as 15-minute cities, where the proximity of services reduces travelling distances [5]. However, the share of private car use will be significant in the future because of the spatial separation of home, work etc. for many people and the societal characteristics. Namely, the car became the symbol of individual freedom creating a culture of using it [6]. Since the emission of conventional petrol and diesel cars cannot be further reduced significantly there is a need for alternative fuels and drivetrains. Thus, the zero local emission electric vehicles (EVs) emerge to reduce air pollution and noise. Despite the drawbacks of EVs, such as long charging time and short range, many private car users may use EV without the decline of travel quality in urban areas.

Therefore, policy makers also promote EVs. According to the aims of the EU, there will be at least 30 million zero-emission by 2030, and nearly all cars, vans, buses as well as new heavy-duty vehicles will be zero-emission by 2050. To achieve these milestones, the development of innovative technologies is supported and demand for zero-emission vehicles is stimulated [7]. Simultaneously, driving restrictions on internal combustion engine cars are imposed. In Germany, many cities, such as Berlin, Hamburg, and Stuttgart, approve bans for diesel vehicles not complying with the EURO-5 standard [8]. Similarly, Brussel will ban diesel cars by 2030 and petrol cars by 2035 [9]. Electromobility is significantly promoted in China and aims to reach 30% sale share of EVs by 2030 [10]. In 2020, China had the largest EV fleet with 4.5 million electric cars, but Europe became the biggest market: 1.4 million electric cars were sold, followed by China and USA with 1.2 and 0.3 million, respectively. The overtake may be because the EU responded to the pandemic generated economic downturn with incentives boosting EV sales [10]. So, in general, electromobility is supported all around the world.

However, incentives have different impacts in the various regions. E.g., electric car sales share was 75% in Norway, and 6% in China in 2020 [10]. Namely, promoting EV use in regions with a low EV stock, limited access to charging infrastructure, lack of EV use culture presents challenges. Transport and urban planning policies, contextual factors and cultural norms and attitudes are important for explaining the success (or lack thereof) of electromobility promotion in a region.

The aim of this paper is to compare the state of electromobility in various regions considering economic and demographic factors. The focus is put on the EV fleet and charging infrastructure. The comparison provides a solid base to identify the key factors affecting the spread of EVs. In this paper, we focus on battery electric passenger car (BEV) and plug-in hybrid electric cars (PHEV). BEVs and PHEVs together are referred as EVs. The novelty of the paper that the electromobility trends of China and Hungary were not compared yet. Our main data sources were the National Bureau of Statistics of China and Hungarian Central Statistics Office. Further data sources are indicated in the text.

1. Literature Review

In the literature, several papers dealt with the electromobility strategies of various countries since policy incentives were identified as the main reason for the success of electric vehicles in Norway [11]. A study was carried out in the Netherlands conducting interviews with stakeholders of the electromobility system [12]. Among others, the representatives of stakeholders pointed out the importance of supportive policies in the early phase of electromobility without mass market. A study found consumer acceptance, technological progress, and incentives as the most decisive factors of electromobility spread [13]. It was also found that the most popular incentives are the subsidies for the purchase of an EV and charging infrastructure development at popular locations. The Norwegian electromobility incentives were analysed after the country became the leader in EV sales per capita [14]. It was found that electric cars are attractive to customers if the subsidies are strong enough. It is expected that the prices are coming down, but it is still not clear whether there is a need for permanent subsidies. The decision of possible EV consumers was modelled to evaluate the impact of incentives in Austria [15]. It was found that subsidies aiming for the joint use of EVs and public transport, such as free subscriptions to Park and Ride service and public transport, do not significantly influence the willingness to buy. In another study, the focus was put on the governmental subsidies and an electric vehicle manufacturer in China [16]. Interviews were made to reveal conflicts of interest among different stakeholders and find synergies. The drawback of the paper that the examination was made in the early stage of electromobility. In addition to direct incentives, it was found that government has an important role in guiding public opinion [17]. Therefore, marketing may be also an important part of the subsidies. In line with that, at the beginning the demand was not high for EVs in Estonia despite the generous subsidies.

