



A Pathway to Decarbonization of the Vehicle Fleet in Serbia and the role of Electric Mobility

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Abbreviations

AC	Alternating current
AERS	Energy Agency of the Republic of Serbia
BEV	Battery electric vehicle
CNG	Compressed natural gas
CO₂	Carbon dioxide
CP	Charging points
CPO	Charge point operator
CS	Charging stations
DC	Direct current
DPF	Diesel particulate filter
DSO	Distribution system operator
EV	Electric vehicle
FCEV	Fuel cell electric vehicle
GDP	Gross domestic product
GHG	Greenhouse gas
HEV	Hybrid electric vehicle
IBRD	International Bank for Reconstruction and Development
IFC	International Finance Corporation
LEV	Light electric vehicle
PHEV	Plug-in hybrid electric vehicle
PLEV	Personal light electric vehicle
REEV	Range-extended electric vehicle
SWOT	Strengths, weaknesses, opportunities, and threats

Executive Summary

This report analyzes the enabling environment for decarbonization and electrification of the transportation sector; makes recommendations for establishing an efficient, sustainable E-Mobility market; and identifies steps to do so. Proposed measures are based on experience and best practices in the region adjusted for the local context. The report should be viewed as a strategic document that provides a list of policy options to support decarbonization and electrification of the transportation sector, underpinned by technical assessments and impact estimates. The report was prepared in 2022 and while some actions have been implemented in the meantime, most recommendations, in particular those related to the decarbonization of vehicle fleet, are still actual and call for urgent systemic effort.

Serbia is transitioning to an environmentally sustainable, low-carbon, climate-resilient economy, but the transition must be accelerated in view of climate change and increasing air pollution. Serbia has Europe's worst per capita record for pollution-related deaths (175 per 100,000 inhabitants), and the Environmental Performance Index shows that Serbia has a score for environmental health and ecosystem vitality below that of most of the Western Balkans Six¹ countries and similar European economies in transition. The problem has several origins, notably excessive reliance on fossil fuels, particularly coal, for electricity generation and heating; outdated, high-emission vehicles, many of which are imported from other European countries; and the declining popularity of public transportation.

A strengths, weaknesses, opportunities, and threats analysis indicates that E-Mobility holds many opportunities for Serbia if it is properly and systematically introduced and identified challenges are mitigated quickly. In addition to its potential to reduce air pollution and improve overall livability, E-Mobility could catalyze research and development that leads to new businesses. That said, there are several challenges to successful implementation of E-Mobility, such as lack of a defined market model and Serbia's coal-dominated energy mix. To realize the benefits of E-Mobility, the energy mix must be decarbonized. Other challenges include overall cost of electric vehicles (EVs), instability of the price of electricity, and associated environmental challenges, such as recycling batteries. All of these can be mitigated with appropriate policies and actions.

Serbia has begun to establish an E-Mobility market with amendments to national regulations and subsidies for EV purchase.² Fully electric buses have been adopted in several cities,³ a few logistic companies have started using light commercial EVs, and public and private entities have installed charging points. Despite these measures, critical elements for coordinated E-Mobility deployment are still missing—in particular, an effective institutional structure, clear objectives, and an enabling market framework. However, there is no planning and strategic framework enabling development of a policy to set national targets for E-Mobility, and E-Mobility-related challenges are insufficiently addressed in the existing strategic, program, and planning documents. According to existing regulations in Serbia, the sectors of energy, environmental protection and transport are vital in building a legal framework for the development of E-Mobility. The existing legal framework

¹ Republic of Albania, Bosnia and Herzegovina, Montenegro, Republic of Kosovo, Republic of North Macedonia, Republic of Serbia

² Igor Todorović: Serbia to subsidize electric vehicles, hybrids, citing air pollution, Balkan Energy News

³ ZeEUS eBus Report #2 - An updated overview of electric buses in Europe

does not envisage provision of financial or nonfinancial incentives for public transportation (buses); construction of public charging stations and EV infrastructure (tolls, parking, yellow lanes); or duty relief or tax or other fiscal benefits. E-Mobility is addressed in one article of the Energy Law and in the regulations on subsidies for taxis and electric and hybrid vehicles and on exemption of EVs from the annual registration fee for motor vehicles.

Serbia's energy mix and the condition of its vehicle fleet, especially in urban areas, pose additional challenges. Only 7.7 percent of registered vehicles are less than five years old, and 95.9 percent of passenger cars do not meet Euro 6 emission standards.⁴ Urban and suburban passenger public transportation is available in 48 cities, with private transportation dominating the market. In 2019, the transportation sector consumed 225,683,000 tonnes of diesel and 102,905 MWh of electricity. Electricity generation in Serbia relies mainly on coal-fired thermal power plants, with hydroelectric plants, biofuels and waste, oil, wind, and solar generating the rest. In 2021, renewable sources such as hydro, wind, and solar provide about 13 percent of electricity generation. Electrification of transportation systems is an opportunity to address the challenge of aging, inefficient vehicles and to improve public transportation services. Implementing renewable energy and providing grid flexibility are essential to decarbonizing electric mobility. Smart grid operations, in particular smart EV charging enabled by advanced electricity pricing (e.g. time-of-use tariffs), would allow for synergies between the transportation and energy systems.

Given the current state of play and vehicle fleet characteristics, transition to electric mobility is essential part of the decarbonization of the transportation sector but alone is not enough. To address these challenges, several scenarios were developed to reduce greenhouse gas emissions, primarily carbon dioxide. Scenarios are harmonized as much as possible with EU directives. Four scenarios were tested, including three basic scenarios and a fourth *balanced* scenario which was chosen to determine future vehicle fleet decarbonization targets for Serbia. The three basic scenarios were *business as usual or pessimistic*, involving a marginal increase in EVs while the composition of the vehicle fleet remains largely the same; *EV-centric*, which assumes that EVs will account for 10 percent of the vehicle fleet in 2030 with the rest of the fleet composition largely unchanged; and *optimistic*, which assumes that EVs will account for 10 percent of the vehicle fleet in 2030 and that the vehicle fleet will be modernized with the elimination of almost all vehicles with Euro 3 or lower standards. Although 10 percent EV penetration might sound unambitious, given the condition of the E-Mobility market and high cost of EV vehicles, it is unlikely that such a target would be achieved even with aggressive government policy. Therefore, a *balanced* scenario was developed that assumes that EVs will account for 5 percent of the market by 2030 and substantial modernization of the overall vehicle fleet. The effects of the scenarios on basic indicators are presented Table ES1.

Table ES1: Effects of Scenarios on Basic Indicators

Indicator	Year	Scenario			
		Business-as-usual	EV centric	Optimistic	Balanced
No of registered vehicles	2020	2,287,740			
	2030	2,717,117			
Total annual energy consumption (t)	2020	2,592,564			
	2030	2.954.140	2,843,602		2.333.576

⁴ The European emission standards are [vehicle emission standards](#) for pollution from the use of new land surface vehicles sold in the [European Union](#) and [European Economic Area](#) member states and the United Kingdom, and ships in EU waters. The standards are defined in a series of [European Union directives](#) staging the progressive introduction of increasingly stringent standards

Table ES1: Effects of Scenarios on Basic Indicators

Indicator	Year	Scenario			
		Business-as-usual	EV centric	Optimistic	Balanced
Annual Energy required from GREED (MWh) - EV	2020	40,005			
	2030	40,005	1,000.952	510.105	
Annual CO ₂ Emission (tonnes)	2020	6,016,890			
	2030	6.844.073	6.303.800	5,261,076	5.462.392
Annual NO _x Emission (tonnes)	2020	107,829			
	2030	114,706	98,301	57,993	63.149
Annual PM Emission PM (tonnes)	2020	3,988			
	2030	3,769	2,965	554	714

Based on the analysis, this report proposes an E-Mobility market model and vehicle fleet decarbonization targets. The proposed market model includes possible governance structure, charging and pricing strategies, and rules for licensing and market entry. Accelerating the establishment of a comprehensive legal and regulatory framework governing all segments of E-Mobility is the highest priority. A framework would define roles, relations, responsibilities, and market entry and exit rules, increasing competitiveness and transparency and ultimately making E-Mobility more viable. In addition, incentives and strategies to encourage EV uptake by car owners and urban public transportation and freight operators should be updated and implemented as soon as possible. The size of incentives intended for each category of users (e.g., individuals, transportation companies, government organizations) must be precisely defined and structured in a way to prevent misuse, which could discourage other players in the transition to E-Mobility.

The report concludes with a Roadmap, a set of measures that would help relevant ministries and local authorities to accelerate decarbonization of vehicle fleet and deployment of E-Mobility. An appropriate set of measures, typically input values, expected benefits, timeframes for implementation, and indicative costs, accompanies each activity described. The roadmap groups measures into the following categories: governance structure and decision on the market model; update of regulatory framework; update of planning and strategic framework; actions to promote vehicle fleet decarbonization, differentiated according to passenger cars, buses, and trucks; and charging infrastructure network and grid capacities. The roadmap also addresses cross-cutting challenges with measures related to social and public awareness, human capital, research and development, technology, and the energy mix. Under a regulatory framework update, the roadmap highlights relevant local laws and changes that should be implemented in or connected to those laws. The same is done for planning and the strategic framework. Actions related to decarbonization of vehicle fleets summarize the most potent policies, including the proposed incentive program and its expected cost.

With the proposed roadmap, EVs will account for 5 percent of Serbia's vehicle fleet until 2030, after which E-Mobility could accelerate, assuming further economic growth and development of educational, industrial, and manufacturing forces. In addition, it is expected that by 2030 there will be an increase in hydrogen-powered vehicles and other advances to reduce pollution from combustion engines. To reach the proposed target, the government should take immediate action to define and regulate the E-Mobility market and expand subsidies and incentives program for overall vehicle decarbonization.

If the proposed activities are implemented, they will have positive effects beyond the transportation sector, for example by improving the health of the population and the environment.

1. Introduction

The transition to an environmentally sustainable, low-carbon, climate-resilient economy is gaining traction in Serbia but must accelerate given the increasingly detrimental effects of climate change and air pollution. Serbia could also realize economic gains by focusing on more-sustainable development, particularly in the energy sector.

The European Green Deal will impose significant obligations on Serbia to take steps toward a cleaner, lower-carbon future because of Serbia's membership aspirations. The Green Deal sets ambitious climate action goals, including cutting greenhouse gas (GHG) emissions by 55 percent by 2030 and achieving carbon neutrality by 2050. Serbia verified its commitment to achieving the Green Deal goals and addressing climate change and environmental challenges by signing the Sofia Declaration on the Green Agenda for the Western Balkans in November 2020; it also endorsed the 58-point Action Plan for a Green Agenda for the Western Balkans and relevant policies for the period until 2030 at the EU-Western Balkan Summit in Slovenia on October 6, 2021. Given the high levels of air pollution and the Europe-wide effort to decarbonize in response to climate change, Serbia has committed to a 9.8 percent reduction in GHG emissions by 2030 from 1990 levels. Increasing energy efficiency in the transportation sector is critical to realizing this goal, because the sector is the second biggest contributor to GHG emissions and the third main contributor to overall air pollution levels.

According to the World Health Organization, shifting to more-sustainable mobility solutions would reduce air pollution and exposure to toxic air pollutants; mobility solutions running on clean energy would also contribute to decarbonization.

Serbia is at the beginning of its journey toward decarbonization. Air pollution, particularly from particulate matter and nitric oxides, is acute. Serbia has Europe's worst per capita record for pollution-related deaths (175 per 100,000 inhabitants), and its environmental health and ecosystem is less vital than that of most of the Western Balkans Six countries and comparator transition economies of Europe according to the Environmental Performance Index. Serbia's carbon dioxide (CO₂) emissions per unit of gross domestic product (GDP) (in purchasing power parity terms) are more than double the EU average. Energy efficiency is one-fourth the EU28 average, according to Eurostat data, because the country strongly depends on fossil fuels.

The problem has several components, including excessive reliance on fossil fuels, especially coal, in electricity generation. Nearly half of electricity in Serbia is generated by coal-fired thermal power plants, with 13 percent from renewable energy sources such as hydroelectric, wind, and solar. Serbia depends greatly on coal in electricity generation because of its large coal reserves. Serbia's two biggest coal mines have 4.1 billion tonnes of proven lignite reserves. Lignite mined in the coal mining and smelting complex Kolubara is the largest energy source, accounting for more than 50 percent of Serbia's electricity generation. National utility Elektroprivreda Srbije, which holds a market share of 97 percent, owns and operates all large power plants.

The transportation sector is also a key contributor to air pollution. Buses were the dominant means of public transportation in 50 cities in Serbia in 2018, 90.2 percent of which with diesel engines; 60

percent of the bus fleet was below Euro 5 emission standards.⁵ The passenger vehicle fleet is old, with many vehicles with high emissions, poor fuel economy, and outdated powertrain technology, and many of which are imported from other European countries. As of 2019, 95.9 percent of passenger cars did not meet Euro 6 emission standards. The situation in Belgrade is somewhat better although still unsatisfactory, with 82.7 percent of passenger cars failing to meet Euro 6 emission standards. Decreasing popularity of public transportation is another problem.

In transportation decarbonization efforts, deployment of E-Mobility in Serbia is important element to combat air pollution and climate change, increase the livability of urban areas, and align with the EU Green Deal and international and European measures promoting decarbonization of the energy sector. In addition to contributing to decarbonization, E-Mobility offers benefits such as less noise pollution, grid balancing, and greater energy efficiency in transportation. Moreover, a well-developed transportation system are fertile field for attracting more investments.⁶

Total lifecycle emissions of EVs depend on the source of the electricity that they use. Thus, the benefits of E-Mobility are best realized in parallel with decarbonization of the electric grid because grid conditions may constrain consumer uptake of EVs. E-Mobility can support decarbonization of the electric grid by providing flexibility and storage services and enhancing the circular economy by reusing and recycling EV batteries. Development of an E-Mobility system requires that various stakeholders be engaged, especially from the energy sector.

In 2021, Serbia had only a few hundred EVs, including passenger cars, vans, and buses, but the government has amended national regulations pertaining to E-Mobility and begun subsidizing EV purchases;⁷ fully e-buses have been introduced in several cities, and public and private entities have installed charging points. These measures are only initial steps toward an electric future. The most important elements for enabling E-Mobility deployment are missing or incomplete, and the few incentives for EV purchases are modest and focused on private vehicles. There is no clear institutional structure or regulatory and strategic environment to govern E-Mobility. The market model has not been defined, and only a few companies are driving EV uptake—in a rather unstructured manner.

The report should be viewed as a strategic document containing a list of policy options to support decarbonization of the transportation sector by replacing outdated vehicles with electric and other less polluting alternatives. The technical assessment was a key input into development of the recommendations and policy alternatives to facilitate development of E-Mobility and overall decarbonization of transport sector. It involved data collection, market research, development and testing of scenarios, analysis of different approaches, and stakeholder consultations.

Potential scenarios were developed based on the condition of Serbia's transportation sector, such as transportation modal split and potential future trends; government policies and strategies for 2021 to 2030; and associated financial, regulatory, and operational implications. Scenarios assumed different levels of ambition, financial implications, and political commitment for decarbonization of vehicle fleet and deployment of an E-Mobility system.

There are various enablers of and barriers to EV adoption.

- **Financing** (e.g., subsidies, indirect incentives)
- **Mobility** (e.g., demand, modal splits, attitudes)

⁵ Transport and Telecommunications in the Republic of Serbia 2019, Republic Statistical Bureau, Bulletin No. 656, 2020

⁶ International Energy Agency: Global EV Outlook 2020

⁷ Igor Todorović: Serbia to subsidize electric vehicles, hybrids, citing air pollution, Balkan Energy News

- **Technology** (e.g., EVs, batteries, charging stations, smart charging)
- **Supply chain and infrastructure** (e.g., grid impacts and upgrades, charging infrastructure, potential of renewable energy integration, battery reuse and recycling)
- **Legislative and regulatory environment** (e.g., directives, codes, subsidies, standards)
- **Private sector participation** (e.g., stakeholders, networks, business models, electricity charging cost, procurement strategies)
- **Environment, health, and society** (e.g., air pollution, GHG emissions, and gender matters)

Based on the analysis, the scenarios developed, and relevant practices across Europe, the report presents a set of policy-oriented recommendations for Serbia to decarbonize vehicle fleet including to transition to E-Mobility by 2030. The recommendations cover the most important elements of the E-Mobility enabling environment, including legal and strategic activities, technical capabilities and human capital, and financial and commercial factors, and should enable Serbia to achieve ambitious transportation decarbonization targets by 2030.

The report was prepared in 2022 and while some actions have been implemented in the meantime, the majority of recommendations, in particular those related to the decarbonization of vehicle fleet, are still actual and call for urgent systemic effort.

The report is structured as follows. Chapter 2 provides a brief overview of E-Mobility in EU countries, covering factors such as stages of E-Mobility achieved and the legal environment related to E-Mobility. Chapter 3 describes E-Mobility ecosystem in Serbia as of 2021, while Chapter 4 describes challenges in and opportunities for E-Mobility deployment in the Republic of Serbia. Based on the information in preceding chapters, Chapter 5 presents optimal scenarios for the spread of E-Mobility in Serbia and elaborates the potential market model and vehicle decarbonization scenarios that consider energy consumption and emissions from main polluters. Chapter 6 presents a roadmap for transportation decarbonization and E-Mobility deployment that details the actions and measures needed for successful decarbonization and electrification of transportation, including timeframes and cost estimates where possible. The report's findings are summarized in Chapter 7.

2. E-Mobility in the European Union

The European Union has developed directives and strategies to move the transportation sector toward E-Mobility, with the aim of reducing GHG emissions, air pollution, and noise while increasing the competitiveness of the EU automotive industry.

As an EU candidate, Serbia has accepted obligations under EU protocols, declarations, and treaties, including rules related to E-Mobility. To this end, the Serbian government must establish a framework enabling and encouraging E-Mobility or convert EU directives and regulations into national legislation. Aligning with EU rules and strategies will ensure international interoperability and an appropriate regulatory environment for investors while facilitating adoption of EU rules. It could also help Serbia accelerate its E-Mobility transition.



In the European Union, adoption of electric cars, buses, and taxis has been faster than expected, although EVs. The share of EVs in overall vehicle fleets varies significantly according to country, with one-quarter of the total electric and hybrid fleet registered in Iceland, Norway, and the United Kingdom.

EU governments have committed to continued EV growth; for example, most EU countries offer financial incentives to support E-Mobility, such as subsidies for EV sales, tax

benefits for EV owners, free parking for EVs, and incentives for investments in related infrastructure.

This chapter discusses these and other EV development trends across the European Union, including regulatory and strategic environments, and outlines lessons learned that might be relevant for Serbia.

2.1. EV fleet and physical infrastructure characteristics

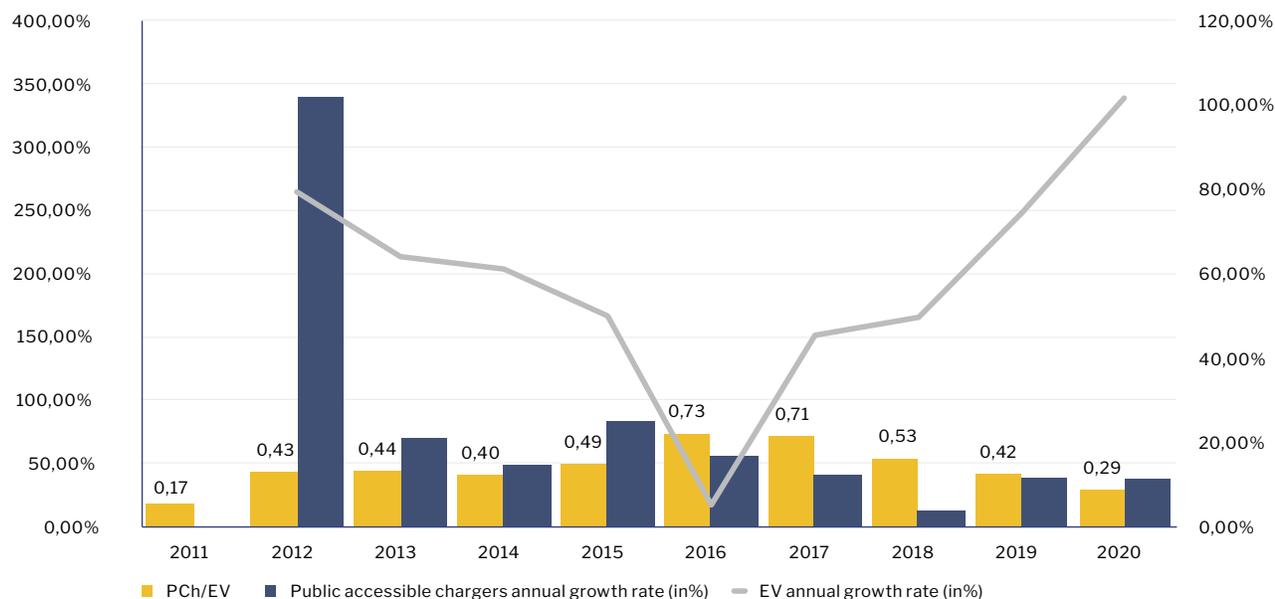
2.1.1. Trends in private EV purchases and importance of physical infrastructure

Of 524,968 EVs and 1,556,684 plug-in hybrid and hybrid cars registered in EU-27 countries in 2020, 25.4 percent (186,432 plug-in hybrids, 320,963 hybrids) were registered in Iceland, Norway, and the United Kingdom.⁸ Access to sufficient publicly accessible chargers is critical to mass

⁸ <https://www.eea.europa.eu/>

uptake of EVs, even though this is not pressing for people with home chargers, especially in low-density urban areas. Increases in EV uptake generally followed a surge in the number of publicly available chargers between 2011 and 2012 (Figure 1). Dynamic growth in the number of EVs was reported from 2011 to 2014, followed by a decline in 2016 and an increase in 2017, with an uptrend continuing until 2020.

Figure 1: Number of Electric Vehicles (EVs) and Publicly Available Chargers in EU Countries and Ratio of EVs to Available Chargers



2.1.2. Government EV fleets, city logistics, and corporate

To better understand how charging infrastructure affects growth of EV fleets, an indicator was derived from the number of publicly available chargers per EV. The ratio rose until 2017, when it reached 0.71 public chargers per EV, after which it began to decline, dropping to 0.29 in 2020. The ratio indicates a disparity between the number of publicly available chargers and the number of EVs.

The EU experience indicates that, at an early stage of E-Mobility market development, support for the electrification of corporate, government, and city logistics fleets can have a rapid, visible impact on E-Mobility uptake. Moreover, these fleets generally included high-mileage vehicles, so greater impact can be achieved with fewer vehicles switching to electric. Such fleets are highly represented in new car registrations all around Europe.

For example, almost 60 percent of new cars sold in Europe are registered through corporate channels because of substantial subsidies offered in the form of deductible value-added taxes and write-offs. Also, company cars travel on average 2.25 times as much as private cars, contributing disproportionality to emissions. Moreover, although company cars account for 3.7 percent of the total vehicle fleet, 10 of the largest leasing companies contribute 8 percent to car CO₂ emissions in Europe (Transport and Environment).

As with corporate fleets, taxi fleets have the potential to catalyze electrification of transportation. Electrifying city logistics is “low-hanging fruit” for quick, visible transportation electrification considering increasing demand for e-commerce and the high daily mileage (300 to 400 km) of

commercial vehicles. City freight return to their depots every night, where they can easily charge. Freight transport is disproportionately represented in road emissions, with commercial vehicles accounting for approximately 2 percent of Europe's vehicle fleet but generating 25 percent of emissions.

2.1.3. EVs in public transportation

Accessible, inclusive E-Mobility can be achieved only with electrification of public transportation, which is at the development stage in the European Union, especially for buses. There are no best practices, given continuous development of battery technology and charging solutions and needed adjustments to bus line infrastructure.



The Zero Emission Urban Bus System project provides the most comprehensive overview of bus line electrification projects in Europe. It is the main EU activity extending fully electric solutions to urban bus networks. The project has collected data from 82 European cities, including 10 demonstration sites, regarding regular e-bus operations, pilot projects, and several tests. The project also closely follows e-bus development projects around the world through the Zero Emission Urban Bus System Observatory.

The European e-bus market is fragmented, with some prominent players. Models from 37 bus manufacturers operate in 82 surveyed cities, but e-buses predominantly operated on city center lines operating on flat terrain, running 13.1 hours in full electric mode. Bus fleets mainly operating in urban areas could be electrified because of their shorter driving distance and driving cycles; 61.9 percent of buses travelled less than 200 km/day and 32.7 percent between 200 and 300 km/day. Buses drove an average of 185.3 km per day.

Charging strategy and technology are critical for bus system electrification. Charging strategies include overnight charging (depot charging) and daytime charging (opportunity charging) or a combination of the two, and use of these strategies depends largely on the characteristics of the bus line. Based on the e-bus projects implemented, the main challenge to on-route opportunity charging is keeping to the timetable, whereas using only overnight depot charging can limit daily driving range.

Of the projects examined, overnight charging strategy was used on 87 percent of bus lines, mainly by installing plug-in depot chargers, and 60 percent of bus services used some type of opportunity charging (even if only at the terminals), with roof-mounted pantograph charging at terminals the most common technology solution. Forty-seven percent of the electrified lines used a mixed charging strategy of overnight and opportunity charging to maximize drive range.⁹

⁹ Path to Electric Mobility for Belgrade, Component 1, section 6.1.1.2., PwC Report, October 2021

According to the EU Alternative Fuels Infrastructure Directive, EU member states must reach a certain share of clean vehicles (electric, hybrid, combined natural gas propulsion-compressed natural gas (CNG)) in their public urban transportation systems by 2025 overall and by 2030 in cities (Table 1).

Table 1: Share of Clean Buses in Passenger Transport in Accordance with EU Directive 2014/94

Country	2025	2030
	%	
Austria, Belgium, Cyprus, Denmark, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Spain, Sweden	50	75
France	48	71
Lithuania	47	70
Finland	46	69
Czech Republic	46	70
Hungary	42	63
Portugal	40	61
Latvia	40	60
Slovakia, Bulgaria	39	58
Greece	38	57
Poland	37	56
Estonia	36	53
Slovenia	33	50
Croatia	32	48
Romania	29	43

Electrification of bus fleets varies according to country. Twelve countries have committed to rapid fleet electrification, and another group of countries will introduce e-buses at a more moderate pace. The share of clean buses will not exceed 75 percent in any EU country by 2030.

2.1.4. Micromobility

One definition of micromobility is “personal transportation using devices and vehicles weighing up to 350 kg and whose power supply, if any, is gradually reduced and cut off at a given speed limit which is not higher than 45 km/h. Micromobility includes the use of exclusively human-powered vehicles, such as bicycles, skates, skateboards and kick-scooters”.¹⁰ With the market expected to grow to a US\$100 billion to US\$150 billion business in Europe by 2030,¹¹ consideration should be given to potential opportunities and risks regarding introduction of these services.

Addressing mobility in southeast European countries requires coordinated action by all stakeholders and should involve a multimodal system of pedestrian, road, bus, bicycle, and rail transportation.¹² Technological advances promoting sustainability should be prioritized to deliver environmentally friendly, energy-efficient renewable energy solutions in transportation.

Micromobility plays an important role in this context. Electric micromobility devices and e-bike and e-scooter shared services have been rapidly expanding in many European cities. Micromobility offers an accessible solution for the first and last miles in urban areas and can substitute for car-based commuting.

¹⁰ Safe Micro Mobility, OECD, International Transport Forum, Paris, 2020.

¹¹ Source: Statista, <https://www.statista.com/accounts/pa>

¹² GIZ. “Sustainable Urban Mobility in South-East European Countries.” 2018.



Data from various sources suggest that shared e-scooters and bikes are particularly suitable for short trips. The typical scooter user or bike share pass holder rides 11 to 12 minutes for one to three km in major cities across the United States. The same trend is observed in European cities. For example, in Paris, the average e-scooter trip takes approximately 11 minutes. E-bikes are often used for longer journeys when walking is not a viable option. Some assessments suggest that the average commuting distance on e-bikes is 11.4 km. In densely populated European cities with lower car use,

such as Paris and Oslo, only 8 to 10 percent of e-scooter trips displace car trips (personal, ride-hail, taxi), but even 10 percent of shared micromobility is enough to affect traffic flow and air quality.

