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AN OVERVIEW OF ELECTROMOBILITY IN ROMANIA

VASILE POPA[1], OCTAVIAN COCOȘ[1], RĂZVAN OPREA[1]

Abstract

Environmental changes, and especially air pollution and global warming, are increasingly affecting population and natural ecosystems. Air pollution only is responsible for the premature death of million people in the entire world. Of the pollution sources, road transport has a significant contribution, including the CO_2 emissions. Under the circumstances, urgent measures are required in order to cut down the polluting emissions by promoting alternative technologies, including electrical mobility. At present, electric cars are less attractive because of their high prices, the underdeveloped battery charging infrastructure and the relatively low autonomy. At the global level, in the year 2018 there were over 5 million electric cars running, but the development occurring over the past years has been quite remarkable. In Romania, until January 2020 were sold more that 3600 electric cars, including plug-in hybrids. These vehicles may represent a substantial component on the long run, but their increasing number may put a higher pressure on electric power production, transport network and price.

Keywords: *air pollution, CO_2 emission, road transport, electromobility, public perception.*

1. Introduction

Air pollution is one of the most serious problems confronting human society and environment. The transport activities, especially the road ones, are a significant source of air pollution because of their emissions of suspended particulate matter, nitrogen oxides, carbon monoxide and hydrocarbons. Also, they account for 24% of the carbon dioxide emissions (IEA, 2017). Worlwide, more than 4 million people

[1] University of Bucharest, Faculty of Geography, E-mail: popavasile2005@yahoo.com; octaviancocos@yahoo.com; opreaconstrazvan@yahoo.com

prematurely die as a result of exposure to outdoor air pollution (OMS, 2018). At the same time, air pollutants have negative effects on climate, biodiversity, waters, soil, crops and buildings. One of the measures to cut down pollution, especially in the big cities, as well as the carbon dioxide emissions (the main gas in the atmosphere leading to greenhouse effect), is the shift to electromobility.

Over the last decade, there has been a significant increase of the number of electric cars on the world roads. If in 2005 were in use only 1890 electric cars and light plug-in hybrids (small-size passenger and commercial motor vehicles), by 2018 their number exceeded 5.1 million, an increase by 2 million in comparison with 2017. China is the largest market in the world, with nearly 1.1 million electric cars sold in 2018 and a reserve of 2.3 million units. Second comes Europe, with 1.2 million cars and the United States, with 1.1 million (IEA, 2019). According to the New Policies Scenario and the EV30@30 Scenario, by the year 2030 the total number of electric motor cars may reach 130 million or, respectively, 228 million units, most of them being light electric vehicles. The New Policies Scenario, designed by the the International Energy Agency, has taken into consideration the existing policies and measures, as well as the potential effects of the announced policies, while the EV30@30 Scenario, designed by the Electric Vehicles Initiative (multi-governmental political forum dedicated to accelerating the introduction of electric vehicles worldwide), has taken into consideration more ambitious policies regarding climate and environment durability.

On the long run, the elecromobility dynamics will depend on several factors, such as: public policies, technological development, battery performance and costs, battery charging infrastructure, availability of raw materials, and the costs of the electric power. In order to encourage the development of electric mobility, the main measures adopted were fiscal incentives for the purchase of electric vehicles, public procurement programs and emission standards. Almost all the countries of the world are committed to reducing greenhouse gas emissions, as an obligation to the Paris Climate Agreement, which aims at restricting the global warming to less than 2°C. Under the circumstances, in 2017 the European Commission has proposed new CO_2 emission standards for the new vehicles as part of the Clean Mobility package, aiming at cutting down

by 30% the emissions of CO_2/km for the new vehicles by the year 2030, in comparison with 2021 (CE, 2018). This was the second important mobility package presented in 2017, the first being Europe on the Move, both of them following the European Strategy for Low-Emission Mobility, adopted in 2016.

