MOBILITY & VEHICLE MECHANICS

https://doi.org/10.24874/mvm.2023.49.02.05
UDC: 629.3.038:502

THE INFLUENCE OF BATTERY ELECTRIC AND PLUG-IN HYBRID ELECTRIC VEHICLE APPLICATION ON CO_2 EMISSIONS

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Received in August 2023 *Accepted in September2023*

RESEARCH ARTICLE

ABSTRACT: This paper provides an overview of the growth in sales of Battery Electric Vehicles (BEVs) and Plug-in Hybrid-Electric Vehicle (PHEVs) in the world, Europe, and Montenegro for the period from 2011 to 2020. The percentage share of sold EVs (Electric vehicles) (BEVs and PHEVs) in the total number of vehicles sold for the mentioned period is also shown. It can be noted that the number of BEVs and PHEVs sold in the world and in Europe is constantly increasing for the period from 2011 to 2020. It was noticed that there is also an increase in the share of BEVs and PHEVs, but it is still very small. As BEVs and PHEVs (when powered by an electric motor) use electricity for propulsion, it is very important to explore the way electricity is produced by sources, which was done in the paper. Electricity is produced not so cleanly, but there is a constant increase in the share of renewable energy sources (RES) in electricity production. Electricity production in the world is dominated by coal and natural gas. An overview of electricity consumption by sector in the world, Europe, and Montenegro is given. For the period from 2011 to 2020, this paper provides an overview of CO_2 emissions by sector. The largest amount of CO_2 emission is emitted in the electricity generation and heating sector. The transport sector also emits a large amount of CO_2 emissions. The transport sector and the electricity/heating production sector are the two sectors that have been targeted as the main culprits for the constant increase in CO_2 emissions. In Europe, the total CO_2 emission is in a slight decline, which is a consequence of the EU's great efforts to reduce this emission from the mentioned two sectors. In this paper, it was shown that the number of BEVs and PHEVs, as well as their share in the total number of vehicles, is still too small to significantly impact the reduction of CO_2 emissions at the global level.

KEY WORDS: *electric vehicles, ecology, CO_2 emission, electricity, decarbonization*

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UTICAJ PRIMJENE ELEKTRIČNIH I HIBRIDNIH VOZILA NA CO_2 EMISIJU

REZIME: U ovom radu dat je pregled rasta prodaje Battery Electric Vehicles (BEV) i Plug-in Hybrid Electric Vehicle (PHEV) u svijetu, Evropi i Crnoj Gori za period od 2011. do 2020. godine. Takođe prikazan je i procentualni udio prodatih EV (Electric vehicles) vozila (BEV i PHEV) vozila u ukupnom broju prodatih vozila za pomenuti period. Može se primijetiti da je u svijetu i Evropi broj prodatih BEV i PHEV vozila u stalnom porastu za period od 2011. do 2020. godine. Primjećeno je da je prisutan i rast udjela BEV i PHEV vozila, ali je on i dalje veoma mali. Kako BEV i PHEV (kada je pogon preko elektromotora) vozila koriste za pogon električnu energiju veoma važno je sagledati način proizvodnje električne energije po izvorima, što je u radu urađeno. Električna energija se proizvodi na ne tako čist način, ali je prisutan stalan porast udjela obnovljivih izvora energije (OIE) u proizvodnji električne energije. Proizvodnjom električne energije u svijetu dominiraju ugalj i prirodni gas. Dat je pregled i potrošnje električne energije po sektorima u svijetu, Evropi i Crnoj Gori. Za period od 2011. do 2020. godine u ovom radu dat je pregled CO_2 emisije po sektorima. Najveća količina CO_2 emisije emituje se u sektoru proizvodnje električne energije i grijanju. Transportni sektor takođe emituje veliku količinu CO_2 emisije. Transportni sektor i sektor proizvodnje električne energije i grijanja su dva sektora koja su targetirana kako glavni krivci za stalno povećanje CO_2 emisije. U Evropi ukupna CO_2 emisija je u blagom padu što je posledica velikih napora EU da smanje ovu emisiju iz pomenuta dva sektora. U ovom radu pokazano je da je broj BEV i PHEV vozila, kao i njihov udio u ukupnom broju vozila i dalje veoma mali da bi imao neki primjetno značajniji uticaj na smanjenje CO_2 emisije na globalnom nivou.

KLJUČNE REČI: *električna vozila, ekologija, CO_2 emisija, električna energija, dekarbonizacija*

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INTRODUCTION

Improving the quality of life in cities is one of the biggest challenges facing society today. Over the years, various studies have been conducted to identify the sources of pollution, among which transport plays a leading role. Therefore, scientific research conducted in search of reducing the negative impact of transport on the environment is predominantly focused on the development of electromobility [1]. We live in a time when it is necessary to make various decisions to minimize the negative impact of transport on the environment. Oil is the dominant source of energy in the transport sector, especially in road traffic. Heavy dependence on fossil fuels makes transport a major contributor to greenhouse gases, and it is also one of the few industrial sectors where emissions are still growing. The impact of transport on climate change is not limited to vehicle emissions, because fuel production and distribution, as well as vehicle production, contribute significantly to the production of greenhouse gases. For example, consideration of the total CO_2 emissions from an average car showed that 76% of this emission comes from the combustion of fuel in the internal-combustion engine (ICE) of the vehicle, while as much as 9% come from the production of the vehicle itself, and an additional 15% come from losses in the system for fuel supply. The fact that, despite great efforts in recent years to reduce the negative impact of transport on the environment, we still live in the age of oil, shows that solving this problem is not very simple [2]. Global transport emissions have grown rapidly over the past decade. The energy transition in transport is currently lagging behind other sectors, and changes in vehicle and fuel technology, as well as pressures to reduce the sector's impact on climate change, may enable a very different future. Large reductions in emissions can be achieved by decarbonizing fuels or vehicles, or a combination of both. Options for reducing emissions include switching from conventional vehicles to electric and hybrid vehicles and switching from fossil fuels to biofuels. Despite strong support from agricultural interest groups, first-generation biofuels have faced availability constraints, sustainability concerns, and public opposition. Instead, attention has shifted to advanced biofuels derived from non-edible lignocellulosic residues and wastes due to their potential to offer significant quantities of low-GHG fuels on a large scale while avoiding many of the problems associated with first-generation biofuels [3]. Electrification is also widely recognized as a very powerful way to reduce greenhouse-gas emissions in transport. However, the study [4] showed that although the number of new electric vehicles in China increased four times from 2016 to 2019, the growth rate of emissions from road traffic is still around 20,5%. The current electrification of road traffic in China can reduce only 0,6% of the total emissions in this sector, but this reduction could be increased to 1,4% if the electricity was completely obtained cleanly, from RESs. The transport sector in China could reach the peak of carbon dioxide emissions in 2030, with 1330,98 Mt. The electrification of transport would not be able to meet the climate goals of 2060, and the continuation of the inertia of conventional vehicles will significantly slow down the path of road traffic towards the complete elimination of carbon dioxide [4]. Two technical ways to reduce greenhouse-gas emissions from the transport sector are [5]:

- increasing the energy efficiency of the drive system i
- reduction of emissions from energy sources.