There are concerns about micromobility competing with cycling and walking, but the data suggest that the average bike sharing trip tends to be longer than the average e-scooter trip. In France, bike sharing is used for distances similar to those for shared e-moped and motor scooter trips (5.25 km).

Micromobility also has potential to be used for city logistics. Survey of “Pedal Me” delivery courier in London reported that using cargo bikes has been found to decrease traffic congestion and carbon emissions. For example, it is estimated that, by expanding e-cargo bike services to replace 10 percent of the van-kilometers driven in London, as much as 133,300 tonnes of CO₂ and 190,000 kg of nitrous oxide could be prevented per year. In addition, switching freight from vans to electric cargo bikes in city centers could result in 60 percent faster delivery times.

2.2. Regulatory enablers—Effective regulatory framework

The following sections present brief summaries of the most relevant EU directives and strategies for E-Mobility development to inform the transition to E-Mobility in Serbia.

2.2.1. EU Directives

End-of-Life Vehicles Directive (2000/53/EC)

The End-of-Life Vehicle Directive (2000/53/EC), adopted in 2000, was the first EU regulation to address sustainable management of vehicles at the end of their useful life. The directive introduced the concept of extended producer responsibility (an important policy designed to reduce the environmental impact of products).

Batteries Directive (2006/66/EC)

The Battery Directive (2006/66/EC) requires battery manufacturers to take back waste batteries and accumulators from distributors or anyone owning waste batteries and to set up accessible collection points. Battery manufacturers must dispose of and landfill battery waste. They may completely or partially outsource battery waste collection and treatment to any organization with the appropriate permit for waste collection and treatment.

According to the Draft as of July 1, 2024, only chargeable industrial and EV batteries with internal storage and a carbon footprint declaration will be allowed to be sold in the European Union; starting July 1, 2027, to comply with maximum carbon footprint thresholds; as of January 2027, owners of batteries with internal storage will have to declare the content of recycled components;

and from 2030 on, batteries will have to contain a minimum level of recycled content.¹³

Alternative Fuels Infrastructure Directive (2014/94/EU)

The Alternative Fuels Infrastructure Directive (2014/94/EU) is the key regulation setting common standards and minimum requirements for EU-wide deployment of alternative fuel (e.g., electricity, hydrogen, liquified natural gas, CNG, liquified petroleum gas) infrastructure. The directive defines alternative fuel infrastructure (e.g., EV, charging point) to facilitate development of EU regulations and policies regarding E-Mobility. More specifically, the directive requires that EU member states adopt national policy frameworks and targets for development of a market for alternative fuel use in transportation (e.g., public transportation, freight, private transportation) and deployment of related infrastructure.

The directive states that the number of charging points shall be determined based on the number of EVs registered until the end of 2020 (at least one charging point per 10 cars). It also highlights the importance of ensuring adequate coverage of publicly accessible charging points, noting that special attention should be paid to public transportation stations, such as airports and railway stations.

Directive requirements for public authorities and market actors include that:

- All publicly accessible charging points enable EV users to charge on an ad hoc basis, without entering into a contract with the electricity supplier or operator concerned
- CPOs are allowed to provide charging services on a contractual basis
- Operators of charging points accessible to the public are free to purchase electricity from any EU electricity supplier, subject to the supplier's agreement
- Distribution system operators (DSOs) cooperate on a nondiscriminatory basis with any other owners or operators of charging points accessible to the public

Proposal for a Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/COD)

The European Commission published a proposal for a Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/COD) to be legally binding on all member states.

New targets and approaches:

- The approach to setting mandatory targets for deployment of charging infrastructure should combine national fleets with location-based (or distance-based) targets (replacement for one charging point per 10 cars).
- Each battery electric light-duty vehicle shall be provided with a total power output of at least 1 kW through publicly accessible charging stations and each PHEV with at least 0.66 kW - replacing one publicly accessible charging point.
- Location-based targets throughout the core and comprehensive Trans-European Transport Network for light- and heavy-duty vehicles, including the distance and the required power output of the charging pools and some charging stations - e.g., publicly accessible charging pools dedicated to light-duty vehicles should be deployed in each direction of travel with a maximum distance of 60 km between them.
- The proposal provides a comprehensive set of definitions covering a wide variety of aspects of E-Mobility.

¹³ European Commission: Green Deal: Sustainable batteries for a circular and climate neutral economy, 2020

- Provisions for ensuring user-friendliness of charging infrastructure and defines payment options, price transparency, non-discriminatory practices, and smart charging.
- The proposal sets a clear pathway for deployment of hydrogen infrastructure (throughout the core and comprehensive Trans-European Transport Network networks and in urban nodes).

Renewable Energy Directive (2018/2001/EU) (Draft)

The Renewable Energy Directive (2018/2001/EU) (Draft) sets a binding EU target for the share of energy from renewable sources in final energy consumption and establishes a common set of rules on electricity from renewable sources and use of energy from renewable sources in the heating and cooling sector and the transportation sector, in line with emission-reduction targets defined in the Paris Agreement, a legally binding international treaty on climate change.

The directive emphasizes that measures should be implemented to ensure availability of renewable electricity at charging points, including the option for bidirectional charging to contribute to use of renewable electricity and grid flexibility. It also stresses the need to create a legal environment for future smart charging solutions, which require free access to basic real-time vehicle data. It also calls for incentives for CPOs to increase renewable energy shares (especially in the form of loans for fuel suppliers).

Energy Performance of Buildings Directive (2018/844/EU)

The Energy Performance of Buildings Directive (2018/844/EU) is designed to guide the realization of a decarbonized building stock in the European Union by 2050, including use of information and communications technology and smart technologies to increase the energy efficiency of buildings and introduction of E-Mobility infrastructure.

The directive includes provisions to ensure that parking lots in new buildings and buildings undergoing major renovation are equipped with charging points or dedicated infrastructure for EVs.

- Residential buildings with more than 10 parking spaces must furnish ducting infrastructure for every parking space to enable installation at a later stage of charging points for EVs.
- Nonresidential buildings with more than 10 parking spaces must be equipped with ducting infrastructure for at least one in every five parking spaces. (Installation of at least one charging point for EVs is required.)
- Ducting infrastructure must be installed in buildings undergoing major renovation.

The directive calls for simplified rules and administrative requirements for deployment of charging points to make it easier for individuals to install charging infrastructure.

Member states must establish their requirements and a minimum number of charging points for nonresidential buildings with more than 20 parking spaces, according to local conditions and characteristics, with requirements to take effect in 2025.

Regulation on CO₂ Emission Performance Standards for Cars and Vans (2019/631/EU)

The Regulation on CO₂ Emission Performance Standards for Cars and Vans (2019/631/EU) introduced emission performance standards (Table 2).

- Passenger cars: 15 percent reduction by January 1, 2025; 37.5 percent reduction by January 1, 2030

- Vans: 15 percent reduction by January 1, 2025; 31 percent reduction by January 1, 2030
- Heavy-duty vehicles: 15 percent reduction by January 1, 2025; 30 percent reduction by January 1, 2030

The Regulation also implies that CO₂ emission standards for new cars and vans will have to come down by 100% by 2035, compared to 2021 levels (only zero-emissions vehicles can be registered).

Clean and Energy-Efficient Road Transport Vehicles Directive (2019/1161/EU)

The Clean and Energy-Efficient Road Transport Vehicles Directive (2019/1161/EU) mainly refers to public road transportation services, refuse collection services, and mail and parcel delivery services, setting minimum public procurement targets for share of clean (low- and zero-emission) light- and heavy-duty vehicles by 2025 and 2030. It calls for incentives to promote market uptake of clean vehicles in various modes of road passenger transportation, refuse collection, and freight and sets targets for member states in accordance with their economic capacity.

Internal Market in Electricity Directive (2019/944/EU)

The Internal Market in Electricity Directive (2019/944/EU) defines the rights and obligations of stakeholders in the internal market for electricity, such as energy regulators, customers, DSOs, and transmission system operators. It also sets requirements for certain operations, such as billing and data management. The directive obliges member states to establish regulatory frameworks to facilitate connection of charging points to the distribution network on a nondiscriminatory basis.

DSOs are allowed to own, develop, operate, or manage charging points only if no other parties have been awarded such rights after an open, nondiscriminatory tendering procedure, subject to approval of regulatory authorities and conducted in line with rules on access of third parties (except private charging points solely for own use of DSOs). Through public consultations, competent authorities or DSOs must regularly (at least every five years) reassess potential interest of other parties to own, develop, operate, or manage these charging points. DSOs must publish network development plans every two years that contain load forecasting, including power needed for charging points for EVs.

2.2.2. Strategies

Many EU strategies are directly or indirectly relevant for E-Mobility development. Below is a brief overview of the three most relevant strategies.

European Strategy for Low-Emission Mobility (2016/501/COM)

The European Strategy for Low-Emission Mobility (2016/501/COM) sets guidelines to support efficiency and innovation in EVs. It recommends:

- Identifying areas requiring policy development and guiding principles for promotion of low-emission mobility
- Optimizing and achieving greater efficiency of the transportation system through digital mobility solutions (e.g., door-to-door solutions and integrated logistics)
- Introducing fair pricing reflecting polluter-pays and user-pays principles
- Promoting multimodal integration by providing incentives for lower-emission transportation modes

- Increasing use of low-emission alternative energy by encouraging use of low-carbon fuels and deploying alternative fuel infrastructure through interoperability and standardization for E-Mobility
- Creating an EU-wide E-Mobility services market that involves cross-border interoperability of payments and provision of real-time information on charging points

European Green Deal (2019/640/COM)

The European Green Deal (2019/640/COM) provides an action plan to encourage efficient use of resources by moving to a clean, circular economy; preserve and restore biodiversity; decrease pollution; and achieve net-zero emissions of GHGs by 2050. By 2025, approximately 1 million public charging and refueling stations will be needed to serve all alternative fuel vehicles in the European Union. The European Commission will support deployment of such infrastructure where “persistent gaps exist,” particularly in less densely populated areas and for long-distance travel.

New Industrial Strategy for Europe (2020/102/COM)

As part of the Green Deal, the New Industrial Strategy for Europe (2020/102/COM) was released in 2020 to help industries transition to a low-carbon future and digitalization. The updated strategy underlines the role the automotive industry plays in supporting Europe’s industrial competitiveness.

With the goal of matching growing demand for alternative fuels, the strategy calls for smart sector integration to ensure effective use of resources. The European Battery Alliance has been established to secure the European Union’s position as a leader in battery technology.

2.3. Technology enablers

In addition to policies and measures to encourage EV uptake, technological innovations that have made EVs more affordable, accessible, and reliable drive EV market penetration. Declining lithium-ion battery prices are also making EVs more affordable to a wider range of customers (Figure 2).

Figure 2: Lithium-Ion Battery Pack Price Evolution (Real 2019 US\$/kWh)

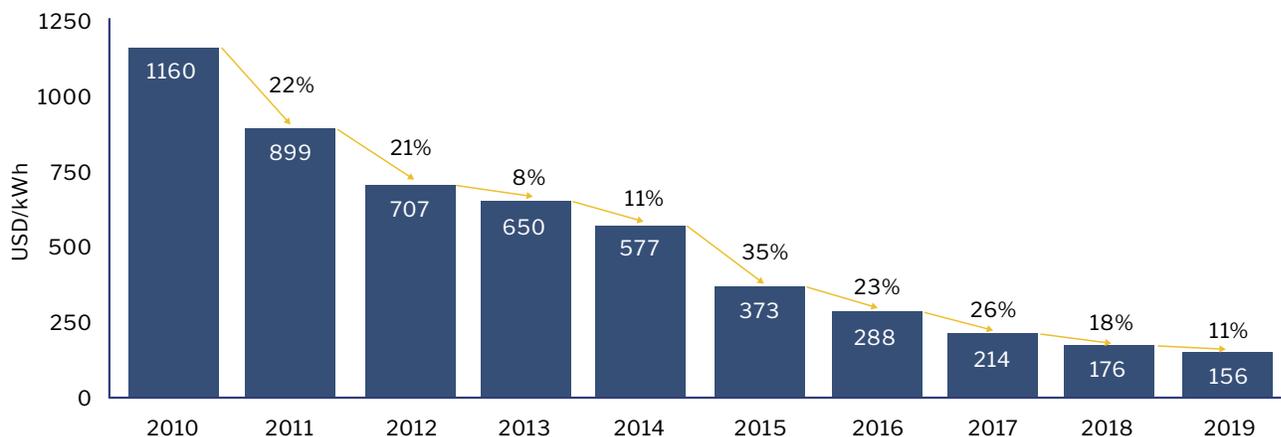


Table 2 lists the types of EVs most relevant for Serbia.

Table 2: Advantages and Disadvantages of Types of Electric Vehicles (EVs) for Serbia

Type	Advantage	Disadvantage
Battery	Zero emission, high efficiency, home charging option, low engine noise	Short driving range (100-300 km), long charging time (depending on type of charger), expensive and therefore not affordable for middle-income consumers
Plug-in hybrid	High efficiency, a home charging option, refueling at any gas station, suitable for regular shorter-range commuting	Short range for solely driving on battery, heavy because of engine and battery
Hybrid	No range limit because of use of combustion engine	Similar environmental impact as latest internal combustion engine vehicles and heavy because of engine and battery

a. This depends on grid emissions.

2.4. Economic enablers—Incentive schemes

Market uptake of electrically chargeable vehicles is directly correlated to a country's GDP per capita, indicating that affordability remains a major concern of consumers. To help make EVs more affordable, most European countries offer subsidies for EV purchase, infrastructure development, tax benefits for EV owners, and other benefits such as free parking. Subsidies are offered to individuals, companies, and public entities to electrify company car fleets and taxis or boost procurement of e-buses.

Purchase incentives for EVs vary greatly between European countries. Some offer subsidy schemes with strong incentives for public transportation; in some, municipalities contribute to national subsidy schemes; and some do not have a uniform subsidy policy. Similarly, subsidy schemes for individuals and businesses vary considerably in scope and exactness, with some countries providing detailed, wide-ranging subsidy schemes and some not offering any direct subsidies. Table 3 presents examples of subsidy schemes offered in some European countries.

Table 3: Examples of EU Subsidy Schemes for Purchase of Electric Vehicles as of 2021

Country	Beneficiary	Subsidy scheme
Austria^a	Individuals	€5,000 for new BEVs and FCEV passenger cars valued max €50,000 €2,500 for new PHEV and REEV passenger cars valued max €50,000
	Businesses	7,500 for new BEV and FCEV vans and minibuses up to 2.5 tonnes €12,500 for new BEV and FCEV vans and minibuses above 2.5 tonnes valued maximum €60,000 €24,000 for new M2 and N2 class BEV and FCEV trucks and buses €60,000 for new M3 and M3 class BEV and FCEV trucks and buses
	Public entities	See above
	Public transportation	Maximum €130,000 for e-buses, depending on passenger capacity
	LEVs	€400-1,200 for electric two-wheelers (e.g., e-motorbikes, e-mopeds, e-bikes, e-cargo bikes)
Bulgaria^b	Individuals	N/A
	Businesses	N/A
	Public entities	€5,000 - €15,000 for new BEVs and PHEVs, including passenger cars, vans, smaller trucks, and minibuses, for public administration and territorial units, maximum three vehicles

Table 3: Examples of EU Subsidy Schemes for Purchase of Electric Vehicles as of 2021

Country	Beneficiary	Subsidy scheme
Bulgaria ^b	Public transportation	No subsidies currently in place for public transportation.
	LEVs	No subsidies currently in place for LEVs.
Croatia ^c	Individuals	Maximum €9,200 or 40% for new BEV and FCEV passenger cars Maximum €4,600 or 40% for new PHEV passenger cars 2020 budget for subsidies: €2.9 million
	Businesses	Maximum €9,200 or 40% for new BEV passenger cars Maximum €4,600 or 40% for new PHEV passenger cars 2020 budget for subsidies: €2.9 million (excluding subsidies for private individuals)
	Public entities	N/A
	Public transportation	Maximum €5.3 million or 40% for e-buses for local municipalities and public transportation providers
	LEVs	Maximum €2,700 or 40% for e-scooters (mopeds), motorcycles, and quadricycles Maximum €670 or 40% for e-bikes
France ^d	Individuals	Maximum €7,000 for new BEV passenger cars and vans (reduced to €6,000 in 2021 and €5,000 in 2022) with a maximum value of €45,000, maximum €3,000 for new BEV passenger cars and vans with a value of €45,000 to €60,000 €2,000 for PHEV passenger cars and vans (reduced to €1000 in 2021, phased out in 2022) with a maximum value of €45,000 €1,000 for used BEV passenger cars and vans Maximum €5,000 for second-hand or new BEVs and PHEVs if scrapping a diesel car (older than 2001) or gasoline car (older than 1997)
France ^d	Businesses	Maximum €9,000 or 20% of purchase price for BEV and FCEV passenger cars and vans Maximum €8,500 or 20% of purchase price for taxis, based on electric driving range Maximum €22,500 or 20% of purchase price for large BEV and FCEV vans and trucks for the first 200 orders, afterwards maximum €9,000
	Public entities	N/A
	Public transportation	No subsidies currently offered to public transportation
	LEVs	€250 per kWh for two- to four-wheel 2- to 3-kW LEVs Maximum €100 or 20% of acquisition costs for two- to four-wheel <2-kW LEVs Maximum €200 for e-bikes
Germany ^e	Individuals	Maximum €9,000 for BEV and FCEV passenger cars and vans with a maximum value of €40,000 Maximum €6,700 for PHEV passenger cars and vans with a maximum value of €40,000 Government and manufacturer each finance a portion
	Businesses	In 2018, €12,000 for BEV and FCEV trucks up to 12 tonnes and €40,000 for BEV and FCEV trucks over 12 tonnes, with a limit of €500,000 per company

Table 3: Examples of EU Subsidy Schemes for Purchase of Electric Vehicles as of 2021

Country	Beneficiary	Subsidy scheme
Germany ^e	Public entities	Targeted subsidies for small and medium-sized enterprises and nongovernmental organizations coming soon
	Public transportation	Total of €620 million for new BEV and PHEV buses up to 80% of the difference in cost in the purchase price between an e-bus and a diesel model
	LEVs	Maximum €2,500 or 30% of price for cargo e-bikes Local subsidies in addition to federal subsidy (e.g., in Munich)
Hungary ^f	Individuals	Maximum €7,000 or 50% for new BEV passenger cars and vans valued maximum €30,500 Maximum €1,400 for new BEV passenger cars and vans valued €30,500 - €42,000 2020 budget for subsidies: €14 million
	Businesses	Maximum €7,000 or 50% for new BEV passenger cars and vans valued maximum €30,500 Maximum €1,400 for new BEV passenger cars and vans valued €30,500 - €42,000 Maximum €23,500 or 55% for BEV taxis (maximum approx. €5.5 million for taxis out of the €14 million budget, which includes subsidies for private individuals)
	Public entities	National and local governments have received 100+ cars from the DSO's E-Mobility service provider company
	Public transportation	Average of 20% subsidies for municipalities for all-electric buses
	LEVs	Maximum €1,500 or 55% for e-scooters (mopeds) valued maximum €2,800 Maximum €420 for e-bikes (employment certificate required as commuting is prioritized)
Norway ^g	Individuals	None
	Businesses	None
	Public entities	None
	Public transportation	Subsidies for e-bus purchase for municipalities; no specific data available
	LEVs	None
Romania ^h	Individuals	Maximum €9,500 or 50% for new BEV passenger cars and vans Maximum €4,200 or 50% for new PHEV passenger cars and vans Additional €1,300 scrapping premium for used cars. 2019 budget: €6.4 million
	Businesses	Maximum €9,500 or 50% for new BEV passenger cars and vans Maximum €4,200 or 50% for new PHEV passenger cars and vans Additional €1,300 scrapping premium for used cars. 2019 budget: €6.4 million
	Public entities	N/A
	Public transportation	N/A
	LEVs	N/A

Country	Beneficiary	Subsidy scheme
Slovenia ^a	Individuals	Maximum €4,500 (reduced from €7,500) for new BEV passenger cars valued maximum €65,000 Maximum €2,000 (reduced from €4,500) for new PHEV passenger cars valued maximum €65,000 Limited funds
	Businesses	Maximum €4,500 (reduced from €7,500) for new BEV passenger cars valued maximum €65,000 Maximum €2,000 (reduced from €4,500) for new PHEV passenger cars valued maximum €65,000 Maximum €3,500 for new BEV cargo vans Maximum €2,000 for new PHEV cargo vans Limited funds
	Public entities	N/A
	Public transportation	N/A
	LEVs	Maximum €1,500 for L6e BEV quadricycles Maximum €2,000 L7e BEV heavy quadricycles €100-1000 (reduced from €4,500) for other L category vehicles, including e-bikes, motorbikes, mopeds, motor tricycles

a. EAFO, ACEA, IEA Global EV Outlook 2020, electrive.com

b. CMS Law, EAFO, Balkan Green Energy News, ACEA, IEA Global EV Outlook 2020

c. EAFO, ACEA, CMS Law, Balkan Energy News

d. EAFO, ACEA, IEA Global EV Outlook 2020, Wallbox, Automotive News Euro

e. EAFO, ACEA, IEA Global EV Outlook 2020, Wallbox, CleanTechnica

f. EAFO, ACEA, e-cars.hu, villanyautósok.hu, ebikepalyazat.hu

g. EAFO, ACEA, IEA Global EV Outlook 2020, Wallbox

h. CMS Law, EAFO, ACEA, IEA Global EV Outlook 2020, Romania Insider, Fleet Europe, Romania Insider 2, ET Energy World

i. CMS Law, EAFO, ACEA, IEA Global EV Outlook 2020

Empirical evidence shows that mass EV adoption requires sufficient charging stations across countries and regions, although as long as the upfront cost of EVs is significantly higher than that of conventional equivalents, availability of charging infrastructure does not provide the necessary impetus for drivers to switch to EVs. Many countries have developed subsidy schemes for deployment of charging stations (Table 4). Again, the scope and exactness of subsidy schemes vary between countries and, among other things, depend on level of market development, existing ratio of EVs to charging stations, and industry development.

Table 4: Examples of EU Subsidy Schemes for Installation of Charging Infrastructure as of 2021

Country	Subsidy scheme
Austria	Maximum €600 for home charging and intelligent cables, €1,800 for multi-occupancy buildings; maximum €30,000 for direct current charging stations for heavy commercial vehicles and buses with more than 150 kW output (when combined with vehicle purchase) €300-15,000 for publicly accessible charging infrastructure depending on charging capacity
Bulgaria	None
Croatia	None (In 2018, the government co-financed charging station installation for maximum €27,000 or 40% of an individual project.) The Croatian Electric Power Industry financed the basic infrastructure, with more than 85% of the invested financed amount coming from EU funds for E-Mobility projects.

Table 4: Examples of EU Subsidy Schemes for Installation of Charging Infrastructure as of 2021

Country	Subsidy scheme
France	€300 tax credit on installation of residential charging Up to 50% off purchase and installation costs of public charging points at workplaces Up to €2,160 off purchase and installation costs per charging point for municipalities Electric vehicle drivers can request an installation point within a 500-m radius of their residence or place of work.
Germany	40% for e-bus charging infrastructure Maximum €3,000 for purchasing charging stations <22 kW Maximum €12,000 for purchasing direct current chargers <100 kW Maximum €30,000 for purchasing direct current chargers >100 kW Maximum €5,000 for low-voltage and up to €50,000 for medium-voltage grid connections (plus local incentives) Subsidies for battery cell manufacturing.
Hungary	Cost of electric charging stations is deductible from corporate tax . Cost of electric charging stations is deductible from income tax base of power suppliers.
Norway	Maximum €5,000 per charging point for housing associations
Romania	Previously, maximum €2,500 for charging stations with up to 22 kW and maximum €30,000 for charging stations more than 22 kW New support scheme for infrastructure deployment expected
Slovenia	In 2017, subsidies for charging point installation for municipalities in protected natural areas or close to these sites were introduced. The electricity distribution operator financed base charging stations, with co-financing from EU funds, Elektro Ljubljana, and other entities from the energy sector.

All countries offer *tax relief* for EV ownership, varying in terms of scope and the tax base. Tax relief schemes depend on individual country tax systems but usually include full or partial exemptions from excise duties for EVs, environmental tax, motor vehicle registration tax, motor vehicle tax, road (tolling) tax, etc. In many countries the program covers several taxes.

Local benefits for EVs mainly include free parking, access to dedicated lanes, and in some countries, free charging. These measures are suitable for implementation at the local level and provide opportunity for local authorities to stimulate E-Mobility development.

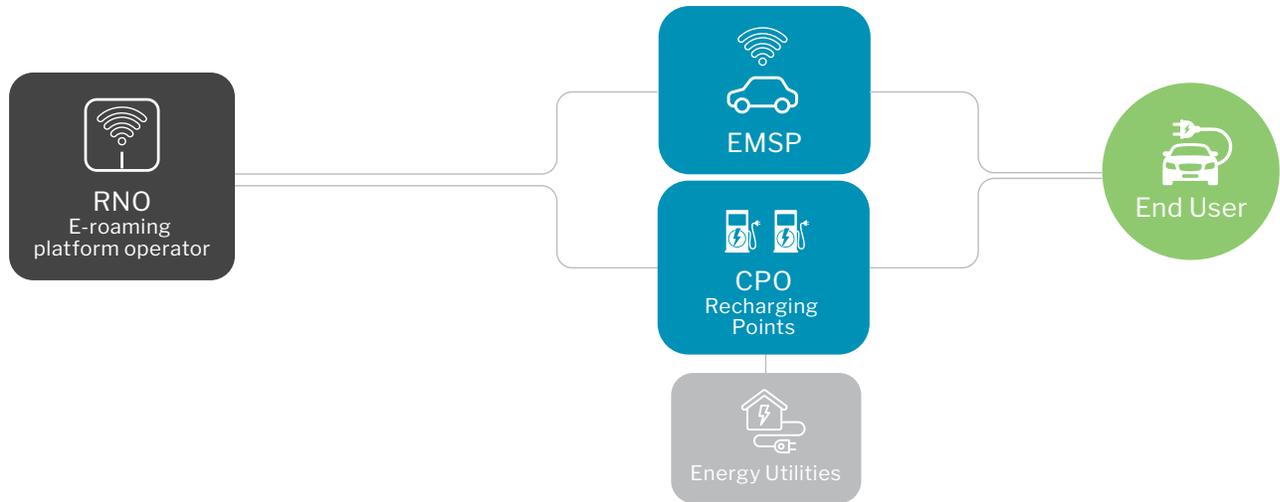
Electric buses are cost-effective and environmentally friendly, but cities in the region still continue to purchase diesel and CNG buses, despite extreme air pollution, largely because of price. Countries have used various *approaches to stimulate development of the e-bus market*. In many cases, the local city initiatives have been supported by government funds to support procurement of zero-emission hydrogen and e-buses.

2.5. Institutional enablers—E-Mobility market

2.5.1. Market organization

An open market for E-Mobility services has been established within the EU with the adoption of the Alternative Fuels Infrastructure Directive and its transposition into national regulations. The directive establishes a common framework of measures that, inter alia, ensure free selection of electricity suppliers by CPOs and cooperation on a nondiscriminatory basis between DSOs and any other entity interested in deploying or operating charging infrastructure. Although organization of the market for EV charging infrastructure varies greatly according to country, EU-wide rules apply to all.

Figure 3: E-Mobility Ecosystem Roles



Source: European Commission (DG for Mobility and Transport): Sub-Group to foster an E-Mobility Market of Services (SGEMS), Netherlands Enterprise Agency: Electric Vehicle Charging Definitions and Explanation, Regulation on the deployment of alternative fuels infrastructure

E-roaming platforms enable connections between market stakeholders, notably mobility service providers and operators of charging points. Contracts regulate arrangements between service providers and energy utilities in accordance with EU rules. Relationships between end users and service providers are regulated similarly. The tariff system should be designed in a way that encourages E-Mobility development and prevents grid overload (e.g., by providing discounts at off-peak times).