2. Materials and methods

In Romania, the air quality monitoring network has autonomous fixed stations and is managed by the National agency for Environmental Protection. The data from the stations can be viewed on the governmental website *calitateaer.ro*. Bucharest and Ploiești also have an independent air quality monitoring network, consisting of 14 sensors, which came into operation on 1st October 2018 and became accesible to the public on the website *https://airly.eu/map/en/*. The data regarding the contribution of road transport to atmospheric pollutant emissions are based on the Informative Report to the National Inventory of Atmospheric Pollutant Emissions, quoted by the Ministry of Energy. The data on electromobility at international level have been provided by the International Energy Agency (IEA), while the source for those referring to Romania has been the Association of Automobile Manufacturers and Importers (APIA). As far as the car park in Romania is concerned, we have turned to the Direction Licence Driving and Vehicle Registration (DRPCIV).

In order to find out the public perception regarding air pollution as a result of road transport and the need to develop electric mobility, we conducted a questionnaire with 385 respondents. In the survey carried out during the period May-August 2019 were allowed to participate all the people interested in air quality, either by accessing the online questionnaire or by filling in the printed copies distributed directly. Of the 385 survey participants, 44% were male and 56% female. Most of them were between 18 and 35 years old (81%) and were higher educated people (69%). Almost half of the participants were students, followed by employees in various public institutions.

3. The car park in Romania and the vehicle exhaust emissions

In recent years, in Romania there has been a rapid growth of the car fleet, especially through the import of used vehicles. Thus, at the end of 2019, more than 8.7 million vehicles were registered in Romania, of which about 7 million were cars (DRPCIV, 2019). Of these, almost 55% were 11-20 years old, and 24% were over 20 years old (table 1).

Table 1

The evolution of the Romanian car park between 2010-2019

Year	Total number of motor vehicles	Age		
		0-10 yr.	11-20 yr.	> 20 yr.
2010	5418953	3038489	1448315	932152
2011	5482654	3011911	1560534	910209
2012	5710773	2612001	2056682	1042090
2013	5985085	2511152	2337921	1136012
2014	6270615	2713119	2453977	1103519
2015	6600325	2618860	2773419	1208046
2016	7010608	2063220	3387739	1559649
2017	7635775	1860244	4055844	1719687
2018	8193278	1742283	4559077	1891918
2019	8749390	1869154	4789134	2091102

Source: DRPCIV, 2019

In 2019, 200895 new vehicles were purchased in Romania (an increase by 7.3% in comparison with 2018), of which 173239 were passenger vehicles (fig. 1). At the same time, 440601 used vehicles were imported (a drop by 6.1% in comparison with 2018), of which more than 50% were older than 12 years (polluting cars, with the pollution norm below Euro 4) (APIA, 2019).

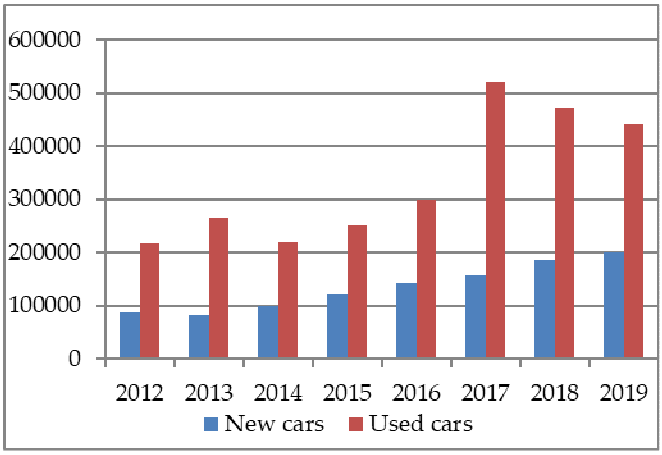

Fig. 1. Purchase of new and used cars in Romania over the period 2012-2019 (*Source:* APIA, 2019)

The contribution of road transport to the total emissions of atmospheric pollutants, according to the Informative Report to the National Inventory of Atmospheric Pollutant Emissions (Ministry of Energy, 2017), which includes the total emissions of atmospheric pollutants for the period 2005-2015, is 40% of the total national emissions for the NOx pollutant (of which: 12% from cars, 23% from heavy vehicles and buses and 5% from light vehicles), 12% of the total national emissions for carbon monoxide and 5% of total emissions for volatile organic compounds, except for methane. Greenhouse gas emissions generated by road transport in Romania increased by almost 68% compared to the level of the base year 1989 (when they were 8998.9 kt CO_2 equivalent) and reached levels of 15093.5 kt CO_2 equivalent in 2015. These represent about 96% of the total greenhouse gas emissions in the transport sector.

