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# Study on e-mobility and Market Study in Bosnia and Herzegovina

**ABSTRACT**

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Abstract

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# Study on e-mobility and Market Study in Bosnia and Herzegovina

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| AC | Alternating Current |
| B&H | Bosnia and Herzegovina |
| DB | District of Brčko |
| DC | Direct Current |
| EBRD | European Bank for Reconstruction and Development |
| EC | European Commission |
| EIB | European Investment Bank |
| EU | European Union |
| FBiH | Federation of Bosnia and Herzegovina |
| GDP | Gross domestic product |
| KM | Convertible mark (bos. Konvertibilna marka) – the official currency of B&H |
| PPP | Public-private partnership |
| PS | Power system |
| KfV | Reconstruction Credit Institute (ger. *Kreditanstalt für Wiederaufbau*) |
| LEAP | Low Emissions Analysis Platform |
| RES | Renewable Energy Sources |
| RED | Renewable Energy Directive EU |
| RS | Republic of Srpska |
| UN | United Nations |
| UNDP | United Nations Development Programme |

## Introduction

In Bosnia and Herzegovina, there are currently no large number of electric vehicles and no charging stations for electric vehicles. There is also little incentive for purchasing and using them, only in 2022 the FBiH Government has adopted a Program that subsidizes the purchase of electric and hybrid vehicles. Nor has a regulatory framework been established that would be a function of the development of electro mobility. The first charging station for electric vehicles in B&H was installed in 2016, and the first new electric vehicles were sold in 2017, and it can be established that the beginning of the development of electro mobility in B&H is 7-8 years behind the developed countries of Europe and the world.

According to current data, there are 1,455 registered hybrid cars and 133 electric vehicles in Bosnia and Herzegovina. According to information from the B&H Indirect Taxation Administration, in 2021, 50 electric and 359 hybrid vehicles were imported into Bosnia and Herzegovina. In 2021, a total of 1,152,743 road vehicles were registered in Bosnia and Herzegovina, which represents an increase of 44,032 vehicles, or 3.97%, compared to 2020.

## Regulatory framework

Bosnia and Herzegovina consists of two entities, the Federation of Bosnia and Herzegovina (FBiH) and Republic of Srpska (RS), and Brčko District (BD) as a separate administrative unit and is a signatory to a significant number of international documents related to environmental protection. For air protection as a component of the environment, important international documents are the Convention on Long-range Transboundary Air Pollution, the United Nations Framework Convention on Climate Change, the Vienna Convention on the Protection of the Ozone Layer, and the Montreal Protocol on Substances that Deplete the Ozone Layer. Bosnia and Herzegovina also ratified the Paris Agreement by which it undertook to reduce the emission of greenhouse gases by at least 40% by 2030 in order to mitigate the consequences of global warming and stop the further rise in air temperature.

At the Federal level in Bosnia and Herzegovina, three laws were passed that treat environmental protection in the broadest sense: Law on Environmental Protection FBiH ("Official Gazette of FBiH", number: 33/03, 38/03), Law on Nature Protection FBiH ("Official Gazette of the FBiH" number: 66/13), and the Law on the Environmental Protection Fund of the FBiH ("Official Gazette of the FBiH No. 33/03). At the Federal level in Bosnia and Herzegovina, laws have been passed that treat individual components of the environment, and the aspect of air protection is relevant for this Study. In this sense, the most important regulation is the Law on Air protection ("Official Gazette of FBiH" number 33/03, 4/10), which regulates technical conditions and measures for preventing or reducing air emissions caused by human activities that must be respected in the process production in the territory of the Federation of Bosnia and Herzegovina, air quality protection planning, special sources of emissions, emissions cadastre, air quality, supervision and fines for offenses for legal and natural persons. In addition to legal regulations, the relevant strategic document is also the Federal Environmental Protection Strategy, the adoption of which is prescribed by the "Law on Air protection", which contains a nature protection strategy, an air protection strategy, a water management strategy and a waste management strategy.