2.5.2. Pricing

The pricing method for charging services is essential for market competition. Market characteristics such as market size, number of other providers, CPOs, users, and the electric grid should be considered when designing pricing strategies. Lawmakers may regulate pricing by prohibiting or endorsing methods, but in most ecosystems, providers have the freedom to create their own pricing policies.

Table 5 describes pricing strategies applied in EU countries and their advantages and disadvantages.

Table 5: Advantages and Disadvantages of Various Pricing Methods

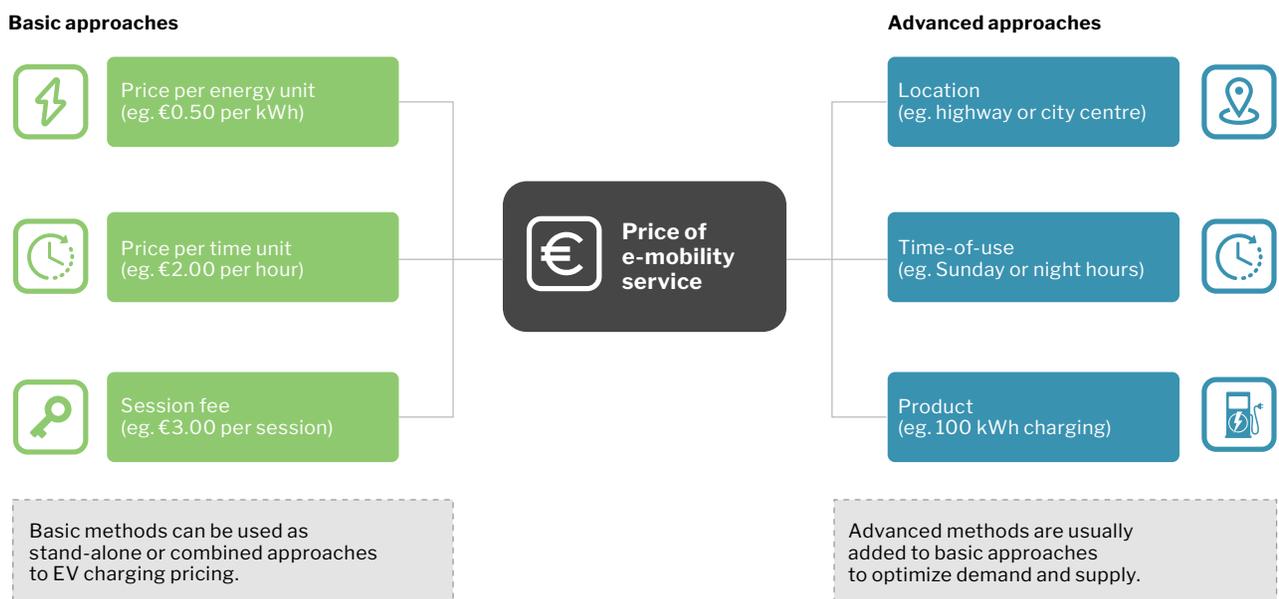
Method	Description	Advantages and Disadvantages
Time based	Users pay according to charging time at an EV charging point; the amount of electricity consumed does not affect the price.	<ul style="list-style-type: none"> • Advantageous for on-board chargers with high efficiency when connected to a fast- charging column for reduced charging time • Encourages E-Mobility service providers to install high-performance chargers • Discourages users from occupying chargers longer than necessary • Does not favor owners of entry- and mid-level EVs • Although charging is easy, and the price can be easily calculated, this method leaves little room for E-Mobility service providers to change the price of their services

Table 5: Advantages and Disadvantages of Various Pricing Methods

Method	Description	Advantages and Disadvantages
Quantity based	Users pay based on energy consumed (measured in kilowatt-hours or megajoules) and cannot pay above their battery capacity.	<ul style="list-style-type: none"> Customer satisfaction surveys conducted in several markets show that EV users prefer kWh- over time-based method.
Session fee	Session fees can be used in combination with time- or quantity-based pricing strategies. A provider sets a uniform session fee or identifies fee categories that are fixed and revised relatively rarely (e.g., every 3 years). A user pays the same base rate each time charging is initiated and an additional time- or kWh-based fee according to charging time or power consumed. A session fee is not proportional to dwell time or electricity consumed during the process of charging; it is a fixed rate, usually calculated based on the fixed cost of a single charging session.	<ul style="list-style-type: none"> Depending on the provider's strategy, a session fee can be subscription based or per session. The provider can use session fees to attract more users under a contract by lowering subscription fees or charging higher fees on ad hoc users. Some users can feel disadvantaged and look for cheaper alternatives.

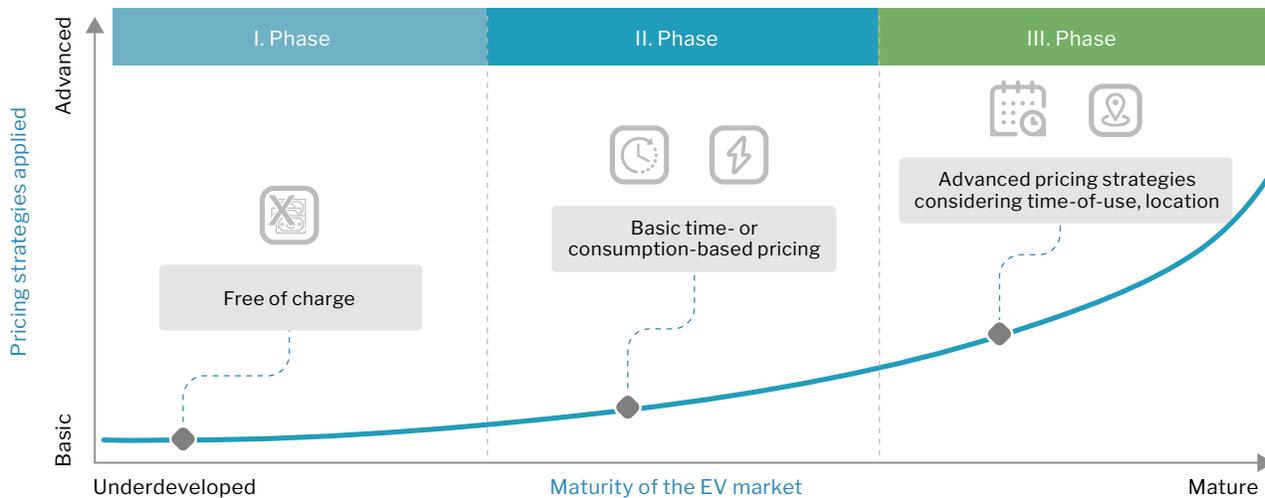
In addition to these approaches, other models should be explored to consider, for example, charging point location (e.g., highway), time of the day for charging, and charger type (power).

Figure 4: Methods for Pricing E-Mobility Services



There is no one-size-fits-all solution for creating an optimal pricing strategy for EV charging infrastructure. E-Mobility pricing methods should correspond to market maturity. Charging fees are incrementally formed, in line with EV market development level as market competition increases. At early development stages, charging services are sometimes offered free; advanced pricing methods become more important as the market matures (Figure 5).

Figure 5: Relationship between Market Maturity and Applied Pricing Strategies



Countries with developed E-Mobility markets usually offer fast and ultra-fast charging stations, which can put a significant strain on the distribution network over a short period. It is therefore important to introduce a sophisticated pricing strategy to encourage EV owners to develop charging habits that affect the EV charging load on the power grid minimally at peak times.

2.6 Main takeaways relevant for the Serbian context

The main takeaways relevant for the Serbian context are summarized in the below table.

Table 6: Main Takeaways relevant for the Serbian context

Condition of EV market	EV markets and public charging networks have developed to varying degrees in different countries. Developed markets include Austria and, to a lesser degree, Hungary. Development of public charging networks does not correspond to number of EVs but is necessary pre requisite to facilitate larger EV uptake.
Incentives	Incentives are offered in all countries in the region and cover different categories of vehicles. Incentives for passenger cars dominate. Incentives for deploying chargers are also different. In some countries, they are offered for individual chargers.
Tax relief	All countries offer tax relief that covers a relatively wide range of arrangements.
Local incentives	Local benefits include free parking, access to dedicated lanes in some countries, and free charging. These type of measures are in particular suitable for implementation in a mature E-Mobility market.
E-Mobility in public transportation	Given continued widespread use of diesel units, measures focus on clean passenger transportation by bus. Under clean passenger transportation by bus the following powertrains are meant: diesel - emission standard Euro 6, natural gas, hydrogen, and electricity. Chapter 3 lists target shares of e-buses in EU countries for 2025 and 2030; shares for 2025 range from 32% (Croatia) to 50% (Austria), and shares for 2030 range from 48% (Croatia) to 75% (Austria).

3. E-Mobility Ecosystem in Serbia as of 2021

To better understand the status of E-Mobility in Serbia, it is important to assess E-Mobility ecosystem in Serbia. To this end, this chapter analyzes current enablers of deployment of E-Mobility in Serbia, including the status of the transportation and energy sectors and the regulatory environment and institutional framework. It should be noted that the data and assessments described below are made based on data from up to 2022. While some parameters are improved in the meantime, the change is still not sufficient and below analysis is still applicable.

The analysis will serve as a baseline for defining gaps between the E-Mobility enabling environment in Serbia and best EU practices. It will also explore potential scenarios for development of E-Mobility in Serbia.

3.1. Energy sector overview

The electricity sector plays a major role in enabling E-Mobility –supplying electricity to market players, upgrading the grid, generating electricity to accommodate demand placed by EVs, and potentially taking the active role in the market. Serbia’s E-Mobility strategy is designed to be aligned with the country’s electricity system, including efforts to decarbonize electricity generation.

As a contracting party of the Energy Community, Serbia is obliged to adopt and incorporate the EU Energy acquis into national legislation, but E-Mobility -related directives are not yet part of the Energy Community acquis, so Serbia is not yet obliged to meet requirements related to E-Mobility. Although the Energy Community has been slow to incorporate EU Directives, inclusion of E-Mobility related rules in the Energy Community acquis can be expected in the near future.

As of 2021, electricity generation in Serbia relied up to 50 percent on coal-fired thermal power plants, with the remainder powered by oil and natural gas or renewable sources. Renewable sources account for about 13 percent of electricity generation. The share of wind and solar power plants has been growing rapidly, generating 3,502 GWh in 2019, up from 297 GWh in 2015. Other sources such as solar, gas, and biomass have a negligible share.

The emission-related benefits of E-Mobility can be maximized only by decarbonizing the electricity mix. The share of electricity and heat producers in CO₂ emissions in Serbia is significantly higher than the EU28 average; immediate efforts should focus on improving the electricity mix.

Table 7: Share of Electricity Generation According to Source, 1990–2019

Year	Coal	Natural gas	Hydro	Biofuel and waste	Oil	Wind, solar, etc.
1990	425,868	108,346	26,982	48,944	215,440	
1995	370,048	56,494	35,647	30,800	77,667	
2000	361,948	64,185	35,357	33,600	60,990	
2005	337,942	81,514	41,078	33,600	18,3419	

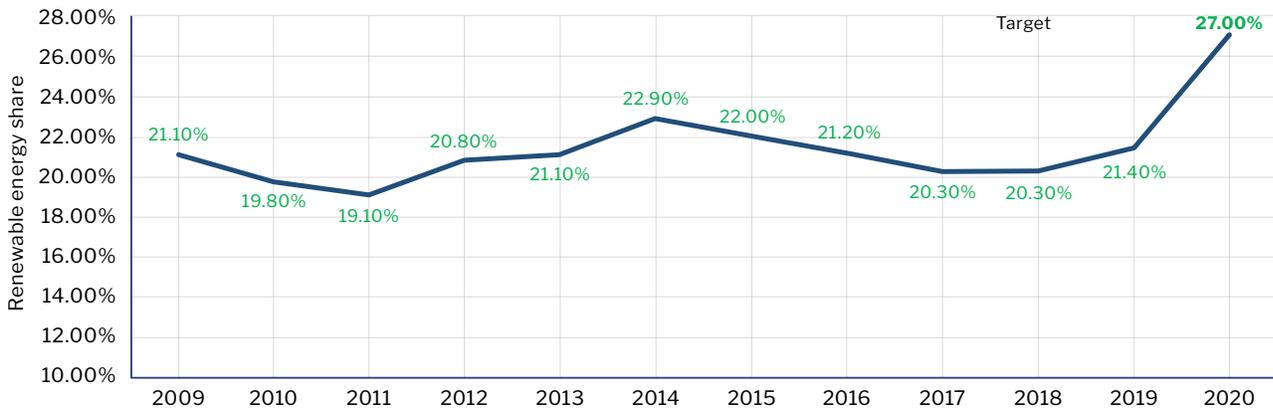
Table 7: Share of Electricity Generation According to Source, 1990–2019

Year	Coal	Natural gas	Hydro	Biofuel and waste	Oil	Wind, solar, etc.
2010	327,696	77,597	42,808	43,388	16,4456	224
2015	324,728	73,283	36,288	44,317	14,2530	297
2019	314,821	83,453	34,046	47,869	15,6326	3,502
				Renewable share		13%

Source: IEA World Energy Balances <https://www.iea.org/data-and-statistics/data-product/world-energy-statistics-and-balances>

As per National Renewable Energy Action Plan as of 2013, the target share of renewables in electricity generation for Serbia was set at 27 percent by 2020 (Figure 7). As of 2021, the national targets for 2030 have not been officially set, but the Energy Community Secretariat proposed a 33 percent share by 2030. The National Integrated Climate and Energy Plan defined targets for renewable energy in total final energy consumption until 2030, 2040, and 2050. Low carbon development strategy with the accompanying action plan, launched in early 2020, envisages a 28.9 percent share of renewables in total energy consumption by 2030.

Figure 7: Share of Renewable Energy in Gross Final Energy Consumption



The transmission system in Serbia consists of high-voltage 400 kV, 220 kV power lines, 110 kV overhead lines and underground power cables, and accompanying transformer stations—a total network of 9,500 km.

The distribution system consists of low-voltage networks in all major consumer centers. According to the Energy Law, Article 128, the distribution network is a functionally connected set of power facilities comprising power lines of 35, 20, and 10 kV, with accompanying transformer stations, merger fields, distribution switchgears, and metering devices. All 110 kV substations are the property of DSO, whereas the transmission system operator owns the 110 kV power lines.

The transmission and distribution systems are reaching the end of their design lifetime, and Serbia is in the process of intensive capital overhaul and revitalization.¹⁴

Metering quality performed by measuring units is extremely poor because devices are old and rarely calibrated, and fewer than 1 percent of consumers were equipped with smart meters in 2021.

It is estimated that integration of a moderate number of EVs into the distribution grids will not have any considerable impact, although mass adoption would most likely create problems for

¹⁴ Path to Electric Mobility for Belgrade, Component 1, section 6.1.1.2., PwC Report, October 2021

grid operation and management. For instance, if an ambitious 10 percent electrification rate of passenger cars, buses, and light- and heavy-duty vehicles is assumed, high-level calculations based on 2018 Serbian vehicle composition data estimate that EVs will account for an approximately 5 percent share of electricity consumption in Serbia.

Although E-Mobility would account for only a small portion of electricity consumption—even if 10 percent of the entire vehicle fleet were electrified—this additional demand could overwhelm the system at peak times. Therefore, grid upgrades or introduction of demand-side management solutions may be required.

It is essential to upgrade the grid and introduce smart grid solutions to be able to meet additional demand for electricity, enhance grid flexibility to accommodate renewable sources, and optimize the system for maximum use of the decarbonized and electrified transportation system.

3.2. Characteristics of transportation sector

This section describes Serbia’s transportation sector and the characteristics of the vehicle fleet, road and railway transportation, population mobility in urban areas, vehicle fleet characteristics, distribution of transportation modes, and overall condition of public transportation.

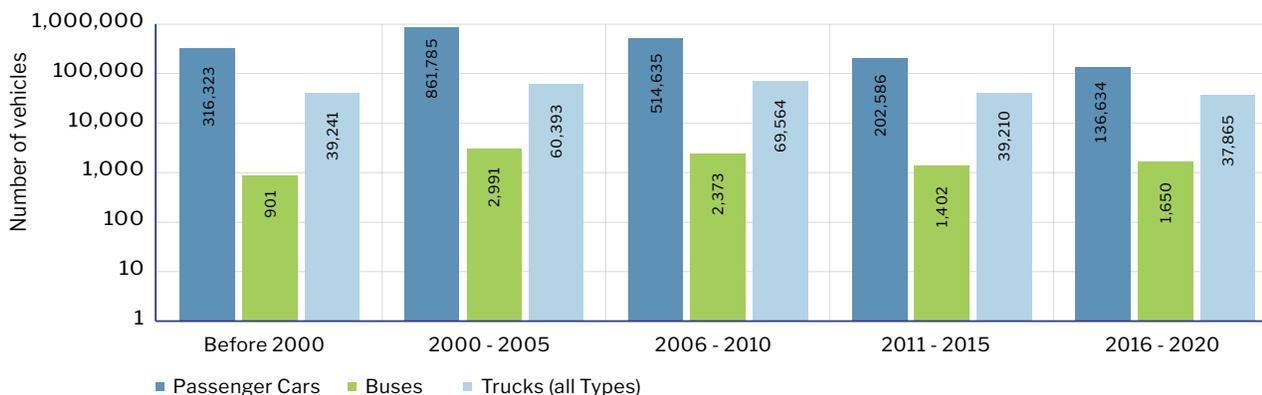
Transit trips, which are of great significance in Serbia, mainly via the Corridor X Highway, which is part of the EU Trans-European Transport Network, were also analyzed. Another important element of the analysis is that intercity and urban traffic rely heavily on bus transportation, which could be the important area for focusing the uptake of EVs in Serbia.

3.2.1. Motorization

Important parameters in the context of decarbonization are the age of vehicles and compliance with European emission standards. The age structure is shown in Figure 8 according to vehicle category.

As of 2021, more than half of passenger vehicles were more than 15 years old; 15.6 percent more than 20 years old, 40.5 percent 15 to 20 years old, 25.6 percent 10 to 15 years old, and 10.6 percent 5 to 10 years old. Only 7.7 percent were less than 5 years old.

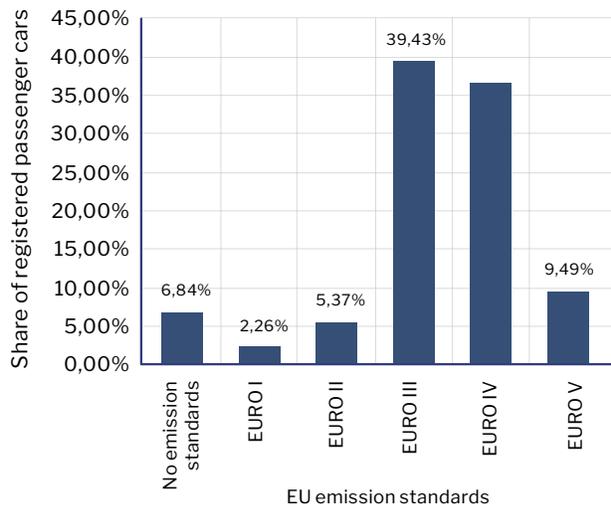
Figure 8: Age Distribution of Registered Vehicles, 2020



Almost 10 percent of buses were more than 20 years old, 32.1 percent 15 to 20 years old, 25.5 percent 10 to 15 years old, 15 percent 5 to 10 years old, and 17.7 percent less than 5 years old. More than 16 percent of trucks were more than 20 years old, 24.5 percent 15 to 20 years old, 28.2 percent 10 to 15 years old, 15.9 percent 5 to 10 years old, and 15.3 percent less than 5 years old.

The age of vehicles mirrors compliance with European emission standards. The Rulebook on Technical Inspection of Vehicles, released in 2018, does not allow vehicles that do not meet limits for harmful exhaust emissions (all vehicles that do not meet Euro 1 emission standard) to be registered,¹⁵ but slightly more than 4 percent of registered passenger cars do not meet Euro 1 emission standards (Figure 9). These vehicles are not equipped with catalytic converters or diesel particulate filters (DPFs). In addition, it is estimated that a substantial number of drivers have removed catalytic converters or DPFs from their vehicles, hoping to improve vehicle performance.¹⁶

Figure 9: Compliance of Registered Passenger Cars with European Emission Standards



The problem is more complicated with the bus fleet (Figure 10). Data from 2021 shows that more than 10 percent of buses do not meet Euro 1 emission standards (do not have catalytic converters and DPFs). Considering the yearly mileage of buses, so many buses not meeting the Euro 1 standard poses a serious threat to air quality and significantly increases emissions. The fact that nearly 60 percent of registered buses do not meet Euro 5 emission standards, which are satisfactory for overall circumstances in Serbia, aggravates the situation. The condition of the truck fleet is similar (Figure 11).

Figure 10: Compliance of Registered Buses with European Emission Standards

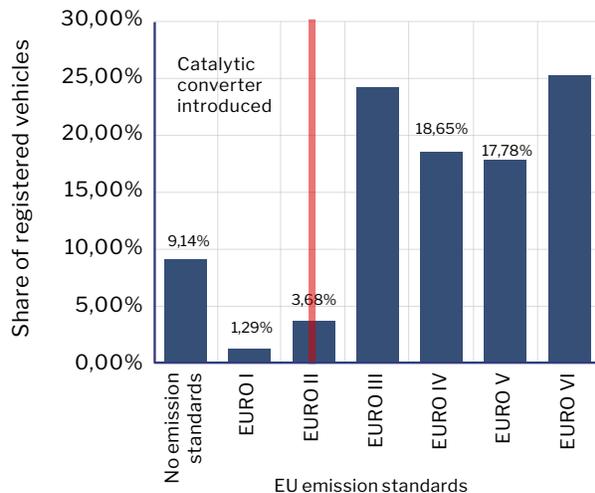
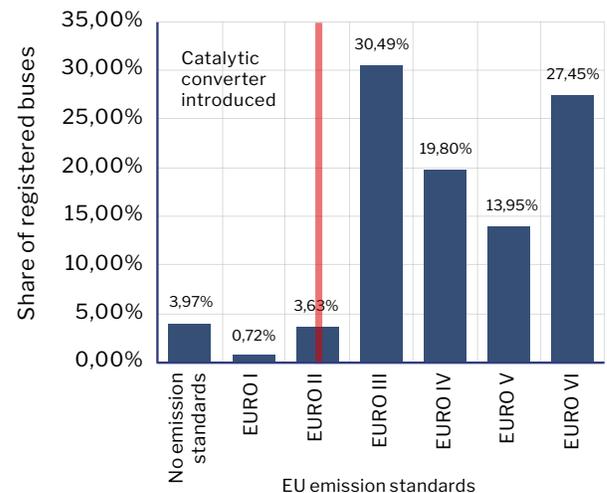


Figure 11: Compliance of Registered Trucks with European Emission Standards



The age of the vehicle fleet and the fact that a large share of buses and passenger cars meet only low Euro emission standards indicate that significant, urgent efforts must be made to modernize and decarbonize the vehicle fleet in Serbia. Keeping in mind the overall condition of the vehicle fleet and its environmental impact, there should be no excuses for further delaying enforcement of the rules established in the Rulebook on Technical Inspection of Vehicles.

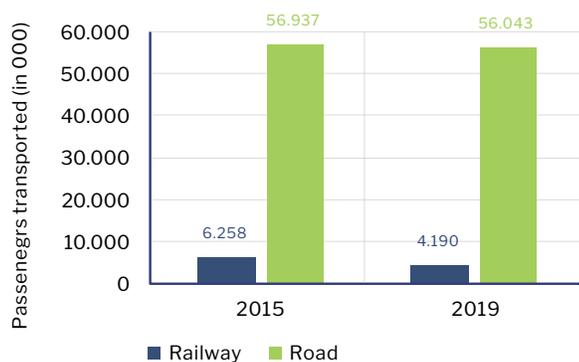
¹⁵ Rulebook on the Technical Inspection of Vehicles, Official Gazette of the Republic of Serbia, No. 3/2018, 70/2018.

¹⁶ It is estimated that 1.2 million vehicles in Serbia that emit an improper amount of exhaust gases, mostly do not have a catalyst converter or a DPF or they are defective. Source: www.paragraf.rs.

3.2.2. Road and rail transportation¹⁷

The main transportation modes for passengers and goods are rail and road. The length of the railways is 3,763 km, of which 1,272 km is electrified. The total length of roads is 43,839 km, of which 29,138 km is modern roads. There are 3,864 km of first-class state roads and 9,650 km of second-class state roads, forming the skeleton of the road network.¹⁸

Figure 12: Transportation of Passengers



The predominant transportation mode for passengers is road (Figure 12). Passenger transport services are provided by 684 entities of different ownership structured, with limited liability companies accounting for 65.8 percent. Entrepreneurs have a 30.7 percent share. Other forms of private ownership account for 1.9 percent of the total number of entities. Only 11 service providers (1.6 percent) are public companies.

Figure 13: Transportation of Goods



While the volume of the goods transported by rail stagnated, the transportation of goods by road almost doubled over the same period.

A total of 148,805,000 tonnes of diesel and 135,266 thousand MWh of electricity were consumed in passenger transportation in 2015 and 225,683,000 tonnes of diesel and 102,905 MWh of electricity in 2019—a 66 percent increase in diesel consumption and a 28 percent decline in electricity consumption.

Figure 14: Energy Consumption in Railway Transportation: Passengers

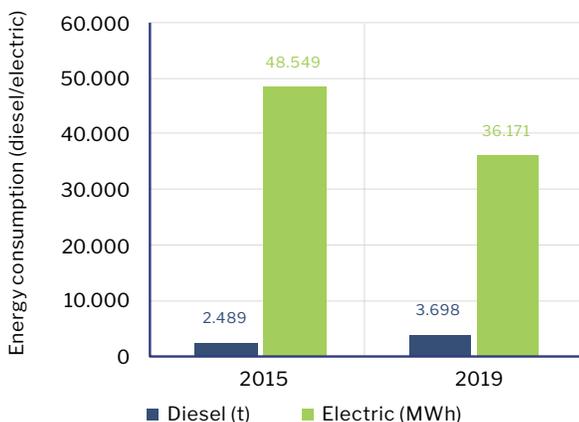
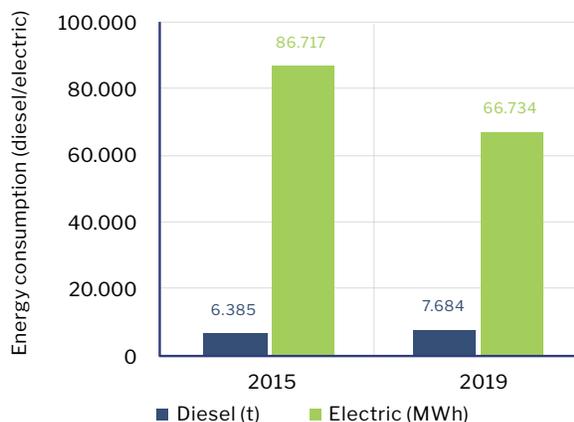


Figure 15: Energy Consumption in Railway Transportation: Goods



¹⁷ Bulletin “Transport and Telecommunications in the Republic of Serbia, 2015 and 2019” (Saobraćaj i telekomunikacije u Republici Srbiji, 2015 i 2019), Nos. 620 and 693.

¹⁸ Statistical Bureau of the Republic of Serbia, Municipalities and Regions in the Republic of Serbia 2020

3.2.3. Urban mobility

The daily mobility coefficient, which defines the number of daily movements per capita (aged 6 and older) on a typical weekday, and the distribution of daily movements according to mode of transportation are often used to describe urban mobility characteristics of a certain city, country, or region. These two indicators are used here to illustrate the main characteristics of transportation demand in urban areas in Serbia. The data were extracted from several traffic studies for cities. Many of these studies date from the 1990s, with only a small number of cities having conducted such studies since 2000. In the absence of more-recent data, these were used as reasonable approximations and are considered to be reliable indicators.