First, improving energy efficiency can reduce energy consumption, which directly reduces greenhouse-gas emissions. Electric motors are more energy efficient for transport use compared to ICEs, due to their high efficiency over a wide speed range. It is electric and plug-in hybrids that use this advantage to reduce greenhouse-gas emissions during the operation. Second, the release of emissions during the electricity production plays a very important role in the decarbonization process. Propulsion systems using renewable fuels are also considered low-carbon propulsion systems. Replacing fossil fuels with fuels that have a low-carbon content has the potential to significantly reduce CO_2 emissions from the transport sector in a progressive manner [5]. In the paper [6], four strategies for the decarbonization of the transport sector at the global level until 2050 are investigated, using the MEDEAS-W model that combines different options of electrification, vehicle replacement, and demand-side management. It is important to note that conventional studies in the literature reveal only that the decarbonization of transport, on a global scale, is only possible under the unreliable assumption that in the future currently uncertain technologies such as advanced biofuels, hydrogen, fuel cells will be widely available commercially and at a sustainable level. The transport sector has been identified as one of the most complicated sectors for decarbonization. Otherwise, the transport sector is also characterized as the sector with the fastest growth in greenhouse-gas emissions compared to other sectors [6].

In this paper, the impact of increasing the number of BEVs and PHEVs in the world, Europe, and Montenegro on CO_2 emissions for the period from 2011 to 2020 is analyzed. As the way of obtaining electricity that will be used by BEVs and PHEVs has a great influence on the decarbonization of road traffic through electrification, this paper also analyzed the production of electricity by sources for the period from 2011 to 2020. As it is expected that in the relatively near future the transport sector, with an increasing share of BEVs and PHEVs on the roads, will be one of the most important consumers of electricity, the consumption of electricity by sector for the period from 2011 to 2020 is also shown.

1. BEVS AND PHEVS - BENEFITS AND CONSIDERATIONS

One of the main ways to decarbonize road traffic is to change the drive of road transport vehicles. In this way, traditional vehicles that use liquid petroleum fuels to achieve propulsion are replaced by vehicles with alternative drives. Vehicles with alternative drives enable incomparably better environmental characteristics compared to conventional vehicles that burn liquid petroleum fuels. The electric drive of road vehicles is the most common and popular type of alternative drive. There are also hybrid-electric vehicles, which have both an electric motor and an ICE. Hybrid-electric vehicles (specifically plug-in hybrid vehicles) are vehicles that are intended to use the ICE on long intercity routes and electric drive in cities. As cities are otherwise the most vulnerable areas that are exposed to the negative impact of traffic in terms of exhaust emissions, but also noise emissions caused by the operation of ICEs, the use of electric drive can reduce these emissions in the mentioned urban areas. Electric vehicles and plug-in hybrid vehicles (when they use only an electric drive) can be considered zero-emission vehicles, but only in the area of use of these vehicles. If we look at the use of electric and plug-in hybrid vehicles on a global level, the achievement of zero emissions depends on the method of producing electricity that the mentioned vehicles use for propulsion. Achieving zero emissions on a global level by using electric and plug-in hybrid vehicles is only possible if the necessary electricity is produced from RES. The production of the necessary electricity, for example, by burning coal in thermal power plants, releases various harmful combustion products, but also CO2 emissions, so in this case we cannot discuss about achieving zero exhaust emissions on a global level. In the last few years, electric vehicles have experienced greater and greater expansion. The number of sold passenger BEVs

and PHEVs in the world for the period from 2011 to 2020 is shown in Figure 1, and in Europe in Figure 2, according to data from the International Energy Agency (IEA) [7].

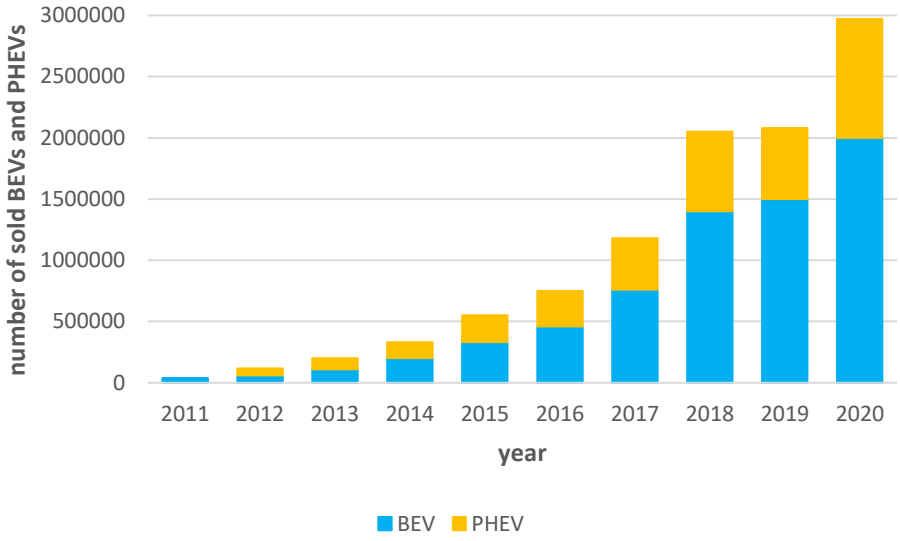

Figure 1. Number of sold BEVs and PHEVs in the world [7]

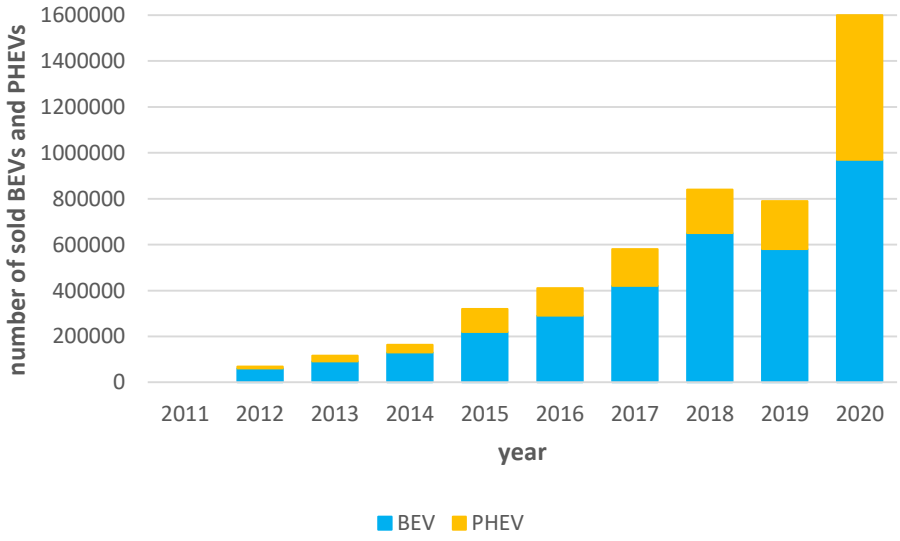

Figure 2. Number of sold BEVs and PHEVs in the Europe [7]

For a better understanding of the complete situation related to BEVs and PHEVs, a very important piece of information is the share of these vehicles in the total number of vehicles sold. The total share of BEVs and PHEVs in the world and Europe is shown in Figure 3, according to data from the International Energy Agency (IEA) [7].