In general, researchers agree that subsidies help the spread of EVs which is good for the society, but there are few exceptions (e.g., [18]). The optimal subsidy was determined based on the total cost of ownership of EVs in [19]. It was found that some EV types do not require subsidies, and direct purchase subsidies are the most efficient. Similarly, the importance of direct incentives was revealed because despite the many incentives, the EV sales are still low in Poland because of the low purchase subsidy [20]. It was also found that non-financial and financial are important to support the expansion of the charging infrastructure [21]. Based on an international expert survey, it was found that charging infrastructure development and parking related incentives helps the most the spread of new EVs, and EV carsharing and pilot projects are the least effective [22]. Incentives focusing on charging management were analysed in [23]. These incentives help to mitigate the negative impact of charging on the power grid. It was found that monetary and symbolic incentives are effective in changing charging behaviour and no statistical differences were found between them.

The structure of the paper is the following: the trends, challenges and aims in the field of road electromobility are summarised for Chongqing, China and Hungary including the main indicators in Section 3. The characteristics of electric car stock and charging infrastructure are given in Section 4 and 5, respectively. The incentives in the investigated areas are given in Section 6. Finally, the conclusions are summarised.

2. Trends, Challenges and Aims

Chongqing and Hungary are committed to the electromobility. Since there are many differences between the regions, the challenges and aims are different. The main differences are the following:

- Population density: there are many large cities in China with high population density. Therefore, the local air pollution of transport is significant. On the other hand, population density in Hungary is significantly lower and the main emitters are related to the heating in cities.
- Vehicle industry: vehicle industry is a key area in both countries. The difference is that the national companies are dominant in China, whilst mainly foreign manufacturers are present in Hungary.
- Market size: China is a significant market on a global level, whilst Hungary not.
- Energy mix: according to IEA (iea.org), the main energy sources are natural gas and nuclear power in Hungary. Whilst China significantly depends on coal (appr. 60% in electricity generation).

The main electromobility indicators are summarised in Table 1 and Table 2.

Table 1. Electromobility indicators of Chongqing and Hungary 1/2 (sources: National Bureau of Statistics of China and Hungarian Central Statistics Office)

Data group	Indicator name	Chongqing	Hungary
Geography, population, economics	Territory size [km^2]	82 400	93 030
	Population [capita] (2022)	32 054 200	9 689 000
	Population density [capita/km^2]	389	104
	GDP per capita [USD] (2021)	13612	18 528
Vehicle stock	Total number of passenger cars (2021)	4 024 888	4 013 000
	Motorization rate [vehicles/1000 capita]	127	414
	Total number of EVs (2021)	138 790	42 641
	Share of EVs [%] (2021)	3.45	1.06
	Annual average EV mileage [km]	14 000	16 000
Market	Number of sold new passenger cars in 2021	450 394	121 940
	Number of sold new EVs in 2021	63 784	8 548
	EV sales share in 2021 [%]	3.5	7.01
	Expected EV sales share in 2030 [%]	48	40 (EU)
	EV ’maturity’ indicator [number of sold new EVs/1000 capita] (2021)	1.99	0.88
Energy production	Renewable energy rate [%] (2020)	35.6	10
	Fossil fuels [%] (2020)	64.4	40
	Nuclear power [%] (2020)	0	50

EU: data refers to European Union;

Based on the differences, the promotion of electromobility may have different impacts. In China, the promotion is a significant indirect support for national vehicle and battery manufacturers that may help to take the leading role in e-vehicle industry. According to the China Association of Automobile

Manufacturers (caam.org.cn), 17 of the 20 most popular electric car types in China in 2020 were made by Chinese manufacturers. Furthermore, the focus is on the local emission decline because of the high share of coal in power generation. Accordingly, BEVs are in the focus of incentives. On the other hand, promotion of electromobility supports the development of electromobility services rather than vehicle industry in Hungary, such as electric carsharing and innovative charging solutions. Furthermore, EVs help to achieve global emission decline rather than on local level. Accordingly, BEVs and PHEVs are equally promoted.

