

## THE STATE OF ELECTROMOBILITY IN THE VISEGRAD GROUP COUNTRIES

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**Abstract:** *Electromobility is a popular topic worldwide because it offers sustainability solutions. It allows us to move from fossil fuels that emit CO<sub>2</sub> to energy supplied by electricity sources, which in turn are charged through the electricity grid. The importance of electrification lies in reducing CO<sub>2</sub> and other greenhouse gases, which is crucial for the transport sector in its efforts to combat climate change. The paper focuses on the identification of the state of electromobility in V4 in terms of the number of registrations, the availability of charging stations and subsidies. It also examines whether the targets set by the European Union for 2020 have been met and whether the Covid-19 pandemic has had an impact on the purchase of electric cars. All of the V4 countries failed to meet the targets for the number of electric vehicle registrations and the number of charging stations despite of The Slovak Republic, which did not manage to meet the target in the number of registered electric cars, but in the area of charging infrastructure it managed to exceed it. It is noteworthy that the Covid-19 pandemic had a positive effect on the purchase of electric cars, due to declining interest in vehicles with a traditional combustion engine.*

**Keywords:** Electromobility, decarbonization, environmental sustainability, charging stations, infrastructure, subsidies

### 1 INTRODUCTION

The advent of electric cars is a response to a major challenge: to drastically reduce the amount of carbon dioxide and air pollutants emitted by various means of transport. This reduction contributes to improving air quality and, of course, to combating climate change. In particular, the targets set by the Paris Agreement have led the European Union to legislate on the amount of CO<sub>2</sub> that a car can produce while driving. Manufacturers anticipated this paradigm shift ten years ago and, as a result, developed vehicles powered solely by electricity. It is the only large-scale automotive travel technology to date. Electric mobility, which is clearly of interest for personal vehicles, is equally important for other modes of transport. Battery buses, electric bicycles, and small electric motor vehicles have spread throughout the cities to provide sustainable transportation alternatives [36].

One of the pillars of the European Union's socio-economic policy is sustainable development for a low-carbon economy. The Treaty on the Functioning of the European Union stipulates that environmental protection conditions will be integrated into policy formulation and implementation, as well as into other Union initiatives. Focusing on the environmental aspect in the concept of sustainable development aims to reduce the negative effects of dynamic transport development. Unsustainable modes of transport are reflected in the rapid growth of motor vehicles as well as the uncontrolled and irreversible use of natural resources (especially oil). This situation destroys global and local ecosystems and poses a risk to human well-being and health [4].

The adoption of the concept of sustainable development into the policies of the European Union has led to the creation of an increasing number of legal

instruments that promote the integration of environmental aspects into its transport policy. Legal action is also needed against the transport sector, which accounts for a quarter of Europe's greenhouse gas emissions, in order to achieve the EU's sustainable development policy goal. Vehicle emission standards and the development of alternative fuels are extremely important for the development of the transport system and the protection of the environment [14].

### 2 METHODOLOGY OF WORK

The aim of the paper is to point out the current state of electromobility in Vysegrad Group in terms of the number of registrations of electric vehicles, availability of charging stations and subsidies and to determine whether the goals set by the European Union have been met. The author of the paper focused on answering two research questions (VO) to achieve the objective of the paper:

*VO1: Have the Visegrad Group achieved the goals set by the European Union by 2020?*

*VO2: How did the state of electromobility change in the Vysegrad Group during the first wave of the Covid-19 pandemic?*

The output of the paper is formulated answers to the results, which answer research questions regarding the achievement of the goals set by the European Union and the impact of the COVID-19 pandemic during the first wave. To obtain the results, we conducted secondary research, which consisted of data collection, processing and subsequent interpretation. The paper also used selected methods using the principles of logical thinking, such as analysis, synthesis and comparison. In this paper, an empirical scientific method was used, which allowed us to

draw conclusions from empirical, ie verifiable evidence. We focused on comparing relevant data and displaying the current state in the research area. For the purposes of data presentation, we used their graphical display.

### 3 RESULTS AND DISCUSSION

The adoption of the Directive on the Development of Infrastructure for Alternative Fuels, which aims to promote the use of alternative fuels in transport (AFID Directive), played a key role in expanding electromobility in 2014. In accordance with the Directive, alternative fuels are fuels or energy sources that [19]:

- Serve at least in part to replace fossil oil resources in the supply of energy for transport.
- Have the potential to contribute to the reduction of oil imports by EU Member States.
- Have the potential to contribute to the reduction of emissions in the transport sector.

Most of the indicative targets for 2020 in these countries have not been met. The only positive development in this regard was the expansion of the infrastructure of high-performance charging stations (above 22 kW), for which the 2020 targets were met in both countries. An interesting fact is that despite the crisis caused by the Covid-19 pandemic in the car market, the development of electromobility accelerated significantly in 2020 in both Slovakia and the Czech Republic. In 2020, when pandemic-related restrictions caused a serious crisis in the new car market in Europe, electric car sales rose sharply. This means that electromobility is much more resilient to downturns in the automotive industry and support for its development should be fully in line with the primary objective of national recovery plans. The extent of the development of electromobility in the Visegrad Four countries is comparable to what we observed a few years ago in the countries of Western Europe, which today have made significant progress in the development of emission-free road transport. However, maintaining and further accelerating this growth rate will require greater commitment from V4 governments and a more active transport policy [18].

The automotive sector in Europe is an important part of the economy, providing up to 13.8 million jobs and accounting for more than 6.1% of total employment in the EU. In 2020, 12.9 million vehicles were produced in Europe, representing approximately 17% of global production in that year. More than 5.8 million vehicles were exported, worth € 134.1 billion [1, 14].

#### 3.1 The state of electromobility in Slovakia

In Slovakia, we perceive a growing trend, which represents a shift from fossil fuels to alternative and sustainable energy sources. The importance of electromobility lies in the fact that transport is currently responsible for up to a quarter of greenhouse gas emissions, which makes it the dominant polluter, especially in urban areas. It is through its introduction

that we can reduce the negative effects of transport on human health and also on the environment, which has a significant impact on it. The impetus for comprehensive measures to support the development of electromobility at the national level was the need to implement the obligations arising from the EU directive on the implementation of infrastructure for alternative fuels. In response to the requirements set out in the Directive, a National Policy Framework for the Development of the Alternative Fuels Market has been developed and adopted. and National Policy for the Development of Infrastructure for Alternative Fuels [25].

Strategic goals and directions for the development of road transport to alternative fuels are specified in the documents. In relation to electromobility, the key objectives include [12]:

- Stimulating demand for electric vehicles.
- Developing charging infrastructure based on building a nationwide network; suitable conditions for the transformation of the transport sector in terms of the introduction of low and zero emission vehicles.
- Creating social acceptance of electric vehicles with special emphasis on economic and environmental benefits arising from the purchase and use of electric vehicles.
- Suitable conditions for the transformation of the transport sector in terms of the introduction of low and zero emission vehicles.

Based on the prepared scenarios of electromobility development and in connection with their impact on the growth of the national economy, indicative targets were proposed for the number of electric vehicles (BEV and PHEV) and charging infrastructure to be achieved by 2030 [18]:

- By the end of 2020 10,000 electric cars on the roads.
- By the end of 2025 - 20,000 electric cars.
- By the end of 2030 - 30,000 electric vehicles.

In terms of charging infrastructure deployment, the total number of planned charging stations at the end of 2020 was 750 (including 600 with power up to 44 kW and 150 with power over 44 kW). The targets for 2025 and 2030 are 1,500 (1,200,300) and 3,000 (2,340,660). The network of high-performance charging stations (above 44 kW) is intended to cover mainly motorways, 25 expressways, major state roads and cities with more than 30,000 inhabitants, where 90% of the planned high-performance charging stations are to be located [18].