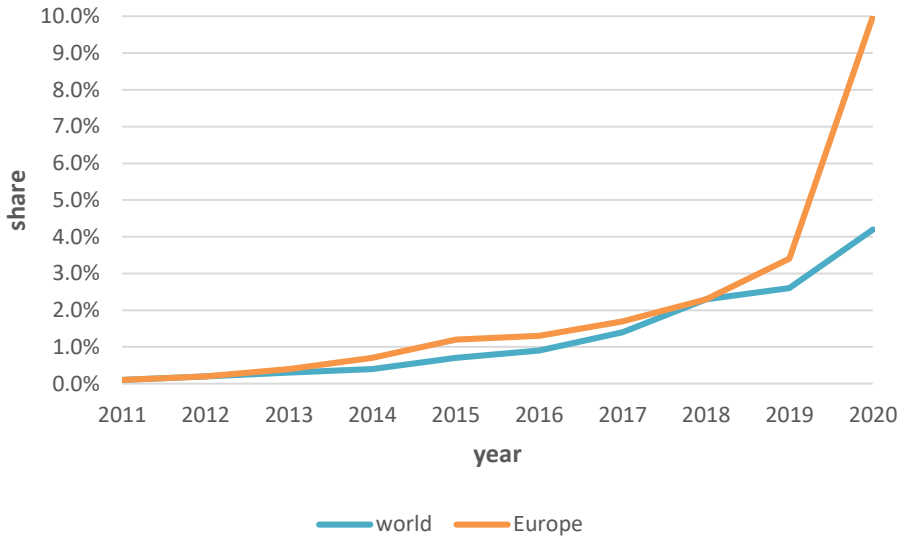

Figure 3. Cumulative share of sold BEVs and PHEVs in the world and Europe [7]

Apart from the number of BEVs and PHEVs sold, as well as the percentage share of these vehicles in the total number of vehicles sold, it is very important to show the number of these vehicles in the total number of vehicles. Figure 4 shows the total number of BEVs and PHEVs in the world, and Figure 5 in Europe for the period from 2011 to 2020 [7].

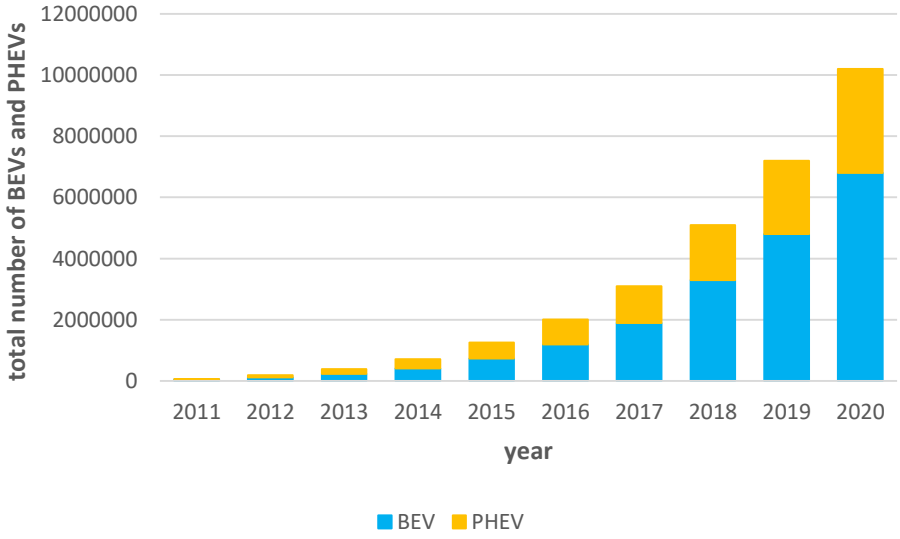

Figure 4. Total number of BEVs and PHEVs in the world [7]

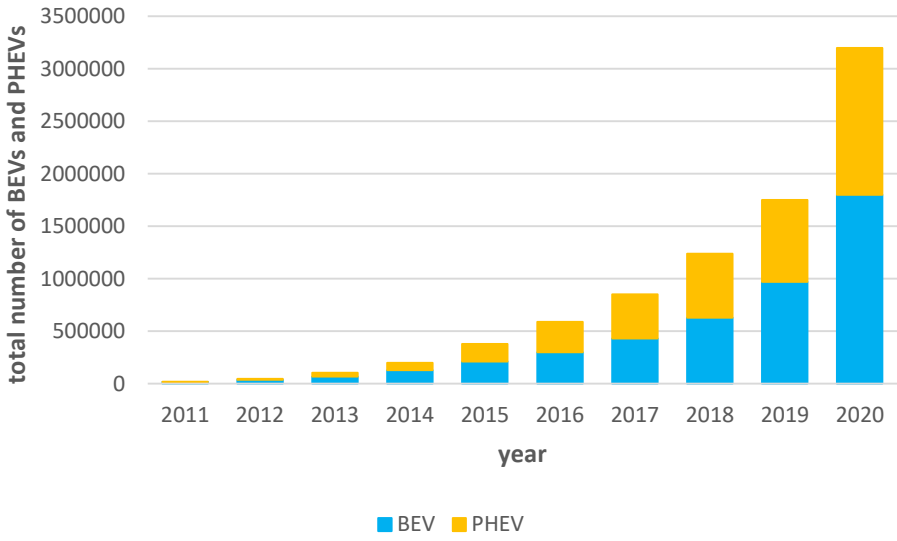

Figure 5. Total number of BEVs and PHEVs in Europe [7]

Data on the number of BEVs and PHEVs sold in Montenegro is not available, but data on the total number of BEVs are available on the website of the Republic of Montenegro Statistical Office, so the total number of BEVs for Montenegro is shown in Figure 6 [8]. In Montenegro, there was also a constant growth of BEVs from year to year. The first such vehicle was registered only in 2013, and in this year there were only 7 registered BEVs.

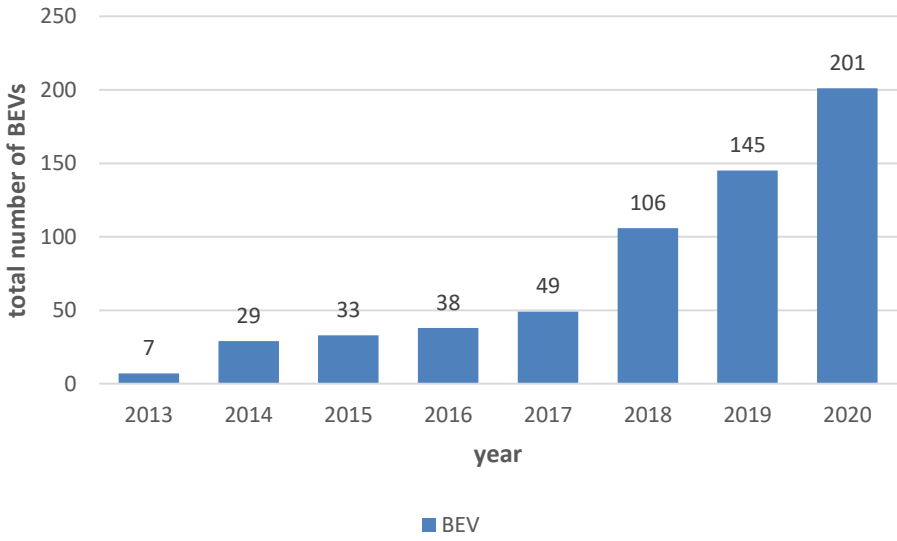

Figure 6. Total number of BEVs in Montenegro [8]

In addition to knowing the total number of sold and the general total number of BEV and PHEV vehicles, it is very important to present the share of BEV and PHEV vehicles in the total number of vehicles. Figure 7 shows the combined share of BEV and PHEV vehicles in the total number of vehicles in the world and Europe [7]. For better visibility, the total number of BEVs in Montenegro is shown in Figure 8 [8].