At the level of the B&H entity of the Republic of Srpska, the most important law dealing with environmental protection is the Law on Environment protection ("Official Gazette of RS", number: 71/12, 79/15, 70/20), which regulates environmental protection, strategic impact assessment and environmental impact assessment, the procedure for issuing environmental permits and the prevention of large-scale accidents, the system of eco-labeling and environmental protection management, financing activities related to the environment, responsibility for damage caused to the environment, as well as the rights and obligations of legal and natural persons who perform the activities established by this law. The Law on Air Protection ("Official Gazette of RS", number: 124/11, 46/17) regulates the protection and management of air quality and determines the measures, the way of organizing and controlling the implementation of the protection and improvement of air quality as a natural good. The Law on Nature Protection ("Official Gazette of RS" No. 20/14) regulates the restoration, protection, preservation and sustainable development of landscapes, natural areas and other components of nature that are part of the environment. The Law on Environmental Fund and Financing ("Official Gazette of the Republic of Srpska", no. 117/11, 63/14) regulates the status, activity, organization, income and method of using funds of the Fund for Environmental Protection and Energy Efficiency of the Republic of Srpska.

At the level of Brčko District, the Law on Environmental Protection ("Official Gazette of the BD" No. 24/04, 01/05, 19/07, 09/09) was adopted, which regulates the preservation, protection, restoration and improvement of ecological quality and capacity of the living environment, measures and conditions for the management, preservation and rational use of natural resources, the framework of legal measures and institutions for the preservation, protection and improvement of the protection of the living environment; financing of activities related to the living environment, and the duties and tasks of the District provided for by law and by-laws. In addition to the aforementioned Law, the Law on Nature Protection ("Official Gazette of the BD" no. 24/04, 1/05, 19/07 and 9/09) was adopted, which regulates the restoration, protection, preservation and sustainable development of landscapes and natural areas and other components of nature, in the manner and according to the conditions established by this Law.

The Air Protection Act ("Official Gazette of BD" no. 25/04, 1/05, 19/07, 9/09) regulates the protection of air from pollution in order to protect human health, the climate and the living environment from the harmful effects of polluted air.

Brčko District does not have an Environmental Protection Strategy, as is the case in the Federation and the Republic of Srpska (as of November 17, 2022), and among the strategic documents in the field of environmental protection in this B&H entity, the Program for Adapting the Legislation of the Republika Srpska with Legal Acquis is in force EU in the field of environmental protection, i.e. Strategy of approximating regulations to the acquis of the EU in the field of environmental protection/environment of Brčko District of B&H. The Government of the Republic of Srpska, at the 195th session, held on November 17, 2022, adopted the Decision on the adoption of the Environmental Protection Strategy for the period 2022-2032 and the same was published in the "Official Gazette of the Republic of Srpska", number 118/22.

Through Directive 2019/944 on common rules for the internal electricity market, Directive 2014/94 on the development of infrastructure for alternative fuels, Directive 2018/844 on the energy efficiency of buildings, Directive 2018/2001 on the promotion of the use of energy from renewable sources and Directive 2019/1161 on the promotion of clean and energy-efficient vehicles in road transport, the European Union has regulated various aspects of e-mobility, leaving the member states the option of choosing appropriate mechanisms and models.

The Energy Community (EC), of which B&H has been a member since 2006, continuously adapts its legislation to new EU acts in order to follow development directions and harmonize its regulatory framework with the European one. As a member of the UN, Bosnia and Herzegovina is committed to implementing the 2030 Agenda for Sustainable Development (Agenda 2030), which consists of 17 sustainable development goals. In 2021, the B&H Council of Ministers adopted the "Framework for the realization of sustainable development goals in B&H", which considers the electrification of the transport sector and the improvement and modernization of electricity distribution networks as an important contribution to the decarbonization of the energy sector.