Modal split of passenger transportation varies greatly from city to city. In urban areas, where public transportation is more available, the share of public transportation is higher than the share of passenger cars.

Figure 16: Energy Consumption in Road Transportation: Passengers and Goods

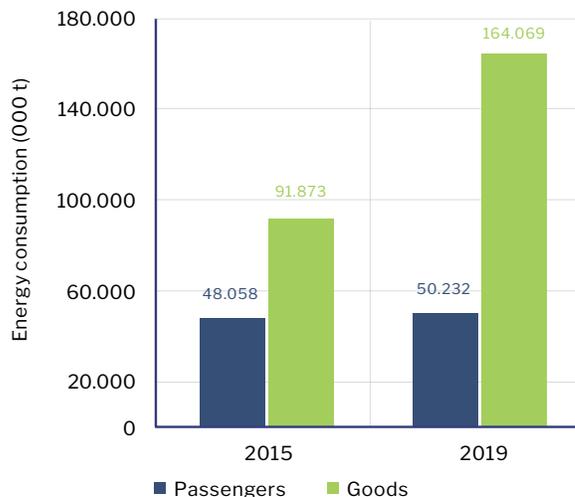


Table 8: City Type

Cities	City size (no. of inhabitants), 2019	City type
Belgrade	Above 1.6 million	1
Kragujevac, Niš, Novi Sad	255,000 – 360,000	2
Kraljevo, Kruševac, Leskovac, Pančevo, Šabac, Subotica, Zreanjanin	110,000 – 137,000	3
Arandelovac, Čačak, Gornji Milanovac, Jagodina, Novi Pazar, Smederevo, Topola, Valjevo	20,000 – 110,000	4

In most type 3 and type 4 cities (Table 17), urban and suburban transportation lines form a single network that is the only mode of public transportation. This means that suburban lines dominate, but because stops are made in densely populated areas, these networks also serve as urban transportation lines. Figure 17 shows the coefficients of daily mobility (Number of Trips per Day per Inhabitant) according to city type.

Figure 17: Number of Trips per Day per Inhabitant According to City Type

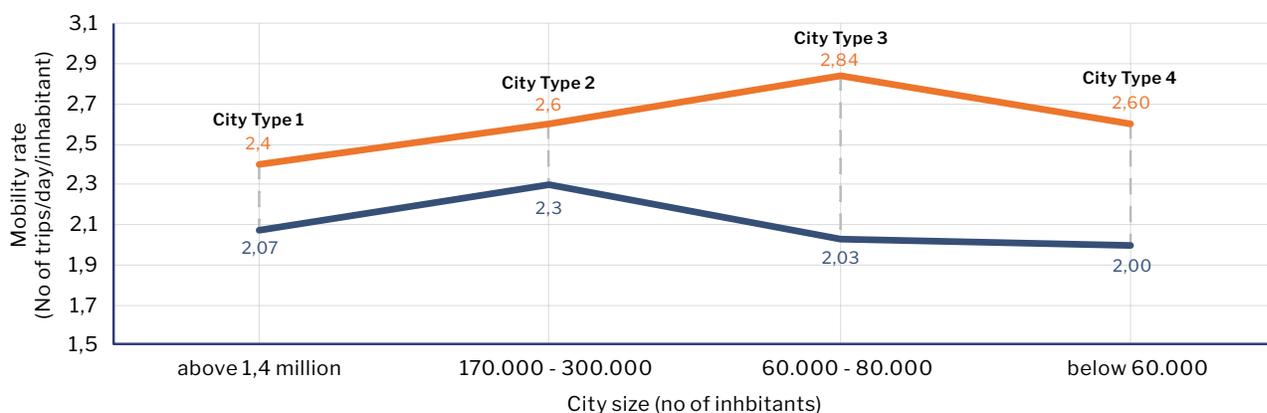


Table 9 shows the prevailing modal split per City Type.

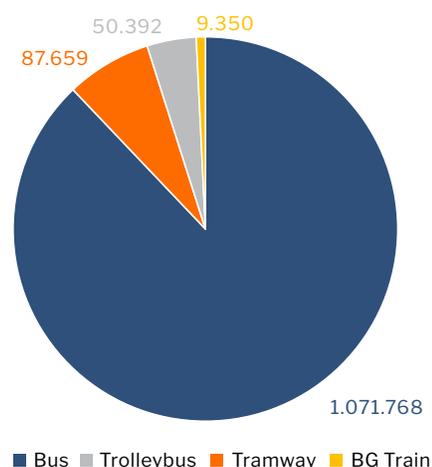
Table 9: Prevailing modal split per City type:

City	City type	Public transportation	Passenger cars
		%	
Belgrade	1	65-77	35-27
Kragujevac, Niš, Novi Sad	2	40-60	60-40
Kraljevo, Kruševac, Leskovac, Pančevo, Šabac, Subotica, Zreanjanin	3	16-49	84-51
Arandelovac, Čačak, Gornji Milanovac, Jagodina, Novi Pazar, Smederevo, Topola, Valjevo	4	3-42	97-58

3.2.4. Role of Public Transportation¹⁹

In Serbia, buses play an important role in urban and interurban transportation, with 48 public urban and suburban passenger transportation systems. There are 1,408 lines with a total length of 31,977 km. The average length (22.7 km) is relatively long because suburban lines are predominant and also serve as city lines in smaller cities. With the exception of Belgrade, where four means of transportation are available (railway (“BG train”), tram, trolleybus, bus), buses are the main and only means of transportation in urban areas. In 2021 there were 2,902 buses that could carry a total of 297,902 passengers seated and standing.

Figure 18: Number of Passengers Transported According to Mode of Transportation (Thousands), 2019



Private companies provide most transportation services. Belgrade, Novi Sad, and Subotica are the only cities where public carriers provide transportation. Cities have also been hiring private companies to provide public transportation services but typically offer only seven-year contracts.

Of 1.2 million passengers transported in 2019, 1.0 million were transported in Belgrade and 0.15 million in Kragujevac, Niš, and Novi Sad.

Buses consumed a little more than 116,000 tonnes of Euro diesel. Belgrade trains, trams, and trolleybuses used 36,364 MWh of electricity.²⁰

3.2.5. Micromobility

Although micromobility devices are widely used in Serbian cities, no data are available. Nevertheless, some of the available ways to purchase and use micromobility devices are worth mentioning.

Public parking management company “Parking Servis” in Belgrade, offers a service for parking lot and garage users that allow them to take bicycles and e-bicycles free of charge while their cars are parked. As per “Parking Servis” own report, more than 92,000 people used this service in 2019 and 2020.

¹⁹ Bulletin “Transport and Telecommunications in the Republic of Serbia, 2019” (Saobraćaj i telekomunikacije u Republici Srbiji, 2019), No. 693.

²⁰ Data for BG Train were not available.

Internet and mobile services providers used interesting way to encourage people to switch to micromobility devices. As part of various packages for mobile phones and Internet services, some of them offers a 24-month repayment option for the purchase of e-bicycles and e-scooters.

One effect of the pandemic is rapid growth of delivery services in Serbia, particularly food delivery. The main mode of transportation for this type of service is e-bicycle. A survey conducted in 2020 found that 360,000 people in Serbia used delivery service providers CarGo, Glovo, and Wolt. If it is assumed that each consumer used this service three times per week, that would be approximately 1 million weekly e-bicycle trips.

A recent study that explored use of e-scooters by residents of Belgrade²¹ found that young and middle-aged individuals were most likely to use them (Milutinovic 2020). The most likely new users of e-scooters are aged 21 to 30, while the openness for this mean of transport is decreasing with age (Figure 18). According to the same study, 19 percent of respondents who used e-scooters also used public transportation, and 10 percent of e-scooter riders used passenger cars. Potential e-scooter riders also used public transportation more often than passenger cars, although 88 percent of potential users used public transportation, and 68 percent used passenger cars. Respondents who did not have an e-scooter also used a taxi (27 percent), a bicycle (24 percent), and a shared car (12 percent) for commuting. The biggest shift to e-scooters was registered among public transportation users. A preliminary conclusion based on this study is that micromobility devices do not significantly affect passenger car use.

The study calculated financial effects of using e-scooters and found that traveling 100 km on an e-scooter costs RSD 20 (about €0.17), electric consumption included (Milutinovic 2020). Traveling the same city distance in a very efficient car requires at least 5 liters of fuel, which costs approximately RSD 750 (€6.4).

While it has potential to decarbonize urban transport, the use of micromobility devices in Serbia requires much deliberation and decision making regarding legal definition, licensing policy, infrastructure requirements, and public acceptance, particularly in city centers, where e-scooters are supposed to share the space with pedestrians.

3.3. E-Mobility in Serbia

According to reports referring to data from Ministry of Internal Affairs, 102 EVs and 1,416 hybrid cars were registered in Serbia in 2020 (0.07 percent of the total number of registered passenger cars). Reported data from the Ministry of the Environmental Protection, indicated that there were 4,000 EVs and hybrid cars in the middle of 2021. It would mean an absolute increase of about 3,500 passenger cars and an increase in the share of EVs to 0.18 percent. This trend is encouraging even though the share of hybrid engines remains dominant.

Initial E-Mobility steps have been taken in the public utility sector. PE Gradska Čistoća (City communal service) has deployed electric mini garbage trucks and 12 scooters in the pedestrian zone in downtown Belgrade. The national postal service, Pošta Srbije, procured five small electric vehicles in August 2020 that make deliveries in the city centers of Belgrade, Niš, and Novi Sad. The company reported excellent results, although did not make them publicly available, and has announced plans for procurement of more EVs. Bexexpress courier service added 10 Voltia EVs to its fleet suitable for

²¹ Milutinovic, M. 2020. "Characteristics of Micro Vehicle Movement in Belgrade." MSc Thesis. Traffic and Transport Faculty of Belgrade.

city deliveries at the end of 2020. Main delivery services in urban areas (e.g., Glovo, Wolt) have been increasing the share of e-bicycles in their fleets.

Belgrade public transportation company GSP Beograd pioneered e-buses in Serbia in 2016, procuring five all-electric buses after a long period of monitoring e-bus developments in Europe and around the world, exchanging information with other transportation companies and bus manufacturers, and pilot testing. Bids were invited in 2015. The line slated for electrification was 8 km long. According to the tender requirement, buses had to be supported by 150-kW fast chargers. After two years in service, GSP Beograd assessed bus performances and concluded the following.

- During the first two years of operation, the reliability of e-buses was 97.5 percent.
- Several factors drove energy consumption, among the most important of which was the need for cooling in the summer and heating in the winter, with consumption increasing 23.3 percent in the summer and 45.4 percent in the winter.
- Regular and corrective maintenance was simpler for e-buses than their diesel counterparts, decreasing maintenance costs from € 9,000 for a diesel bus to €3,000, and time needed for component replacement.

In 2021, there were various charging opportunities for EVs:

- The network of electric chargers consists of publicly available chargers, chargers in hotels and shopping malls, and chargers owned by companies.
- The dominant charging power is 22 kW, but 50-kW chargers can be found.
- Public Enterprise Roads of Serbia has installed chargers along the Subotica-Niš-Preševo Highway, at the Subotica and Preševo toll plazas, each providing 22 and 50 kW of power.
- There are charging stations at the Šid toll plazas (in the direction of travel toward Croatia) and Dimitrovgrad (in the direction of travel toward Bulgaria), each 22 and 50 kW.
- Ultra-fast 175-kW chargers are available at the location of former Niš highway toll plazas.
- Twenty-two charging stations have been installed, mostly in the region of Vojvodina and along the Belgrade-Niš stretch of European route E75.
- Twenty-two charging stations have been installed in hotels, public garages, shopping malls, and businesses in the Belgrade region.
- There were an estimated 52 electric chargers in Serbia in 2021, each with one or more charging points.

The following overview (Table 19) provides general information on the development of the E-Mobility market as of 2020.

Table 10: Serbian E-Mobility Market in 2020

Main market indicators (2020 data)	Description
Number of EVs	1,518, of which 102 are pure electric
Estimated number of charging points	52 (2021)
Share of EVs in total fleet	0.07%
Market share of EVs in new sales	N/A ^a

Main market indicators (2020 data)	Description
Purchase subsidies	
Individuals	€5,000 for new BEV passenger cars and vans €3,500 for new PHEV and REEV passenger cars and vans with emissions up to 50 g of CO ₂ /km €2,500 for new HEV passenger cars and vans with emissions of up to 140 g of CO ₂ /km (calculated according to the Worldwide harmonized Light vehicles Test Procedure methodology) 2020 budget for subsidies: €1 million
Businesses	Maximum €5,000 for new BEV, REEV, PHEV, and HEV taxis (+Euro 6 and compressed natural gas) valued minimum €13,000 for taxi companies legally 6,000 vehicles per year can receive subsidies for 2020-2023 €5,000 for new BEV passenger cars and vans €3,500 for new PHEV and REEV passenger cars and vans with emissions of up to 50 g of CO ₂ /km €2,500 for new HEV passenger cars and vans with emissions of up to 100 g of CO ₂ /km (vans with a maximum of 9 seats including the driver's seat and light truck with a mass not exceeding 3.5 tonnes). 2020 budget for subsidies: €1 million (including subsidies for private individuals)
Public entities	N/A
Public transportation	N/A
Light electric vehicles	€500 for motorcycles, heavy tricycles, light quadricycles, and heavy quadricycles €250 for mopeds and light tricycles
EV charging incentives	None
Tax benefits	Exemption from motor vehicle tax for BEVs, REEVs, PHEVs, and HEVs
Local incentives	Free charging at state-owned charging points

a. Electric vehicle (EV) (including hybrids) sales were 2.6 times as high as 2020 sales.

Serbia's is in the early phase of E-Mobility market development. In the early phase of E-Mobility development, piloting different vehicles and charging technologies is a good way to strengthen the competition and interoperability of vehicles and charging technologies of different manufacturers and to find solutions that best fit the local context. Choosing solutions that limit competition are likely to result in dependence on one manufacturer and technology.

3.4. Institutional and legal framework

As part of its journey to EU accession, Serbia signed the Stabilization and Association Agreement in 2008, which came into force on September 1, 2013. Its most important obligations in the accession process are establishing a free-trade area and harmonizing national legislation with EU regulations. Serbia is also a member of the Energy Community and the Transport Community Secretariat.

The European Green Deal will require Serbia to take steps toward a clean, low-carbon future. It sets ambitious climate action goals, including cutting GHG emissions by 55 percent by 2030 and achieving carbon neutrality by 2050. Serbia verified its commitment to the EU Green Deal goals and addressing climate change and environmental challenges by signing the Sofia Declaration on the Green Agenda for the Western Balkans in November 2020 and endorsing the 58-point Action Plan for Green Agenda for the Western Balkans for the period until 2030 at the EU-Western Balkan Summit in Slovenia on October 6, 2021.

3.4.1. Institutional framework

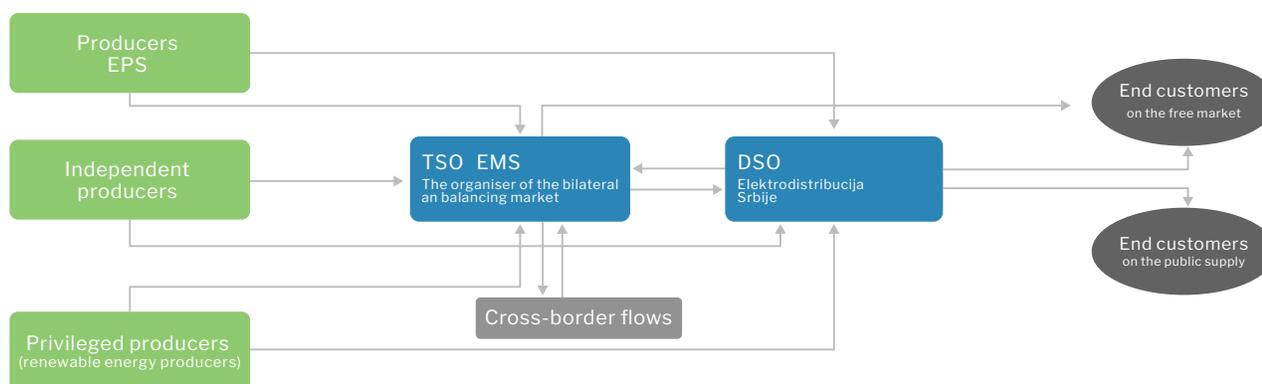
Development of an appropriate legal framework for E-Mobility should be a joint effort of all relevant ministries. According to applicable regulations, the Ministry of Mining and Energy; Ministry of Environmental Protection; and Ministry of Construction, Transport, and Infrastructure should play key roles in defining a legal framework for the E-Mobility enabling environment (Table 20).

Table 11: Overview of Responsibilities of Ministries for E-Mobility

Ministry	Responsibility
Mining and Energy	Draft laws regulating E-Mobility.
Environmental Protection	Administer subsidies for electric vehicle purchases (introduced in 2020).
Construction, Transportation, and Infrastructure	Promulgate rules on construction and urban development, road infrastructure, traffic safety, passenger transportation (all types), and freight transportation. Administer subsidies for taxis (introduced in 2019).
Finance	Developing the market model and, in cooperation with other relevant ministries, create guidelines for the E-Mobility market.

The Energy Law, which incorporates EU regulations in line with the Energy Community acquis, establishes the roles and responsibilities of electricity market players. In addition to the ministries, other E-Mobility participants include the energy regulator, the transmission system operator, the DSO, suppliers, electricity producers, electricity traders, power exchangers, and customers (Figure 19).

Figure 19: The roles and responsibilities of electricity market players in Serbia



The Energy Agency of the Republic of Serbia (AERS; the energy regulator) is one of the key energy-related decision makers and has an important role in E-Mobility. According to the Energy Law, the responsibilities of AERS include, but are not limited to:

- Developing tariff systems for electricity
- Developing tariff systems for access to and use of the power transmission network
- Determining the methodology for defining tariff elements for calculation of electricity prices
- Defining criteria and methods for determining costs of connecting to the electricity transmission and distribution systems
- Issuing licenses for energy-related activities
- Approving grid codes and the electricity market code that the transmission system operator proposes

3.4.2. Planning and strategic framework for E-Mobility

E-Mobility is insufficiently addressed in Serbia’s strategic, program, and planning documents, even at the early stage that Serbia is in. It is addressed in only two strategic and two planning documents²² and only at a basic level or, in some instances, indirectly (Table 21).

Activities related to E-Mobility, such as installation and operation of charging stations, are regulated indirectly, primarily in the Energy Law and related by-laws.

Table 12: Strategic and Planning documents addressing E-Mobility

Document	E-Mobility related provisions
Energy Sector Development Strategy of the Republic of Serbia until 2025	Addresses conditions necessary to support the E-Mobility market, such as sustainable energy, green energy from renewable sources, modernization of the transmission and distribution networks, and decarbonization The strategy clearly states that the model for the transition to sustainable energy must be based on the market price of energy from conventional sources (including costs for environmental protection and reducing the impact of climate change) and application of incentives and disincentives.
Program for Implementation of the Energy Sector Development Strategy of the Republic of Serbia until 2025, with Projections until 2030, for the period 2017-2023²³	Describes the following activities: <ul style="list-style-type: none"> Establishing a working group to model incentives for EVs Studying how to increase use of EVs and develop new regulations in this area Studying how to add EV consumption calculations to charts showing daily electricity production so enable integration of electric transportation into the national energy system Upgrading and installing needed equipment in the transmission and distribution system (two-way real-time digital communication) Replacing electric meters with smart systems for remote meter reading and management of electricity consumption
Sustainable Urban Development Strategy of the Republic of Serbia until 2030²⁴	Sets priorities for sustainable urban mobility policy: <ul style="list-style-type: none"> Development of sustainable mobility plans Development of road network with services for pedestrians, cyclists, disabled people Modernization of public transportation, focusing on non-motorized transportation Introduction of new technologies in electric transportation, new modular public transportation systems, car sharing
Action Plan for Implementation of the Sustainable Development Strategy of the Republic of Serbia until 2030, for the period 2021-2022²⁵	Introduces new technologies in electric transportation through implementation of four E-Mobility projects: <ul style="list-style-type: none"> “E-Mobility Cloud Centre” (map of available chargers for EVs, monitoring and management, “e-roaming”), implemented by the Ministry of Environmental Protection with partners Research and development and test center for electric and autonomous vehicles and drones Reduction of pollution by transitioning to E-Mobility in Belgrade, implemented by the city of Belgrade and funded by the World Bank “City for All”: urban mobility based on artificial intelligence, implemented by the city of Subotica with partners

To ensure successful development of E-Mobility, all aspects of deployment, implementation, and electric transportation growth must be covered. This should be done in alignment with EU planning

²² Energy Development Strategy of the Republic of Serbia until 2025 with an estimate until 2030 (“Official Gazette of RS,” No. 101 of December 8, 2015).

²³ Program for the implementation of the energy development strategy of the Republic of Serbia until 2025 with projections until 2030 (“Official Gazette of the RS,” No. 104 of 22.11.2017.) (Program-POS)

²⁴ Strategy for Sustainable Urban Development of the Republic of Serbia until 2030 (“Official Gazette of the RS,” No. 47 of June 28, 2019)

²⁵ Action Plan for the Implementation of the Sustainable Development Strategy of the RS until 2030, for the period from 2021 to 2022 (“Official Gazette of the RS,” No. 021 of March 18, 2021).

documents and requires that the existing strategies and planning documents be amended. It also calls for development of strategic and planning documents that would be based on the following EU strategies:

- European Strategy for Low-Emission Mobility (2016/501/COM)
- European Green Deal (2019/640/COM)
- New Industrial Strategy for Europe (2020/102/COM)

3.4.3. Assessment of existing regulatory framework

Defining the sound legal framework is the main prerequisite for establishment and development of a strong, sustainable E-Mobility market. Such a framework enables an efficient transition from an initially weak market (with a small share of EVs) to a mature market (with a larger share of EVs).

Serbia’s legal framework does not sufficiently address E-Mobility. There is no systemic law in Serbia explicitly defining E-Mobility in general or in a specific segment. In the existing legal framework, E-Mobility is addressed in only one article of the Energy Law and in the provisions on subsidies for taxis, EVs, and HEVs and exemption of EVs from annual registration fees. Existing regulations and provisions that explicitly address E-Mobility and the areas covered are presented Table 22.

Table 13: Regulations and Provisions That Address E-Mobility

Regulation	E-Mobility aspects covered
Energy Law of April 2021 (Article 210 c)	<p>This law is the first step in establishing the regulatory framework for E-Mobility. The previous Energy Law defined only approach to installation of individual charging points for EVs, primarily at people’s homes, companies for their own needs, hotels, and the like.</p> <p>The updated law establishes regulatory guidelines for deployment of public charging stations for EVs, which is the first step in creating a new market for E-Mobility. A charging service provider has the status of the end customer in the electricity supply market, which essentially enables free access to supply and also to the grid.</p> <p>Grid connection charges are high.</p> <p>A special act will set out technical requirements for deployment of EV charging infrastructure, charging electric meters and their location, obligations of the system operator and EV charging service providers, and other issues related to charging infrastructure deployment.</p>
Government Decree on the conditions and manner of conducting subsidized procurement of passenger vehicles for the needs of renewing the taxi fleet as public transportation (from December 2019)	<p>Subsidies of €8,000 are available to taxi drivers for purchasing new vehicles with electric, hybrid, compressed natural gas, and Euro 6 emission standard engines. The minimum vehicle cost has to be €13,000. A total of 6,000 taxi subsidies are planned over three year period.</p> <p>The Ministry of Construction, Transport, and Infrastructure is responsible for administering subsidies over a three-year period.</p>
Government Decree on the conditions and manner of conducting subsidized purchase of new vehicles that have exclusively electric drive, as well as vehicles that, in addition to an internal combustion engine, have an electric engine (hybrid drive) (from December 2020 and May 2021)	<p>The first state subsidies for legal entities and individuals for the purchase of new EVs (mopeds, motorcycles, plug-in hybrid EVs, hybrid EVs, EVs, and trucks weighing up to 3.5 tonnes).</p> <p>Depending on vehicle type, the subsidy ranges from €250 to €2,500 for hybrid vehicles and €3,500 to €5,000 for full EVs.</p> <p>The planned annual budget for subsidies is €1 million.</p> <p>The Ministry of Environmental Protection is responsible for administering these subsidies.</p>
Law on Taxes on the Use, Possession and Carrying of Goods	<p>Exempts EVs from the annual registration fee. It is the only tax benefit applicable to EVs.</p>

Assessment of the existing legal framework highlights the urgent need to strengthen the legal framework and define all elements of E-Mobility based on the principles of multidisciplinary, interoperability, and sectoral harmonization in systemic legislation and other regulations and policies to establish a comprehensive, optimal regulatory landscape.

3.4.4. Suggestions for regulatory framework improvements

Serbia has introduced important incentive schemes for purchasing EVs but must be more ambitious and cover other elements of E-Mobility, most importantly to improve regulatory framework so to define the market model, pricing, institutional organization, targets for EVs and chargers, and requirements for deployment of charging stations. E-Mobility development will depend on interplay and coordination of different institutions and thus require clear definition of institutional set up and responsibilities and obligations of various government bodies. Setting up the inter-ministerial working group to guide E-Mobility and transport decarbonization efforts is immediate need and is seen as a starting point for this reform agenda.

The incentive framework for EV purchase has received positive feedback from dealers and customers. However, incentives for HEV purchase should be gradually relaxed and the focus shifted to EVs with the purchasing power growing. HEVs use old technology with limited environmental benefits. Moreover, incentives for charging infrastructure deployment could be considered along with EV purchase subsidies, to set up the enabling infrastructure an environment for EV uptake.

Because the existing legal framework does not include monetary and nonmonetary incentives or subsidies for public transportation (buses), public charging infrastructure deployment, use of EVs (tolls, parking, yellow lanes), or duty relief and tax benefits, the appropriate model for incentives must be determined at the national and local levels. Furthermore, the procedure to obtain building and grid connection permits to install charging infrastructure is challenging because parking spaces in cities are limited, there are not enough grid connection points with adequate supply, and are administratively burdensome.

According to the existing law, it is not possible to set EV charging fees based on electricity consumption because, in line with the rules on energy trading, it prescribes separate meters for each user. Thus, CPOs and E-Mobility service providers usually apply time-based charges, which is not necessarily the fairest treatment of customers. Consequently, developing the appropriate regulatory framework for pricing is essential for market development.

The existing regulatory framework has no targets for EVs and charging points. Their inclusion is needed to boost EV uptake by creating a seamless experience for EV drivers and should rely on the EU Alternative Fuels Infrastructure Directive or the Energy Performance of Buildings Directive. Only the City of Belgrade, which has set ambitious E-Mobility targets for 2030, has recognized the potential of E-Mobility to improve air quality and the transportation system.

The transition to nonmotorized transportation and safer mobility requires an official definition of micromobility, primarily in the Law on Road Traffic Safety and the Law on Roads. Areas requiring particular attention are establishing clear technical requirements and classifications, deploying appropriate infrastructure, addressing emerging legal concerns, regulating land use, and planning transportation. The following areas are vaguely incorporated into existing laws and needs to be addressed:

- What devices fall within the definition of micromobility?
- Where is it permitted to ride a micromobility device (safety concerns)?
- Does a micromobility device need a license plate?
- What are equipment and feature requirements for micromobility devices?
- Who is eligible to ride a micromobility device (driving license)?
- What other rules are important for driving an electric device?
- Who will enforce regulations and punishments on e-scooter riders?

The gaps and proposals for regulatory framework improvements identified are outlined in Table 23.