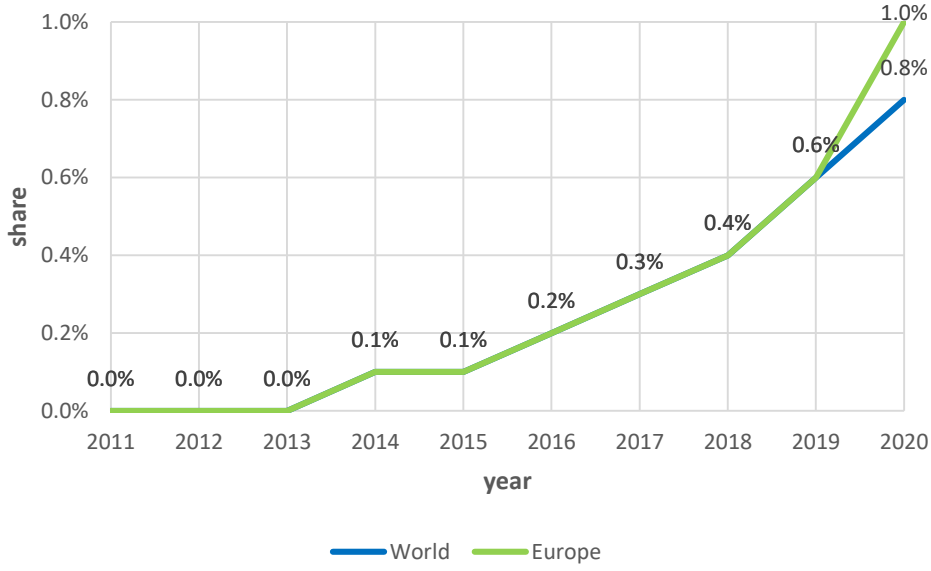

Figure 7. Cumulative share of BEVs and PHEVs in the world and Europe [7]

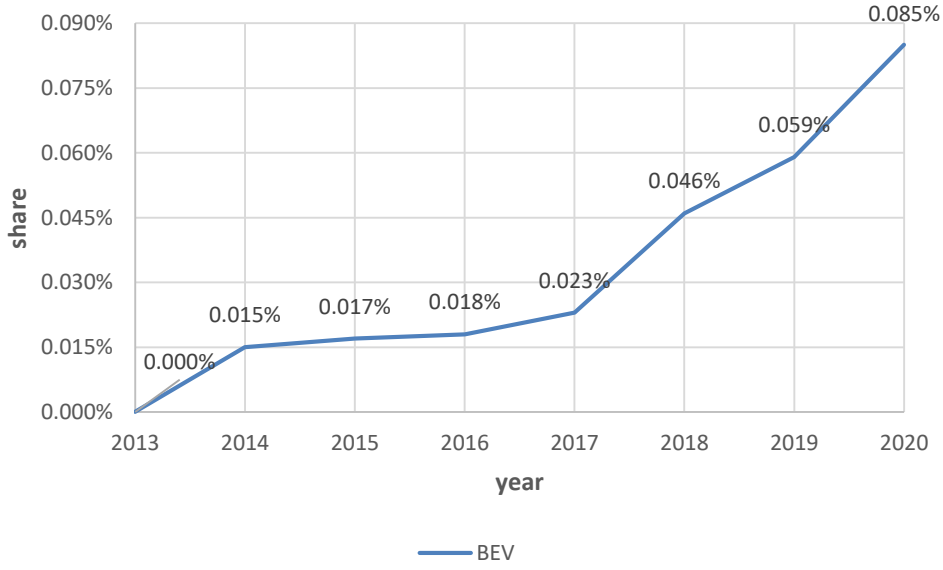

Figure 8. Total number of BEVs in Montenegro [8]

The number of BEVs and PHEVs in the world and Europe has a constant growing trend in the period from 2011 to 2020. Furthermore, the number of BEVs in Montenegro for the period

from 2011 to 2020 has a growing trend. A growing trend was also recorded when it comes to the number of BEVs and PHEVs sold in the world and Europe in the period from 2011 to 2020. It is noted that the share of sold BEVs and PHEVs in the total number of vehicles sold, as well as the share of these vehicles in the total number of vehicles, has a growing trend in the world and Europe for the period from 2011 to 2020. The share of BEVs and PHEVs in the total number of vehicles, despite the growing trend, is relatively very small. In the observed period, when it comes to the total share of BEVs and PHEVs, the maximum was reached at the end of the analyzed period, i.e. in 2020, both in the world and in Europe. In this year, the combined share of BEVs and PHEVs in Europe was only 1%, and even 0,8% in the world. When it comes to the share of BEVs in Montenegro, with constant growth from year to year during the observed period, the maximum was also reached in 2020, which is significantly below the world and European level and amounts to only 0,085%. It is very important to point out that if we look only at the total number of EVs (BEVs and PHEVs) in the world in 2020 (Figure 4), PHEV vehicles are represented by 33,33%, and BEVs by 66,67%. On the other hand, in Europe in 2020 (Figure 5), PHEV vehicles are represented by 43,8%, and BEVs by 56,2% in the total number of EVs (BEVs and PHEVs). This highlights the reason that PHEV vehicles have a very significant share in the total number of EVs (BEVs and PHEVs) in the world and Europe, and it is very difficult to estimate their contribution to the consumption of electricity for their movement. As PHEV vehicles have two types of drives, electric motor drive, and ICE drive, the use of one of these two drives depends on the way the vehicle is driven. Although PHEV vehicles are designed to use an electric drive for relatively short distances in city driving, and ICE drive for longer distances, the decision to use one of these two drives is often a subjective decision of the driver.

2. ELECTRICITY PRODUCTION BY SOURCES

In this chapter, an analysis of electricity production by sources in the world, Europe, and Montenegro was carried out. Electric vehicles use electricity to move, so the way they get the electricity is very important. The concept of electric vehicles as zero-emission vehicles at the global level depends on the way of producing the electricity that these vehicles use for propulsion. The data on electricity production in this chapter was taken from the International Energy Agency [9].