Electromobility was not considered a priority for development in the alternative fuels sector and was not given much attention. Much greater emphasis has been placed on increasing the number of natural gas vehicles (CNG and LNG) and related infrastructure. For example, for natural gas vehicles, the indicative targets for 2020, 2025 and 2030 are 5,000, 15,000 and 30,000 - almost the same values as for electric vehicles. Very little attention has also been paid to the development of hydrogen-

powered vehicles and their filling infrastructure, as no targets have been set for this technology [18].

In 2019, an action plan for the development of electromobility was adopted. The document expands the range of activities planned for 2030 to include the electrification of public transport in cities and also provides a program to promote hydrogen as an alternative fuel. However, the indicative targets for electromobility have remained unchanged. In line with the assumptions for 2019 set out in the plan, support for the development of electromobility is to be financed almost exclusively from EU funds and the availability of funds has been defined as a condition for its implementation. Efforts in the same areas, which are related to gaseous fuels (CNG, LNG), should be financed primarily from the state budget [25].

This means that Slovakia in its policy identifies natural gas as a priority direction for the development of low-emission transport. However, in the context of the current approach to natural gas in the European Union, the adoption of such a strategy should be considered risky and also one that does not guarantee the achievement of the new targets of reducing greenhouse gas emissions by 2030 as well as the strategic goal of climate neutrality by 2050. As in the Czech Republic, electromobility is not regulated by a separate legislative law in Slovakia. Issues related to the technical aspects of the charging infrastructure and classification of electric vehicles have been incorporated into existing regulations. The only law dedicated exclusively to electromobility concerns only the rules on financial support for the purchase of vehicles and the construction of charging infrastructure [10].

As stated in the planning documents, the financial support mechanisms for the purchase of vehicles and the development of charging infrastructure operated on the basis of EU funds under cohesion policy. In the years 2016 - 2018, the program to support the purchase of electric cars was completed, in which the maximum amount of the subsidy for a purely electric vehicle was 5,000 euros and for a plug-in hybrid electric car 3,000 euros. The subsidies covered a total of more than 830 vehicles (BEV and PHEV) [13]. The first subsidy package for Slovakia, which amounted to 5.12 mil. euros have not been exhausted.

The second subsidy package in the amount of 6 mil. However, it was exhausted in 3 minutes and 42 seconds (nine out of ten applications related to fully electric vehicles. The amount of the subsidy was € 8,000 for a pure electric vehicle and € 5,000 for a plug-in hybrid electric vehicle. than 50,000 euros with VAT This package was to cover up to 750 electric cars [3].

As a result, we can assume that there will be similarly high interest in the third grant package. Based on the statement of the Minister of Economy of the Slovak Republic Richard Sulík, the third subsidy package will look different. It will be "a sufficiently large package of money and enough support for one car" says Sulík. Therefore, we expect a higher number of contributions in a lower value. The exact launch date has not yet been determined [41].

The only fiscal instrument implemented is the registration fee, which for the holder of a motor vehicle whose only energy source is electricity is EUR 33, while for the holder of a hybrid motor vehicle (HEV) and a hybrid electric vehicle (PHEV) the registration fee is reduced by 50%. The amount of the registration fee for a hybrid vehicle depends on the engine power and ranges from EUR 167 for engines up to 86 kW to EUR 2,997 for vehicles with an engine power exceeding 254 kW. As the fee for the most popular vehicles on the market is low and represents a one-off cost, its impact on the purchasing decisions of potential buyers is negligible [26, 32].

According to the forecast included in the National Policy Framework for the Development of the Alternative Fuels Market, a total of 10,000 fully electric and plug-in hybrid vehicles should be on Slovak roads at the end of 2020. Based on the published data, a total of approximately 3,500 such vehicles were registered in Slovakia at the end of December 2020. This means that only 35% of the target was met [9].

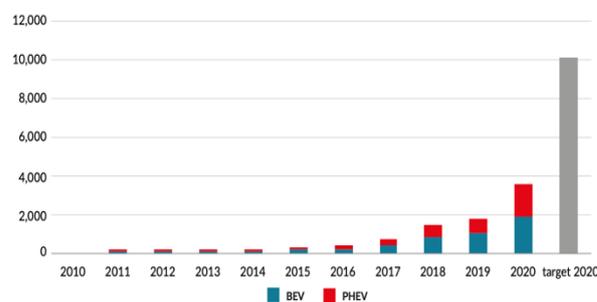


Figure 1 Number of electric vehicles (BEV and PHEV) in Slovakia in 2010-2020  
Source: euki.de, 2021

As we can see in the picture above, the number of registrations is constantly growing. While in 2019 1782 electric cars were registered, in 2020 there were up to 3506, so the number almost doubled. We can state that the number of registrations has been growing rapidly since 2017, and in 2020 these vehicles represented almost 2% of the new vehicle market. For the following years, this figure is positive, given the significant decline in the number of new vehicles sold in all European markets in 2020 due to the COVID-19 pandemic. The primary goal of policies and regulations in the coming years should be to maintain current trends, which will make the indicative targets for 2025 and 2030 in Slovakia fully achievable [6].

At the end of 2020, there were 924 functional charging stations in Slovakia. This means that the indicative target of 750 charging stations was exceeded by more than 23%. Slovakia is the only country not only to achieve, but has exceeded the indicative targets for 2020 for the number of normal power (up to 22 kW) and high-performance (over 22 kW) charging stations. The number of charging stations with an output of more than 22 kW exceeded the target by more than 78%, and the number of charging stations with an output of up to 22 kW exceeded the target by more than 9% [6].

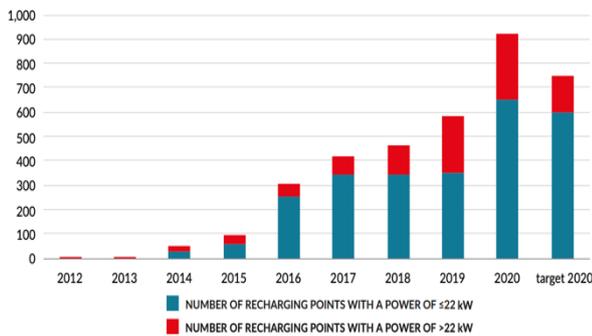


Figure 2 Number of charging stations in Slovakia in 2012-2020

Source: euki.de, 2021

In the market of charging station operators, GreenWay from Slovakia is the largest player in the segment of charging points with an output of over 22 kW. The company received € 17 million in 2018 from the European Investment Bank, which it is to use for network expansion and further research. The power company ZSE Energia has the largest share in the segment of charging stations with an output of up to 22 kW. These companies plan to build at least a few charging stations along the main roads in Slovakia in the coming years, equipped with high-performance charging stations (with a capacity of at least 150 kW) [6, 38].

### 3.2 The state of electromobility in Czech Republic

In the Czech Republic, electromobility as a part of sustainable transport first appeared in the National Environmental Policy for 2012-2020 and the National Transport Policy for 2014-2020. These documents stated that the development of low and zero emission vehicles is one of the priority actions, but no specific plans have been presented in this area. Electromobility was further addressed in the National Energy Policy until 2040, in which it was identified as a measure aimed at:

- Reduction of domestic consumption of liquid fuels.
- Improving energy efficiency in road transport.
- Increasing the share of alternative fuels, including electricity [28].