Table 2. Electromobility indicators of Chongqing and Hungary 2/2
(sources: National Bureau of Statistics of China and Hungarian Central Statistics Office)

Charging infrastructure	Number of public charging points (2022)	22 571	1627
	Rate of DC fast chargers [%] (2022)	41	
	Number of ultrafast chargers (>75 kW)	8 026	19
	Public charging availability [number of EVs/number of public charging points] (2022)	6.14	26.2
Tariff	Home charging energy price [USD/kWh]	0.085	0.12
	AC normal charger (<22 kW) [USD/kWh]	0.1-0.16	0.29-0.31
	DC normal charger (<22 kW) [USD/kWh]	0.16 (along highways)	0.35-0.45
	AC/DC fast charger (>70 kW) [USD/min]	0.28	0.23
	AC/DC fast charger (>70 kW) [USD/kWh]	0.41	0.35
	Number of gratis charging facilities	0	253
Energy consumption	Average BEV consumption [kWh/100 km] (2022)	10-15	17
	Average PHEV consumption [kWh/100 km] (2022)	8	10.2
	Annual consumed energy* [GWh]	>7.14	90
Emission	Share of transport in CO_2 emission [%]	9 (CN)	22 (EU)

CN: data refers to China;
EU: data refers to European Union;
Further Hungarian data sources: MOL Plugee (molplugee.hu),Mobilit
** estimation based on annul mileage, vehicle stock and energy consumption*

The main trends, challenges and aim are summarised for Chongqing and Hungary.

2.1 Chongqing

1. Decreasing subsidies in second half of 2019 implied a break in market share of new EVs.
2. China has put tremendous efforts for the past few years in deploying public electric vehicle charging stations, with over 0.87 million by the end of 2020 (China Electric Vehicle Charging Infrastructure Promotion Alliance, 2020).
3. Existing stations in China generally suffer from low utilization rates.
4. China has made an ambitious pledge to become carbon neutral before 2060.
5. The subsidy policy for the purchase of new energy vehicles in 2022 will be terminated on December 31, and the licensed vehicles will no longer be subsidized.
6. By the end of the 14th five-year plan (around 2025), China's electric vehicle charging capacity can meet the charging demand of more than 20 million EVs.
7. Chongqing city plans to build itself into a demonstration city of power exchange mode and hydrogen fuel cell vehicle by 2023, with more than 200 power exchange stations and 10 hydrogen refuelling stations.
8. From the beginning of 2021 to the end of February this year, State Grid Chongqing electric power company has built 58 new charging stations and 430 charging piles and built an expressway charging service network in the city. The company plans to build 256 new public charging and replacement power stations and 166 intercity fast charging stations by 2025.

9. Since June 2019, the financial subsidies for new energy vehicles in Chongqing have declined year by year. In 2022 and 2021, the subsidies for the purchase of new energy vehicles have declined by 20% and 10% respectively based on the previous year.
10. In China, 1298 replacement power stations have been deployed by the end of 2021.

2.2 Hungary

Quick spread of EVs is explained by the simultaneous effect of several global trends. Hungary belonging to the group of developed industrialized countries of the world perceived these trends directly, and it has therefore joined the framework of relevant international commitments. The most relevant ones are the following:

- International climate protection commitments (e.g., the 2015 Paris Agreement to Combat Climate Change).
- The European Union's common energy and climate policy.

The main tendencies are as follows:

1. The EU's "Fit for 55 Package" (published in July 2021) revealed its plans to reduce emissions by at least 55% by 2030 (compared to 1990 levels), and to be the world's first climate-neutral continent by 2050 [24].
2. Vehicle powertrain developments focus on hybrid and pure battery electric technologies.
3. Spread of EVs are facilitated by development of energy storage technologies (especially Lithium-ion based technologies). Accordingly, energy density and capacity are increasing, cost/kWh indicator is decreasing.
4. Total life-cycle cost of EVs is still higher than that of internal combustion vehicles. However, an equal and then lower level is expected around 2026-2030 [25].
5. Electric vehicles are spreading, but pace is not so fast as it was expected. Nonetheless, development pace considering number of electric vehicles in Hungary is outstanding in the Central-European region.
6. Moderate EV uptake is expected up to 2030, where EV penetration will reach 10%. Major penetration is expected after 2030 [24].
7. The push towards EVs needs to be coupled to an increase of low-carbon electricity generation.
8. Number of all charging facility types is increasing gradually. However, development of the charging infrastructure is just average or slightly backward in the Central-European region.
9. In the next decades, most of the chargers will be deployed at home (app. 75%); the remaining part is installed at workplaces or in public spaces. An increased deployment of EVs in middle- and lower income households without home-charging options, especially in urban environments, will likely require a significant public charging infrastructure [26].