Table 14: Gaps in the Regulatory Framework and Proposals for Improvements as of 2021

Regulation	Elements relevant for E-Mobility	Needed amendments and further alignment with EU regulations	Relevant EU directives
Energy Law (Article 210 c)	<p>Defines the market for charging EVs in public space. Establishes the definition of the service provider (legal entity, entrepreneur, natural person) as the owner or manager.</p> <p>The service provider has the status of the end customer.</p> <p>The charging station is a public place where a charging service is provided.</p> <p>The service provider may access the transmission and distribution network on non-discriminatory terms.</p> <p>Distribution system operators cannot own, develop, or operate charging stations for EVs unless exclusively for their own use.</p>	<p>Amendments to the law:</p> <p>Not all elements of the Alternative Fuels Infrastructure Directive have been incorporated into the law.</p> <p>Further action is needed to define the E-Mobility main actors and the market model:</p> <ul style="list-style-type: none"> • entry and exit procedures for providers • licenses • permits • tariff policy • basic pricing • billing system • technical specifications for charging stations • metering method and location • obligations of distribution system operators to charging station operators • obligations of charging services provider • supervision 	<p>Alternative Fuels Infrastructure Directive (2014/94)</p> <p>Proposal of the Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/COD)</p> <p>Revision of the Alternative Fuels Infrastructure Directive (2014/94/EU)</p> <p>As a part of the Fit for 55 Package⁶², the European Commission released a proposal to amend the Alternative Fuels Infrastructure Directive by repealing the directive and replacing it with a regulation—a binding legislative instrument that all member states must incorporate into their legislation to ensure coherent development across the European Union.</p> <p>Directive on Common Rules for the Internal Market for Electricity (2019/944)</p>
Decree on conditions for electricity supply and delivery	<p>Defines general rules for grid connection (for granting access to the network; applicable to all applicants). Upon fulfillment of technical and other requirements (ownership structure, building permits), approval is granted. Electricity supply is regulated under the grid connection agreement with the distribution system operator (the connection is part of the distribution system) and the supply agreement with the authorized electric power supplier.</p>	<p>Not all elements of the directive have been incorporated into the decree, so further action is needed.</p>	<p>Directive on Common Rules for the Internal Market for Electricity (2019/944)</p>

Table 14: Gaps in the Regulatory Framework and Proposals for Improvements as of 2021

Regulation	Elements relevant for E-Mobility	Needed amendments and further alignment with EU regulations	Relevant EU directives
Law on the Use of Renewable Energy Sources	Increasing the share of renewable energy sources provides conditions for decarbonization and full effectiveness of E-Mobility. Fuel suppliers must ensure the share of renewable energy sources by 2030 in accordance with the National Energy and Climate Plan.	Not all elements of the directive have been incorporated into the law, so further action is needed.	Directive on Promotion of the Use of Energy from Renewable Sources (2018/2001)
Law on Energy Efficiency and Rational Use of Energy	The law creates preconditions for increasing energy efficiency, with incentives and plans for deployment of advanced metering systems by the distribution system operator.	Not all elements of the directive have been incorporated into the law, so further action is needed.	Directive on Energy Performance of Buildings (2018/844)
Law on Environmental Protection	Monitoring indicators enable effects that have been achieved and measures that could be used to encourage E-Mobility to be assessed.	Not all elements of the directive have been incorporated into the law, so further action is needed.	Regulation on CO ₂ Emission Standards for Cars and Vans (2019/631)
Law on Waste Management	The law defines rules for special waste flows, including used batteries, accumulators, vehicle waste.	Not all elements of the directive have been incorporated into the law, so further action is needed.	Battery Directive (2006/66/EC) Waste Vehicle Directive (2000/53/EC) Draft Directive for Improvement of Regulations for Batteries, December 2020
Law on Planning and Construction	The law does not envisage deployment of public charging infrastructure for EVs. The law envisages simple construction procedures (not requiring issuance of a building permit, Articles 144-146).	Amendments to the law should include requirements for deployment of EV charging infrastructure while making the deployment procedure simple (with minimal technical and other requirements) to attract investors. They should also set out requirements for installation of electric cable for EV charging in new buildings and those undergoing major renovation.	Directive on Energy Performance of Buildings (2018/844) Proposal of Regulation 2021/0223/COD
Law on Roads	The law defines charging stations for EVs as an accompanying or integral part of the road infrastructure. The road manager is responsible for establishing technical requirements and verifying their fulfillment.	Amendments to the law and further harmonization are needed, especially in the part referring to deployment of charging stations on highways throughout the Trans-European Transport Network (every 60 km).	Alternative Fuels Infrastructure Directive (2014/94) Proposal of Regulation 2021/0223/COD
Law on Road Traffic Safety and the accompanying Rulebook on Classification and Registration of Vehicles	Then law defines only type of engine, which identifies electric and hybrid vehicles, without providing detailed specifications. Vehicles that are widely used such as electric bicycles and scooters are not covered to the necessary extent, and use of scooters on the road is not regulated.	Changes are needed to provide a precise definition of vehicle type (battery electric vehicles, plug-in hybrid electric vehicles, hybrid electric vehicles, electric bicycles, scooters). Not all elements of the directive have been incorporated into the law, so further action is needed.	Regulation on CO ₂ Emission Standards for Cars and Vans (2019/631)

Table 14: Gaps in the Regulatory Framework and Proposals for Improvements as of 2021

Regulation	Elements relevant for E-Mobility	Needed amendments and further alignment with EU regulations	Relevant EU directives
Law on Road Transport of Passengers	The law does not define E-Mobility or recognize the need to subsidize e-buses. ⁹	Not all elements of the directive have been incorporated into the law, so further action is needed.	Clean Vehicles Directive (2019/1161)
Public Procurement Law	The law defines public procurement of goods and services.	It is necessary to define the obligations of the procuring entity in vehicle procurement procedures to include energy efficiency and the impact of CO ₂ emissions as a scoring criterion (the EU vehicle emission standards and incentive scoring for EV). Further alignment with EU directives and inclusion of EU best practices is needed.	Clean Vehicles Directive (2019/1161)

Amendments to the listed laws and regulations would provide the necessary conditions for establishing a market for charging services and would facilitate smooth market development and further improvements at a later stage as the share of EVs increased. It is therefore important that changes to laws and regulations define simple, clear requirements that encourage investors and do not involve too much paperwork or impose too many restrictions.

The Ministry of Finance plays a key role in developing the market model and, in cooperation with other relevant ministries, must create guidelines for the E-Mobility market based on good practices of EU countries and in line with the commitment to achieve emission reduction targets and limit adverse effects on human health and the environment.

3.5. Main takeaways

The table below summarized the main characteristics of the E-Mobility ecosystem in Serbia.

Table 15: Main characteristics of the E-Mobility ecosystem in Serbia as of 2021

Energy sector	The large share of electricity generated from coal limits decarbonization. Certain efforts to shift to clean energy sources (renewable) show results. With existing hydropower potential, electricity generation from wind is growing.
Motorization	Old age of rolling stock of all categories limits decarbonization. Rules on vehicle registration (allowing vehicles without catalytic converters and diesel particulate filters to be registered) are not enforced. Proposed changes to taxation of older vehicles are not harmonized with transportation decarbonization requirements.
Road and railway transportation	The dominant type of transportation of passengers and goods is by road. In 2019, road and railway transportation consumed 225,683,000 tonnes of diesel and 102,905 MWh of electricity. Private service providers dominate road passenger transportation; 11 are public transportation companies.
Urban mobility	The number of movements per day per capita in urban areas ranges from 2.0 to 2.8. The modal split distribution varies according to size of urban area and development level of public transportation system.

Table 15: Main characteristics of the E-Mobility ecosystem in Serbia as of 2021

<p>Urban and suburban public transportation</p>	<p>Buses account for a large share of trips within and between cities. 48 cities have passenger public transportation service. There are 1,408 lines with a total length of 31,977 km. The average line length is 22.7 km. In smaller urban areas, passenger lines are mainly oriented toward suburban areas (serving commuters), but they also stop within urban areas and thus meet a percentage of urban residents' needs. This is important because suburban lines are significantly longer than urban lines. With the exception of Belgrade, where there are four means of transportation (rail (BG train), tram, trolleybus, bus), the main means of transportation in urban areas is bus. There are 2,902 buses (mostly old), with 297,902 seats and standing places. Buses consumed 116,000 tonnes of Euro diesel in 2019, and trams, and trolleybuses used 36,364 MWh of electricity.</p>
<p>Governance structure</p>	<p>A leading entity for the E-Mobility agenda has not been appointed. No working group has been established to coordinate stakeholders.</p>
<p>Legal framework</p>	<p>Despite the recently adopted amendments to existing laws (listed in section 3.3.3), a legal framework that would favor deployment of E-Mobility has not been completed. The market model, main stakeholders, and institutional setup have not been defined. The existing incentive scheme has had some results but must be extended, targeted, and more ambitious. Clear targets should be set. Regulatory guidelines for deployment of public charging infrastructure for EVs have not been provided. Grid connection charges are high. Changes to laws and regulations should provide simple, clear requirements to encourage potential investors and not involve too much paperwork or too many restrictions.</p>
<p>E-Mobility market</p>	<p>Serbian E-Mobility is underdeveloped but has grown in recent years. Incentives are available in the form of subsidies and tax breaks. No subsidies are available for deployment of chargers. No incentives are available for public transportation or for public operators or companies. Incentives should slowly shift from HEVs to modern EVs.</p>
<p>Micromobility</p>	<p>Electric micromobility initiatives are available on a case-by-case basis. If significant development of micromobility is desired, deliberation and decision-making regarding legal definitions, licensing policies, infrastructure requirements, and public acceptance are necessary, particularly in city centers where they are supposed to share the space with pedestrians. The appropriate legal definition of the use of micromobility devices would encourage e-micromobility service providers.</p>

4. E-Mobility in Serbia: Challenges and Opportunities

In line with the abovementioned assessment results, key opportunities for and challenges to accelerating the E-Mobility agenda and bringing the market to a more mature stage are presented here. The strengths, weaknesses, opportunities, and threats (SWOT) analysis will inform the definition of final scenarios for decarbonization and electrification of transport in the Republic of Serbia and, as such, the roadmap for E-Mobility in Serbia.

4.1. Challenges

4.1.1. Power system capacity

The power system must respond to technological and market challenges, which include accommodation of an increase in adoption of EVs while ensuring grid reliability and safety. Integration of a moderate number of EVs into the distribution network does not have a large effect, but mass adoption of EVs would be likely to create problems for power system operation and management.

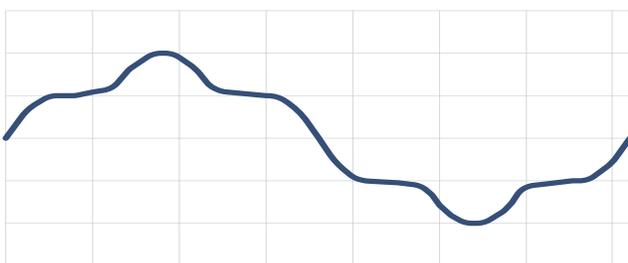
For example, if an ambitious 10 percent target for electrifying passenger cars, buses, and light- and heavy-duty vehicles is assumed and high-level model for calculation of energy consumption are applied using 2019 data on fleet composition in Serbia, connection of EVs to the grid would increase annual electric power consumption by approximately 5 percent. However, policies are needed to regulate peak charging hours and, as such, prevent large pressure to the energy grid at once.

4.1.2. Grid preparation

As electrification rates grow, it is essential to prepare the grid for critical power quality phenomena such as harmonic distortion, overloads, and voltage drops.

Harmonic distortions are common voltage and current variations occurring due to frequency variation in the electrical distribution system. They are deviations from the typical sinusoidal variations in voltages or currents (Figure 20). Harmonics are mainly caused by nonlinear loads such as those associated with power electronic converters.

Figure 20: Typical Voltage Variation Due to Harmonic Distortion²⁶



An EV should be perceived as uncontrollable load on the grid that can consume as much electricity as a typical household at peak times. Peak demand increases can generate voltage drops, which can disrupt electricity system operation. With the expected increase in power demand, smart solutions should be developed and the system optimized as soon as possible.

²⁶ Krarti, Moncef. 2018. "Optimal Design and Retrofit of Energy Efficient Buildings, Communities, and Urban Centres, 1st Edition." Elsevier.

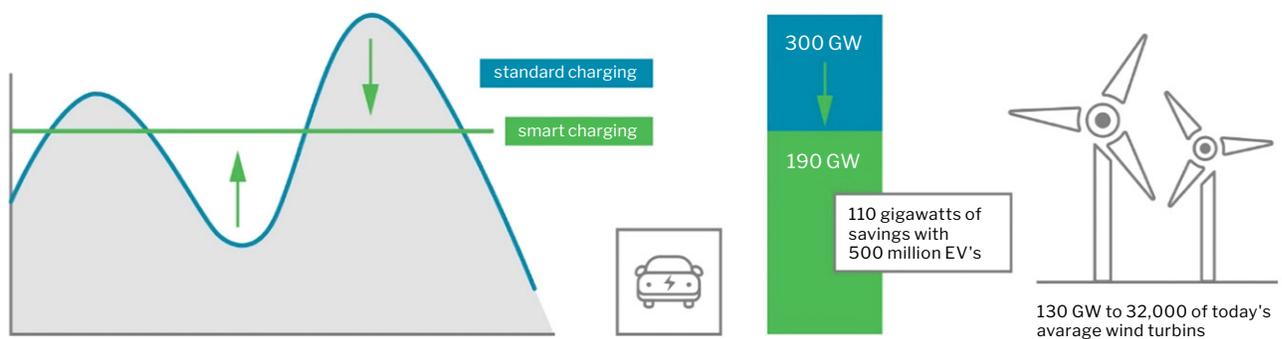
Smart charging can address most challenges associated with peak demand and low-voltage network charging at the local level and in residential areas.

Smart charging refers to a system in which an EV and a charging device share a data connection so that how the EV charges can be intelligently managed by connecting it to the grid (Figure 21). Smart charging makes optimal use of energy available during a certain period.

Figure 21: Smart Charging

Peak load avoidance versus standard charging of electric vehicles (EV's), worldwide projection for 2040.

EV fleet consumption profile during working days



In many cases, smart charging reduces overload on the power grid. For example, if 500,000 EVs used smart charging instead of standard charging, overloads on the power grid would fall from 300 MW to 190 MW. The full benefits of smart charging will be realized with further growth of E-Mobility.

Challenges also include current grid condition and management (smart management). This is of special importance for deployment of supporting infrastructure—EV charging stations. The wear and condition of metering devices presents a challenge, too.

4.1.3. Energy price fluctuations and tariff setting

External factors can destabilize energy prices, which in turn may affect EV owners. One challenge is establishing an effective pricing strategy to ensure balanced, optimal pressure on the grid and a competitive market. It is not possible to set tariffs currently because charges are not paid directly to providers, as is the case with parking fees. This is not the fairest model or most transparent for users. According to models used in EU countries, pricing strategies are based on time and quantity.

A few new models should be explored that would account, for example, for the location of a charging point (e.g., highways), time of day for charging a vehicle, and charger type (power) (see section 3.5.2.).

4.1.4. Nonexistent governance structure and unregulated E-Mobility market

E-Mobility is a multidisciplinary field, and selection of the key actor should be adjusted to the local context. There are various solutions across the European Union, and none fits all. In the context of Serbia and given the strong potential of E-Mobility to contribute to overall decarbonization, the Ministry of Energy and Mining appears to be the best choice.

The existing regulatory framework is immature, which can lead to nontransparent operation, anticompetitive behavior, and proprietary (vendor) lock-in. The sooner the regulatory environment is set, the greater the benefits of E-Mobility will be to the country and its citizens.

4.1.5 High (upfront) cost of EVs

EVs are expensive for most potential users. The existing incentive scheme provides subsidies for EVs, but they might be insufficient to encourage purchases of the cleanest EVs, such as BEVs. The support provided for HEV purchase has resulted in a notable increase in HEV uptake, but their environmental benefits are limited and just slightly above those of the newest internal combustion engines. Finally, the budget for subsidies is insufficient to drive the transition to EVs. If the country wants to decarbonize the sector, subsidy allocations should be increased and focused on modern technologies rather than HEVs.

4.1.6 Outdated fleet and road as dominant mode of transportation

The outdated fleet is a matter of concern. Obsolete vehicles are driven throughout Serbia, with the numbers growing in southern parts of the country. Of particular concern are high-mileage vehicles (trucks and buses). Many of these vehicles, used in urban and suburban passenger transportation, have outdated engines. Road transportation dominates transportation of goods and people within and between cities.

4.2. Opportunities

Promotion of E-Mobility to citizens highlighting its environmental, economic, and social benefits can make the E-Mobility market attractive to prospective customers. Moreover, E-Mobility -related services can be profitable business opportunities and thus accelerate the spread of E-Mobility uptake.

4.2.1. EV maintenance, servicing, and repairs

EVs requiring service are sent back to their country of origin because Serbia does not have workers qualified to provide required services.

4.2.2. Reuse of lithium-ion batteries

Repurposing or reusing lithium-ion batteries that no longer meet requirements of EV performance standards but can be used for stationary energy storage purposes could be an alternative for extending battery lifetime and reduce the environmental impacts of their disposal. Even though reuse only delays recycling of batteries and end-of-life treatment required for certain types of batteries, such as lithium-iron phosphate batteries, reuse can be more advantageous than recycling, because batteries contain valuable components. When a battery becomes unfit for use in an EV, second-life applications offer opportunities for reducing the carbon footprint and introduction of new services. Most retired batteries can be reused in the following ways:

- Direct reuse in EVs after being remanufactured or refurbished;
- Indirect reuse as stationary energy storage;
- Residential energy storage;
- Peak shaving for high-power charging stations;
- Allow for higher penetration of renewables;
- Frequency regulation for utilities;
- Backup power storage for telecommunication towers.

There are several use cases for repurposing of batteries. Tesla Motors and Nissan have been offering their customers refurbished battery packs when replacements are needed under warranty. Retired

EV batteries repurposed as stationary storage can extend the lifetime of a lithium-ion battery by an average of 5 to 15 years, depending on the type of second-life application and the battery's initial condition.

4.2.3. Making transportation more accessible and inclusive

Direct and indirect effects of E-Mobility uptake offer opportunities to make transportation more accessible and inclusive, which means job creation and prevention of health-related costs and eventually benefits to society as a whole.

Better, more-sustainable transportation opportunities have propelled the spread of EVs, increasing women's mobility. Research shows that women have different transportation behavior than men. They tend to take shorter trips and use public transportation and taxi services more often. According to CIVITAS data, women also walk and use bicycles more than men and are consequently much more exposed to airborne pollutants. This finding points to potential impacts of such transportation behavior on children's health because they often travel with their mothers, who are the predominant family caregivers.

Switching to electric public transportation and electrifying passenger transportation can significantly reduce health impacts of emissions from transportation, improving women's living conditions. In addition, because women are more likely to walk than men, significantly more female than male pedestrians are killed in traffic accidents. Most new cars (internal combustion and EVs) are equipped with some type of advanced driver-assistance system, such as blind spot monitoring and lane-keeping assistance. Consequently, the decarbonization of vehicle fleet may reduce the number of traffic accidents and thereby improve women's safety in traffic.

4.2.4. Designing regulatory environment based on best practices

Because the regulatory environment in Serbia is at an early stage, there are numerous opportunities to incorporate best practices and align with EU regulations. The country can avoid making mistakes by following good examples. Effective regulatory environment design will lead to an open, transparent market; create business opportunities; and support decarbonization.

4.2.5. Technology

The automotive industry in Serbia includes car production in a FIAT factory, manufacture of car parts, and development of sophisticated transportation solutions. With the electrification of transport there is potential for job growth in the industry.

4.2.6. Long-term energy sector development strategy

The Energy Sector Development Strategy, established on the foundations of the Energy Law, outlines a long-term development plan, defines strategic directions, and provides guidelines for restructuring and technological modernization of the market, supported by the Strategy Implementation Program adopted in 2017. The strategy calls for the key requirements of development to be focused "as much as possible on renewable energy sources and as little as possible on exhaustible sources." The unused potential in renewables in the country is vast. The strategy highlights that the exploitable potential of renewable sources depends on development of transmission and distribution networks. In addition to renewables, the strategy highlights the potential of energy efficiency measures and forecasts that 1,359 less megatonnes of oil equivalent will be consumed in 2030 if energy efficiency measures are implemented. Moreover,

the strategy highlights several related business opportunities in the development process, such as public-private partnerships, intensive use of EU funds in the energy sector, and a creating more competitive market.

4.3. SWOT Analysis

4.3.1. Importance of legal and institutional coherence

Fundamental requirement is to develop institutional and legal framework. Therefore, institutional and legal framework is not addressed in the SWOT analysis. The SWOT analysis assumes that the main legal documents and institutional framework have been established and incorporated into relevant regulations and laws. The framework is also critical to ensure sustainability and efficiency of the E-Mobility agenda in Serbia and is the foundation on which all other activities are built.

4.3.2. SWOT analysis—Approach and results

For the purpose of this report and to determine short-, medium-, and long-term impacts under the SWOT analysis, the following E-Mobility enablers and their sub-elements were analyzed:

- General and energy
- Energy composition
- Power grid
- Environment
- Education
- Industry and technology
- Key mobility elements
- Public transport
- Freight transport
- Private cars
- Two-wheelers
- Companies with large fleets
- Key infrastructure –charging network
- Charging points for buses
- Publicly accessible charging points for private cars

Results of the SWOT analysis are presented in Tables 24, 25, and 26.

4.3.3. SWOT analysis—Conclusion

A general overview of the SWOT analysis reveals that the potential benefits of strengths and opportunities are much greater than the cumulative effects of weaknesses and threats. Recommendations will consider every identified weakness and threat and propose an action that should mitigate their impact. Minimizing weaknesses and threats should significantly improve the overall policy on accelerated deployment of E-Mobility.

Results of the SWOT analysis will be used to define potential scenarios and select one that is ambitious yet realistic for the context of Serbia.

Table 16: Strengths, Weaknesses, Opportunities, and Threats: General and Energy

Enablers	Strengths	Weaknesses	Opportunities	Threats
Energy composition	In Serbia, the cost of energy is low.	Bad structure of existing energy sources; high reliance on coal and carbon dioxide and sulfur emissions	Ideal for development and construction of new renewable energy-based sources (e.g., solar, wind, nuclear)	When electricity supply does not meet domestic demand, electricity must be imported, meaning dependence on external markets. Possible volatility in the exchange rate could increase the cost of and discourage E-Mobility. A higher EV uptake will increase emissions arising from energy generation.
Electrical grid	Building more electric connections is not expensive and creates fewer problems in securing space for new electric supply lines.	The power grid is not properly developed (in terms of accessibility and capacity) for intensive deployment of E-Mobility.	Expanding the power grid will contribute to better energy coverage and smart management that could be used for other purposes (e.g. digitalization).	Potential faults and disturbances could generate instability in the power supply and collapse of the e-powered transportation system.
Environment	E-Mobility is clean technology, and EVs do not generate local pollution or noise.	Battery production is based on dirty technologies.	Reduction in nonrenewable sources of power reduces pollution.	EV batteries and EVs are not recycled or disposed in accordance with applicable regulations.
Education	The level of general education in Serbia is high, including in foreign languages.	The education program at all levels must be professionally defined and cover all education grades in the field of design, production and maintenance of EVs. This could be lengthy process.	Because of Serbia's location, service and maintenance shops may attract an above-average number of E-Mobility users in the region, and Serbia could become a regional hub for EV maintenance and upgrade.	In the absence of adequate salaries, the development of E-Mobility industry specialists could accelerate brain drain.
Industry and technology	Qualified workers in the automotive industry (e.g., Fiat, Siemens, Ikarbus) could be easily prequalified for production of EVs or parts. Recently opened high-technology companies, such as Continental in Novi Sad, could quickly expand their portfolios to include additional software components for smart support to E-Mobility.	Intensive development of E-Mobility (compared with nothing at present) could generate a shortage of workers.	Additional state-backed investments will keep highly professional staff stimulated to remain in the sector and in the country.	In the absence of adequate salaries, the E-Mobility industry could accelerate brain drain.

Table 17: Strengths, Weaknesses, Opportunities, and Threats: Key Mobility Enablers

Subject	Strengths	Weaknesses	Opportunities	Threats
Public transportation	A growing market will attract e-bus operators. Electric buses can also attract new passengers that would also show their responsible behavior toward environment.	High purchase cost of new buses could limit the number of new e-buses.	Involvement of public-private partnerships in funding and financing the purchase of vehicles. Retrofitting diesel buses with electric motors should reduce capital expenditures and delivery time. Establishing a leasing agency that could purchase a large number of new buses (with optional maintenance) for a more attractive price could be an alternative.	A more than average number of cold days in the winter and extremely hot periods in the summer could limit battery life. Reducing environmental output from buses cannot be achieved with the transition to E-Mobility alone but also requires immediate replacement of non-Euro buses with Euro 6 or similar compressed natural gas buses.
Freight transportation	Easier to drive and maintain. Electric traction provides better driving performance. Cheaper spare parts. Better for the environment.	Creation of waiting queues in case of insufficient number of charging points and thus longer total time needed to recharge the vehicle. There are not many charging stations in rural areas and the region (e.g., Turkey and Greece).	Lower operating cost than with conventional vehicles. Environmental benefit (e.g., pollution, noise). A continuous reduction in battery prices will make the total cost attractive and generate a return on investment in a few years.	Shortage of spare parts and replacement batteries could affect the supply chain and global economy. If supported through subsidy program including tax and toll relief measures, greater uptake could reduce revenues from toll collection and taxes.
Private cars	Lower energy and maintenance costs. Environmental benefits and less noise.	Battery duration could be halved because of the number of charging cycles, extreme climate conditions, and low charging infrastructure coverage.	Potential for creation of new businesses, which will recycle batteries and prepare parts for EVs. Making urban areas more livable.	An uncontrolled increase in electricity prices due to shortages in electricity supply. There are no regulations on battery recycling. If supported through toll and tax relief measures, greater uptake could reduce revenues from toll collection and taxes.
Two-wheelers	Users tend to shift to active mobility (including two-wheelers) when there is adequate infrastructure and their use is regulated.	Safety concerns have not been addressed. Risk of theft is high.	Two-wheelers are an efficient mode of transportation in terms of rational use of space and minimal energy consumption. Shift to two-wheelers could reduce congestion in urban space and has positive impact on environment.	A large shift to two-wheelers could lead to insufficient space for all transport modes. Lack of proper regulation can make usage of two-wheelers unsafe and space competitive.
Companies with large fleets	Charging can be performed at any time, when the price of electricity is cheaper. It is easy to optimize and introduce a smart charging process. Reduced air pollution, especially in urban areas	Batteries in the whole fleet need to be renewed or replaced frequently, which could limit availability of the fleet.	Lower operating cost and greater reliability of EVs.	Access to charging points dedicated to special services (e.g., police, ambulance, fire fighters) must be restricted. Keeping a few conventional vehicles in reserve will reduce the risk of these services collapsing if electric chargers are unavailable.

Table 18: Strengths, Weaknesses, Opportunities, and Threats: Charging Network

Subject	Strengths	Weaknesses	Opportunities	Threats
Charging points for buses	Could be installed in garages or large terminal points.	Proper power supply is essential. Reliability of supply cannot be jeopardized. Charging takes longer than refilling a standard gas tank.	No need for refueling infrastructure, reservoirs, or transportation of liquid fuels.	Insufficient number of charging points could minimize benefits of E-Mobility.
Publicly accessible charging points for private cars	More charging points across the space in comparison to fuel stations, especially in high-density urban zones.	Shortages in electricity supply or incompatibility with connectors or the adapter for a particular type of vehicle.	Infrastructure cost is significantly lower than for a liquid fuel station, reservoirs. Higher safety and security. Electricity sources for charging could also be renewable energy sources (e.g., solar). Because E-Mobility is in the early stage, a strategy for distribution of charging stations can be developed from the outset.	Emergency measures for electricity supply needed in case of power outage. Standby generators for emergency charging. A special list for priority users.