The only planning document with a comprehensive approach to electromobility in the Czech Republic is the National Action Plan for Clean Mobility, which was adopted in October 2015 in fulfillment of the obligations arising from the implementation of EU Directive 2014/94 / EU. He talks about implementing infrastructure for other fuels. The following priorities have been defined in the section on the deployment of electromobility:

- Reduction of domestic consumption of liquid fuels.
- Creating demand for electric vehicles.
- Creating conditions for social acceptance of electric vehicles.

- Increasing the economic benefits of purchasing and using electric vehicles [6].

EU funds available under cohesion policy, specifically under the Transport Operational Program from the EU Structural Funds, have been identified as the main source of funding. The planned financial support concerns the purchase of electric cars and the development of public and private charging infrastructure.

The scenario of electromobility development in the Czech Republic, which is presented in the National Action Plan for Clean Mobility, includes a perspective until 2030. The indicative goals presented in the document are structured quite unusually - not only from a quantitative but also from a spatial point of view.

According to the adopted scenario, by the end of 2020, there should be 17,000 electric vehicles on the road in the Czech Republic, of which 6,000 BEV and 11,000 PHEV. The charging infrastructure was assumed to consist of at least 1,300 public points, including at least 500 high-performance points located along:

- Highways.
- Major state roads.
- In localities with population over 100 000 people [7].

High-performance charging stations form the basic network that enables the smooth movement of electric cars in the Czech Republic - the places are up to 150 km apart, which is less than the range of a personal electric car. The remaining 800 points, mostly of normal performance, should create another network located mainly in localities with a population of at least fifteen thousand. The construction of such a network in 2020 is estimated to provide access to charging infrastructure for at least a quarter of the country's population. Thirty-five thousand BEVs and sixty-six thousand PHEVs are to be registered by 2025. The infrastructure network will expand to locations with more than tens of thousands of inhabitants.

In 2030, the electric vehicle fleet is to include approximately 250,000 BEV and PHEV cars, with the charging service based on real-time pricing. The price of the service will depend on the time and current network load. Two-way power flow based on V2G (Vehicle-to-Grid) technology will be provided. It is expected that after 2030, the mechanisms supporting electromobility will be terminated. The reason will be to achieve full maturity and competitiveness, even in terms of cost, compared to traditional drive technologies.

The initiative in the Czech Republic, which concerns education, is also very interesting. In 2018, elements were introduced into the school curriculum that speak of environmentally friendly forms of transport and mobility. This step helps to build social awareness and also to accept emission-free transport at school age [18].

Issues related to electromobility in the Czech Republic have not been comprehensively addressed in

a separate legislative act. The technical side of the charging infrastructure was addressed by the amendment to the Act on Fuel and Petrol Stations. The Public Procurement Act includes provisions that allow public entities in the procurement process to use criteria based on an analysis of the costs that need to be incurred for the entire life cycle of a vehicle. This makes it possible to take into account the full range of benefits associated with the purchase and subsequent use of electric vehicles. In the Czech Republic, an amended Road Act came into force in 2019, according to which special license plates are issued by electric cars, which facilitate their identification on the roads. Owners of electric cars and hybrids could request a brand change free of charge. For special license plates, it is necessary to meet the condition that defines that the average emissions of the vehicle are less than 50 g / km [39].

In terms of support instruments, financial support for the purchase of vehicles and the development of charging infrastructure has so far been provided through EU funds under cohesion policy. Support is provided through the EU and Member States, through grant funds. The competencies will be taken over by individual ministries and their subordinate agencies, which are responsible for subsidies. They have been made available primarily to companies and local government institutions. The projects that were completed in this area were described in the report on the implementation of the national policy framework for the development of the market for alternative fuels [28].

The operational program, aimed at increasing the competitiveness of companies, financed the purchase of more than 500 electric cars and the purchase and installation of approximately 270 charging stations. The total amount of funding was EUR 20 million (approximately EUR 4 million of which was for the purchase of electric vehicles). The amount of the subsidy for the purchase of an electric car was up to 10,000 euros. It was also possible to obtain subsidies for the purchase of the electric bus, but its amount was only 40 thousand euros [18, 39]. Unlike other countries, in the Czech Republic, subsidies to support electromobility are intended only for legal entities.

There have been 6 calls for subsidies in the Czech Republic so far. The State Agency for Enterprise and Innovation (API) recently launched applications for the "Low Carbon Technologies" program, which also includes subsidies for electric cars and charging stations. This program supports three areas, namely electromobility, energy storage and secondary raw materials. Approximately € 24 million has been earmarked for subsidies, of which € 50 million is to support electromobility. This call was primarily focused on commercial electric vehicles and the minimum amount of the subsidy was EUR 10,000. The amount initially set aside for financial support was approximately EUR 2 million, but was later tripled to approximately EUR 6 million [16, 40].

Other programs were originally planned to be launched in 2021, but the Ministry of Industry and Trade has announced that this will not happen [16, 18]. Once again, there will be several subsidy programs available that will ensure a more advantageous purchase of electric cars, but again, ordinary consumers will not see them [16].

As regards tax measures, the following incentives have been applied:

- Exemption from road tax for electric cars (the tax applies only to entrepreneurs),
- Remission of the fee for issuing special tables with a registration number,
- From 1 april 2020, passenger cars will also be exempt from motorway tolls [19].

Local governments have also been given the power to exempt electric cars from parking fees and to allow such vehicles to drive in bus lanes. As previously announced by the Czech government, further tax incentives were planned to be introduced in 2021, such as a toll exemption for DMC > 12 t electric tolls and to increase depreciation in the first year of use of the charging station. However, due to the economic downturn caused by the COVID-19 pandemic, the implementation of these plans is uncertain [18].

In line with the forecast set out in the National Clean Mobility Action Plan, approximately 17,000 electric cars should be on the road in the Czech Republic at the end of 2020, of which 6,000 BEV and 11,000 PHEV.

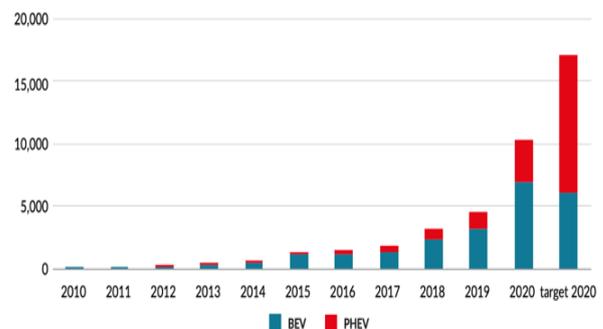


Figure 3 Number of electric vehicles in Czech Republic in 2010-2020  
Source: euki.de, 2021

As we can see in the picture, the growth rate of electric vehicle registration has increased significantly over the last two years. With ongoing support mechanisms, such as the possibility of drawing subsidies for the purchase of EVs for individuals, the prospects for further growth of the EV market in the Czech Republic are very promising.

However, data from the end of 2020 show that 10,000 electric vehicles were registered in the Czech Republic. Most of them, almost 7,000 BEV and more than 3,300 PHEV. The common target was thus reached at around 60% and the target for BEVs was exceeded by 15%.

The 2015 forecast shows that the domestic market potential for plug-in hybrid electric vehicles was significantly overestimated, as the target was only met at 28%. The data clearly show that these types of vehicles, which were not previously covered by financial and non-financial support mechanisms, are much less attractive to Czech customers than purely electric cars. Achieving the indicative targets set out in the National Clean Mobility Action Plan for 2025 and 2030 is thus fully within reach [18].