The regulatory framework for e-mobility is related to the aforementioned sectors and includes strategic documents for the planning and development of e-mobility, as well as the legal framework regulating the technical conditions for the construction and connection of charging stations to the electricity system, tariff mechanisms, the roles of distribution system operators and regulators, advanced measurement structure and security aspects, various incentive measures, tax aspects, etc.

Although there are currently no large number of electric vehicles or charging stations for electric vehicles in B&H, in the month of March 2022, the Parliament of the Federation of Bosnia and Herzegovina adopted the budget for 2022, in which an incentive is provided ***for the development of electro mobility in the Federation of Bosnia and Herzegovina in the amount of one million convertible marks***. The incentive for the development of electro mobility is foreseen in the budget item "6142 - *Current transfers to individuals - Incentive for individuals when purchasing electric cars*".

The difficulties that slow down the growth of the number of electric vehicles in B&H, that is, the development of the infrastructure of charging stations, are inconsistent legal frameworks, undeveloped awareness of citizens, and low purchasing power of citizens. The basic market roles in the e-mobility concept are the e-mobility service provider and the charging station infrastructure operator who manages a certain number of charging stations and connects them to the service provider.

Given that in the early phase of e-mobility development, due to the relatively high price of electric vehicles, development based solely on market principles is not possible, there is a need to establish certain incentive mechanisms. As a result of the economies of scale and scope and learning curve effects expected in the e-mobility sector, it is to be expected that the costs of infrastructure and e-vehicles will decrease over time. Financing of e-mobility can be divided into several phases:

- Phase 1 (short term), which represents the period of the next few years, during which preconditions for the development of e-mobility in B&H should be created,
- Phase 2 (mid-term), which represents the period during which e-mobility will gain significant momentum at the global level and during which e-mobility will become "almost" cost-competitive, and
- Phase 3 (long term) when e-mobility becomes a competitive activity in relation to conventional mobility.

The Study looked into international financial institutions and domestic sources of financing as potential sources of financing for the first and second phases of e-mobility in B&H. International financial institutions (WB, EBRD, EIB, KfW), funds of international agencies and bilateral donors (UNDP, GiZ, SIDA, USAiD), vertical development funds (Green Climate Fund, Global Environmental Facility) were analyzed from international sources of financing. From the domestic sources of financing, the FBiH Environmental Protection Fund, the RS Environmental Protection and Energy Efficiency Fund, the FBiH Development Bank, the RS Investment and

Development Bank, public and private companies as market participants, borrowing by e-mobility market participants, city and municipal green bonds were considered and PPP models.

As part of the study on e-mobility and the market study in Bosnia and Herzegovina, a model of road traffic in Bosnia and Herzegovina until 2050 was created, which includes a scenario analysis of the vehicle fleet structure, energy consumption, $CO_2$ emissions and power system load diagrams due to electric vehicle charging. The study first described the model creation methodology, the tool used, and the basic results, followed by the results of specific analyses.

## Road traffic model

The road traffic model was created using the software tool LEAP (*The Low Emissions Analysis Platform*). For the purposes of this study, two scenarios are defined in the model. The first, the Reference scenario, represents the future movements of energy flows in accordance with the expected improvements in technology and structural changes in road traffic driven mainly by market principles without the implementation of the e-mobility development strategy. The second, the Electric Mobility Scenario, assumes the implementation of an active policy to support the faster development of e-mobility in the territory of Bosnia and Herzegovina. This scenario in the model predicts a strong penetration of electric vehicles in categories where there will be no technical restrictions.

The modelling of future changes in the structure of road traffic in this study was based on data on the vehicle fleet for the base year 2021, however, energy consumption and vehicle mileage are aligned with data from the energy balance for 2019, since it is the last pre-pandemic year.

Based on the available data, the existing fleet of vehicles in Bosnia and Herzegovina was reconstructed for the base year 2021. It was determined that the total number of registered road vehicles in 2021 is 1.1 million. The classification of vehicles by category was made (almost 90% are passenger vehicles, so that segment was given the greatest attention in modelling) and classification by fuel.