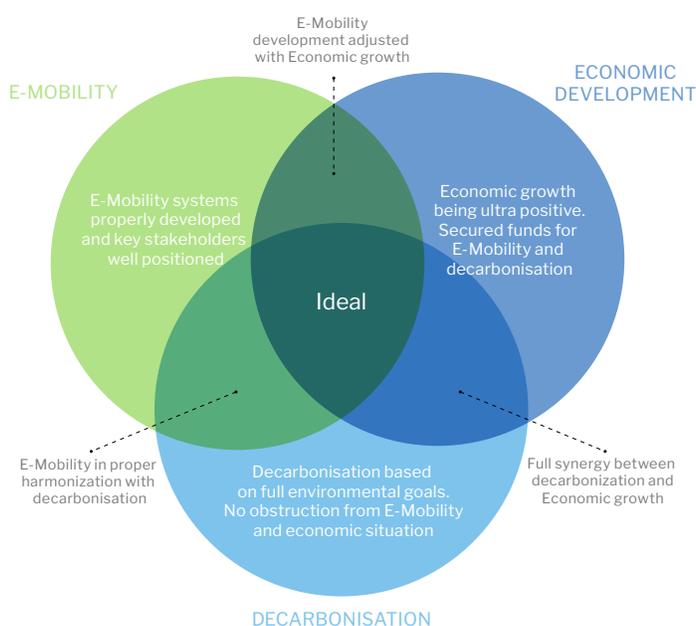
5. Proposed E-Mobility model for Serbia

Serbia is in the early stages of E-Mobility development, with only a few hundred EVs. Although the first steps toward E-Mobility have been taken, these measures are just the beginning of the journey to an electrified future. The most important elements for successful E-Mobility deployment are missing or incomplete. There is no clear institutional structure or regulatory and strategic environment. The market model has not been defined, and only a few companies are driving uptake of EVs in a rather unstructured manner. Clear strategic targets are missing, and incentives are modest and focused on private vehicles.

The E-Mobility model proposed for Serbia in this report is based on assessment of the E-Mobility enabling environment in Serbia in 2021 and best practices in EU and neighboring countries applicable to the local context, including important transportation and energy characteristics.

The most important elements for successful deployment of E-Mobility have not been established or are incomplete. Definitions and rules have not been incorporated into the regulatory framework. The vehicle fleet is outdated, and the incentive program is not ambitious enough and covers only passenger cars. All these elements must be addressed because they are essential for successful, transparent, market- and user-oriented E-Mobility. Figure 22 illustrates the overlaps between E-Mobility, decarbonization, and economic development.

Figure 22: Relationship Between E-Mobility, Decarbonization, and Economic Development



This chapter explores the main parameters for establishing an E-Mobility institutional and market model and setting vehicle fleet decarbonization targets and incentives. The overall approach proposed for Serbia relies on the assumption that E-Mobility and energy transition are deeply interlinked because lifecycle emissions from EVs depend on the source of the electricity they consume. Thus, decarbonizing the transportation sector through electrification must be synchronized with decarbonization of the energy sector.

Serbia has an old vehicle fleet (average age 15 years). A notable percentage of the fleet does not have DPFs, and a substantial percentage does not meet Euro 4 emission standards. These vehicles should be gradually scrapped. EVs are expensive, so a long-term strategy and well-designed incentive program are needed. EU experience shows that market uptake of EVs is

directly correlated to a country's GDP per capita, indicating that affordability is a major barrier to greater uptake. EU experience also shows that E-Mobility development can be successful in countries with lower GDP per capita if state subsidies prioritize public transportation, company fleets, and city logistics at an early developmental stage.

To promote change and ensure sustainable deployment of EVs, it is necessary to establish an appropriate governance structure and market model. As shown in previous chapters, there is no universal approach to establishing an E-Mobility market model across the European Union. Countries have adjusted approaches according to local contexts. Furthermore, E-Mobility is relatively new, and countries have been learning by doing. This provides an opportunity for countries like Serbia, which are in the early phases of E-Mobility deployment, to learn from the lessons described herein and choose the model that best fits the local context.

5.1 Vehicle fleet decarbonization scenarios

Various scenarios for the transition in vehicle composition were developed to simulate the desired change in vehicle fleet composition and expected impacts on the environment.

Decarbonizing the vehicle fleet is important for the roadmap, but it is necessary to identify realistic targets for policy recommendations. The scenarios developed assess the potential uptake of EVs by 2030. If a large increase in the number of EVs is expected, a supporting strategy is needed, which was also explored. The supporting strategy envisages that upgrades of vehicles that do not meet Euro 4 emission standards will run concurrently with uptake of EVs. The scenarios assumed that the objective of the process is to decarbonize the transportation fleet to a socially justified level, and they explored approaches whereby the transportation fleet would be decarbonized to the maximum degree aligned with EU policies and directives. They explored strategies whereby two processes run concurrently: reducing emissions from the existing rolling stock by scrapping vehicles with emission standards that do not meet Euro 4 emission standards by 2030 and increasing the number of EVs (including hybrid vehicles).

The primary purpose of the model that was developed was to indicate the effects of the simulated scenarios. Input values used for the model were sourced from existing public databases, such as the International Association of Public Transport's. Available data for buses were used as a base to estimate outputs from private cars and trucks. The exact outputs from the model might differ from those of other studies but are valid for indicating increases and decreases in important environmental parameters caused by changes in vehicle composition.

5.1.1. Main inputs

To highlight the interdependence of EV uptake and energy consumption by transportation, CO₂ emissions from road transportation and transportation electricity consumption were used to model their reduction or increase in the scenarios. Data for 2020 were used as the baseline for CO₂ emissions related to road transportation and electricity consumption.

The main variable in the model is the age structure of vehicles in Serbia in 2020 according to road transportation sector (passenger cars, buses, trucks). The number of vehicles per vehicle type and emission levels and the projected change were used to assess the impacts of each scenario.

The pollution categories from Euro 0 to Euro 6 were determined based on the age category within each group. Average consumption and emissions per kilometer were used, in accordance with

the European Monitoring and Evaluation Programme/European Environment Agency Emission Inventory Guidebook and the International Association of Public Transport database. These average parameters were derived for each emission standards: up to Euro 3; Euro 4 and Euro 5; and Euro 6, CNG, and EVs. The model assumes that vehicles will move from one Euro category to another, simplifying the calculation of change in consumption and air pollution.

For each group of vehicles, estimated average annual distance driven was 15,000 km for passenger cars, 70,000 km for buses, and 110,000 km for trucks.

The estimate of the number of vehicles in 2030 relied on a forecast from Euromonitor that predicts an approximately 14 percent increase by 2030. Although this seems low when compared with the motorization rate in Serbia and comparable EU countries, it was used because it illustrates the decarbonization potential even with this lower growth projection.

Based on the results, the number of EVs in 2030 can be modeled as a share of the total vehicle fleet. The number of CNG vehicles and EVs was estimated using other information collected from official statistical data in Serbia and the Global Syngas Technologies Council database.

Table 19: Road Transportation and Road Transportation-Related Electricity Consumption and Carbon Dioxide (CO₂) Emissions in Serbia, 2020

Road transportation total CO ₂	Road transportation - EV CO ₂ emissions
6,016,891 tonnes	1,800 tonnes due to the marginal number of EVs
Number of vehicles in Serbia 2020	Number of vehicles in Serbia 2030
2,287,740	2,717,117

5.1.2. Explored scenarios

The purpose of the models was to provide an objective, robust framework for estimating energy consumption and exhaust emissions for each scenario. To define the transport electrification and decarbonization development targets and its potential impact on the environment, four scenarios were developed for the period until 2030. Having analyzed three basic scenarios and their potential impacts on and implications for the vehicle fleet, a fourth scenario was developed that included a mix of targets that seemed most suitable to the local context. The following scenarios were simulated to illustrate the potential environmental impacts of various decarbonization approaches.

Scenario 1: Business as usual (pessimistic). Assumes that no additional measures are taken and that the share of EVs in the fleet increases marginally, with an overall increase in the number of vehicles equally spread among Euro categories and a small reduction in the lowest Euro class fleet. It is a worst-case (pessimistic) scenario, under which the vehicle fleet remains old and the number of EVs is negligible (a share close to zero in the vehicle fleet). The aim is to show potential changes (growth) in CO₂ and air pollution by 2030 if no measures are implemented before then. The key characteristic of Scenario 1 is that the number of Euro 3 vehicles will decrease only slightly, because of the lack of incentives to scrap them. It was attempted to project a “do nothing” approach as a worst possible option without any restrictive measures regarding the critical technical condition of a car (e.g., missing catalytic converter or DPF, cracks in the chassis, quality of braking system) or increased incentive scheme. Under the scenario, there are no specific regulations that would motivate any additional positive change in the structure of vehicles.

Scenario 2: EV-centric. Assumes ambitious EV uptake of approximately 10 percent, which would be substantial growth in the number of EVs by 2030. The scenario illustrates the results that can be expected if penetration of EVs remains close to 10 percent while other categories increase proportionally in the vehicle fleet. Under this scenario, in 2030 EVs will make 10 percent of total vehicle fleet, but there will be no significant difference in the number of highly polluting vehicles (under Euro 3) nor in Euro 4 and Euro 5 emission group.

Scenario 3: Optimistic. Assumes ambitious EV uptake of approximately 10 percent with concurrent significant scrapping of old vehicles. It assumes systematic restructuring of road vehicle fleet to increase energy efficiency and environmental performance. This should be viewed as the optimal scenario, designed to reduce CO₂ and other exhaust emissions from transportation significantly from 2020 levels. It assumes continuous reduction in the number of vehicles with engine standards that do not meet Euro 3 emission standards by 2030, when it is assumed that such vehicles will be removed almost completely from the fleet. This scenario assumes that all requirements in EU documents and directives are met.

Scenario 4: Balanced. Although Scenario 3 would be desirable, it assumes a large number of EVs by 2030 and a significant transition toward Euro 4 and above engines and would be difficult to achieve. Therefore, Scenario 4 assumes a 5 percent share of EVs in the country's fleet by 2030 and gradual conversion of vehicles to Euro 4-and above engines but slower than under Scenario 3.

All scenarios assume that an increase in the number of EVs in the vehicle fleet involves all vehicle types (cars, trucks, buses). Changes in the number of road vehicles per category for each scenario are presented in Tables 28, 29, 30, and 31, which illustrate the implications of the main assumptions of the scenarios and how these scenarios would change the composition of the vehicle fleet.

Under the business-as-usual scenario, the number of vehicles that do not meet Euro 3 emission standards will decrease slightly from 1.15 million to 1.05 million because of the overall age of the vehicles. The increase in the number of Euro 4 and Euro 5 vehicles will match the size of the increase in the size of the fleet, and there will be approximately 30 percent more Euro 6 cars than in 2020 (Table 28). This is a worst-case scenario, which can be deemed pessimistic, but it is important to highlight what could happen if no restrictive or affirmative measures are taken to motivate the transition to more environmentally friendly engine standards.

Table 20: Scenario 1: Business as Usual (Pessimistic)

Type of vehicle	2020	2022	2024	2026	2028	2030
	Number of vehicles					
Total	2,287,740	2,367,811	2,450,684	2,536,458	2,625,234	2,717,117
Euro 3 (up to)	1,148,526	1,150,945	1,149,567	1,142,576	1,130,580	1,050,897
Euro 4 and 5	829,599	896,384	968,978	1,049,028	1,135,978	1,272,094
Euro 6	165,515	174,730	184,563	195,451	207,441	222,033
Compressed natural gas	142,100	143,521	144,942	146,363	147,784	161,994
Battery electric vehicle	2,000	2,230	2,635	3,040	3,450	10,100

Under Scenario 2, the number of vehicles that do not meet Euro 3 emission standards will decrease slightly, from 1.15 million to 0.8 million, whereas the numbers of vehicles under all other Euro emission standards will increase, with the biggest increase in the Euro 4 and 5 group (from

0.83 million to 1.27 million) and the Euro 6 group (from 0.17 million to 0.22 million) (Table 29). To achieve the target of a nearly 10 percent share of EVs in the total vehicle fleet by 2030, the number of EVs must grow significantly, from 2,000 to 244,055. This will require implementation of a comprehensive system of subsidies, accompanied by a strong taxation policy on old vehicles.

Table 21: Scenario 2: Electric Vehicle (EV) Centric—High EV Uptake but Minimum Fleet

Type of vehicle	2020	2022	2024	2026	2028	2030
	Number of vehicles					
Total	2,287,740	2,367,811	2,450,684	2,536,458	2,625,234	2,717,117
Euro 3 (up to)	1,148,526	1,142,787	1,134,903	1,118,809	1,095,565	807,192
Euro 4 and 5	829,599	896,441	969,096	1,049,174	1,136,158	1,272,094
Euro 6	165,515	175,718	186,587	198,166	210,505	223,653
Compressed natural gas	142,100	148,080	153,299	158,709	164,307	170,149
Battery electric vehicle	2,000	4,785	6,800	11,600	18,700	244,030

Optimistic Scenario 3 assumes a high fleet decarbonization rate by concurrent uptake of EVs and replacement of obsolete vehicles with vehicles that meet Euro 4 standards. With strong government support and appropriate measures in place, vehicles with engines that do not meet Euro 3 emission standards will almost disappear. The number of Euro 6 vehicles will increase from 165,515 to 880,500 (Table 30), which is on the path to achieving compliance with EU standards. The number of EVs will be the same as in Scenario 2. For this scenario to be successful, national and local governments must strongly support measures that will lead to elimination of under Euro 3 vehicles from the vehicle fleet and generally lead to vehicle fleet with higher emission standards.

Table 22: Scenario 3: Optimistic—Enforced and Multifunctional Restructuring of Vehicle Fleet with High Electric Vehicle Uptake

Type of vehicle	2020	2022	2024	2026	2028	2030
	Number of vehicles					
Total	2,287,740	2,367,811	2,450,684	2,536,458	2,625,234	2,717,117
Euro 3 (up to)	1,148,526	1,039,716	909,379	637,835	480,773	66,794
Euro 4 and 5	829,599	923,500	1,043,000	1,162,750	1,212,000	1,295,604
Euro 6	165,515	242,500	318,500	534,000	704,500	880,500
Compressed natural gas	142,100	157,310	173,005	190,273	209,261	230,190
Battery electric vehicle	2,000	4,785	6,800	11,600	18,700	244,030

Under Scenario 4, Balanced scenario, the percentage of EVs in the vehicle fleet in 2030 will be lower, only 5 percent, but there will still be a significant transition to higher Euro standards. There will be 90 percent fewer cars that do not meet Euro 3 emission standards than in 2020 (Table 31). This is greater than projections under Scenario 3 but is considered realistic. It is believed that this scenario could be achieved if targeted measures and actions are deployed immediately.

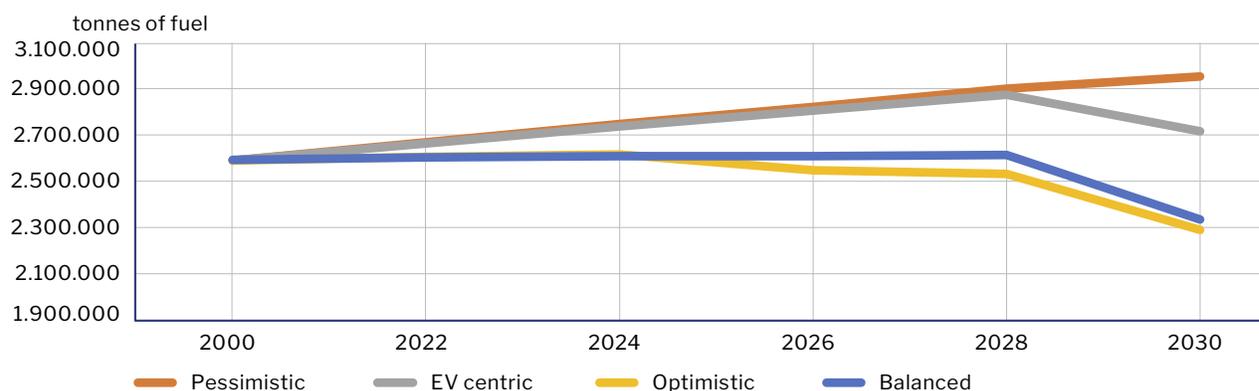
Table 23: Scenario 4: Balanced

Type of vehicle	2020	2022	2024	2026	2028	2030
	Number of vehicles					
Total	2,288,640	2,368,742	2,451,648	2,537,456	2,626,267	2,718,186
Euro 3 (up to)	1,148,526	1,026,687	889,374	749,047	620,384	110,564
Euro 4 and 5	829,599	928,847	1,033,510	1,134,376	1,211,184	1,368,284
Euro 6	165,515	250,724	347,449	452,171	570,361	880,019
Compressed natural gas	143,000	158,200	174,666	192,812	212,838	235,220
Battery electric vehicle	2,000	4,285	6,650	9,050	11,500	124,100

5.1.3. Estimated environmental impacts under each scenario

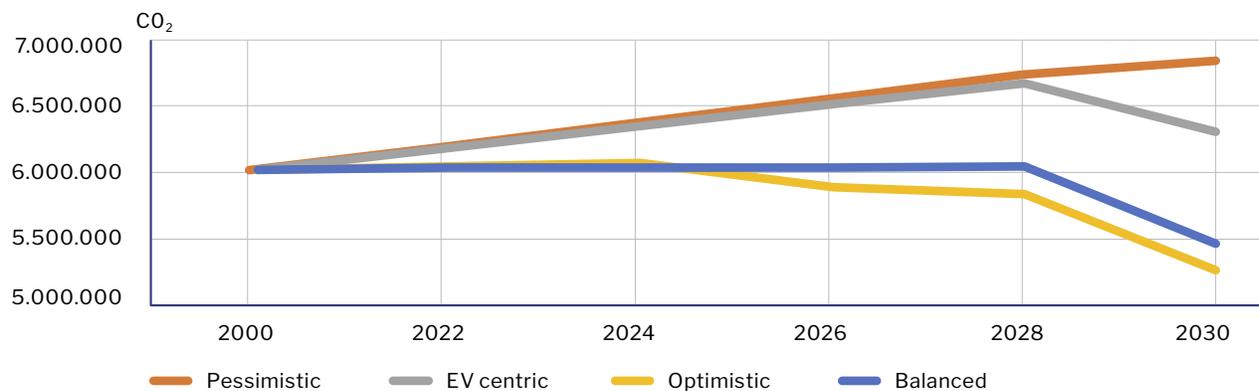
Changes in the number of vehicles according to Euro categories will significantly affect energy consumption, including electricity consumption converted into tonnes of fuel. Total consumption would be 2,954,140 tonnes under Scenario 1 (Pessimistic) and 2,291,121 tonnes under Scenario 3 (Optimistic) (22.5 percent less). Under Scenario 2 (EV centric), total power consumption would be 2,720,218 tonnes, which is 8 percent less than under Scenario 1. Under Scenario 4 (Balanced), power consumption would be 21 percent less than under Scenario 1 (Figure 23).

Figure 23: Power Consumption According to Scenario



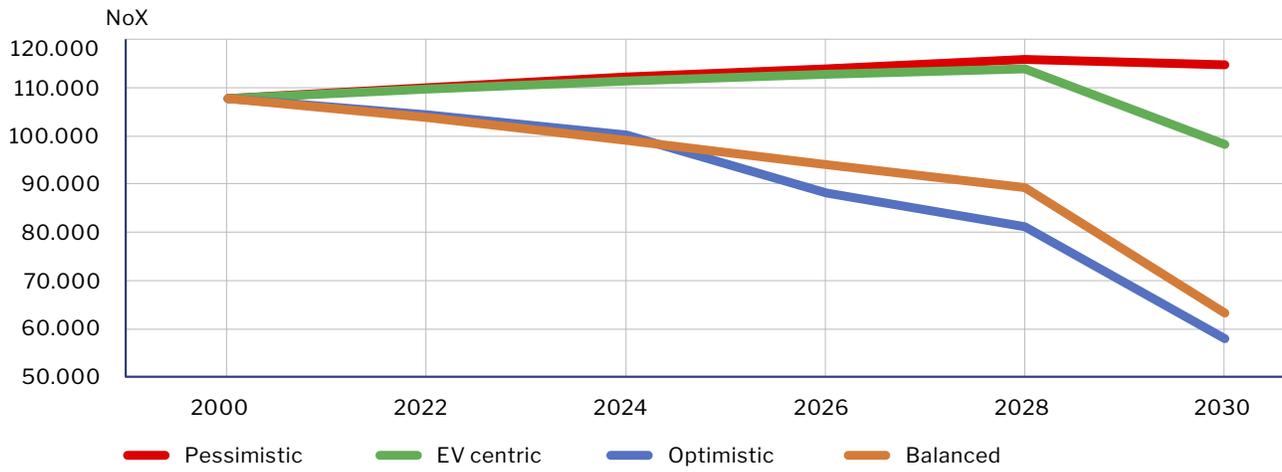
The most drastic reduction in CO₂ emissions related to road transportation (Figure 24) can be expected under Scenario 3 (Optimistic). Scenario 4 (Balanced) will keep CO₂ emissions and energy consumption at the same level despite the expected increase in the size of the vehicle fleet but will begin to decrease in 2028, when substantial decarbonization of vehicle fleet would take place.

Figure 24: Carbon Dioxide Emissions Under the Various Scenarios



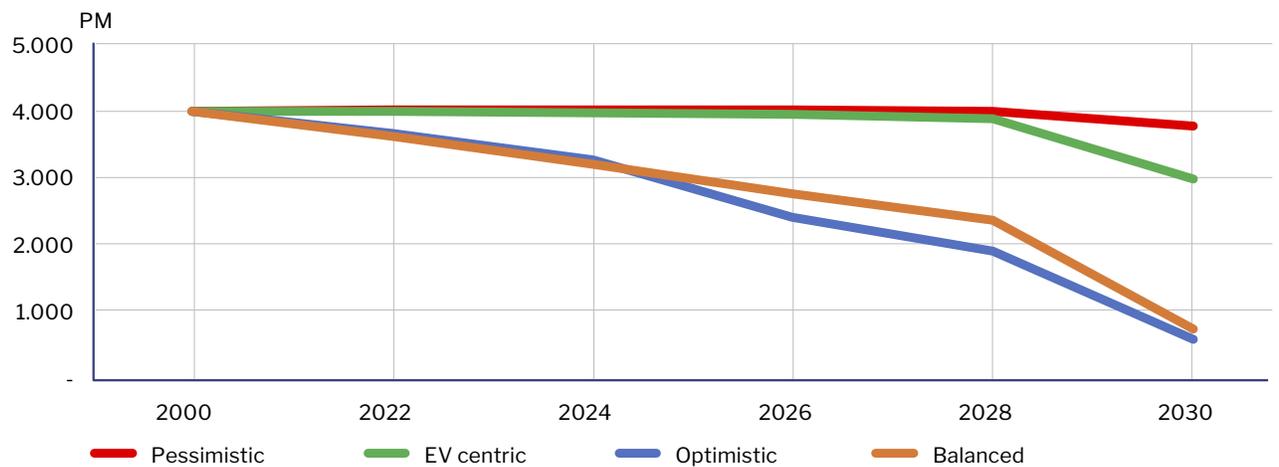
NoX emissions (Figure 25) would be 9 percent lower under Scenario 2 (6,844,073 tonnes) than under Scenario 1 (6,303,800 tonnes), 23 percent lower under Scenario 3 (5,261,076 tonnes), and 20 percent lower under Scenario 4.

Figure 25: Nitrous Oxide Emissions According to Scenario



By 2030 particulate matter pollution will decrease from 3,988 tonnes to 3,769 tonnes under Scenario 1, to 2,965 tonnes (26 percent) under Scenario 2, to 3,434 tonnes (15 percent) under Scenario 3, and to 3,273 under Scenario 4 (19 percent) (Figure 26).

Figure 26: Particulate Matter Emissions According to Scenario



5.2 Incentive program to drive a change

Under Scenario 4, it is projected that, by 2030, there will be 228,692 CNG-powered cars, 120,000 electric passenger cars, 350 CNG-powered buses, 600 e-buses, 1,148 CNG-powered trucks, and 1,500 electric trucks. (Electric includes HEVs and BEVs.)

Achievement of these targets will depend largely on the size and scope of the accompanying incentive program. Incentives can be a mix of subsidies for purchasing vehicles, tax benefits, charging incentives, and local incentives (Figure 29).

Figure 29: Possible Incentives to Stimulate E-Mobility Uptake

	Private individuals	Private businesses	Public entities
EV purchase subsidies	Purchase subsidy for new BEV cars, vans, motorcycles and mopeds etc.		
	Purchase subsidy for used BEV passenger cars and vans		
	Scrapping bonus when buying new or used BEV, PHEV and REEV passenger cars or vans		
Tax benefits	Progressive motor tax reduction based on CO ₂ emissions		
	Progressive registration tax reduction based on CO ₂ emissions		
	Progressive customs reduction based on CO ₂ emissions		
	Progressive VAT benefits based on CO ₂ emissions		
Charging incentives	Progressive company car tax based on CO ₂ emissions		
	Public recharging station deployment subsidies		
	Home charging subsidies		
	Subsidies for workplace chargers		
Local incentives	Corporate tax deduction for recharging station deployment		
	Free parking		
	Traffic allowances during smog alerts		
	Green licence plates		

Source: Path to Electric Mobility for Belgrade, Component 1, section 6.1.1.2., PwC Report, October 2021.

To achieve the desired vehicle decarbonization rate, the incentive program must be adjusted to average purchasing power and living standards. Average purchasing power was estimated using a publicly available data from the Statistical Office of the Republic of Serbia.

Average household income was €9,658 per year (€805 per month), and average household consumption was €6,850 per year (€570 per month), a difference of €2,808 per year (€234 per month).

The prices (with no state subsidy) of the most affordable HEVs (Toyota Yaris, Renault Clio E-Tech, Honda Jazz, Hyundai Ioniq) range from €20,790 to €25,990. The down payment for the purchase of a passenger car is 30 percent, the interest rate is 3.5 percent, the repayment period is 84 months, and the monthly payment ranges from €191 to €251. Average household debt is approximately €4,702.

This basic calculation indicates that the average household can hardly afford even the cheapest HEV. Even if the average household has no debt, it has other expenditures (e.g., vacation, furniture). If the average household buys the cheapest car, it would be left with only €43 per month. Subsidies reduce the monthly installment, but many people still cannot afford an EV. If Serbia wants to achieve a higher level of BEV market penetration, subsidies for BEVs should be increased and coupled with other incentives such as tax benefits and additional local benefits (e.g. parking, charging, etc.).

Given the current market maturity and characteristics of emissions from various fleet categories, Serbia should target incentives at decarbonization of bus fleets, passenger car fleets, and public passenger car fleets and logistics companies, in that order.

5.2.1 Incentives for decarbonization of bus fleets

A substantial percentage of the bus fleet does not meet Euro 4 emission standards and even has units without DPFs. Scenario 4 assumes that, by 2030, the number of buses that do not meet Euro 3 standards will decrease from 3,892 to 203, the number of buses that meet Euro 6 standards will increase from 1,650 to more than 5,000, the number of CNG buses will increase from 1,000 to 3,250, the number of e-buses will increase by at least 600 (5 percent increase); and 31 percent of the bus fleet will be CNG or electric.

There are many options for encouraging the transition. Proposed incentives are based on practices across the European Union and local purchasing power. The government can consider recommendations here as a starting point and decide on the final scheme in consultation with a wide stakeholder group.

The incentive program should be combined with an extended public service contract to enable longer repayment periods for private operators and thus make this goal more feasible or focused on retrofitting of old buses into CNG or electric. Extending duration of a public service contract from a range of 5 to 7 years to 12 to 15 years would have financial effects similar to those of a conventional loan for the purchase of a Euro 6 diesel or CNG bus. In turn, operators will commit to have a fleet with a minimum of 5 percent of e-buses and up to 85 percent of buses that meet Euro 6 emission standards or run on CNG²⁷ by 2030. Retrofitting an existing Euro 4 to Euro 6 fleet to electric (or even CNG) buses will enable faster replacement. Retrofitting buses is environmentally attractive because it significantly reduces the amount of waste material that must be disposed of somewhere in an already polluted land.

E-bus operating costs are much lower than those of conventional buses; operators can account for these savings to justify higher upfront costs of e-buses. The incentive program can be slowly relaxed as the number of e-buses approaches the target.