3. Electric Car Stock

In Europe, the rates of produced and sold new EVs among all vehicle types are increasing [7]. Until 2030, the share of conventional car sales decreases, but mostly because of increasing mild-hybrid car sales. In 2030, a significant increase in EV sales is expected so 53% of sold vehicles can be charged (34% BEV and 19% PHEV) and only 18% of sold vehicles will not include electric drivetrain. In China, most of the produced EV will be BEV (90% BEV and 10% PHEV) in 2030. The first EV produced in Hungary was manufactured by Mercedes-Benz in Kecskemét on 22.10.2021. Accordingly, the number of EVs produced in Hungary are still not significant. However, more and more suppliers participate in the entire value-chain. Regarding the development and production of batteries (mainly through investments by Korean companies such as Samsung at Göd), significant potential has also been and will continue to be developed nationally in the coming years. In 2021, 5 million alternative energy vehicles, mostly electric, were operating in China. Furthermore, the country is the largest EV market and manufacturer: 50% of EVs and 90% of heavy-duty electric vehicles are produced in China. In line with that, BYD is the second largest EV manufacturer after Tesla (US) [27].

The vehicle stock sizes are given in Table 3 and 4. The number of sold EVs are given between 2016 and 2021 in Figure 1 and 2.

Table 3. Vehicle stock in Chongqing between 2017 and 2021
(source: National Bureau of Statistics of China)

	2017	2018	2019	2020	2021
Total number of passenger cars	2.8 M	3.3 M	3.6 M	3.8 M	4 M
Total number of EVs	12 654	36 081	49 567	76 090	138 790
Share of EVs [%]	0.45	1.09	1.39	2.00	3.45

Table 4. Vehicle stock in Hungary between 2017 and 2021
(source: Hungarian Central Statistics Office)

	2017	2018	2019	2020	2021
Total number of passenger cars	3.5 M	3.6 M	3.8 M	3.9 M	4 M
Total number of EVs*	4 542	9 858	16 720	27 123	42 641
Share of EVs [%]	0.13	0.27	0.44	0.69	1.06

**vehicles with green plate*

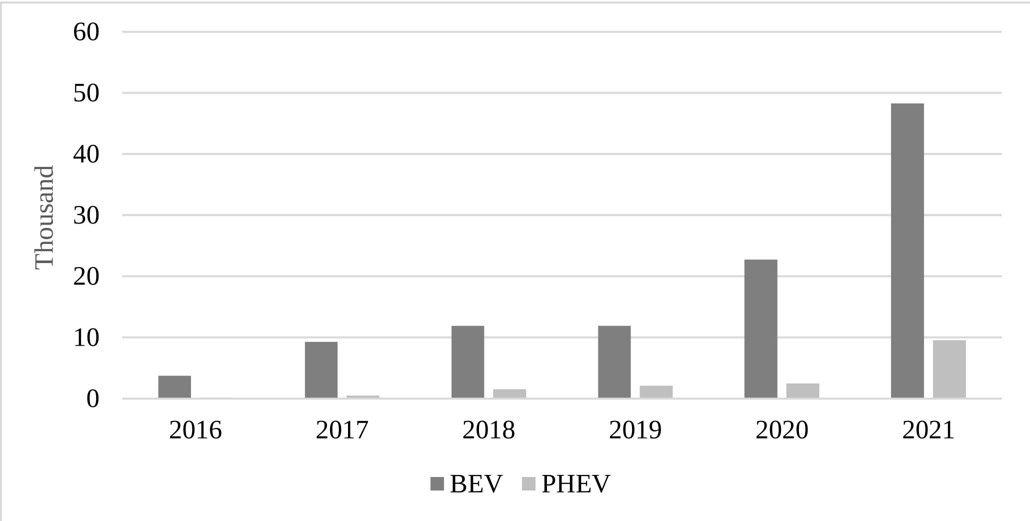

Figure 1. Number of sold new BEVs and PHEVs in ***Chongqing*** *between 2016 and 2021*
(source: National Bureau of Statistics of China)