After that, based on the collected and estimated data, energy consumption in road traffic in Bosnia and Herzegovina was modelled, and population projections were used to determine future needs for passenger vehicles.

Before starting the modelling of the "electric mobility" scenario, in the third chapter of the study "Business models for the rapid introduction of e-mobility infrastructure", the international and most important experiences of the development of infrastructure for e-vehicles (Croatia, Slovenia, Sweden, the Netherlands) were first listed France, Italy, Germany and Sweden) that can serve as examples and foundations for infrastructure development in Bosnia and Herzegovina.

In addition, an overview of the key actors for the successful implementation of the concept of electro mobility in Bosnia and Herzegovina, their responsibilities and activities in this area so far is given. After that, a general overview of different types of charging stations with the most important characteristics was given, and the locations in Bosnia and Herzegovina where it is necessary to install electric vehicle charging stations were discussed.

According to the data of “Autoceste FBIH” and “Autoputeva RS”, Bosnia and Herzegovina currently has 219 km of motorways, and an additional 214.5 km are still under construction. It was concluded that on the motorways in Bosnia and Herzegovina it is necessary to build charging stations at 16 locations (8 locations on both sides) so that there are at least 2 fast chargers on each. According to data from the Ministry of Communications and Transport of Bosnia and Herzegovina, there are currently 3,820 km of main roads in Bosnia and Herzegovina. Since the construction of charging stations in settlements is also expected, it is possible to install them at a greater distance from the motorways, so it is recommended to install charging stations at 80 locations.

According to the current situation, the motorway in Bosnia and Herzegovina consists of two sections, the section Tarčin - Zenica, and Gradiška - Doboj. On the section Tarčin - Zenica, one charging station is needed on both sides, at the location of the town of Visoko. Currently, a charging station with fast AC and DC chargers (22kW and 50kW) has been installed at the "Lepenica East" rest area, and the same should be installed at the "Lepenica West" rest area.The next such station needs to be set up (on both sides) at the location of the city of Zenica.

On the section Gradiška - Doboj, with a total length of about 93 km, it is necessary to install a charging station on both sides in the locality of the municipality of Prnjavor, which is located approximately in the middle of the section. Stations with fast DC chargers must be placed at the beginning and at the end of the specified section, also on both sides.

After that, the projections of the fleet of Bosnia and Herzegovina were presented, that is, the modelling results for the "electric mobility" Scenario (total fleet of vehicles by category and especially for each category of structure of newly registered vehicles and the resulting fleet of vehicles).

When it comes to passenger vehicles, it was assumed that the share of electric vehicles in the total fleet will be 10% in 2030 and almost 80% in 2050.

The study also provides projections for other categories of vehicles: motorcycles and mopeds, light goods vehicles - N1 category, goods vehicles - N2 and N3 categories and buses.

In accordance with the Proposal for a Regulation of the European Parliament and the Council on the introduction of infrastructure for alternative fuels, the necessary infrastructure for charging electric vehicles has also been projected.

It was determined that in the period until 2050, it will be necessary to build about 46 thousand publicly available chargers of smaller power (below 22 kW) and about 800 chargers of higher power (above 50 kW). As a rule, chargers of smaller power will be installed in parking spaces in urban areas (for example, in front of shopping centers, business premises, catering facilities, etc.). On the other hand, fast chargers will generally be installed on transit roads and intermodal hubs.

It is important to emphasize that in the future it is expected that most charging will take place at the so-called home charging stations. It is estimated that home charging will account for more than 70% of all electric vehicle charging processes. Accordingly, in the period up to 2050, the installation of around 735,000 home charging devices is expected.

In the study, the investment costs by item for the construction of infrastructure for charging electric vehicles are detailed, and based on this, it is estimated that the total cost of investment in infrastructure in the period up to 2050 is about 2.1 billion KM.

As part of the study, three larger cities (Sarajevo, Banja Luka and Mostar) were selected, for which a detailed analysis of the needs of publicly available infrastructure for charging electric vehicles and calculation of investment costs was performed.