Proposed subsidies and stimulative programs consist of 15 percent of the cost to purchase a new e-bus; 10 percent of the cost to purchase a new CNG bus; 10 percent of the cost to retrofit a bus; a maximum of €30,000 to install a bus charging point with the purchase of an e-bus; progressive motor, registration, and duty tax relief and reduction in value-added tax rate based on CO₂ emissions; and extension of public service contracts for 10 years or more when an operator commits to a 5 percent share of EVs and an 85 percent share of Euro 6 vehicles in their fleet.

A government-wide approach could be considered wherein the government would procure buses on behalf of interested parties for a country-wide program. Buses will be delivered to operators who apply for the program, who will pay the vehicle price minus the deductible under the incentive scheme. Procurement of a large number of buses should lead to a cheaper price per unit, better maintenance, and an extended warranty. A uniform approach across the country should also enable easy transfer of knowledge.

It is estimated that, until 2030, the program would require a cumulative budget of €101 million or more to reach targets set in the Balanced scenario (Scenario 4), assuming 5 percent penetration rate of e-buses and replacing of Euro 3 buses and below with buses with Euro 4 and above. Under this approach, an annual budget for subsidies would be of €12.6 million (Table 32). The eventual reduction in revenues from tax collection was not accounted for.

²⁷ The typical cost of a Euro 6 bus is €250,000 and of an e-bus is €550,000.

Table 24: Costs Incentives for Decarbonization of Bus Fleets

Assumptions	Associated costs
Calculation used the following assumed average prices: New Euro 6 bus: €240,000 CNG bus: €270,000 Conversion upgrade kit for e-bus: €250,000-350,000 New e-bus (12 m long): €550,000 ^a	
The chosen scenario (Scenario 4, Balanced) assumes that 600 e-buses will be operating in 2030. The estimated subsidy for procurement of these buses starts at at least 15% of the cost of a new bus.	Assuming that two-thirds of the fleet would be purchased on the incentive program, the cumulative budget for subsidies until 2030 would be €33 million.
The same scenario envisages that, in 2030, there will be 3,250 CNG buses—2,250 more than in 2022. The proposal is to limit the subsidy to 10% of the new bus cost.	Estimated cumulative budget for subsidizing procurement of CNG buses by 2030 is €61 million.
Some buses will be retrofitted, assuming a 10% retrofit subsidy.	Assuming that one-third of electric vehicles will be retrofitted by 2030, the budget for subsidies would be €7 million.
Charging points cost - Consider introducing targeted subsidy for e-bus charging station procurement and the installation. Subsidy should be determined based on the charging capacity and condition/combined with vehicle purchase.	€30,000 for a small power unit
CNG charging station	Part of CNG gas supplier investment for developing its business
Total cumulative budget for proposed measures until 2030 (excluding subsidies for charging stations, which should be also considered)	€33+€61+€7=€101 million
Annual budget for the subsidy program assuming 8 years for implementation (from 2022 to 2030)	€101 million/8=€16.4 million

a. Source: Electrobus –Analyze der Lebenszykluskosten verschiedener Busantriebskonzepte, Bremen,2013 .

5.2.2. Incentives for decarbonizing passenger car fleet

RSD 120 million (~€1.0 million) was allocated in the 2020 budget. Four hundred thirty-five grants were awarded to individuals (for 232 vehicles) and companies (for 282 vehicles). €1.0 million was also allocated in 2021 and 2022 (similar to 2020), so it is estimated that a similar number of vehicles were purchased in all three years. With these budgets for subsidies, a more dynamic pace of electrification of passenger vehicles can hardly be expected. With this model in place, a maximum of 4,500 vehicles will be purchased by 2030, 4 percent of the target.

However, with a mix of the ambitious incentive program and appropriate market regulations, the passenger vehicle fleet could be fully renewed. Renewal will involve a 5 percent uptake of EVs by 2030 and restructuring of old diesel and petrol vehicles that do not meet Euro 3 emission standards as they are replaced with vehicles that meet Euro 4 standards and above.

The Scenario 4 estimates that by 2030 the number of private cars that do not meet the Euro 3 emission standard will decrease from 1,045,000 to 92,643, the number of Euro 6 cars will increase from 126,000 to 750,019, the number of Euro 4 and Euro 5 cars will increase from 717,000 to 1,220,084, and the number of EVs (including hybrids) will increase to 122,000.

This comprehensive approach to stimulating purchases of EVs and CNG and Euro 6 cars must

include subsidies for purchasing Euro 4 and Euro 5 cars and for scrapping vehicles that do not meet Euro 3 emission standards. Car replacement and import policies must be strengthened, and technical requirements for old and obsolete vehicles (that do not meet Euro 3 emission standards) must be enforced.

To achieve a 5 percent share of EVs, the budget for subsidies must be substantially increased. If the budget for subsidies increases by 50 percent each year, it will be €25.6 million in 2030. The cumulative budget for subsidies for the purchase of EVs (and HEVs) would be approximately €75 million by 2030, which would enable the purchase of about 37,800 HEVs, or 31 percent of the desired number of this type of vehicle by 2030.

To accelerate fleet modernization, it is proposed that the size of the program be increased by at least 50 percent more, which would mean €110 million cumulatively by 2030, or approximately €13.5 million annually if the program would last 8 years. This proposal also suggests an increase in subsidies for BEVs, PHEVs, and REEVs and provision of subsidies for Euro 6 vehicles. Subsidies for HEVs should remain unchanged. Subsidies for companies and private individuals should be equalized. Incentives for private individuals and business owners should be the same (with the exception of logistics and rental companies and taxis). It is estimated that such increased program will lead to the purchase of approximately 45,000 vehicles, or 37 percent of the projected desired number of EVs, by 2030.

The following incentive programs are proposed:

- €8,000 for new BEV passenger cars and vans, except for taxi fleets, which should be offered €9,000
- €4,500 for new PHEVs, REEVs, and vans with emissions up to a maximum of 50 g of CO₂/km
- €2,500 for new HEV passenger cars and vans with emissions up to 140 g of CO₂/km (calculated using the Worldwide harmonized Light vehicles Test Procedure methodology)
- €1,500 for new Euro 6 vehicles
- A maximum 50 percent or €200 for purchase and installation of home chargers
- A maximum €20,000 for charging station procurement and installation, based on charging capacity, at taxi company depots when combined with vehicle purchase and after there are a certain number of EVs in the company's fleet
- Taxes to be based on CO₂ emissions rather than on engine size
- Exemption of BEVs from registration, motor, and import taxes
- Reduction of transfer tax for private vehicles being scrapped and Euro 3 vehicles
- Interest-free loans up to €3,000 repayable monthly or annually for purchasing Euro 4, 5, and 6 vehicles and EVs to owners who scrap vehicles that do not meet Euro 3 standards
- Tax benefits for companies purchasing EVs and Euro 6 vehicles

5.2.3. Incentives for freight, including city logistics

Per Scenario 4, the freight fleet will consist of 292,495 vehicles of all kinds in interurban, urban, and suburban areas in 2030. Scenario 4 assumes significant restructuring of the category of old diesel vehicles that do not meet Euro 3 standards. The increase in the number of electric trucks will be moderate in 2030, with more weight given to upgrading vehicles to Euro 4 plus and CNG. The main outputs of the scenario 4 (Balanced) are:

- The number of freight vehicles that do not meet Euro 3 standards will fall from 99,634 to 17,718.
- The number of Euro 6 trucks will increase from 37,865 to 125,000.
- The number of Euro 4 and Euro 5 freight vehicles will increase from 108,774 to 145,000.
- There will be 3,277 CNG vehicles and 1,500 EVs.

With a combination of the incentive program and appropriate market regulations, the truck fleet will be renewed and replaced with more environmentally friendly solutions. To achieve the scenario targets, stimulative measures will be used to encourage purchase of electric, CNG, and Euro 6 trucks, and subsidies will be provided for purchase of Euro 4 and 5 vehicles for companies scrapping vehicles that do not meet Euro 3 standards.

The scenario assumes accelerated uptake of light commercial vehicles for delivery of goods and courier services in urban and suburban areas. It also includes small companies with one or two vehicles that should be encouraged to scrap old trucks and shift to Euro 6 trucks or EVs.

Development of the targeted subsidy scheme for electrification of high-mileage vehicles, including for taxi companies, city logistics companies, and central and local government fleets, can significantly increase the number of EVs and improve air quality with electrification of a relatively small number of vehicles. The proposed approach would require a medium-sized incentive program for old vehicle replacement. A detailed calculation is not available, but based on available case studies, a budget of €5 million for the next several years should be a sufficient start. The proposed subsidy scheme is summarized here.

- Amend the latest provisions of the law on taxes on the use, possession, and carrying of goods (the section on vehicles) based CO₂ emission rather than the engine size. Exempt EVs from road taxes. Reduce transfer taxes on private vehicle owners scrapping old vehicles.
- Introduce an €8,000 subsidy for new battery electric vans up to 2.5 tonnes for companies involved in city logistics or related services.
- Introduce a €12,000 subsidy for new battery electric vans greater than 2.5 tonnes for companies involved in city logistics or related services.
- Introduce a €500 to €1,000 subsidy for new commercial e-cargo bikes.
- Introduce a targeted maximum €20,000 charging station procurement and installation subsidy based on charging capacity at logistics companies' depots when combined with vehicle purchase and after there are a certain number of EVs in the company fleet.
- Support local (cargo) e-bike manufacturing by offering subsidies for expanding production

5.3. Defining the market model

The most critical factors in deployment of E-Mobility are a well-defined governance structure and market model. Responsibilities of the main stakeholders in E-Mobility deployment are not defined; nor has a relevant working group been formed.

Because the market model is not defined in existing regulations, no rules on the responsibilities of stakeholders, market entry requirements, pricing strategy and models, or charging network deployment have been written. With unclear responsibilities, vague market entry requirements, and no market model, existing providers cannot directly collect charging fees (instead, these fees are collected through other services, e.g., parking charges), so significant development of E-Mobility in Serbia is unlikely.

The leader role in pursuing the agenda should be delegated to a specific stakeholder, the roles and responsibilities of all other stakeholders should be agreed upon, and a working group comprising members representing relevant entities should be established. The concept of the market model should be agreed upon based on best practices and EU regulations and adjusted to the local context.

The agreed-upon governance structure and the market model should be incorporated into relevant legal documents, most notably the Energy Law. A list of key terms should be defined following international best practices and the EU framework; a minimum list of definitions to be included in the legislation should be in line with the regulation on the deployment of alternative fuels infrastructure (2021/0223/COD).

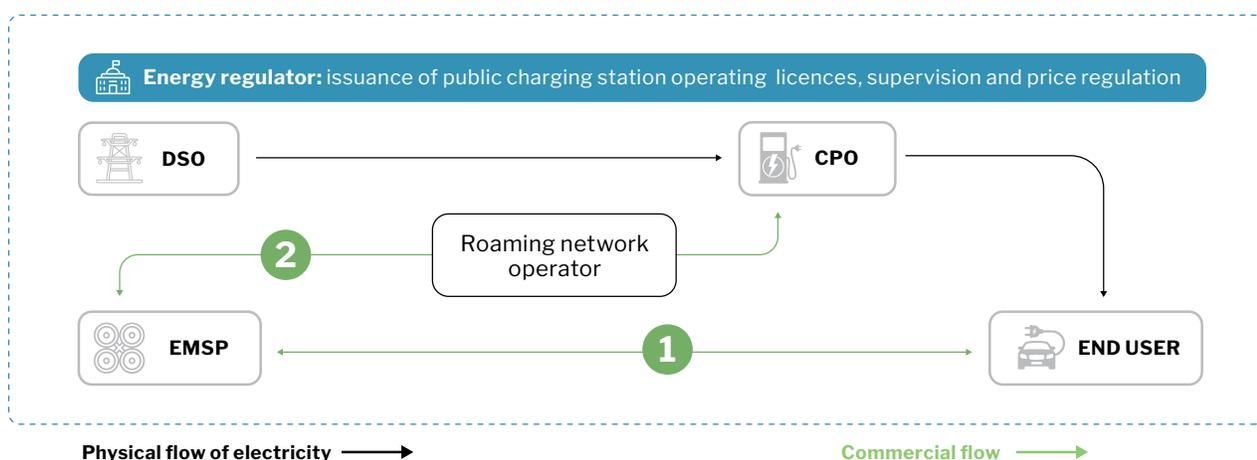
5.3.1. Governance structure and market model

The market model should be based on EU directives and define clear roles and responsibilities of and minimum requirements for market players and their relationship, based on EU examples and adapted to the Serbian regulatory and institutional framework.

The Hungarian model, a relatively new yet well-established model incorporating all relevant EU requirements, could be a model for Serbian legislation. Hungary has an energy market structure comparable with Serbia's, dominated by a state-owned energy company and its subsidiaries. The Hungarian model has been successful in engaging the private sector in developing and operating the charging infrastructure network.

For Serbia, the governance structure and the market model could be described as follows. The DSO supplies electricity to CPOs, which supplies it to users (Figure 30). In commercial terms, E-Mobility service providers and CPOs (which are sometimes the same entity) can communicate and transact directly or via a roaming network operator, which facilitates information exchange between multiple players to ensure interoperability through digital and cross-border exchange. AERS regulates and supervises market activity.

Figure 30: Market Model



Source: Path to Electric Mobility for Belgrade, Component 1, section 6.1.1.2., PwC Report, October 2021

The following potential authorities and their respective roles were considered.

- E-Mobility Administrator and Coordinator: **Potential authority: Ministry of Mining and Energy.**
- Energy Regulator: It is proposed that responsibility for issuance of licenses to operate public

charging stations be placed with AERS, which would also be responsible for developing technical requirements and pricing regulations and supervising compliance with such requirements.

Potential authority: AERS

- DSO: The DSO is directly involved with the charging infrastructure because it supplies electricity required for operation. To ensure non-discriminatory access, the DSO's role should be restricted to operating charging points solely for its own use; it should not own, develop, manage, or operate any publicly accessible charging point (in line with the Internal Market in Electricity Directive (2019/944/EU)). **Potential authority: Elektrodistribucija Srbije.**
- CPO: CPOs are responsible for management and operation of charging points, including in the name and on behalf of E-Mobility service providers. It is recommended that charging point operation be a licensed activity, separate from energy trading. **Potential authority: This is a licensed activity; anyone can enter the market without restrictions.**
- E-Mobility service provider: An E-Mobility service provider is a legal person who provides E-Mobility services (charging services) to end users in return for remuneration. In line with international examples, providing E-Mobility services could be a registered activity. A CPO and an E-Mobility service provider can be the same entity. **Potential authority: This is a registered activity; anyone can enter the market without restrictions.**

5.3.2. Pricing strategy

Existing electricity trading regulations are unsuitable for providers of charging services, making it technically impossible to charge on the basis of consumption per user. Consequently, in line with the separation of energy trading from E-Mobility services, an appropriate framework for pricing should be defined that enables basic and advanced pricing methods.

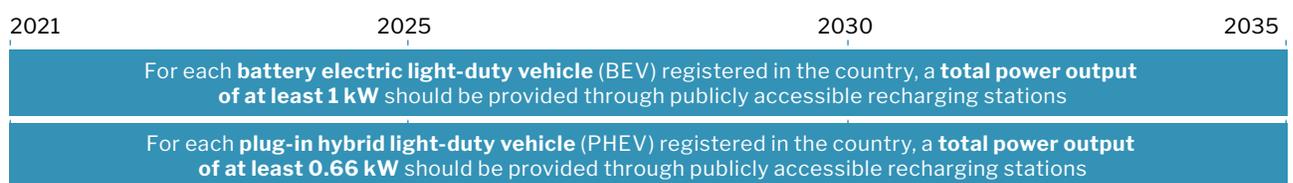
The recommendation is to follow existing EU directives (especially the Proposal of the Regulation on Deployment of Alternative Fuels Infrastructure) to ensure international interoperability and to ease adoption of EU rules at a later stage.

5.3.3. Charging infrastructure strategy

Clear targets should be defined for deployment of the publicly accessible charging infrastructure, in line with a proposal on the Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/COD). The proposed regulation, setting EV fleet- and location-based targets, can provide guidance and enable a clear pathway for developing a charging network with country-wide coverage.

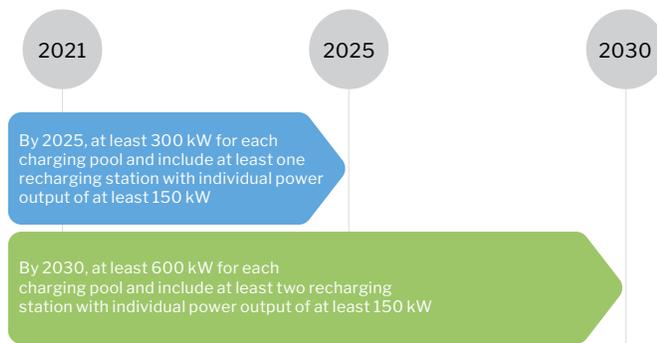
When calculating the needed power output for EV fleet, the approach as shown under Figure 31 could be considered.

Figure 31: Power Output Targets



Publicly accessible charging stations dedicated to light-duty EVs should be deployed in each direction of travel along the core Trans-European Transport Network, with a minimum distance of 60 km in between.

Figure 32: Location-based targets



The Energy Performance of Buildings Directive (2018/844/EU) should be relied on regarding installation of charging points in buildings, because it can stimulate deployment of the country-wide charging infrastructure and ease future installation of charging points in residential buildings. It establishes rules on construction of new buildings and buildings undergoing major renovations in relation to charging infrastructure for EVs, with the following requirements:

- For new residential buildings and buildings undergoing major renovation with more than 10 parking spaces, installation of electric cables for every parking space to enable installation charging points at a later stage
- For new nonresidential buildings and those undergoing major renovation with more than 10 parking spaces, installation of at least one charging point
- For nonresidential buildings with more than 20 parking spaces, specification of the minimum number of charging places in accordance with local conditions (for Serbia, it is recommended that the minimum criterion [at least two] be met)
- Practice around the European Union shows that, once a critical number of charging points (calculated according to the above recommendations) is deployed, infrastructure deployment can be a viable business opportunity for the private sector, although the government should stay involved until this tipping point.

Additional elements should be defined in relevant laws.

- Establishment of minimum standards for deployment and construction of public infrastructure for the supply of alternative fuels (electricity, hydrogen), for example, in buildings and on public roads
- Determination of requirements for public charging points based on location and distance so that each BEV has guaranteed at least 1 kW and each PHEV 0.66 kW (for light vehicles) or a similar
- Provision of ad hoc charging at public charging stations (without contractual obligation), as well as contractual services
- A user-friendly, nondiscriminatory policy ensuring transparent prices, payment options, and smart charging
- Whether the DSO is allowed to develop charging stations if no other entity has shown interest in the tendering procedure
- Obligation of the DSO to account for possible overload caused by construction of infrastructure for EV charging points when planning grid development

Mixed charging principles (uncoordinated and smart) should be supported if possible. The level of E-Mobility development in Serbia is low, and there is no practical experience or data on the potential benefits of different charging approaches. Simulation results from other countries show the benefits of smart charging. For any national vehicle fleet with EVs penetration of above 20 percent, introduction of smart charging is inevitable. Smart charging will enable greater capacity at off-peak times, although it requires continuous digital communication between vehicles, the control center, and charging points.

5.4. Implications for the roadmap

Pollution emissions generated by the old vehicle fleet are posing a serious threat to population health. The goal is to replace obsolete units with vehicles that meet Euro 3 emission standards, establish the E-Mobility market, and provide an incentive scheme to ensure that EVs account for a minimum of 5 percent of the vehicle fleet.

The scenario analysis also highlights that even highly ambitious EV uptake and decarbonization targets can lead to an increase in road transportation-related emissions as the consequence of the overall growing number of vehicles (including EVs) and growing demand for electricity for road transportation. Thus, serious commitments and resources are required in the long run to accelerate transportation decarbonization, which require that transportation and electricity sector players make fundamental changes.

In theory, all scenarios should be possible, but large increases in the number of EVs under Scenarios 2 and 3 would be possible in the countries that have had E-Mobility structure for many years. The ambitious goals set in Scenarios 2 and 3 might be difficult for Serbia to achieve considering that it is at an early stage of developing an enabling E-Mobility environment.

Scenario 4 appears to be the most realistic but needs a jump-start. The targets set in this scenario can be attained only if there are no more delays and comprehensive measures, including incentive schemes, are implemented immediately. The roadmap defines the actions on the assumption that Scenario 4 is a minimum target to be achieved by 2030.

In addition to decarbonizing the vehicle fleet, the E-Mobility strategic approach must be comprehensive and include activities that will lead to introduction of environmentally friendly systems in urban areas such as trams and trolleybuses, a higher modal share of railways, regulated micromobility, and a simultaneous increase in renewable energy sources in final electricity consumption. Given the ownership structure of bus operators, with private operators dominating, special attention should be paid to articulating measures to promote private bus fleet modernization and electrification.

This cannot be implemented effectively without an adequate governance framework and market model, which can be established by amending relevant laws, regulations, and strategies and implementing the new versions at all levels of government. For the governance structure and the market model, it is proposed to follow EU directives adjusted to local context. The Ministry of Mining and Energy should take on the role of E-Mobility administrator and coordinator, and AERS should be the regulator. Provision of charging service should be a licensed activity separate from energy trading.

6. E-Mobility roadmap for Serbia

6.1. Vision

Serbia's E-Mobility vision supports decarbonization of the transportation sector through the developed and open E-Mobility market based on international best practice, which can include a variety of strategies regarding electrification of private and public transportation and company fleets and renewable electricity generation scenarios.

6.2. Strategic areas underpinning E-Mobility roadmap

The roadmap is focused on E-Mobility ecosystem elements that are expected to yield the greatest benefits and fully exploit the transition potential. Based on an analysis of European best practice, current uptake of E-Mobility, the condition of the vehicle fleet in Serbia, weaknesses and threats identified in the SWOT analysis, and electrification and decarbonization potentials identified in 4 scenarios, the following activities were assessed:

Foundation	1. Establishing a governance structure and concept for the market model
	2. Developing an adequate regulatory framework
	3. Developing an adequate planning framework
Mobility	4. Decarbonizing the road transportation vehicle fleet Bus fleet Passenger cars Government fleet, taxi fleets, freight transportation Charging infrastructure network
	5. Shifting to electrified transportation (trams and trolleybuses in urban areas, rail)
Cross cutting	6. Decarbonizing the energy sector and ensuring power grid adequacy
	7. Implementing social and awareness raising measures
	8. Investing in human capital, industry, and research and development

The approach to urban passenger transportation involves deployment of environmentally friendly systems such as trams and trolleybuses in cities where transportation volumes and public space justify the investment, for example, Belgrade, Kragujevac, Nis, and Novi Sad. Micromobility based on EVs can have significant benefits in urban environments, especially through city logistics.

Electrification of rail transportation and creating an environment that would enable a modal shift to rail is included in the strategy. To achieve decarbonization through transportation electrification, the energy grid must be decarbonized and the share of renewables in gross final energy composition increased.

6.3. Prioritizing actions

Figure 33 illustrates the core enablers of transportation decarbonization that must be addressed to increase the number of EVs in the vehicle fleet. It also shows cross-cutting issues that must be addressed to yield maximum benefits of the transition to E-Mobility. The core activities described in the roadmap are pivotal in the process. Cross-cutting issues are also addressed in the roadmap and are perceived as the enablers that, if properly mainstreamed throughout all stages of the transition to E-Mobility, could multiply benefits.

Figure 33: Core transportation decarbonization enablers

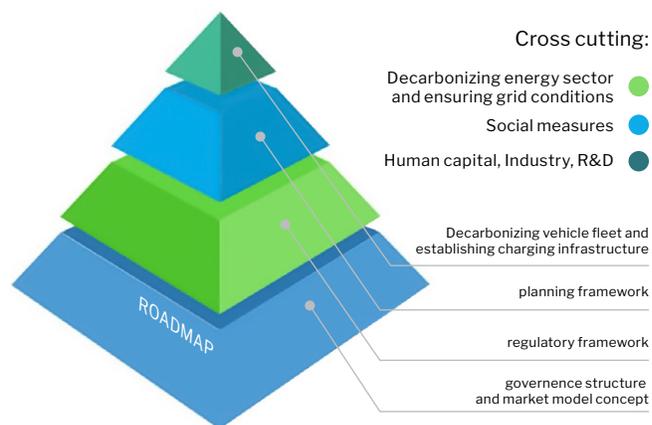


Figure 33 shows that absolute priority should be given to creating an institutional and regulatory framework. As describe in the scenarios, decarbonization of the vehicle fleet should involve decarbonization of the bus, truck, and passenger vehicle fleets. Installation of a sufficient number of charging stations must accompany an increase in EV uptake, which could require an increase in grid capacity. To prioritize the most important activities as defined under Chapter 6.2, they

are mapped against relative costs and benefits in Figure 34. The assumption is that activities that are expected to bring more benefits at lower cost should be prioritized.

The priority list highlights the activities that the government should focus on at this stage, but because the process is not sequential, activities can be performed in parallel. Still, best practice will be followed in establishing an effective governance framework and the market model and updating the regulatory framework in the early phase.

Activities that should be given priority in the current E-Mobility enabling environment in Serbia are prioritized in Table 25.

Figure 34: Cost and Benefits of priority transportation decarbonization activities

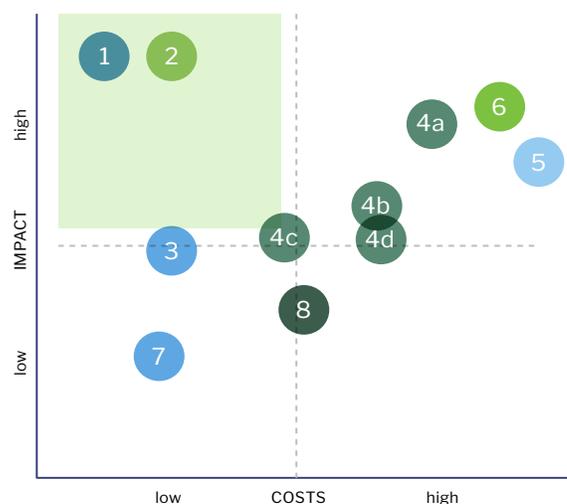


Table 25: Prioritized Activities

Priority	Activity name and number	Costs	Impact	Timeframe
CORE ACTIVITIES				
1	1) Establish governance structure and concept for the market model	Low	High	2024
2	2) Develop regulatory framework	Low	High	2024
3	3) Develop planning framework	Low	Medium	2024-25
4	4a) Support decarbonization of bus fleet	High	High	2024 start
5	4b) Encourage decarbonization of private cars	High	High	2024 start
6	4c) Support decarbonization of public fleets and freight transportation	Medium	Medium	2024 start
7	4d) Encourage deployment of charging network	High	Medium	2024 start
CROSS-CUTTING ACTIVITIES				
8	6) Decarbonize energy mix and ensure power grid adequacy	High	High	2024-30
9	5) Switch to electrified transportation modes (e.g., trams, rail)	High	High	2024-30
10	7) Implement social measures	Low	Low	2024-30
11	8) Strengthen human capital, industry, research and development	Medium	Medium	2024-30

In terms of vehicle fleet decarbonization, priority action 4 to 6 targets are defined according to the simulation scenarios, which is ambitious but considered feasible if the actions are initiated now. It assumes a 5 percent share of EVs and scrapping all vehicles with engines that do not meet Euro 4 standards by 2030. The strategy calls for simultaneously promoting EVs and increasing the share of renewable energy sources. It also states that priority should be given to the bus fleet, followed by the government fleet and city logistics. Given the ownership structure of bus operators, with private operators dominating, special attention should be paid to measures to promote private bus fleet modernization and electrification. Decarbonizing the passenger car fleet is essential but is expected to take longer to implement and depends more on external factors.

The cross-cutting themes are expected to be mainstreamed throughout all stages of the process. They are not a barrier to E-Mobility deployment at this stage but are necessary for ensuring sustainability and yielding extra benefits. They will be briefly described in the roadmap.