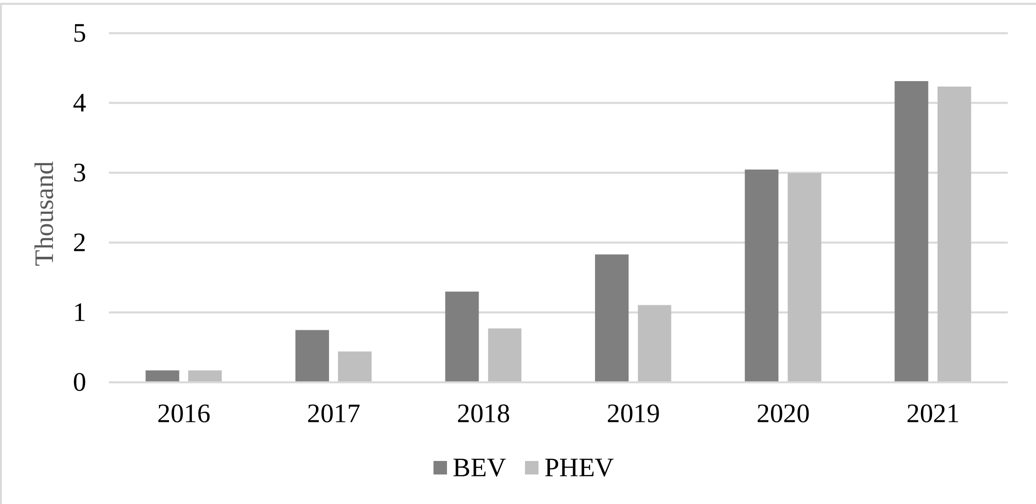

Figure 2. Number of sold new BEVs and PHEVs in ***Hungary*** *between 2016 and 2021 (source: ACEA)*

It was noted that the electromobility is more mature in China than in Hungary. It may be because of the more powerful subsidies and the lower difference between conventional and electric car prices. Another finding is that BEVs are much more popular in China than PHEVs, whilst in Hungary they are equally favoured.

Annual increasement of EV stock is significant in Hungary; however, the rate of increasement is slowing down. Rate of BEVs and PHEVs does not change significantly. 43 % of EVs are registered in Budapest, 57 % of EVs are registered in countryside.

4. Charging Infrastructure

The number of charging units are summarised in Table 5. It is noted that Chongqing pays a huge attention on the number of charging units and plans to expand its charging infrastructure at a higher rate than Hungary. It may be because Chongqing has a high population density and private charging at home is not typical. Therefore, public charging may have a greater role in Chongqing than in Hungary.

Table 5. Number of charging points in 2017-2030 (2025 and 2030 are own estimations) (sources: National Bureau of Statistics of China and Hungarian Central Statistics Office)

	2017	2018	2019	2020	2021	2022	2025	2030
Chongqing	4949	9004	11245	17533	30000	39800	105 000 - 230 000	165 000 – 470 000
	100%	182%	227%	354%	606%	804%	2122 - 4647%	3334 – 9497%
Hungary	272	580	930	1320	1471	1627	3800 - 8100	5900 – 18 100
	100%	213%	342%	485%	541%	598%	1397 – 2978%	2169 – 6654%

4.1 Chongqing

The power of AC slow charging is relatively small, generally 3.5 kW, and 7kW. The power of mainstream charging piles in the market is between 60 kW and 90 kw, and generally the maximum power does not exceed 120 kW.