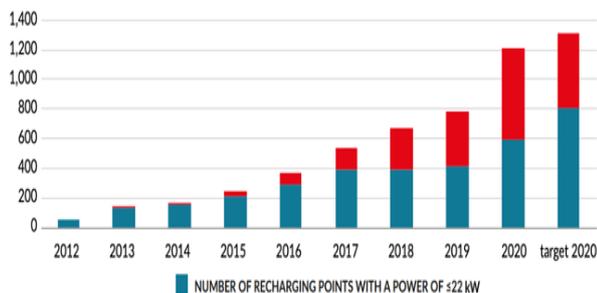


Figure 4 Number of charging stations in Czech Republic in 2012-2020

Source: euki.de, 2021

The result can be assessed positively, given that the Czech legal system does not set any binding targets for the development of infrastructure for charging electric vehicles.

The EV charging market in the Czech Republic is diverse. The market leader is the power company ČEZ. According to estimates, the company operated more than 230 charging stations (about 400 points) at the end of 2020 with a market share of more than 35%. The second largest player in the market in terms of the number of charging stations is the energy company E.ON (approximately 12% market share). Unlike Slovakia, two large foreign entities are starting to build their infrastructure network in the Czech Republic: the American Tesla (Supercharger with a capacity of at least 150 kW) and the consortium of European car companies IONITY (high-power points - with a capacity of at least 150 kW) [18].

### 3.3 The state of electromobility in Poland

European Commission adopted “Fit for 55” package, which goal is to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. This package assumes the withdrawn of the combustion engine vehicles from the market by 2035. One of the steps to achieve this goal and reduce generated CO2 emissions in Poland is to popularize the usage of electric (or another fuel) cars among consumers and to replace most of the governmental vehicles and public transport with electric vehicles. Electromobility in Poland is currently defined by one of the key documents, which is the Responsible Development Strategy, adopted in 2017. The document sets an indicative target of at least 1 million electric vehicles on Polish roads by the end of 2025 for the first time [22, 24].

The Polish government adopted a Plan for the Development of Electromobility in Poland in March 2017. This document defines the priority measures in the field of electromobility which should be implemented. The most important of these are:

- Changing the perception of electric vehicles among potential users.
- Development of an incentive system for electric vehicle users, including tax measures.
- Development and support of manufacturers in the segment of electromobility.
- Regulatory changes determining and supporting the development of electromobility.
- Modernization of the electricity network and its adaptation to the specific characteristics of electricity consumption by electric vehicles [22].

In 2018, The Act on Electromobility and Alternative Fuels was adopted to implement the measures and priorities set out in the Plan for the Development of Electromobility. It stipulates the following:

- Conditions for development and rules for the location of alternative fuel infrastructure in transport, as well as rules for the provision of electric vehicle charging services.
- Obligations of public entities which are related to securing a specific share of emission-free vehicles in their fleets and public transport fleets (buses).
- Rules for the operation of clean transport zones in cities [18].

Provisions that are contained in the law pave the way for the provision of benefits and incentives to owners and users of electric vehicles. They include:

- Exemption from excise duty on the purchase of personal battery electric vehicles (BEV) and, until 1 January 2021, on the purchase of personal plug-in hybrid electric vehicles (PHEV) 14.
- Allow electric vehicle drivers to use bus lanes by the end of 2025.
- Exemption of electric vehicles from fees in paid parking zones.
- Increasing the depreciation ceiling [18].

In response to many calls for the need to amend existing regulations, a proposal was drawn up in november 2021 proposing changes to the establishment and operation of clean transport zones, new tax measures and changes to the rules for the development of charging infrastructure.

Poland's energy policy until 2040 also included provisions on electromobility, adopted in February 2021. Under Specific Objective 4 - Development of energy markets and its part C) - Development of the market in oil and alternative fuels, including biocomponents and

electromobility, the target, below which the number of battery electric vehicles and plug-in hybrid electric vehicles registered in Poland was recorded in 2030, should be 600,000. 11,000 points with normal performance should be built. The previously adopted targets for the number of electric vehicles have therefore been reconsidered in the light of the current state and pace of development of the sector in Poland. The document also specifies the lines of action to be taken to reduce emissions from public transport. Following targets for cities with more than 100,000 inhabitants to increase the role of public transport in reducing so-called low pollutant emissions are also set in the document:

- From 2025 - all new buses purchased for public transport services will be electric and hydrogen buses.
- Since 2030 - fully emission-free public transport bus fleet [21].

In July 2018, on the basis of an amendment to the Act on Biocomponents and Liquid Biofuels, a Low-Emission Transport Fund was established, which was to serve to finance the planned activities related to the development of alternative fuels and electromobility infrastructure. The main objective of the fund was to provide financial support for the fulfillment of the tasks set out in the national documents for the development of electromobility and related infrastructure. An emission fee was set as a source of financing, which was set at PLN 0.08 per liter of fuel. The fund was to receive 15% of the fee income. Based on regulatory impact assessments, it was stated that revenues should reach PLN 1.7 billion in 2019. PLN 230 million of this should be transferred to the Low Emissions Fund. In ten years, revenue from the Low Emission Transport Fund was expected to reach PLN 6.75 billion. Despite the implementation of implementing acts drawn up and published in 2019 laying down rules for the disbursement of funds (including facilitating the purchase of electric vehicles for individuals, companies and institutions), the Low Emissions Transport Fund was never considered too complex and a decision was taken to liquidation. In practice, the low-emission fund was replaced by a multi-annual commitment from the National Fund for Environmental Protection and Water Management. The aim was to speed up the allocation of public funds for the development of low-emission transport by simplifying payment procedures. All funds raised in the Low Emissions Fund (estimated at approximately PLN 610 million at the end of September 2020) were transferred to the National Fund for Environmental Protection and Water Management [22, 33].

So far, only a small pilot project to support the purchase of an electric car has been implemented and completed in Poland. In June 2020, the National Fund for Environmental Protection and Water Management launched a call for applications under the priority programs on the basis of its own resources. This call was aimed at co-financing the purchase of the following vehicles:

- Cars for private individuals.
- Supplies for small and medium-sized enterprises (smes).
- Passenger cars used as taxis

Relatively complicated reimbursement procedures, low level of maximum support and also the launch of the program without prior notice were the cause of little interest from customers. Only 7% of almost PLN 150 million set aside for its implementation was paid [22, 31, 33].

Support for the purchase of emission-free buses was provided by the EU Transport Projects Center using the EU Cohesion Policy Fund (Operational Program Infrastructure and Environment and Regional Operational Program). As a result, virtually all electric buses that have been registered in Poland have been purchased. The maximum aid intensity could also be 85%. Support was provided for the purchase of buses and also for the purchase and installation of related charging infrastructure [31].

The National Fund for Environmental Protection and Water Management launched the Kangaroo Program in 2020. The purpose of this program was to support the purchase of emission-free buses (along with the purchase and installation of charging infrastructure) to bring children to schools, especially in rural communities. The amount of funding depended on the population and wealth of the village. For the smallest (up to 5,000 inhabitants) and least wealthy municipalities, the program could also cover 95% of the costs of purchasing an electric bus and the costs of purchasing and installing the related charging infrastructure. The funds that were allocated to the program amounted to PLN 60 million, including PLN 40 million for grants and PLN 20 million for loans. The Kangaroo program was implemented through the Green Investment Scheme (GIS). At the beginning of 2021, the National Fund for Environmental Protection and Water Management launched the Green Public Transport Program, which was to support the development of emission-free public transport. The budget for the first phase of the program (2021) is PLN 1.3 billion. A total of three calls under the program are scheduled for the end of 2023 [18].