2.1. Production of electricity by sources in the world and Europe

The production of electricity by source in the world, based on data from the International Energy Agency, for the period from 2011 to 2020 is shown in Figure 9 [9]. It can be noticed that the production of electricity in the world is constantly increasing from year to year for the period from 2011 to 2020. Coal has the largest share in electricity production in each year of the analyzed period, followed by natural gas, hydropower, and nuclear energy. It can also be noted that the amount of electricity produced from RES (solar and wind) is constantly increasing. The production of electricity by burning oil has a very small share, and it is noticeable that it is constantly decreasing. Also, biomass, tide, geothermal energy, and other energy sources have a very small share in the total production of electricity in the world for the period from 2011 to 2020. The energy mix of electricity production in 2020 in the world looked like this: coal 35,2%, natural gas 23,6%, hydropower 16,6%, nuclear energy 10,0%, and other sources around 15,5%.

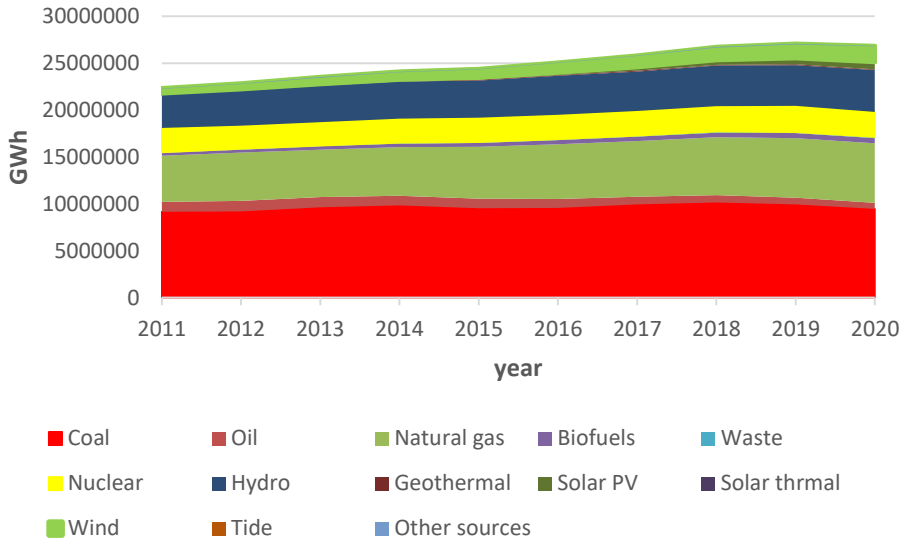

Figure 9. Electricity production by sources in the world [9]

Electricity production by sources in Europe is shown in Figure 10 [9].

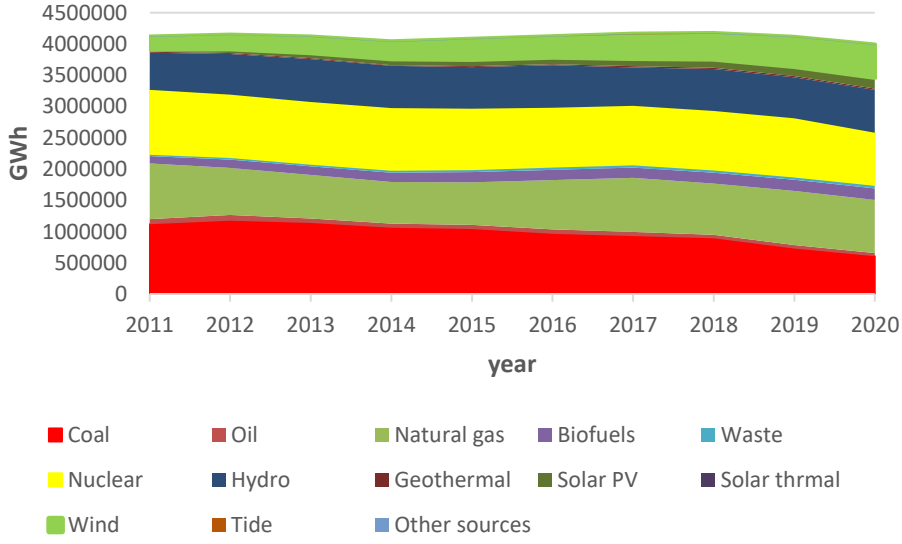

Figure 10. Electricity production by sources in Europe [9]

Electricity production in Europe for the period from 2011 to 2020 is more or less at the same level, and in the last few years, it has been on the decline, which is caused by the consequences of European policies in the area of reducing energy consumption and energy efficiency. One of the main goals of the EU is the decarbonization of the energy sector, which is reflected to a large extent in the territory of Europe. The consequence of EU policies can best be seen through the fact that the production of electricity from coal in the period from 2011 to 2020 is constantly decreasing. Furthermore, very important is the fact that the production of

electricity from coal in Europe in 2020 is almost two times less compared to 2011. In Europe in 2020, electricity was produced from the following sources: natural gas (21,3%), nuclear energy (20,9%), hydropower (17,2%), and only then coal (15,1%), wind (12,8%) and other energy sources (12,7%).

2.2. Electricity production by sources in Montenegro

The Montenegrin energy system is very simple. The largest amount of electricity in Montenegro is produced in a thermal power plant and two large hydropower plants. Also, in the last few years, electricity in Montenegro has been produced using two wind power plants and several small hydroelectric power plants. Electricity production by sources in Montenegro is shown in Figure 11 [9]. Electricity production in Montenegro in 2020 took place according to the following energy mix: coal (47,8%), hydropower (42,9%) and wind (9,3%). If you look at the entire period from 2011 to 2020, you can see that electricity production in Montenegro is oscillatory, which is a consequence of the different amounts of electricity produced in hydroelectric power plants per annum during the observed period. Electricity production from hydroelectric power plants varies depending on the amount of precipitation. The main production facilities in Montenegro are [10]:

- HPP "Perućica", installed power 307 MW,
- HPP "Piva", installed power 342 MW,
- TE "Pljevlja", installed power 210 MW.

In 2018, the "Krnovo" power plant with an installed capacity of 72 MW began operating, and in 2019, the "Možura" power plant with an installed capacity of 46 MW began operating [11].

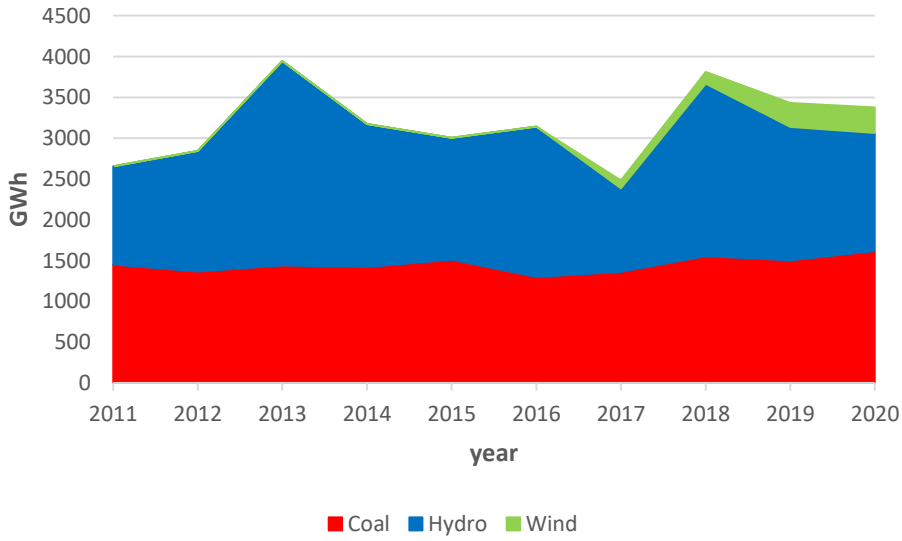

Figure 11. Electricity production by sources in Montenegro [9]

3. ELECTRICITY CONSUMPTION BY SECTORS

When analyzing the impact of the use of electric vehicles to decarbonize road traffic, it is very important to know how electricity is consumed in a certain sector. This chapter presents how

electricity is consumed by different sectors in the world, Europe, and Montenegro, according to data from the International Energy Agency [9].