Based on the projections of the fleet of electric vehicles and the requirements of the Proposal for a Regulation of the European Parliament and the Council on the introduction of infrastructure for alternative fuels, the number of electric vehicles, i.e. the output power of publicly available charging stations for three cities, was calculated.

Regarding the representation of the type of charging stations, it is predicted that in the first period there will be a higher share of fast charging stations, while in the long term their share will decrease due to the significant expansion of smaller capacity charging stations. Therefore, it is predicted that in 2025 the share of fast charging stations (share in the total installed capacity) will be 15%, and in the long term it will fall to 5%.

The average power of publicly available charging stations was assumed to be 50 kW for faster charging stations and 22 kW for standard ones in the first phase, however, in the long term, an increase in average power for fast charging stations can be expected. The required number of charging stations for the three selected cities was calculated from the above assumptions.

The same analysis was done for the transit corridor Vc, the length of which in B&H, when fully built, will be about 320 km. In accordance with the requirements of the Proposal of the Regulation of the European Parliament and the Council on the introduction of infrastructure for alternative fuels, Bosnia and Herzegovina should in the short term (within 5 years) provide collective charging points in each direction of travel with a maximum distance of 60 km between them. For the charging of light vehicles, each collective charging point must have an output power of at least 300 kW and include at least one charging station with an individual output power of at least 150 kW. For charging heavy vehicles, each collective charging point must have an output power of at least 1400 kW and include at least two charging stations with an individual output power of at least 350 kW.

In the medium term (within 10 years), for the charging of light vehicles, each collective charging point must have an output power of at least 600 kW and include at least two charging stations with an individual output power of at least 150 kW. For charging heavy vehicles, each collective charging point must have an output power of at least 3500 kW and include at least two charging stations with an individual output power of at least 350 kW.

The peak load of the electric power system is the maximum engaged power achieved at some point within one year. With the increase in the number of electric vehicles every year, the achieved peak load due to the charging of electric vehicles increases. According to the "Electric mobility - charging management" scenario, the peak load of the electric power system due to the charging of electric vehicles will be 82.7 MW in 2030 and 563.7 MW in 2050.

The development of e-mobility and the gradual abandonment of fossil fuels will result in a significant reduction of greenhouse gas emissions in road traffic. According to the "Electric Mobility" scenario, emissions from road traffic will decrease from 4.05 million $tCO_2$ to 3.75 million $tCO_2$ in 2030, or 1.16 million $tCO_2$ in 2050. The annual emission reduction compared to the Reference Scenario will amount to 0.35 million $tCO_2$ to 3.75 million $tCO_2$ in 2030, or 2.88 million $tCO_2$ in 2050.

The study also analyzed the benefits of the development of e-mobility in Bosnia and Herzegovina, of which the reduction of greenhouse gas emissions stands out at the national level. The following table shows the cumulative savings that will be realized in accordance with the scenario "Electric mobility" in relation to the Reference scenario (B&H road transport model until 2050).

The study first recommended activities for raising the awareness of the general public and the faster development of e-mobility in Bosnia and Herzegovina, and then an analysis of the effect of the introduction of e-mobility on a macro level was carried out.

## Economic factor

The assessment of the macroeconomic effects of capital investments was carried out using an analytical tool based on the so-called input-output tables specified for B&H. The tables in question describe the flow of goods and services between all sectors of the economy. The analysis quantified the direct and indirect (multiplicative) effects on the economy that are expected in the period up to 2050.

The assessment of macroeconomic effects was carried out for the defined development scenario of the construction of infrastructure for charging electric vehicles. Capital investment in the construction of the relevant infrastructure in the period until 2050 amounts to 2.1 billion KM.

In the entire analyzed period, the average annual investment amounts to 2,119 million KM. It is to be expected that the investments in question will lead to an increase in the number of new employees (on an annual average by 951 persons compared to the initial year of the analysis). GDP would increase by 51 million KM annually on average, while the added value would amount to 43 million KM annually on average.