In the first phase, funding will be provided as follows:

- Up to 80% of the cost of purchasing or renting electric buses and hybrid trolleybuses, including the cost of training drivers and maintenance staff.
- Up to 90% of the cost of purchasing or renting hydrogen buses, including driver costs and training of maintenance staff.
- Up to 50% of the costs for modernization and / or construction of hydrogen charging and / or filling infrastructure [30].

In the next phases of the program, which are planned for 2022-2023, the rate of support for the purchase or lease of electricity. buses and trolleybuses will be reduced to 70% and 60% (but the 90% aid rate

for hydrogen buses has remained unchanged). The second call for proposals is scheduled to be launched in 2022 and the third in 2023. The support program has not yet been set up to build a publicly available charging infrastructure. In December 2020, consultations were launched on a draft regulation by the Minister of Climate and the Environment, which specifies co-financing rules for the purchase and also for the installation of public and private charging stations for electric vehicles. According to the document, PLN 800 million is to be set aside for this purpose. The support would be provided as a priority for the programs of the National Fund for Environmental Protection and Water Management until 31.12.2023.

In accordance with the published proposal, the grant will be available for:

- Self-governing units.
- Entrepreneurs.
- Housing cooperatives and communities [18, 35].

At the end of 2020, the number of electric vehicles (BEV and PHEV) registered in Poland was 18,875, of which 10,041 were battery electric vehicles (BEV) and 8,834 plug-in hybrid electric vehicles (PHEV). The target that was set in the Electromobility Development Plan (50,000 EV) has been met at 38%.

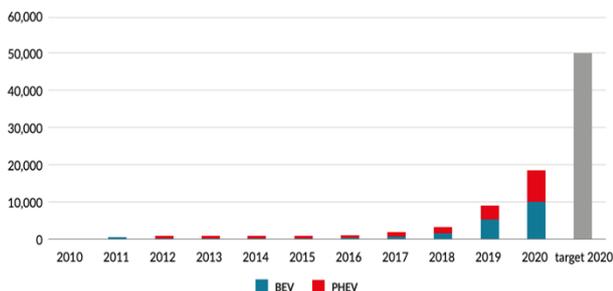


Figure 5 Number of electric vehicles (BEV and PHEV) in Poland in 2010-2020

Despite significantly lower presence of electric vehicles on the market compared to e.g. with the Netherlands, the United Kingdom, Germany or the Scandinavian countries, the growth rate in Poland is similar to that in these countries a few years ago. If the growth rate over the last three years is the same in the coming years, around 100,000 electric vehicles will be registered by the end of 2025 and the target of 1 million registrations will be reached around 2030. The situation is better for electric buses. At the end of 2020, there were 372 2,728 electric buses on Polish roads, making Poland 8th in the EU. Such a strong performance is largely due to the legally binding targets set for the share of emission-free buses in the municipal public transport fleet. In accordance with the provisions of the Act on Electromobility and Alternative Fuels, a territorial unit (municipality or region with a population exceeding 50,000 inhabitants) is obliged to ensure the share of emission-free buses in its fleet is at least:

a) 5% - from 1 January 2021,

- b) 10% - from 1 January 2023,
- c) 20% - from 1 January 2025,
- d) 30% - from 1.1.2028 [6, 31].

The interest of Polish consumers in purchasing electric cars is growing year by year. According above report, 29% of Poles declare that they are willing to buy an electric car, where in 2017 this percentage was only 12% [24].

There should be approximately 6,400 public EV charging stations in Poland by the end of 2020, including 6,000 stations with normal power (up to 22 kW) and 400 high-power stations (more than 22 kW) according to the forecast in the Electromobility Development Plan. The Act on Electromobility and Alternative Fuels established an obligation to provide an adequate number of public charging points in municipalities that meet certain criteria., The minimum number of charging points installed by the March 31, 2021 in public should be:

- 1,000 - in municipalities with a population of over 1 million people, where at least 600,000 people are registered. motor vehicles and there are 700 motor vehicles per 1000 inhabitants.
- 210 - in municipalities with a population of over 300 thousand, where at least 200 thousand are registered. motor vehicles and there are at least 500 motor vehicles per 1 000 inhabitants.
- 100 - in municipalities with more than 150,000 inhabitants, where at least 95,000 motor vehicles are registered and there are at least 400 motor vehicles per 1,000 inhabitants.
- 60 - in municipalities with more than 100,000 inhabitants, where at least 60,000 motor vehicles are registered and there are at least 400 motor vehicles per 1,000 inhabitants,

The number of public charging stations at the end of 2020 was around 1,700, of which fast charging stations accounted for 38% (648) and stations with a normal output of 62%, according to the European Observatory on Alternative Fuels (1,039) [8, 18].

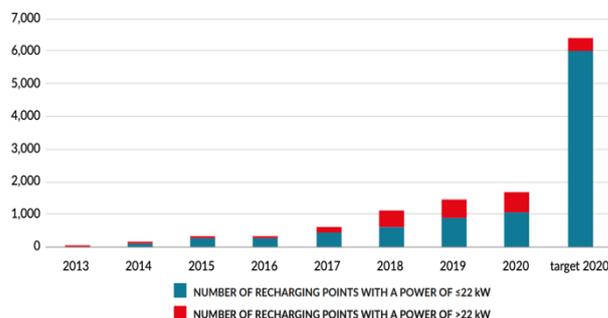


Figure 6 Number of charging stations in Poland in 2013-2020

The indicative target for charging infrastructure for electric vehicles by the end of 2020 has been met at 37.5%. Insufficient number of charging stations with normal performance - just over 1000 out of 6000 points were installed, which is 17% of the planned number is

the reason of such an output. The number of high-performance charging points (648) exceeded the target by more than 50%. The delayed fulfillment of the objectives set out in the Act on Electromobility and Alternative Fuels, combined with the lack of financial support instruments for the construction of such stations, is the reason for the insufficient number of charging stations. Greenway of Slovakia had the largest share on the Polish electric vehicle charging market. At the end of 2020, Greenway operated more than 800 charging stations, including most high-performance ones, based on an analysis of infrastructure data for alternative fuels. The leader was followed by state energy companies such as Orlen-Energa, PGE and Tauron<sup>31</sup>. It is worth noting that the rapid expansion of the charging infrastructure of these entities has been achieved thanks to EU funding provided under the specific instrument - the Connecting Europe Facility [6, 22].

The above trends and statistics showing the development of electromobility also translated into changes in the law introduced by the Polish legislator. Some of these are:

- With the planned investments of non-residential buildings, it will be necessary to provide one charging point and allow the installation of charging points for at least 1 in 5 parking spaces. Also for apartment buildings with more than 10 parking spaces, it will be necessary to set up charging points for each parking space.
- Public administration and self-government will be obliged to increase the fleet of electric vehicles (e.g. In municipalities with more than 50,000 inhabitants, electric buses will account for 20% in 2025, while the fleet of public authorities will have to account for 50% of electric cars).
- Specific regulations for the development of hydrogen refueling infrastructure and the definition of hydrogen as fuel are to be implemented;
- Charging services will be allowed to provide by more than one supplier [24].

### 3.4 The state of electromobility in Hungary

In order to develop a competitive e-mobility sector in Hungary, the government has taken several steps. The Jedlik Ányos Plan has been revised and updated, a predictable regulatory environment has been created for e-mobility providers through the Electromobility Act and its implementing regulations, and the infrastructure required can continue to be built in a competitive environment.

The document identifies key activities until 2030:

- Development and implementation of financial support instruments and incentives for electric vehicle users and development of charging infrastructure.