At the beginning of 2022, Chongqing approved the code for design of supporting facilities for electric vehicle charging equipment in civil buildings as a mandatory standard for engineering construction, which will be implemented from September 1, which is the first mandatory local standard for electric vehicle infrastructure construction in China. From the distribution of electric vehicle parking spaces to the installation of charging facilities, clear provisions are given. In addition, it is proposed to build a power supply monitoring system for electric vehicle charging facilities in civil buildings, which is very beneficial to the standardization and safety of the construction and use of civil charging facilities.

As of April 2022, 22 571 public charging piles have been built in Chongqing.

4.2 Hungary

According to most common regulations „normal" (<40 kW; mostly 22kW AC power) and 'fast' (>=40 kW; either 43kW AC, but mostly >= 50kW DC power) charging facilities are distinguished. Nevertheless, 'ultrafast' chargers (with 150 or 350kW power) are also available at some locations as a consequence of market and technology development. Charging facilities are deployed, in many cases, from tender sources. To facilitate seamless transit traffic „fast" and „ultrafast" chargers are going to be installed in framework of NEXT-E project. 54 fast and 5 ultrafast charging facilities are expected soon [27]. Fast and ultra-fast charging points are mostly installed along highways, since they are aiming at users that travel for long distances and need a quick source of energy supply. These stations thus show a low degree of flexibility in the demand, and they are also charging higher prices to the customers per unit of energy supplied. Conversely, slow- and normal-speed charging points are generally used for occasional charging or a substitute for household or workplace charging for users that do not have access to those options [26]. As most of the EVs are operated in Budapest agglomeration the public charging facilities are also concentrated in the central region. The charging facilities are deployed and/or operated by state-owned companies or private companies working in electricity production and distribution or conventional fuel commerce sectors. These companies mainly focus on high-power charging point installations along highways. Unfortunately, integration is still not typical, neither in domestic nor international context, which hinders easy use of these facilities.

Current charging infrastructure and EVs are often unsuitable for V2G operations, and to support a future V2G deployment is of paramount importance to define proper standards and targets. The deployment of a large charging infrastructure that would not be able to support V2G could represent a significant limitation for its future success. While V2G represents a promising flexibility solution, some barriers need to be addressed to ensure a widespread deployment. Those include the need of additional research on the potential impact of additional charging cycles on EV batteries lifetime, the need of additional charging infrastructure due to the increased connection times, and the little economic value that is currently associated to grid services [26].

The most typical pricing schemes applied are as follows:

1. Free of charge sometimes with additional constraints, including maximum duration, with fixed parking fees, required membership, only for customers (e.g. supermarket, shopping mall).
2. Annual or monthly pass, for a fixed cost.
3. Charging price based on energy, expressed in HUF/kWh, with variable values related to the charging power that is available. The most popular schemes are in the range for normal and fast chargers are 0.29–0.35 USD/kWh (80-120 HUF/kWh), for ultrafast chargers 0.35 USD/kWh (155 HUF/kWh).
4. Charging price based on time, expressed in HUF/minute, with variable values related to the charging power that is available. Price-based tariff is used usually in the ultrafast chargers. The most popular scheme is 0.23 USD/minute (80 HUF/minute).
5. More complex pricing schemes, including combinations of energy consumption, duration and fixed price per charging. In some cases, the cost is flat, with a maximum duration of the charging process.

Types 1, 3 and 4 are typical for Hungary. Usually un-registered and ad-hoc customers need to pay a higher fee. Monthly subscription fee is not typical. According to the service operators the ultrafast chargers are used on energy-based or on time-based. In some cases, there are additional time-based penalty costs for a charging at ultrafast chargers longer than 30 minutes.

5. Incentives

Incentives for EV purchase and operation are summarized in Tables 6. and 7.

Table 6. Incentives for EV purchase

Incentives	Chongqing	Hungary
Subsidies for purchase	Yes	Yes
Regulation and subsidies for institutional purchase/procurement	Yes	
Subsidies for special purchase (waste shipment, taxi, etc.)	Yes	Yes
Decreasing VAT		
Preference for income tax		
Exemption from taxes and other fees (registration tax, transfer fee, local tax, money-making fee, etc.)		Yes
Subsidies for installation of local power generation systems (e.g., solar panels)		

Purchase incentives for EVs have been introduced in Hungary from the 15th of June 2020. 7 350 EUR is given for gross price of up to 32 000 EUR and 1 500 EUR is given if price between 32 000 and 44 000 EUR.