## Electrification of the B&H fleet

In order to identify with certainty the true and realistic possibilities for the electrification of the B&H fleet, it is necessary to review the data given in the chapter with projections of the vehicle fleet in B&H until 2050 and compare them with the trends in the European Union countries. Surveys carried out in several European Union countries (France, Austria, Germany) and Norway provided a profile of potential buyers of electric cars, where they were described as people with a university degree, coming from large households with high incomes and using the vehicle on a daily basis. . Furthermore, potential customers are described as young people open to new technologies and environmentally conscious. When we look at Bosnia and Herzegovina, according to data from the Agency for Statistics of Bosnia and Herzegovina, 30% of the population between the ages of 30 and 34 have a university degree, while almost 5% of the total population left education before completing it. Also, the average salary in Bosnia and

Herzegovina is far below the average of the European Union, and the vast majority of users of personal electric cars in the European Union are well-to-do, highly educated people, so it is unlikely to expect a large and rapid rise in the use of electric personal car sin B&H.

Based on all of the above, it can be assumed that the development of the fleet of personal electric cars will progress very slowly in Bosnia and Herzegovina, and that it will encounter a lot of difficulties. Due to all of the above, during the preparation of the study it was decided to pay more attention to the transport sector, i.e. to the cargo categories of vehicles, more precisely to the N1 category (light cargo vehicles) and the N2 and N3 categories of heavy and super heavy cargo vehicles, as well as to the public transport sector or buses. It is predicted that the number of electric vehicles from these categories will reach 9,000 vehicles by 2050.

Looking at the fact that existing conventional vehicles from these categories exclusively use diesel fuel and that they cover long distances, the electrification of this fleet would achieve significant savings in energy, looking at the growth trends of fossil fuels in the world, while the price of electricity remains relatively unchanged. Also, by electrifying this fleet, significant reductions in $CO_2$ emissions can be achieved.

## Reducing the energy consumption

According to the "Electric Mobility" scenario, the total energy consumption in road traffic in Bosnia and Herzegovina will decrease from 15.3 TWh in 2021 to 14.6 TWh in 2030 (4.7% reduction) and to 8.5 TWh in 2050 (44.7% decrease). The reduction in consumption is primarily the result of the introduction of electric vehicles, which are more energy efficient than those powered by fossil fuels.

With the increase in the share of electric vehicles, savings in energy consumption will also increase compared to the reference scenario. On an annual level, these savings will amount to 1.0 TWh in 2030 and 7.5 TWh in 2050. Cumulatively, by 2050, savings in the amount of 96.9 TWh will be achieved.

With the growth of the number of electric vehicles in Bosnia and Herzegovina and their gradual majority share in the vehicle fleet, it will be necessary to expand production capacities in order to meet the need for energy, especially during peak loads due to the charging of electric vehicles. At the same time, it is important to provide additional capacities through renewable energy sources so that the entire transport electrification system is in line with strategies for reducing $CO_2$ emissions.

Hourly and seasonal load coefficients were defined for the purposes of calculating the peak load due to electric vehicle charging, and load diagrams were created. In the segment of passenger vehicles, the highest traffic activity is expected in the summer months, and therefore the seasonal coefficient for the summer period is the highest, which means that the peak load of the electric power system will be realized in that period. For buses, the same traffic activity is expected throughout the year.

Since the time period of the analysis refers to long-term projections until the year 2050, an additional scenario was created in which a greater representation of electric vehicle charging infrastructure is expected, which enables advanced management of the charging process, i.e. the shift of a certain amount of charging from peak load hours to less load hours , mostly at night. This will ultimately lead to lower peak loads and lower needs for electricity production capacity. An additional scenario is called "Electric Mobility - Charging Management".

Given that transport is responsible for around a quarter of greenhouse gas emissions in the EU, the Study analyzed the impact of the development of e-mobility on the reduction of greenhouse gas emissions. The development of e-mobility and the gradual abandonment of fossil fuels will result in a significant reduction of greenhouse gas emissions in road traffic.