- Creation of an adequate and supportive regulatory environment for the development of electromobility.
- Deployment of a backbone-based charging infrastructure strengthening research and development in the domestic automotive industry.
- Electrification of public transport.
- Implementation of pilot projects designed to increase social awareness and acceptance of electromobility [18, 23].

The National Policy Framework for the Development of Infrastructure for Alternative Fuels was designed and adopted in 2016, in fulfillment of the obligations set out in Directive 2014/94 / EU. In 2020, an implementation report was submitted to the European Commission, which presents scenarios in line with the National Energy and Climate Plan. The indicative targets set out in both the electric vehicle fleet and charging infrastructure documents were as follows:

- 2020 - 21,200 electric vehicles and 1,500 charging stations.
- 2025 - 81 800 electric vehicles and more than 8 200 charging stations.
- 2030 - 182 000 electric vehicles and more than 20 600 charging stations [18].

A comprehensive revision of the National Electromobility Development Program took place in 2017, on the basis of which a completely new version was subsequently introduced and adopted - the Jedlik Ányos 2.0 Action Plan. The document identifies new, long-term policy goals for the development of electromobility:

- Implementation of a national model of the electromobility market, which will ensure the availability of electric vehicles for the widest possible group of retail and institutional customers.
- Decarbonisation of public transport (buses).
- Further expansion of the charging infrastructure.
- Involvement of central and local authorities in the implementation of the charging infrastructure and the expansion of the vehicle fleet using electric vehicles.
- Promotion of electric cars [7, 37].

Electromobility is considered to be an essential element of the decarbonisation of the transport sector, which is necessary to achieve the objectives of national and EU territorial policy. Unlike other V4 countries, natural gas was considered an unpromising fuel, which does not contribute to the implementation of climate policy objectives. The new program also provides updated electromobility scenarios, with more synthetic indicative targets for 2025 and 2030. It is estimated that there will be almost 300,000 (in 2025) and more than 500,000 (in 2030) electric vehicles on the road and that

23,000 (in 2025) and more than 53,000 (in 2030) rechargeable stations [18].

As part of the effort to adjust the regulatory environment, a legislative act dedicated exclusively to electromobility was drafted and approved, which addresses the definitions and key rules of the market for electromobility and brings them into law. In the amendment to the existing legislation, attention was also paid to other aspects of electromobility:

- In the Hungarian Energy Act, the obligation to have a license to trade in electricity was waived for charging station operators (a similar measure was applied in the Polish Electromobility Act).
- An RTP system for operators has been introduced.
- Procedures related to the construction and connection of charging stations have been significantly simplified.
- Special license plates for electric vehicles have been introduced into the Road Act.

In 2019, the National Public Transport Electrification Plan (Green Bus) was adopted, the purpose of which is to ensure by 2030 at least a 30% share of emission-free buses in the city bus fleet. In practice, this means exchanging approximately 900 buses for electric buses over the next 10 years [18].

The Hungarian electromobility support system is certainly the most extensive of those adopted by the Visegrad Group countries. Electromobility is supported by significant funding not only from EU cohesion policy funds, but above all from national funds. The transport sector typically accounts for more than one-fifth of greenhouse gas emissions, with vehicles accounting for the largest share. Kaderják stressed that the government's support for electromobility is a key part of climate protection, while transport is one of the most important areas where intervention is needed. The Green Economy Financing System is the key source of Hungarian support for the development of electromobility, supported by proceeds from the sale of emission allowances under the EU Emissions Trading Scheme (EU ETS). At present, around 50% of the funds spent on this system are used to support the purchase of vehicles and the expansion of charging infrastructure. Thanks to a consistent inflow of revenues from the sale of emission allowances in the coming years, the system has a stable, extra-budgetary source of financing electromobility, similar to the National Fund for Environmental Protection and Water Management (non-repayable grants) and from the European Investment Bank (EIB) provided as repayable assistance (soft loans) [18, 23].

Several financial support schemes have been completed in Hungary since 2016, aimed at the purchase of electric cars by individuals, companies and public institutions. In accordance with the criteria applied, the scheme favored the purchase of smaller and cheaper passenger cars, the price of which did not exceed EUR 48 300. A subsidy of EUR 5 000 was provided only for fully electric vehicles (BEVs). By

2020, a total of four calls for proposals had been launched, totaling around € 40 million. In June 2020, another edition of subsidies was launched for the purchase of electric vehicles with different conditions. In the case of an electric car whose gross price did not exceed 32,000 euros, the buyer received a subsidy of 7,350 euros. Vehicles with a price from EUR 32,000 to EUR 44,000, subsidy EUR 1,500. The purchase of more expensive vehicles is not covered by financial support. In 2019, as a result of the national bus strategy, the Hungarian government launched a green bus program aimed at replacing the obsolete public transport fleet by supporting the purchase of electric buses and encouraging domestic bus production. One part of the program is the implementation of a demonstration project of green buses, which brings electric buses to rural cities [18].

According to the scenario adopted in the National Policy Framework for the Development of Alternative Fuels Infrastructure, the number of electric vehicles in Hungary by the 2020 should be 21,000. The target that was set has been reached at around 50% and with pure electric vehicles (BEV) more than 6,100 [7].

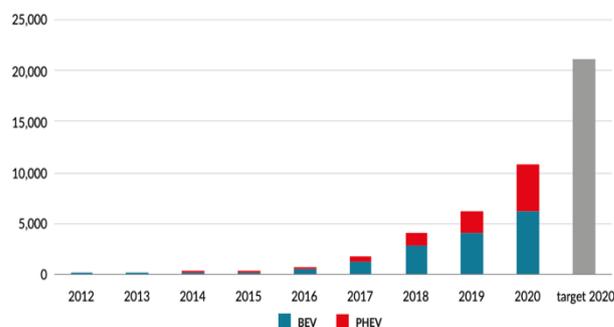


Figure 7 Number of electric vehicles (BEV and PHEV) in Hungary in 2012-2020

The share of electric vehicles (BEV and PHEV) in the new vehicle market exceeded 5.7% in 2020, which was almost twice as much as in other Visegrad Four countries. The growth rate of electric vehicles in Hungary is by far the highest of all V4 countries [7].

At the end of 2020 there were a total of 1,300 charging points (including 1,008 to 22 kW and 287 above 22 kW), which is approximately 87% of the target (1,500). The target for charging stations with an output of more than 22 kW has been achieved with a large surplus and the location of stations along motorways, expressways and major state roads allows the smooth movement of electric vehicles across Hungary. The pace of expansion of charging stations up to 22 kW was slower, with the exception of a few of the largest cities [18].

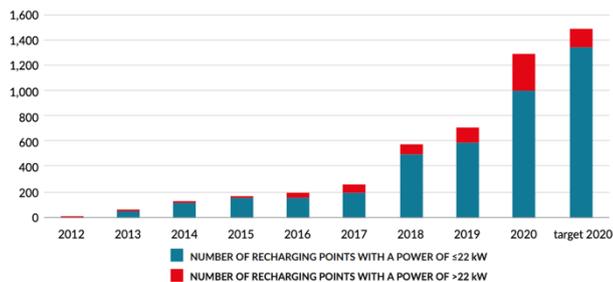


Figure 8 Number of charging stations in Hungary in 2012-2020

There are more than a dozen entities operating in the country, and the largest networks of charging points (from 10 to 40 points) are operated by E.ON, ELMU, E-MOBI, NKM Mobiliti and MOL [7].