3.1. Electricity consumption by sector in the world and Europe

Electricity consumption by sector in the world for the period from 2011 to 2020 is shown in Figure 12 [9]. It can be seen that the total consumption of electricity is constantly increasing in the mentioned period. The largest consumer of electricity in the world in each year of the observed period is the industry sector, followed by the residential sector, then the public and service sectors. Electricity consumption in the transport sector is very small and mostly refers to rail traffic. The consumption of electricity in the industry is constantly increasing from year to year during the observed period from 2011 to 2020. The largest consumers of electricity in the world in 2020 are: industry (41,7%), residential sector (27,6%), public and service sector (20,2%), agriculture (3,2%), transport (1,8%) and other consumers (5,5%).

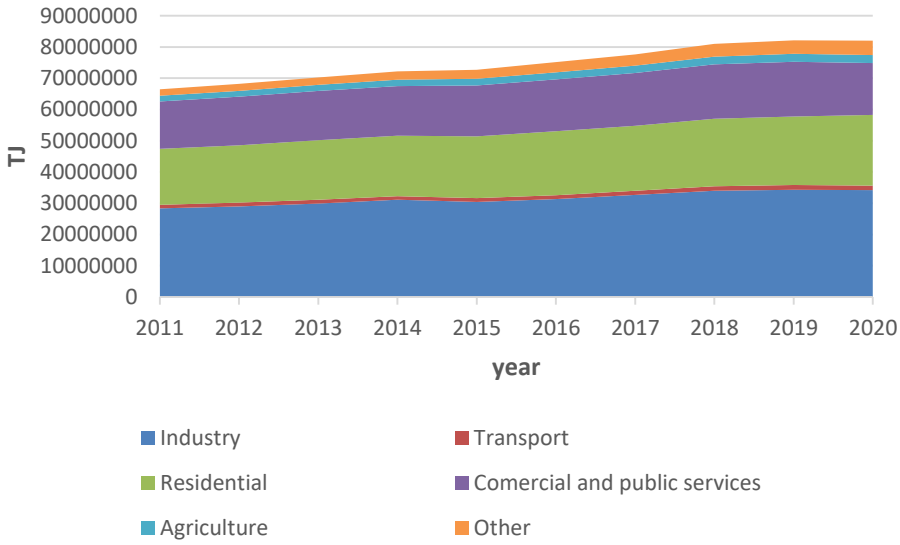

Figure 12. Electricity consumption by sector in the world [9]

Electricity consumption in Europe is maintained at an approximately constant level in the observed period from 2011 to 2020. The three largest consumers of electricity in Europe are the same as in the world. A very small consumer of electricity is the transport sector, mostly rail traffic. Electricity consumption in Europe by sector for 2020 looked as follows: industry (37,1%), residential sector (30,7%), public and service sector (27,4%), agriculture (2,3 %), transport (2,1%) and other consumers (0,4%). Electricity consumption by sector in Europe for the period from 2011 to 2020 is shown in Figure 13 [9].

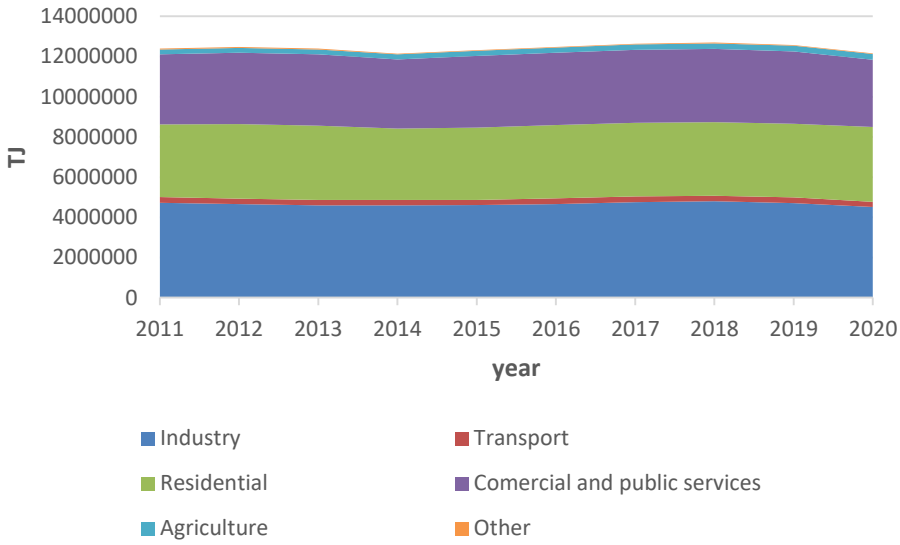

Figure 13. Electricity consumption by sector in Europe [9]

3.2. Electricity consumption by sector in Montenegro

Electricity consumption by sector in Montenegro for the period from 2011 to 2020 is shown in Figure 14 [9]. At the beginning of the observed period, industry was the largest consumer of electricity, but in 2014 it significantly decreased and remained at approximately the same level until 2020. It can also be noted that the public sector and the service sector had a very low consumption of electricity at the beginning of the analyzed period because it was probably calculated together with the residential sector. Electricity consumption by sector in

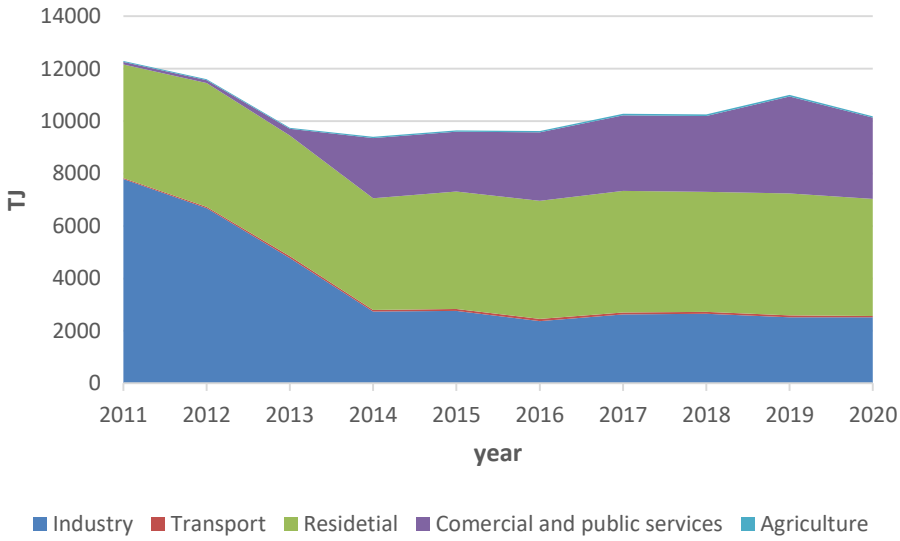

Figure 14. Electricity consumption by sector in Montenegro [9]

Montenegro for 2020 was as follows: residential sector (43,9%), public and service sector (30,4%), industry (24,8%), agriculture (0,5%) and transport (0,4%). In Montenegro, the transport sector is the smallest consumer of electricity in the entire observed period. Furthermore, the transport sector burdens the electric power system of Montenegro to a very small extent, and mostly rail traffic as a sub-sector of transport.