4. The evolution of electric vehicles market in Romania

In 2014, the development of the infrastructure for alternative fuels and the stimulation of the purchase of vehicles incorporating advanced, non-polluting or low pollution technologies were almost non-existent. By January 2020, 3659 electric vehicles were sold in Romania, including

plug-in hybrids (fig 2). In 2019, 95% more electric vehicles were delivered in comparison with 2018, i.e. 1924 units (APIA, 2019).

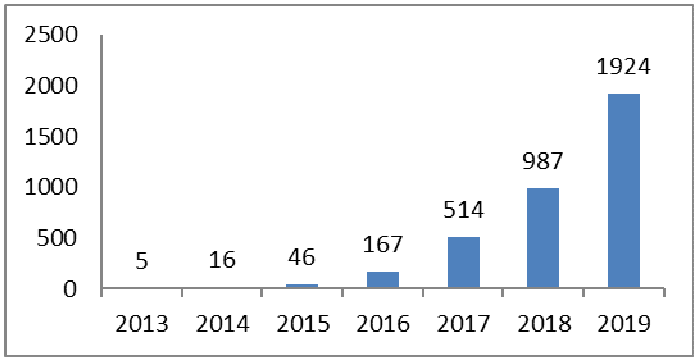

Fig. 2. Numerical evolution of passenger electric vehicles (including rechargeable hybrids/plug-ins) sold during the period 2015-2019 *(Source:* APIA, 2020*)*

Of the 1924 electric vehicles delivered in 2019, 1523 were 100% electric (an increase by 123% in comparison with 2018) and 401 were plug-in hybrids (an increase by 31.5% in comparison with 2018). The most sold were the following:

- 100% electric cars: Renault (439 units), Nissan (375), BMW (229), Volkswagen (218), Smart (183), Jaguar (37) (Table 2);
- hybrid plug-in: Mitsubishi (134 units), Volvo (79), BMW (58), Porsche (41), Land Rover (40), Mini (28), Mercedes-Benz (11), Toyota (10).

Table 2

The main vehicles sold in Romania – comparative analysis

Car brand	Battery capacity	Real autonomy	Battery charging time depending on the charging source	Price of the basic model with VAT, in euros (2020)
Renault ZOE	44,1 kWh	255 (180-385)	Between 45 minutes (CCS station 50 kW DC; battery charging from 10 to 80%) and 21 hours (Wall Plug 2.3 kW; 0-100%)	30350
Nissan Leaf	40 kWh	220 (155-325)	Between 40 minutes (CHA of de MO50 kW DC; 10-80%) and 18 hours and 30 minutes (Wall Plug 2.3 kW; 0-100%)	36700
BMW i3	42,2 kWh din	235 (165-365)	Between 36 minutes (CCS 50 kW DC; 10-80%) and 19 hours and 30 minutes (Wall Plug 2.3 kW; 0-100%)	40282
Volkswagen e-Golf	35,8 kWh	190 (135-285)	Between 36 minutes (CCS 50 kW DC; 10-80%) and 16 hours and 30 minutes (Wall Plug 2.3 kW; 0-100%)	38913
Smart EQ fortwo Cabrio	17,6 kWh	95 (65-155 km)	Between 55 minutes (22 kW) and 8 hours and 45 minutes (Wall Plug 2.3 kW; 0-100%)	25867

Source: Electric Vehicle Database, 2020

Electric passenger vehicles (including plug-in hybrids) and hybrid vehicles (having no batteries that can be charged to the outlet) accounted for 3.8% of the total new passenger vehicles sold in Romania in January 2020, a value higher than in 2018 (2.9%).