In addition, the development of e-mobility and the use of electricity as an energy source in road transport will enable the improvement of security of supply and the reduction of dependence on imported fossil fuels, as well as the increase of energy efficiency and the opening of space for greater integration of RES into the power system.

Due to the increase in peak load caused by the installation of infrastructure for charging electric vehicles, there will be negative impacts on the distribution network in terms of increasing losses in the network and worsening the quality of voltage and frequency, which will have the greatest negative impact in the time period of peak load (from 10 a.m. to 2 p.m. and from 18 to 20 hours). Due to all of the above, it is necessary to integrate other solutions that are currently in the development and testing phase, such as smart grids or increasing tariffs for the calculation unit of electricity during periods of unfavorable conditions in the network.

The development of electric vehicles and their chargers is aimed at eliminating the aforementioned negative impacts on PS, and we can also talk about positive impacts on the grid in terms of storing electricity and returning it to the grid. By storing such a large amount of electricity, the issues of balancing (imbalance) and secondary and tertiary frequencies can be solved, for which thermal power plants and imports are currently used, which would consequently mean more production from production facilities that use undesirable sources for their electricity production. The result of such a measure would be a reduction in emissions of harmful gases, primarily carbon dioxide and sulfur dioxide.

Balancing the electric power system through the provision of auxiliary services through electric vehicles depends, first of all, on the performance of charging stations, that is, electric vehicles, then on the method of charging electric vehicles, the possibilities provided by the platform for mutual communication between the charging station, the electric vehicle and the network, but also on other non-technical aspects of the provision of auxiliary services in the electric power system of Bosnia and Herzegovina. Several electric vehicle charging concepts are explained in the Study: classic charging, planned (smart) charging, Vehicle to grid technology and induction charging with a conclusion on the (im)possibility of implementing auxiliary services for each individual electric vehicle charging concept.

In the context of monitoring and managing the network of electric vehicle charging stations, without ICT technologies it is not possible to integrate electric vehicle charging stations into smart grids and to implement options such as demand management, V2G (energy recovery in network), frequency regulation, auxiliary services and the like. The basis of integration into smart networks is that the charging station itself is equipped with ICT technologies that will make it "smart", i.e. enable all the necessary advanced functions.

In the context of user applications, it is necessary to implement software support, i.e. web and mobile applications that will provide users with access to information about charging stations, enable calculation, invoicing and payment of services, CRM functions for developing relationships with users and other options for smooth communication of charging stations. Given that this is a very important aspect of the entire research on the development of the business of electric vehicle charging stations, it is necessary to elaborate this segment in detail in terms of defining specific technical solutions and designing ICT systems/services in the function of electric vehicle charging activities.

As for the possibility of balancing the PS BiH using electric vehicles, for the functioning of the system in which electric vehicles represent a distributed energy storage for intermittent energy sources, and then the potential for providing flexibility services, it is necessary to fulfill certain prerequisites that can be divided into technical, legal and regulatory and economic. In a technical sense, the basic prerequisite for ensuring flexibility is the existence of infrastructure, vehicles and other parts of the system that support the two-way flow of electricity and data exchange, where all elements are integrated into the smart grid concept. From a legal and regulatory point of view, it is necessary to recognize the elements of the concept of e-mobility in the sense of providing new services, including the possibility of providing flexibility to the power system, and defining them in the legal framework. Finally, the need to manage the entire process of providing flexibility services opens up space for the creation of new business models in which different stakeholders will find their interests, and one of the basic conditions is the existence of a sufficient number of electric vehicles and adequate infrastructure for the economy.

## Conclusion

Considering the extremely complex legislation in Bosnia and Herzegovina, potential regulatory issues or challenges for owners and operators of charging infrastructure in accessing the electrical network and supplying electricity were considered through the Study. In the aforementioned chapter, regulatory issues for each category of infrastructure owner or operator are analyzed, starting from natural persons who primarily want to have infrastructure (chargers) for their personal needs to legal persons who see investments in infrastructure as one of the future types of business.