4. CO_2 EMISSION

This chapter provides an overview of CO_2 emissions by sector in the world, Europe, and Montenegro. Data on CO_2 emissions were taken from the International Energy Agency [9]. Data on CO_2 emissions by sector for Montenegro are not available in the source [9], so they were taken from [12].

4.1. CO_2 emissions by sector in the world and Europe

The emission of CO_2 by sector in the world for the period from 2011 to 2020 is shown in Figure 15 [9]. The CO_2 emission in the period from 2011 to 2020 had an increasing trend. In 2020, a significantly lower CO_2 emission was emitted, which was mostly caused by the significant suspension of industry and transport this year due to the pandemic of the COVID19 virus. The largest amount of CO_2 emissions were emitted in the electricity generation and heating sector, followed by the transport sector and the industrial sector in the entire period from 2011 to 2020. The fact that the most CO_2 emissions were emitted in the electricity generation and heating sector is not surprising because most of the electricity in the world is produced by burning coal. The most CO_2 emissions in 2020 in the world were emitted by the following sectors: electricity production and heating (42,9%), transport (22,4%), industry (19,5%) and other sectors (15,2%).

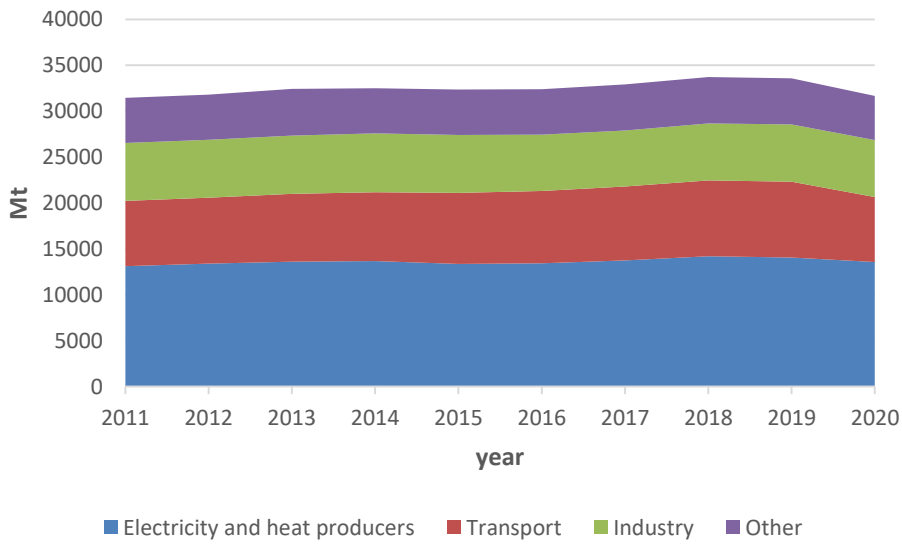

Figure 15. CO_2 emissions by sector in the world [9]

CO_2 emission by sector for the period from 2011 to 2020 in Europe is shown in Figure 16 [9]. Europe recorded a significant decrease in CO_2 emissions throughout the period, which is a

consequence of various policies related to energy efficiency, reduction of fuel consumption, and decarbonization of the energy and transport sectors. In Europe, the highest emissions in 2020 were responsible for: electricity production and heating (32,4%), transport (27,7%), industry (14,7%), and other sectors (25,2%).

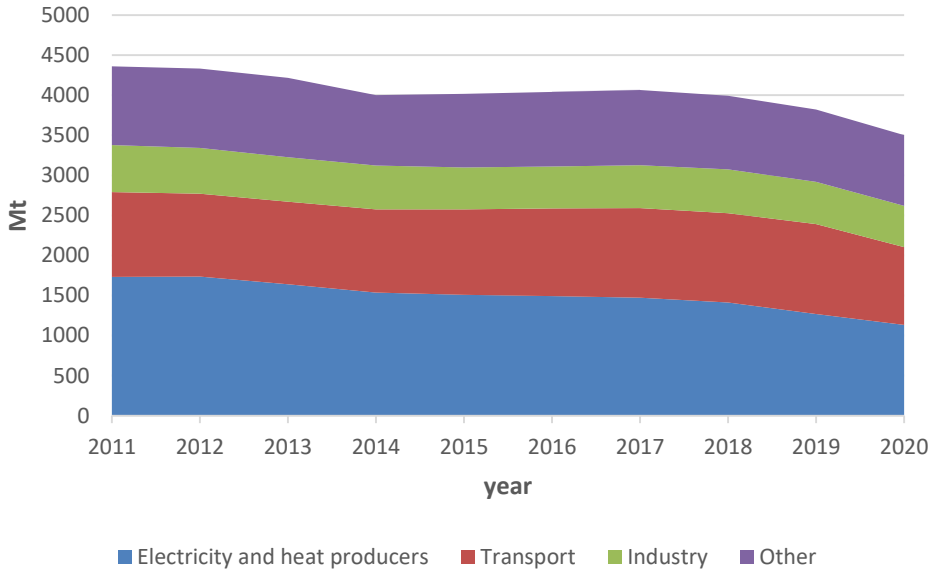

Figure 16. CO_2 emissions by sector in Europe [9]

4.2. CO_2 emissions by sector in Montenegro

Data on annual CO_2 emissions by sector are not available on the website of the International Energy Agency, as mentioned earlier, so this emission is shown according to the data of the website Our World in Data [12]. Figure 17 shows annual CO_2 emissions by sector in Montenegro for the period from 2011 to 2020 [12]. According to the data from the website Our World in Data, CO_2 emissions are shown from the electricity and heating production sectors, as well as from the transport sector. The highest CO_2 emissions in Montenegro in each year of the observed period come from the electricity and heating production sector. In 2020, CO_2 emissions in the electricity and heating production sector in Montenegro were 61,1%, and in the transport sector 38,9%. In the last few years of the observed period, there has been an increase in carbon dioxide emissions in the transport sector, but for example, in 2020, fewer CO_2 emissions were emitted in this sector compared to 2019. This decrease in the amount of carbon dioxide emissions in 2020 was probably caused in large part by the COVID-19 pandemic virus.