#### 4 COMPARISON OF ELECTROMOBILITY GROWTH IN THE VISEGRAD FOUR COUNTRIES

The automotive sector in Europe is very important part of the economy, providing up to 15 million jobs and accounting for more than 6.7% of total employment in the EU. In 2019, 18.5 million vehicles were produced in Europe, which represents approximately 20% of global production. More than 5.5 million vehicles were exported, creating an EU trade surplus of € 74 billion. There are currently 313 million vehicles on the road in Europe. The production of vehicles and their components is one of the specializations of the manufacturing industry in the V4 countries. Poland and the Czech Republic have the largest number of companies operating in the automotive sector. The production in the sector also grew extremely fast in Slovakia and Hungary in the years 2010-2017. Slovak automotive industry is the most important for the econom. In 2010-2017, employment growth in the automotive sector was record high (54%) and Slovakia is nowadays the global leader in the annual production of vehicles per 1,000 inhabitants. In 2021, more than a million cars were produced in Slovakia, 184 per 1,000 inhabitants were produced, which makes this country a leader in the production of vehicles per capita [18] [38].

The automotive industry in the V4 countries is very important part of exports. Compared to other members of the group, Poland has a significant share in the automotive parts and components sector. While in the Czech Republic, Slovakia and Hungary, factories for the production of vehicles and main components (engines) play the most important role, Poland specializes in the production of spare parts and smaller automotive components [18].

The further development of electromobility in the Visegrad Four countries should be assessed in terms of two key factors:

- EU policies.
- Countries' commitments to measures to decarbonise transport.

As we can see in the above overview, the vast majority of the indicative targets for 2020 in the Visegrad Four countries have not been met. The only positive development was the expansion of the infrastructure of high-performance charging stations (above 22 kW), for which the 2020 targets were met in all V4 countries. The figure above represents the level of achievement of the electromobility development targets for 2020 in terms of vehicle fleet and charging infrastructure. What's interesting is that despite the crisis in the car market caused by the COVID-19 pandemic, the development of electromobility accelerated significantly in 2020 in all Visegrad Four countries [18].

#### 5 CONCLUSION

We can conclude that electromobility in the V4 countries is at an early stage of development. Activities related to obtaining direct financial support and fiscal instruments to support the use of electric vehicles were not sufficient to achieve the 2020 targets. The automotive sector is an important sector for all V4 countries because it accounts for a significant part of national GDP, offers a large number of jobs and exports. At present, we can say that the use of internal combustion engines is already in decline. This sector will have to undergo major changes, which will represent a transition to zero-emission technologies. This is in line with the main pillar of the new EU development paradigm, the green and digital economy. The future of the automotive sector in the V4 countries will be highly dependent on effective measures for such investments. Achieving the EU's greenhouse gas reduction target from 40% to 55% by 2030 compared to 1990 will require a significant reduction in emissions in the road transport sector. In addition to regulations setting standards for internal combustion engines, the primary measures to reduce emissions will be the development of electromobility and the decarbonisation of the energy mix.

Given that the Visegrad Four countries have considerable potential in the automotive sector, they can make a significant contribution to achieving these goals. The first flagship project recommended for the V4 countries is the creation of ElectricRoute. The aim is to connect the capitals of the V4 member countries with a network of multifunctional charging stations, ensuring the smooth movement of electric vehicles of all types between the capitals, which is Warsaw, Prague, Budapest and Bratislava. The second recommended flagship project is the establishment of a Regional Competence Center for Electromobility, which would strengthen the potential for electromobility development throughout the eastern part of the European Union. The center should support the training of engineers in new areas at technical universities and also develop and run a training and apprenticeship program for production workers. The Visegrad Fund would play a key role in the establishment and functioning of such an institution.

The Covid-19 pandemic had a negative impact on the automotive sector. However, it has had a positive impact on the sale of electric cars, as we have seen a growing trend. The reason is the declining interest in vehicles with a traditional internal combustion engine, and, conversely, the growing interest in electric cars and plug-in hybrids. The decision to reduce EU greenhouse gas emissions from 40% to 55% by 2030 compared to 1990 implies the need to ensure significant reduction in emissions in the road transport sector.

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## REFERENCES

- [1] Acea.auto, 2021. EU motor vehicle exports, top 10 destinations (by value) [online] Dostupné na: <https://www.acea.auto/figure/eu-motor-vehicle-exports-top-10-destinations-by-value> [cit.2021-12-12].
- [2] Acea.auto. 2021 World motor vehicle production [online] Dostupné na: <https://www.acea.auto/figure/world-motor-vehicle-production/> [cit.2021-12-12].
- [3] Autobild.pluska.sk, 2019. Vykúšali sme si registráciu na dotácie na elektrické automobily. Podarilo sa nám ju získať? Miliónový balík bol minúty takmer okamžite [online] Dostupné na: <https://autobild.pluska.sk/novinky/ziadali-sme-dotaci-u-e-auto-sest-milionov-eur-slovaci-rozchytali-styri-minuty> [cit.2021-12-17].
- [4] Consilium.europa.eu, 2021. Parížska dohoda o zmene klímy [online] Dostupné na: <https://www.consilium.europa.eu/sk/policies/climate-change/paris-agreement/#> [cit.2021-12-13].
- [5] Eafo.eu, 2015. National Action Plan for Clean Mobility (NAP CM) [online] Dostupné na:
- [6] Eafo.eu, 2021. European Alternative Fuels Observatory, Poland [online] Dostupné na: <https://www.eafo.eu/countries/poland/1748/vehicles-and-fleet> [cit.2021-12-22].
- [7] Eafo.eu, 2021. Ministry for Innovation and Technology, Report on alternative fuels infrastructure development in Hungary [online] Dostupné na: <https://www.eafo.eu/sites/default/files/nir/Hungary%20NIR%202019.zip> [cit.2021-12-23].
- [8] Eafo.eu, 2022. Database of the European Alternative Fuels Observatory, Hungary [online] Dostupné na: <http://www.eafo.eu/countries/hungary/1736/vehicles-and-fleet> [cit.2022-01-03].
- [9] Eafo.eu, 2022. Source: In-house analysis based on the European Alternative Fuels Observatory's data [online] Dostupné na: <http://www.eafo.eu/countries/hungary/1736/infrastructure/electricity> [cit.2022-01-03].
- [10] Ec.europa.eu, 2015. Európske štrukturálne a investičné fondy [online] Dostupné na: [https://ec.europa.eu/regional\\_policy/sources/docgener/guides/blue\\_book/blueguide\\_sk.pdf](https://ec.europa.eu/regional_policy/sources/docgener/guides/blue_book/blueguide_sk.pdf) [cit.2021-12-10].
- [11] Ec.europa.eu, 2019. Integrated National Energy and Climate Plan for 2021 to 2030 [online] Dostupné na: [https://ec.europa.eu/energy/sites/ener/files/sk\\_final\\_ncp\\_main\\_en.pdf](https://ec.europa.eu/energy/sites/ener/files/sk_final_ncp_main_en.pdf) [cit.2021-12-12].
- [12] Economy.gov.sk, [online] Dostupné na: <https://www.economy.gov.sk/uploads/files/crmLjLKj.pdf> [cit.2021-12-12].
- [13] Economy.gov.sk, 2017. Základné informácie o príspevku na kúpu elektromobilu [online] Dostupné na: <https://www.economy.gov.sk/aktuality/zakladne-informacie-o-prispevku-na-kupu-elektromobilu-1> [cit.2021-12-10].
- [14] Eea.europa.eu, 2016. Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions [online] Dostupné na: <https://www.eea.europa.eu/policy-documents/a-european-strategy-for-low> [cit.2021-12-16].
- [15] Eipa.udt.gov.pl, 2021. Office of Technical Inspection, Register of Alternative Fuels Infrastructure [online] Dostupné na: <http://eipa.udt.gov.pl/> [cit.2021-12-22].
- [16] Elektrickevozy.cz, 2020. Stát navyšuje dotace na elektromobily [online] Dostupné na: <https://elektrickevozy.cz/clanky/stat-navysuje-dotace-na-elektromobily> [cit.2021-12-15].
- [17] Elektrickevozy.cz, 2021. V Česku budou dotace na elektromobily a nabíjecí stanice, známe podrobnosti [online] Dostupné na: <https://elektrickevozy.cz/clanky/v-cesku-budou-dotace-na-elektromobily-a-nabijeci-stanice-zname-podrobnosti> [cit.2021-12-11].
- [18] Euki.de, 2021. Visegrad Electromobility – State, perspectives and challenges [online] Dostupné na: <https://www.euki.de/en/euki-publications/visegrad-electromobility/> [cit.2021-12-16].
- [19] Eur-lex.europa.eu, 2014. DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2014 on the deployment of alternative fuels infrastructure [online] Dostupné na: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32014L0094> [cit.2021-12-15].
- [20] Gov.pl, 2016. Ministry of Energy, Electromobility Development Plan in Poland “Energy for the future” [online] Dostupné na: <https://www.gov.pl/attachment/75d21d4a-fd28-400e-b480-a3bbc3f7db5e> [cit.2021-12-15].
- [21] Gov.pl, 2017. Strategy for Responsible Development until 2020 (with an outlook to 2030) adopted by the Council of Ministers on 14 February 2017 [online] Dostupné na: <https://www.gov.pl/documents/33377/436740/SOR.pdf> [cit.2021-12-15].
- [22] Gov.pl, 2021. Polityka energetyczna Polski do 2040 r. [online] Dostupné na: <https://www.gov.pl/web/klimat/polityka-energetyczna-polski> [cit.2021-12-15].
- [23] Hungarianinsider.com, 2020. New tenders announced to increase electromobility in Hungary [online] Dostupné na: <https://hungarianinsider.com/new-tenders-announced-to-increase-electromobility-in-hungary-5291/> [cit.2022-02-11].
- [24] Irglobal.com, 2021. Growth of the electromobility in Poland – promising sector and opportunities for foreign entities in SmartCity projects [online] Dostupné na: <https://www.irglobal.com/article/growth-of-the-electromobility-in-poland-promising-sector-and-opportunities-for-foreign-entities-in-smart-city-projects/> [cit.2022-02-11].
- [25] Mhsr.sk, 2019. Návrh - Akčného plánu rozvoja elektromobility v slovenskej republike [online] Dostupné na:

- <https://www.mhsr.sk/uploads/files/5wuw3Lle.pdf> [cit.2021-12-13].
- [26] Mhsr.sk. Vyhodnotenie medzirezortného pripomienkového konania [online] Dostupné na: [https://lrv.rokovania.sk/data/att/150782\\_subor.pdf](https://lrv.rokovania.sk/data/att/150782_subor.pdf) [cit.2021-12-14].
- [27] Mojelektromobil.sk, 2021. Dotácie na nákup elektromobilov a plug-in hybridov v roku 2022 nebudú [online] Dostupné na: <https://www.mojelektromobil.sk/dotacie-na-elektromobily-2022-nebudu/> [cit.2021-12-10].
- [28] Mzp.cz, 2019. Čistá mobilita [online] Dostupné na: [https://www.mzp.cz/cz/cista\\_mobilita\\_seminar](https://www.mzp.cz/cz/cista_mobilita_seminar) [cit.2021-12-10].
- [29] Nfosigw.gov.pl, 2021. The National Fund for Environmental Protection and Water Management, Green car – co-financing of purchase of an electric passenger car (M1) [online] Dostupné na: <http://nfosigw.gov.pl/oferta-finansowania/srodki-krajowe/programy-priorytetowe/zielony-samochod/> [cit.2021-12-16].
- [30] Nfosigw.gov.pl, 2021. The National Fund for Environmental Protection and Water Management, Kangur – Safe and eco-friendly journey to school [online] Dostupné na: <http://nfosigw.gov.pl/oferta-finansowania/system-zielonych-inwestycji---gis/konkursy/kangur-bezpieczna-i-ekologiczna-droga-do-szkoly-2020/> [cit.2021-12-20].
- [31] Pb.pl, 2020. Puls Biznesu, PSPA: program dopłat do zakupu samochodów elektrycznych do poprawy [online] Dostupné na: <http://www.pb.pl/pspa-program-doplat-do-zakupu-samochodow-elektrycznych-do-poprawy-999442> [cit.2021-12-20].
- [32] Podatki.sk, 2017. Rejestracja samochodu na Słowacji [online] Dostupné na: <http://podatki.sk/2017/03/20/rejestracja-samochodu-na-slowacji/> [cit.2021-12-12].
- [33] Przemyslisrodowisko.pl, 2020. Przemysł i Środowisko, Likwidacja FNT - zmiany w ustawie o biopaliwach, 2020 [online] Dostupné na: <https://przemyslisrodowisko.pl/likwidacja-fnt-zmiany-w-ustawie-o-biopaliwach/> [cit.2021-12-17].
- [34] Pspa.com.pl, 2021. Polish Alternative Fuels Association, E-mobility Meter [online] Dostupné na: <https://pspa.com.pl/research/licznik-elektromobilnosci/>. 28 [cit.2021-12-22].
- [35] Regislacja.rcl.gov.pl, 2020. Ministry of Climate and Environment, Draft regulation of the Ministry of Climate and Environment on detailed conditions for granting state aid for electric vehicle charging infrastructure and hydrogen refuelling infrastructure [online] Dostupné na: <http://legislacja.rcl.gov.pl/projekt/12341508> [cit.2021-12-22].
- [36] Renaultalways.com, 2021. Electric mobility a bright future [online] Dostupné na: <https://renaultalways.com/en/2021/06/29/electric-mobility-a-bright-future/> [cit.2021-12-13].
- [37] Startuponline.hu, 2020. R. Jánoska, Ez a terv a magyar elektromos autózással kapcsolatosban, StartUp! [online] Dostupné na: <https://startuponline.hu/ez-a-terv-a-magyar-elektromos-autozassal-kapcsolatban/> [cit.2021-12-23].
- [38] Techbox.dennikn.sk, 2018. GreenWay získal milióny, postaví 850 nových nabíjacích staníc [online] Dostupné na: <https://techbox.dennikn.sk/greenway-ziskal-miliony-postavi-850-novych-nabijacich-stanic/> [cit.2021-12-16].
- [39] Teslamagazin.sk, 2018. České elektromobily a hybridy dostanú špeciálne ŠPZ, ktoré prinesú výhody. A čo Slovensko? [online] Dostupné na: <https://www.teslamagazin.sk/elektromobily-hybridy-cesko-podpora-spz-vyhody/> [cit.2021-12-15].
- [40] Teslamagazin.sk, 2021. Česi spustili dotácie na elektromobily a nabíjacie stanice. Ako fungujú? [online] Dostupné na: <https://www.teslamagazin.sk/dotacie-na-elektromobily-cesko/> [cit.2021-12-10].
- [41] Teslamagazin.sk, 2021. Nový slovenský dotačný program pre elektromobily stále nemá presnejší termín spustenia [online] Dostupné na: <https://www.teslamagazin.sk/dotacie-elektromobily-2021-slovensko/> [cit.2021-12-11]

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