5. Electric vehicle charging infrastructure

To increase the attractiveness of electric vehicles, the wide distribution of charging stations and the battery charging speed are essential, especially in urban areas and for long distance travel. In general, depending on the power of the station (socket), there are several charging modes: slow (normal), fast and ultra-fast. The domestic socket ensures the charging of a small capacity battery (up to 20-25 kWh) in about 8-10 hours. For larger capacity batteries Normal Charge or Fast Charge stations (Combined Charging System/CCS, Charge de Move/CHAdeMO, Tesla Supercharger) are required. The first charging point for electric cars in Romania, a normal 230 V and 16 A power outlet, was inaugurated on June 22, 2011 at the Transelectrica headquarters near the Piața Unirii in Bucharest. At the end of 2014, there were only two public battery charging stations in Romania, in Bucharest and Brașov, a few other power points being at the premises of private companies (Green Report, 2014).

In 2015, the first high-power station (50 kW) was installed at the Porsche Romania headquarters in Pipera, and in 2016 similar stations came into operation at the BMW Group headquarters and in the parking lots of the large shopping centers Kaufland and Lidl (in Bucharest). The number of charging stations nationwide has increased year by year, reaching 441 in January 2020 (up 82% from January 2019), according to the PlugShare application (EV Romania, 2020). Applications, such as PlugShare or Electromaps, provide a map of all public charging stations. To these are added some private stations. There is no uniform distribution of charging stations, the highest density being in urban areas (137 stations in Bucharest). In all major cities there are several medium power charging points (22 kW) and at least one fast station (50 kW). In contrast, from Bucharest to Constanța, on the Sun Highway, there is no station. There

are not enough stations in the southwestern counties of the country, either. However, there are prospects for development. For instance, Enel X Romania (Enel's new global division) plans to create a charging infrastructure for electric vehicles, which will cover the entire country. Around 2500 charging points will be installed between 2019 and 2023 in all regions of Romania, in the big cities and on the main roads. The infrastructure will be based on state-of-the-art technology developed by Enel X and will consist of Quick (22 kW), Fast (50 kW) and Ultrafast (150 kW) stations.

In Romania, among the charging station operators stands out Renovatio e-charge, which, at the beginning of 2020, had the largest network of charging stations for electric cars in Romania, with 173 charging points and 44 fast charging stations, in 58 locations in the country. Many charging points are in the parking lots of Kaufland stores.

6. Policies to support electromobility

In general, the electric vehicle industry was supported by the political factor. The most important measures were the fiscal incentives for the purchase of electric vehicles, the public procurement programs and the stricter emission standards. In Romania, three programs funded by the Environment Fund (established by the Emergency Ordinance no. 196 of December 22, 2005) were promoted:

1. The program regarding the reduction of greenhouse gas emissions in transport activities by promoting clean and energy efficient road transport vehicles; in 2018, for the purchase of a 100% new electric vehicle, an eco-voucher of 45000 lei was granted, and for the purchase of a hybrid electric vehicle with an external power source, which generates an amount of CO_2 emissions less than 50g / km, the eco-voucher had the value of 20000 lei.

2. The program on reducing greenhouse gas emissions in transport activities by promoting infrastructure for clean and energy efficient road transport vehicles, as well as by setting up recharging stations for plug-in hybrid and electric rechargeable vehicles.

3. The program on improving air quality and reducing greenhouse gas emissions through the use of less polluting vehicles in local public passenger transport.

Also, by the Government Decision no. 739 of October 5, 2016 was approved the National Strategy for Climate Change and Economic Growth based on Low Carbon Emissions for the period 2016-2020, as well as the National Action Plan for the implementation of this strategy; the objectives of this policy regarding the transport sector include: introducing strong economic incentives for an ecological transport system and increasing the efficiency of urban transport.

Law 34/2017 on the installation of alternative fuels infrastructure (transposition of Directive 2014/94/EU) regulated the measures designed to install the alternative fuels infrastructure, in order to minimize the dependence on oil and to mitigate the impact of transport on the environment. The national policy framework for the development of the market regarding alternative fuels in the transport sector and for the installation of the relevant infrastructure in Romania was designed in accordance with the provisions of Chapter II of Law 34/2017.