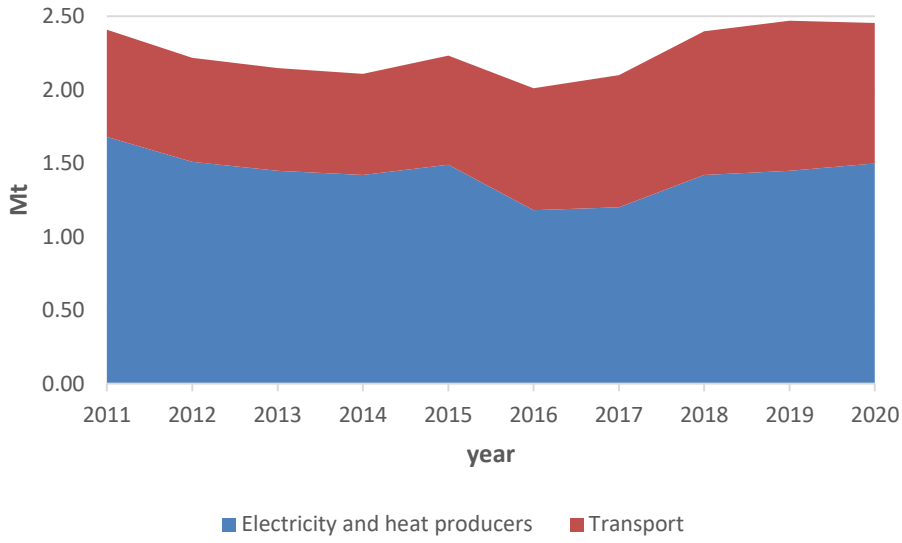

Figure 17. CO_2 emissions by sector in Montenegro [12]

4.3. CO_2 emissions per capita

In order to better compare the trends in the world, Europe, and Montenegro in terms of annual CO2 emission, it is necessary to show the amount of this emission per capita, which is done in this chapter. The annual CO_2 emission per capita for the period from 2011 to 2020 is shown in Figure 18 in the world, Europe, and Montenegro according to data from the International Energy Agency website [9]. The emission of CO_2 per capita in the world is maintained at an approximately constant level with a significant decrease in 2020, which was caused as a result of the COVID-19 virus. Europe, when it comes to emitted CO_2 emissions per capita, has a downward trend. In Montenegro, CO_2 emissions per capita from 2011 to the end of 2020 remained at an approximately constant level.

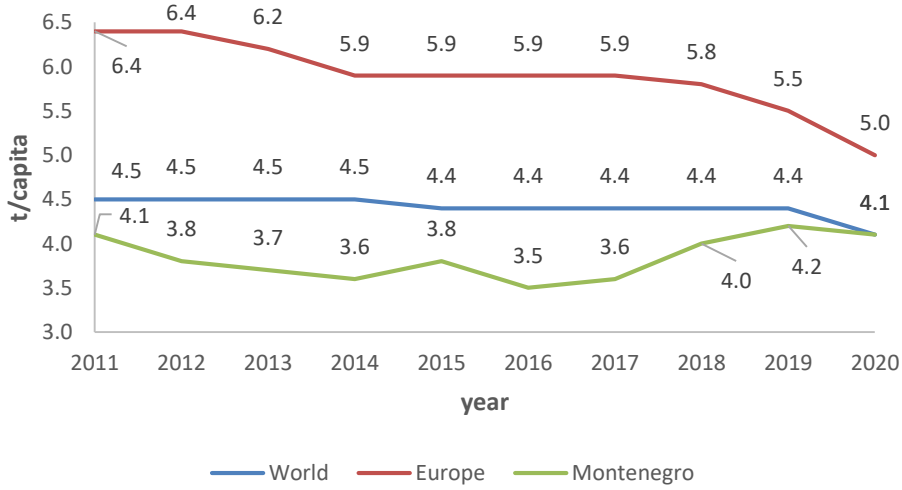

Figure 18. CO_2 emissions per capita in the world, Europe, and Montenegro [9]

5. CONCLUSION

Decarbonization of road traffic is one of the main priorities facing the world, and electrification is characterized as the most popular solution to this problem. In the world and Europe, a steady increase in sales of BEVs and PHEVs was recorded in the period from 2011 to 2020. The share of these vehicles in the total number of vehicles sold is also growing from year to year for the observed period from 2011 to 2020. However, despite the growth in the number of sold BEVs and PHEVs, as well as the growth of their share in the total number of vehicles, these vehicles still have a very small share in Europe of even 1%, and only 0,8% in the world in 2020. Montenegro has a very small percentage share of BEVs in the total number of vehicles in 2020, only 0,085%. Although the percentage share of BEVs and PHEVs in the total number of vehicles is relatively small, both in the world and in Europe, but also in Montenegro, an increase in the percentage share was recorded. Given the relatively small percentage shares of BEVs and PHEVs, it is not surprising that very little electricity is consumed in the transport sector. When it comes to the production of electricity by sources in the world, coal has the largest share. A relatively very small share of electricity both in the world and in Europe is produced from renewable-energy sources, if we exclude production in hydroelectric power plants, as a traditional renewable energy source. For the period from 2011 to 2020, a constant increase in the production of total electricity in the world is noticeable. In the world, for the mentioned period, the production of electricity from coal and natural-gas is increasing from year to year. In 2020, slightly more than 35% of electricity in the world was obtained from coal and slightly more than 23% from natural gas power plants. As shown in this paper, the largest share of electricity in the world is still produced in a not very clean way, which can have a very unfavorable impact on the decarbonization of road traffic through electrification. Montenegro receives most of its electricity from a thermal power plant and two large hydroelectric plants, but the share of new renewable-energy sources is also constantly increasing (two wind farms have been built in the last few years). Considering the very small share of BEVs and PHEVs, it is currently very difficult to discuss about the impact of these vehicles on CO_2 emissions. In the world for the period from 2011 to 2020, the total emission of carbon dioxide is constantly increasing. The sector with the largest share of carbon dioxide emissions is the electricity generation and heating sector. The second sector with the highest emission of carbon dioxide is the transport sector. A constant trend of increasing CO_2 emissions in the transport sector was recorded, with a very small decrease in 2019. Given that the transport sector in this paper includes all types of traffic, it would be important to see how much each type of transport has a share in the total carbon dioxide emissions in the transport sector, although when it comes to carbon dioxide emissions, road traffic plays a significantly dominant role. A large reduction in total CO_2 emissions was recorded in all sectors in 2020. The biggest impact on this reduction was the pandemic of COVID-19 virus because in 2020, all, industry was interrupted for a long period, and mobility was significantly reduced. In Europe, there is a decrease in total carbon dioxide emissions, which is a consequence of the great efforts of the European Union to reduce CO_2 emissions in the energy and transport sectors, through various policies and strategies. Despite the great efforts of the EU to reduce carbon dioxide emissions in the transport sector, if we look at the period from 2011 to 2020, in 2019 a record was achieved in terms of annual emissions in the transport sector when 1123 Mt of CO_2 emissions were emitted. The current share of BEVs and PHEVs in the total number of vehicles is relatively very small, so accordingly it has almost no influence on the total CO_2 emission, nor the CO_2 emission of the transport sector in the world, Europe, and Montenegro.

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