As future owners and operators face a very large number of challenges, it is necessary to provide them with support in all segments. Support does not necessarily have to be co-financing, but it could certainly be the release of high levies, an accelerated and simplified procedure for issuing necessary permits, a reduced number of necessary documents, etc. Below are potential solutions for individuals and legal entities.

During the development of e-mobility, it is necessary to look at the challenges in terms of customs policy. In order for cars to be exempted from customs duties on the import of cars, they must meet the conditions regarding the preferential status of goods from countries with which Bosnia and Herzegovina has concluded free trade agreements. If no such type of agreement has been concluded, when importing cars, importers are required to pay 5% customs duty on electric vehicles, and 15% customs duty for all other vehicles. During 2019, an initiative was sent to the Ministry of Foreign Trade and Economic Relations, related to the harmonization of the customs rate on the import of electric cars, as is the case in countries in the region, i.e. the former Yugoslavia.

Department for research, analysis and planning of customs-tariff policy measures at the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, on whose proposal the Council of Ministers of Bosnia and Herzegovina should eventually adopt a permanent suspension of the customs rate on electric vehicles if the justification of the initiative is achieved through a temporary suspension.

The absence of legal assumptions about encouraging environmentally friendly vehicles in Bosnia and Herzegovina is another challenge on the way to the development of e-mobility. Bosnia and Herzegovina is the only country in the region of the former Yugoslavia, as well as beyond, that does not have any kind of subsidies for the purchase of electric cars. Bosnia and Herzegovina has thus classified itself as one of the few countries in the region and Europe that does not keep pace with the development of electro mobility. Without subsidies, it is not possible to expect a significant purchase of electric cars due to the high price difference of approx. 15-20% compared to cars powered by fossil fuels from the same segment. The higher price difference of electric cars still makes them unattainable for the majority of buyers in Bosnia and Herzegovina, although the potential exists, whether they are individuals or legal entities. In this regard, it is necessary to encourage environmentally friendly modes of transport and issue financial incentives in terms of promoting environmentally friendly modes of transport.

One of the significant barriers is the property tax for electric vehicles, whereby owners of electric cars within the entities of the FBiH, i.e. cantons, pay the maximum amount of property tax on an electric car. On average, this amount reaches the value of 180-220 KM. As an example of good practice, the Tuzla Canton is cited in the Study, which has completely abolished the payment of property tax for electric cars, while for hybrid-powered vehicles this amount has been reduced by 50%. Identical initiatives should be sent to other cantons in FBiH, which would ultimately have an additional and positive effect on potential owners of electric cars and hybrid vehicles.

Limitations regarding the mapping of electric charging stations in Bosnia and Herzegovina are inevitable, and in order to overcome the aforementioned limitations, it is definitely suggested to create an application with entered locations and basic data of available charging stations.

When it comes to challenges regarding the software integration of electric charging stations, the current status is such that the majority of installed charging stations in Bosnia and Herzegovina have their own systems or do not exist at all, and it is necessary to organize the area in such a way that the minimum requirement that the software must meet in terms of satisfaction of all qualitative and SMART aspects related to the smooth operation of future bottling plants, as well as monitoring their efficiency, consumption and applicability.

In addition, very often there is no vertical, nor horizontal signage pointing to the location where the electric charging station is installed, and it is necessary to legally regulate this area by creating unique regulations on the conditions, method and type of characteristics of the electric car charging station, and through the procedure refer to competent institutions for adoption.

Ultimately, the abolition of tolls for electric cars would represent an additional incentive for their use, given that they are cars that do not pollute the environment, and it is proposed to send an initiative to abolish tolls for electric cars.

In addition to the above, it is also proposed to legally regulate the area of assistance in the event of a traffic accident and challenges regarding charging for the use of charging stations.