In Chongqing, the local municipality introduced some incentive measures for supporting the promotion and application of new energy vehicles; namely, EVs in 2020 as follows:

1. For new energy passenger vehicles sold and licensed in the city, if the price is reduced according to the guidance price (after deducting the national subsidy, the same below), the Municipal Finance and the district and county finance where the vehicle enterprise is located will reward the vehicle enterprise according to 25% of the preferential price respectively.
2. Accelerate the promotion, application, and pilot demonstration in the public sphere, including the incentive policies of enterprises or units such as online car hailing, cruise taxis, driving test vehicles, grass-roots official vehicles, buses and logistics vehicles.

Table 7. Incentives for EV operation

Incentives	Chongqing	Hungary
Decreasing electric energy price	Yes	
Increasing conventional fuel price		
Traffic restriction exemptions	Yes	
Bus lane use		
Dedicated lanes		
Dedicated parking places (with charging infrastructure)	Yes	Yes
Only for EV zones		
Parking for free or reduced fare	Yes	Yes
Road toll exemption		
Public transportation for free or reduced fare for EV owners		
Assessment of environment load tax for non-electric vehicles		

In China, the number of EV charging points had a significant impact on battery electric vehicle sales. It is suggested to increase EV sales by reduction of the electricity rates, while financial help for the investment in charging infrastructure has proven to be ineffective [29].

The current incentives in Hungary are still not effective enough. In order to achieve higher market share, further incentives are to be introduced. During home charging separated meters are still not required to measure the amount of energy used for re-charging. Thus, the state controlled, reduced prices for social reasons (0.12 USD/kWh) are applied for this purpose as well.

Conclusion

Data about road electromobility system have been collected for Hungary and Chongqing region, which is the main contribution of the paper. The key findings of the data analysis are the following:

1. China provides an indirect support through subsidies to the national electric car and battery manufacturers. In Hungary, the main aim is to reduce global emission of road traffic. Accordingly, pure electric vehicles are favoured in Chongqing, and plug-in electric vehicles in Hungary.
2. Electric road mobility in Chongqing is more matured than in Hungary. The number of EVs in China is app. 3-times higher than in Hungary. However, domestic market share of new EVs is only half (3,5 %) than that in Hungary. Accordingly, Hungary is over the initial stage and a quick increasement in number of EVs is expected in the coming some years.
3. Replacement of power stations technology is applied in China. This technology is not preferred in Hungary
4. Wide spread of EVs in China do not contribute to the reduction of GHG pollution significantly as the electric energy is produced mainly from fossil fuels.
5. Public charging plays a significantly greater role in Chongqing than in Hungary.
6. Home and normal charging is significantly (30-50%) cheaper in China. However, charging facilities for free are not available in China.
7. As share of Range-Extended Hybrid EVs is significant in China, this category is considered separately. In Hungary, only BEVs and PHEVs are distinguished.

During research, it was challenging to find reliable and up-to-date data sources referring to the same basis. For example, Open Charge Map (OCM) represents the most complete open global dataset of EV charging stations currently available. Despite the many volunteer developers, it may not include all the available charging points. A comparison with data for EU countries from another source, based on commercial data (ACEA), shows that the total number of EV charging points registered in OCM is around 25% lower than the figures provided in [26]. The terminology was also different in some cases, e.g., charging piles vs. charging points; new energy vehicles vs. EVs in China and Hungary, respectively. Our research plan is to extend the analysis to other European countries and China.

Acknowledgement: *„Project no 2019-2.1.11-TÉT-2020-00176 has been implemented with the support provided by the Ministry of Innovation and Technology of Hungary from the National Research, Development and Innovation Fund, financed under the 2019-2.1.11-TÉT-2020 funding scheme.”*

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