7. Public perception of air pollution and the need to develop electromobility in Romania

The questionnaire analysis showed that people are concerned about air pollution in the area in which they live, work or study, one of the biggest concerns being the emission of suspended particles. It is also well known that air pollution can have negative effects on human health, the environment and the economy, and that road transport is a major source of pollution (Table 3). Although more than half of the respondents are considering to purchase in the future an electric car or a plug-in hybrid, 63% of them would not buy right now an electric car because the price is too high and there is not enough battery charging infrastructure (Figures 3 and 4).

Table 3

The perception regarding the role of road transport in air pollution

Question	Answer	Percentage
Are you concerned about air pollution in the area where you live/wor /study?	Yes No	98% 2%
What are the main air pollutants that concern you the most? (multiple choices)	Suspended particles Nitrogen oxydes Carbon monoxide Carbon dioxide Hydrocarbons Ground level ozone	75% 31,7% 59,5% 56,6% 41% 14%
Do you know that air pollution can have negative effects on human health, the environment and the economy?	Yes No	100% 0%
Is road transport (motor vehicles) a major source of pollution?	Yes No I don't know	98,2% 1% 0,8

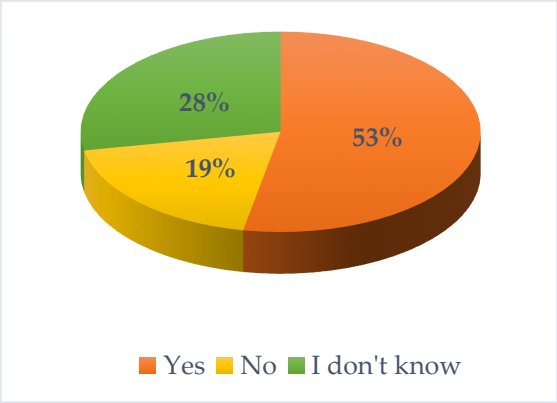

Fig. 3. Do you consider purchasing an electric car or plug-in hybrid?

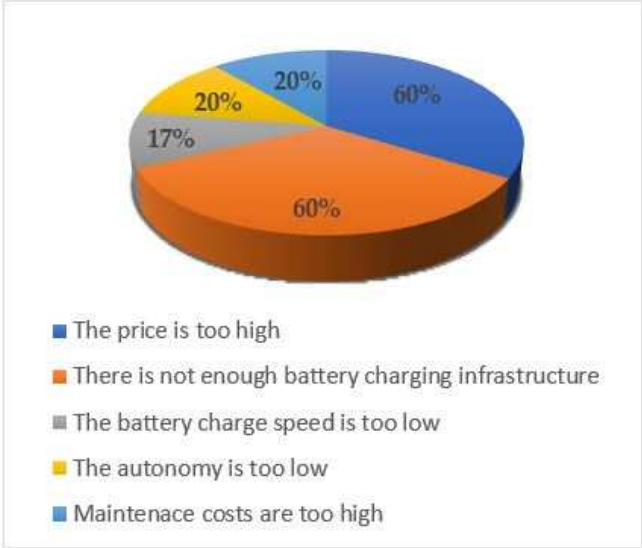

Fig. 4. Why haven't you bought an electric car or plug-in hybrid? (multiple choices)

Conclusions

Although for the time being the share of electric vehicles is very low, electric mobility is expected to become a consistent component of long-term road transport. In the context of the current level of technological development, in the coming years we can expect an expansion of electromobility in urban and peri-urban environments, especially through the electrifying of public transport. Thus, the lack of direct emissions will especially contribute to the improvement of air quality in the cities. In the future, the expansion of electric mobility will depend on the technological developments in the field, the expansion of the charging infrastructure, the accessibility, as well as on the price of raw materials and energy. In order to reduce pollution, it is necessary to cut down the share of fossil fuels (especially coal) in electricity production and to use extensively the renewable sources, because most of the carbon footprint of electric vehicles (during the life cycle) comes from electricity consumption.

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