6.4. Roadmap structure

The roadmap is structured to help policy and decision makers accelerate E-Mobility. Each activity and activity group is described below through the following structure:

- Activity Name
- Current E-Mobility enabling environment
- Description of the activity and expected outputs
- Expected outcome
- Tentative costs
- Expected timing throughout the process
- List of actions for the specific activity, containing information on the purpose of each action, the action description, and the responsible authority

6.5. Detailed description of each activity

6.5.1. Establishing a governance structure and concept for the market model

Current condition: The responsibilities of the main stakeholders in deployment of E-Mobility are not defined, nor has a relevant working group been formed. Because the market model is not defined in existing regulations, no rules have been established regarding stakeholder responsibilities, market entry requirements, pricing strategy and models, or charging network deployment. With vague market entry requirements and no market model, which means that existing providers cannot collect charging fees directly, significant development of E-Mobility in Serbia is unlikely.

Activity description and expected output: The leadership role in pursuing the agenda is delegated to a specific stakeholder, the roles and responsibilities of all other stakeholders are agreed upon, and a working group comprising members of relevant entities is established. Accountability of the government is well defined. The concept of the market model is agreed upon based on best practice and EU regulations and adjusted to the local context. With the agreed-upon concept of the market model, the provisions can be incorporated into legal and regulatory framework.

Expected outcome: The expected outcome is stronger government leadership; a competitive, open E-Mobility market; and a maximized benefit of E-Mobility. Defined responsibilities across sectors and an established concept of the market model can ensure safe market activity, more-rapid market development, and a competitive market. An appropriate pricing framework can enhance the economic viability of market players while ensuring fair pricing and transparent services to

customers. Defining the approach to charging station deployment will enable charging infrastructure to correspond to and support a higher rate of EV adoption.

The agreed governance model must be incorporated into the national regulatory framework (primarily the Energy Law). A minimum list of definitions to be included in the legislation should be in line with the Proposal of the Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/COD).

Rough cost estimate: Low – should be done by the government bodies but if external support than mainly through legal and consultancy costs

Activity 1.1	Assign a leader and regulator for the E-Mobility agenda
Purpose	Institutionalize accountability for the E-Mobility agenda across government sectors.
Description	Designate a main authority to lead and coordinate E-Mobility efforts across sectors and a market regulator. Harmonize the work of the relevant authorities and ensure clear division of responsibilities according to their respective competences. Coordinate efforts to meet E-Mobility development and transportation decarbonization targets.
Responsible authority	Lead authority: Ministry of Energy and Mining Regulator: AERS For more details, see section 7.3.1.
Activity 1.2	Establish a working group for E-Mobility
Purpose	Ensure coordination across sectors and strengthen E-Mobility development through the strong consultative process.
Description	Guide and monitor developments related to E-Mobility. Ensure vertical and horizontal coordination across central and local governments and systematic and transparent E-Mobility deployment.
Responsible authority	Coordinator: Ministry of Energy and Mining Members of the working group (not limited to): Ministry of Construction, Transport and Infrastructure; Ministry of Environmental Protection; AERS; Ministry of Finance; representatives of local authorities as needed
Activity 1.3	Agree on concept of market model and approach to pricing and charging infrastructure deployment
Purpose	Increase competition and transparency and ensure safe market activity. Enhance economic viability of market players while ensuring fair pricing and transparent services for customers and clearly defined targets and basic concepts to guide deployment of charging infrastructure.
Description	Follow existing EU directives (mainly Alternative Fuels Infrastructure Directive (2021/0223/COD)) to ensure international interoperability and ease adoption of EU rules at a later stage. Clarify key tasks of and minimum requirements for market players and their relationships, based on European examples and suited to the Serbian regulatory and institutional framework. Agree on key definitions and criteria for obtaining an operator's license (e.g., requirements, verification, terms for revoking licenses). To enhance efficiency and ease market entry, consider separating E-Mobility services from energy trading. In line with the proposed separation of energy trading from E-Mobility services, an appropriate framework for pricing should be agreed upon to enable basic and advanced pricing methods. Consider different charges depending on time of day to minimize pressure on the grid.
Description	Agree on clear targets for deployment of publicly accessible charging infrastructure, in line with the Proposal on the Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/COD). Have EV fleet-based targets and location targets covering the road network and installation in buildings. The regulator should define minimum standards for deployment and construction of charging infrastructure in buildings, public roads, and other public places. The DSO should commit to developing a standardized process for charging station installation, including assessment of local access to the grid and standard grid development measures, and connecting charging stations to the grid. Once agreement is reached, the agreed-upon concept must be incorporated into the regulatory framework. For more details, see sections 7.3.1 (the market model), 7.3.2 (pricing strategy), and 7.3.3 (charging infrastructure deployment)
Responsible authority	Ministry of Energy and Mining through the working group, AERS

Timeframe: All pending activities that would lead to clear and effective institutional arrangements and governance structure should be completed within few months, certainly during 2024.

6.5.2. Developing an adequate regulatory framework

Current condition: The regulatory framework is insufficient for opening a new E-Mobility market. The most relevant EU directives have not been incorporated. The Energy Law contains the basic definitions, and although that is a good start, it is only basic and is insufficient to establish the desired governance structure, the market model, or environmental targets.

Description or output: The agreed-upon E-Mobility approach is incorporated. The regulatory framework is updated with all necessary elements for enabling an efficient E-Mobility market. The main EU documents that should serve as a basis for the proposed changes are presented in section 2.2. The absolute priority is activity 2.1, and subsequent priority activities are 2.2. to 2.4.

Expected outcome: Efficient, transparent, effective deployment of E-Mobility according to the predefined targets

Costs: Low, mainly consultancy and legal

Activity 2.1	
Update Energy Law - amendments and/or separate decree	
Purpose	Adjust according to best practices and EU directives to define stakeholders and the market model.
Description	This is the most critical activity under the E-Mobility agenda. At minimum, define the market model, roles and responsibilities of the main stakeholders, charging service market entry and exit requirements (licenses, permits), tariff policy (with special attention to use of smart solutions), pricing, billing system, technical requirements for charging stations, metering method and location, DSO's obligations to charging service providers, obligations of service providers, supervision. Some of these definitions will come from the administrator (Ministry of Energy and Mining) and some from the regulator (e.g., AERS) and should be referenced in the framework. A list of key terms to be defined should be based on international best practice and the EU framework; that is, a minimum list of definitions to be included in the legislation should be in line with the Proposal of the Regulation on the Deployment of Alternative Fuels Infrastructure (2021/0223/ COD) and the proposed governance and market model.
Responsible authority	Ministry of Energy and Mining
Activity 2.2	
Update Law on Road Traffic Safety and accompanying Rulebook on Classification and Registration of Vehicles	
Purpose	Exclude old, dangerously polluting vehicles from the vehicle fleet and encourage purchase of EVs.
Description	Supplement section on vehicle identification (vehicle type, e.g., battery electric vehicle, PFEV, hybrid, electric bicycles and scooters). Do not further delay enforcement of regulations on CO ₂ emission standards for vehicle registration, which should be aligned as much as possible with EU Regulation on CO ₂ Emission Standards for Cars and Vans (2019/631).
Responsible authority	Ministry of Internal Affairs
Activity 2.3	
Update Law on Planning and Construction	
Purpose	Simplify market entry for charging infrastructure.
Description	Incorporate relevant concepts from activity 1.3 related to defining requirements for deployment of charging stations for EVs. Consider applying the simplest possible procedures (with minimal technical and other requirements), which will stimulate investors. Consider applying solutions related to construction of buildings that do not require a building permit (Articles 144-146). For construction of new buildings, include a requirement for a minimum number of chargers or plugs to ensure sufficient capacity according to the number of residents and parking spaces.
Responsible authority	Ministry of Construction, Transport, and Infrastructure

Activity 2.4 Update Law on Public Roads	
Purpose	Ensure sufficient chargers throughout the network in line with best practices.
Description	Incorporate the concepts agreed upon under activity 1.3, particularly those related to the optimal number of chargers and electricity capacity throughout the national road network. Because charging stations for EVs are an integral part of the road infrastructure, they fall within the remit of the road manager (Public company Roads of Serbia), and this should be defined under the law. The law should also include a reference to clear guidelines for development of alternative fuel refueling infrastructure (including hydrogen) throughout the state road network and urban areas.
Responsible authority	Ministry of Construction, Transport, and Infrastructure
Activity 2.5 Update Law on Environmental Protection	
Purpose	Set CO ₂ standards for cars and vans in line with EU regulations (or close to).
Description	The EU regulation on CO ₂ emission standards for cars and vans should be included (2019/631).
Responsible authority	Ministry of Environmental Protection
Activity 2.6 Update Law on Waste Management	
Purpose	Define clear, strict rules for recycling and reuse of EV batteries.
Description	Expand definitions regarding waste treatment and management of EV batteries in accordance with European directives: Battery Directive (2006/66/EC); Waste Vehicle Directive (2000/53/EC); Draft Directive for the Improvement of Regulations for Batteries, December 2020.
Responsible authority	Ministry of Environmental Protection
Activity 2.7 Update Law on Public Procurement	
Purpose	Encourage procurement of cleaner vehicles.
Description	Establish criteria on energy efficiency and CO ₂ emissions in public procurement of vehicles and incentives for procurement of EVs. Refer to EU Clean Vehicles Directive (2019/1161). Strengthen incentive for utilization of green procurement approach.
Responsible authority	Public Procurement Office and Ministry of Finance

Timeframe: The most critical activity is amendments to the Energy Law. The next priority should be amendments to the Law on Planning and Construction and the Law on Road Traffic Safety and the accompanying Rulebook on classification and registration of vehicles (activities 2.2 and 2.3). Amendments to these three laws should be prioritized and update process should be completed during 2024. All other laws should be amended as soon as possible, either in parallel or shortly after the three priority ones are updated.

6.5.3. Developing an adequate planning framework

Current condition: Serbia has no planning or strategic framework for defining national E-Mobility policy and targets.

Description or output: Relevant strategies and plans updated to include E-Mobility and adopted. Stakeholders monitoring coordinated and focused efforts to achieve targets.

Expected outcome: Efficient, effective deployment of E-Mobility through actions coordinated across sectors to achieve defined targets.

Costs: Low, mainly consultancy and legal

Activity 3.1 Integrated National Energy and Climate Plan and Action Plan for Energy Transition	
Purpose	Define aspects relevant for energy sector decarbonization and transportation electrification.
Description	In addition to energy-related topics such as decarbonization of the energy mix and energy efficiency, the plan should address low-emission mobility, including transportation electrification.
Domestic and EU reference documents	Energy Development Strategy, Sustainable Urban Development Strategy until 2030 European Low-Emission Mobility Strategy (2016/501/COM), European Green Deal (2019/640/COM), New Industrial Strategy for Europe (2020/102/COM)
Responsible authority	Ministry of Energy and Mining
Activity 3.2 Action Plan for the Energy Development Strategy until 2025 with projections until 2030	
Purpose	Include elements relevant for E-Mobility such as market development and incorporation of alternative fuel regulations into national legislation.
Description	Include actions that will support the adopted market model and incorporate the alternative fuel directive. Improving conditions for operation of alternative fuels infrastructure, developing the E-Mobility market in terms of sustainable energy use and improving the transmission and distribution network management systems, which should ensure optimal integration of EVs into the national energy system.
Domestic and EU reference documents	The Energy Development Strategy until 2025, with an projections until 2030; National Energy and Climate Plan European Low Emission Mobility Strategy (2016/501/COM), European Green Deal (2019/640/COM), New Industrial Strategy for Europe (2020/102/COM), and other relevant EU directives
Responsible authority	Ministry of Energy and Mining
Activity 3.3 Action Plan for the Sustainable Urban Development Strategy until 2030	
Purpose	More thorough elaboration of aspects relevant for E-Mobility such as inclusion in sustainable mobility plans, deployment of charging stations, transition to public transportation, modernization of transportation fleets.
Description	Include activities related to development of infrastructure for non-motorized mobility, modernization of public transportation fleets, taxi transportation, and municipal fleets (e.g., relevant authorities, public utility enterprises). Set realistic and bold targets for such transition.
Domestic and EU reference documents	Sustainable Urban Development Strategy until 2030; Energy Development Strategy; National Energy and Climate Plan European Low Emission Mobility Strategy (2016/501/COM), European Green Deal (2019/640/COM)
Responsible authority	Ministry of Construction, Transport, and Infrastructure
Activity 3.4 Strategy for development of rail, road, water, air, and intermodal transportation – expired	
Purpose	Include the approach to E-Mobility in the strategy and shift to electric transportation.
Description	Define goals for sustainable transportation systems development in all modes of transportation; principles of safety, efficiency, and rational use of resources; encouragement of low-emission mobility and environmental protection. Address E-Mobility goals described herein and targets of the transition to electric transportation.
Domestic and EU reference documents	Existing strategies for transportation sector, programs, action plans; National Energy and Climate Plan European Low Emission Mobility Strategy (2016/501/COM)
Responsible authority	Ministry of Construction, Transport, and Infrastructure
Activity 3.5 Waste management strategy until 2031	
Purpose	Strengthen targets related to recycling and reuse of EV batteries.
Description	Amendments to the law should address end-of life EV batteries, with emphasis on reuse and recycling and raising targets for waste collection.
Domestic and EU reference documents	European Green Deal (2019/640/COM), New Industrial Strategy for Europe (2020/102/COM)
Responsible authority	Ministry of Environmental Protection

Timeframe: Updating the planning framework can start immediately. Depending on the length of the consultative process, it is expected that all these documents will be updated within a year.

6.5.4. Decarbonizing bus fleet

Current condition: More than 10 percent of buses do not meet Euro 1 emission standards, meaning that they do not have catalytic converters and DPFs. In addition, nearly 60 percent of registered buses do not meet the Euro 5 emission standard. There is no incentive program for e-buses, and the public service contract is not designed to support vehicle fleet renewal.

Description or output: Significant modernization of the bus fleet and replacement of old with more environmentally friendly modes of transportation supported by appropriate regulations and coupled with an effective incentive program.

Expected outcome: Less pollution and noise, greater livability, and better health.

Costs: High, minimum €101 million cumulatively by 2030 (~12.6 million annually over 8 year period) to cover costs of the incentive program that should enable targets set in Scenario 4 to be reached. The scenario assumes a 5 percent share of e-buses in the total fleet and replacement of Euro 3 buses and under with Euro 4 buses and up. The proposed incentives are based on practices across the European Union and local purchasing power and are not overly ambitious. They include subsidies for purchasing new vehicles and retrofitting old buses and converting them to CNG or electric and tax benefits. The eventual reduction in revenues from taxes is not accounted for. Incentives should be combined with extended public service contracts to enable longer loan repayment periods for private companies and thus make this goal more feasible.

The incentive scheme can be gradually relaxed as the number of buses approaches the targets. Detailed assumptions and calculations behind the proposed incentive program are given in section 5.2.1

Activity 4.1		Extend public service contracts to a period of 12 to 15 years and include a clause on greening the fleet that also applies to public operators
Purpose	With their contracts extended, private operators will have more funds available for procuring EVs. The clause on greening the fleet by 2030 is expected to increase the number of vehicles with higher emissions standards and EVs. Public operators should commit to the same targets.	
Description	Extend duration of public service contracts from 5 to 7 years to 12 to 15 years. In financial terms, the annual effects of this measure should be similar to those of a conventional loan for the purchase of a Euro 6 diesel or CNG bus. Longer contracts would provide certainty on the return of investments and justify higher expenditures for electric and modern busses. When bidding for a public transportation service contract, a private operator will commit to having a minimum 5% share of e-buses and up to an 80% share of buses that meet Euro 6 emission standards or CNG by 2030. ^a Public transportation operators would have to meet the same requirements on fleet composition.	
Responsible authority	Local governments	
Activity 4.2		Introduce incentives for fleet modernization and retrofitting program
Purpose	Stimulate the transition to e-buses and replacement of old vehicles.	
Description	<p>The incentive program as described in section 5.2.1 proposes:</p> <ul style="list-style-type: none"> • 15% subsidy for purchasing e-buses • 10% subsidy for retrofitting existing buses to e-buses or CNG buses • 10% subsidy for purchasing CNG buses • Progressive motor, registration, and import tax reduction based on CO₂ emissions • Progressive value-added tax reduction rate based on CO₂ emission reduction • Electric bus charging station procurement and installation subsidy, based on charging capacity, and combined with vehicle purchase 	

Responsible authority	Ministry of Finance, local governments
Activity 4.3	Optional: Procurement of e-buses through government programs or initiatives
Purpose	Economy of scale - larger volumes of procurement should lead to a lower price per bus, better maintenance, and extended warranty.
Description	The government procures buses on behalf of interested parties for a country-wide program. Buses will be delivered to operators who apply for the program, who will pay the vehicle price minus the amount deductible under incentive and tax schemes. Procurement of a large number of buses should lead to a cheaper price per unit, larger maintenance capacities, and better contractual conditions including extended warranty. A uniform approach across the country should facilitate transfer of knowledge.
Responsible authority	Ministry of Finance, local governments
Activity 4.4	Optional: Introduce e-bus leasing companies
Purpose	Reduce the capital cost of new CNG buses and e-buses and transfer maintenance services to leasing companies.
Description	The government should offer interest-free loans for financing large, financially stable leasing companies. Many private operators employ a small number of maintenance workers; maintenance contracts will help them cut capital and operating costs without jeopardizing transportation safety.
Responsible authority	Local governments

a. The typical cost of a Euro 6 bus is €250,000 and of an e-bus is €550,000.

Timeframe: All activities can start within a year, programmed for eight-year period. Depending on interest, the incentive program could be updated within this period.

6.5.5. Decarbonizing passenger cars

Current condition: The passenger car fleet is 15 years old on average, with a high proportion of vehicles with engines that do not meet Euro 4 emission standards. With the forecast growth in number of cars, the passenger car fleet will pose serious health threats if they all have internal combustion engines.

Description or output: Scenario 4 (Balanced) assumes fleet modernization that will result in 5 percent share of EVs by 2030 and significant restructuring of the vehicle fleet composition. The subvention program currently actual in the country cannot be expected to lead to a significant change as described in section 5.2.2. A mix of a moderately ambitious incentive program and proper market regulation could lead to full renewal of the passenger vehicle fleet. To achieve a 5 percent share, the budget for subsidies and retrofitting must be substantially increased. Based on the incentives offered across the European Union, subsidies for BEVs should be increased, subsidies for companies and individuals should be equalized, and taxes should be reduced. Details of the basic implications of Scenario 4 and the incentive program calculation and proposal are presented in section 5.2.2.

Expected outcome: Less pollution and noise, greater livability, and better population health.

Costs: High, €110 million cumulatively by 2030 (~€13.5 million annually assuming eight-year program) to finance the incentive scheme.

Activity 5.1	Increase subsidies for purchasing EVs and fleet renewal
Purpose	Accelerate replacement of old cars with Euro 4-plus standard vehicles and EVs.
Description	<p>Increase state subsidies for purchase of BEVs. Keep the same subsidy for HEVs. In parallel, a smaller budget for subsidies should be introduced for the purchase of new Euro 6 vehicles. Subsidies for companies and individuals should be equalized, with the exception of taxi services. Additional support for replacing old vehicles under Euro standards and buying Euro 4-plus vehicles should be provided through interest-free loans. With the number of vehicles increasing, consider withdrawing subsidies for HEVs and Euro 6 vehicles.</p> <p>Summarized incentive program for passenger cars is given below:</p> <ul style="list-style-type: none"> • €8,000 for new BEV passenger cars and vans • €4,500 for new PHEV and REEV passenger cars and vans • €2,500 for new hybrid electric passenger cars and vans with emissions up to 140 g of CO₂/km • €1,500 for new Euro 6 vehicles and for retrofitting cars with engines below Euro 4 emission standards • Maximum 50% or €200 subsidy for purchase and installation of home chargers • Targeted maximum €20,000 charging station procurement and installation subsidy for taxi fleets • Tax on vehicles based on amount of pollution, mostly CO₂ emissions, rather than the engine size • Exemption of BEVs from registration, road, and import taxes • Reduction in transfer tax for private vehicle owners for scrapping units that do not meet Euro 3 standards • Interest-free loans of up to €3,000 for purchase of vehicles that meet Euro 4, 5, and 6 emission standards and EVs to people scrapping vehicles that meet Euro 3 and lower emission standard • Strict technical inspection for annual registration renewal • The detailed subsidy scheme and calculations behind it are presented in section 5.2.2.
Responsible entity	Ministry of Finance
Activity 5.2	Strict technical inspection for annual vehicle registration renewal
Purpose	Accelerate replacement of old cars with Euro 4-plus and EVs.
Description	Rigorously enforce existing regulations and amend them to be more in line with EU regulations.
Responsible entity	Ministry of Internal Affairs
Activity 5.3	Encourage companies to renew their fleets.
Purpose	Accelerate replacement of old cars with Euro 4-plus and EVs.
Description	<p>Private companies should be offered the same subsidy scheme as presented in activity 5.1, with the exception of taxis. Taxi service subsidies for BEVs should be at least €9,000. The government agency or office responsible for the vehicle fleet should restrict future public procurement to EVs and Euro 6 vehicles. A similar requirement should be applied to local governments and public companies and national and local level.</p> <p>Tax benefits for companies that purchase new EVs or Euro 6 vehicles.</p>
Responsible entity	Ministry of Finance
Activity 5.4	Optional: Help car rental or leasing businesses modernize their fleets.
Purpose	Accelerate replacement of old cars with those meeting Euro 4-plus standards and EVs.
Description	Financial subsidies and soft loans for purchasing new EVs, as mentioned under activities 5.1. and 5.3.
Responsible authority	Ministry of Finance

Timeframe: The incentive program could be updated within a year projected to last for 6 to 8 years. It could be adjusted after several years, depending on its success.

6.5.6. Decarbonizing freight (including urban logistics)

Current condition: Freight companies, including urban logistics companies, use old vehicles. Some urban delivery companies have replaced some of their vehicles with e-bikes and e-vans. There is no focused government support program.

Description or output: A mix of an incentive program and appropriate market regulations will lead to modernization of the truck fleet and replacement of vehicles with more environmentally friendly vehicles. A fleet of 292,495 vehicles of all kinds will be in operation in 2030 in interurban, urban, and suburban areas. Development of a targeted subsidy scheme for electrification of high-mileage vehicles, including fleets of taxi companies, urban logistics companies, and central and local governments, can significantly increase the number of EVs, and electrification of a relatively small number of vehicles can improve air quality. The main assumptions behind the proposed action are given in section 5.2.3.

Expected outcome: Less pollution and noise, greater livability, better population health.

Costs: Medium, An incentive program for replacing old vehicles. Based on the available case studies, a scheme offering €5 million over the next several years should be sufficient to start.

Activity 6.1 Subsidies for freight companies including city logistics and taxis	
Purpose	Accelerate replacement of old vehicles.
Description	<p>The incentive program includes:</p> <ul style="list-style-type: none"> • €8,000 subsidy for new battery electric vans up to 2.5 tonnes for companies active in urban logistics or related services • €12,000 subsidy for new battery electric vans above 2.5 tonnes for companies active in urban logistics or related services • €500 to €1,000 subsidy for new commercial e-cargo bikes • Targeted maximum €20,000 charging station procurement and installation subsidy based on charging capacity at logistics companies' depots when combined with vehicle purchase and after a certain number of EVs in the company fleet • Subsidies for expanding production local (cargo) e-bike manufacturing.
Responsible authority	Ministry of Finance

Timeframe: The program could within a year and last for 6 to 8 years. Depending on its success, it could be adjusted during implementation.

6.5.7. Deploying charging network

Current condition: There were an estimated 52 electric chargers in Serbia in 2021. While the number increased since then, there are no national targets or requirements for charging infrastructure deployment, which has limited installation of appropriate charging network, slowing EV uptake.

Description or output: A sufficient number of charging stations installed and number of BEVs increased.

Expected outcome: Less pollution and noise, greater livability, and better population health. An adequate network would be essential in providing a base for market development.

Costs: High

Activity 7.1 Subsidies for charging station deployment	
Purpose	Establish a solid charging network across the country to facilitate EV adoption.
Description	<p>Introduce subsidies for deployment of public charging stations covering purchase and installation costs: maximum €10,000 or 30% for an alternating current charging station and €20,000 or 30% for a direct current charging station</p> <p>Introduce maximum 50% or €200 subsidy for purchase and installation of a home charger.</p> <p>Introduce maximum 50% or €400 subsidy for purchase and installation of workplace chargers with multiple connectors.</p> <p>Optional: Offer additional corporate tax deduction for installation of public and private charging stations.</p>
Responsible authority	Ministry of Finance

Timeframe: The program should start immediate upon update of relevant regulatory and strategic documents, and last for 6 to 8 years. Depending on results, it could be adjusted during implementation.

6.5.8. Implementing social and awareness raising measures

Current condition: Not all benefits of EVs are known, and the common understanding is that they are too expensive for the average household. There is no national promotion program raising E-Mobility awareness in Serbia, and social awareness of E-Mobility is still at an early stage.

Description or output: Targeted awareness raising and outreach campaigns should be implemented continuously. Campaigns should focus on promoting E-Mobility among citizens, highlighting the environmental and economic potential and social benefits and making entering the E-Mobility market attractive to a larger pool of potential customers. Moreover, E-Mobility -related services can become profitable business opportunities, enhancing the attractiveness of spreading E-Mobility. Special focus should be on introducing E-Mobility at touristic sites and natural parks and resorts.

Expected outcome: Better environmental and population health. Citizens have been making environmentally aware purchasing decisions, with clear understanding of their role in protecting the environment. Public opinion has been shifting in favor of EVs, resulting in more EVs being sold (new and used). Not only will electrified fleets at touristic and natural resort locations serve as promoters of E-Mobility, but visitors to popular tourist sites will also have the opportunity to see E-Mobility solutions at those locations and thereby obtain a better perception and understanding of E-Mobility.

Costs: Low – would maybe support awareness-raising campaigns and outreach campaigns based on international experience. For the initial phase, €1-1.5 million over a few-year period would suffice.

Activity 8.1 Social and awareness raising measures	
Purpose	Raise awareness of green vehicles and renewable energy to encourage environmentally aware purchasing decisions.
Description	<p>Awareness raising and outreach campaigns on green vehicles and renewable energy at all levels. Better understanding of the role and importance of EVs in terms of efficiency, economy, environmental protection, and human health. Some possible measures:</p> <ul style="list-style-type: none"> • Launch targeted, data-based (using profiling) social media and billboard campaigns (especially in urban areas and along highways) highlighting potential environmental and economic benefits of E-Mobility.

Activity 8.1 Social and awareness raising measures	
Description	<ul style="list-style-type: none"> • Visible marking/labelling government EV fleets and urban logistics and public transportation EVs to increase visibility of E-Mobility. • Increase visibility of charging stations across the country, such as green paint in parking lots and well-designed, appealing charging stations. • Introduce green license plates for BEVs, PHEVs, REEVs, and FCEVs to make them distinct and more visible. • Conduct awareness-raising and professional conferences, technical fairs, and expositions on E-Mobility -related topics. • Promote E-Mobility in tourist areas and environmental protection areas, highlighting the environmental benefits of spreading E-Mobility primarily through information points and stands, events, and EV renting opportunities, with the help of the Ministry of Trade, Tourism, and Telecommunications
Responsible authority	Various: Ministry of Environmental Protection; Ministry of Energy and Mining; Ministry of Construction, Transport, and Infrastructure; Ministry of Trade, Tourism, and Telecommunications

Timeframe: The program should start immediately and last for 6 to 8 years. Should be revised every few years and adjusted or extended as it shows needed.

6.5.9. Investing in human capital, industry, and research and development

Current condition: Familiarity with E-Mobility within academia and businesses is still low.

Description or output: Support innovative projects and research and development of EV-related industries. Line ministry programs should include projects for development of innovative and sustainable entrepreneurship, the ecosystems, the industry, and innovation infrastructure for projects related to E-Mobility , with grants to support and promote the transition to electric transportation. Consider providing stronger support to local companies producing EVs and e-bikes.

Expected outcome: Strengthen human capital and create new modern businesses.

Costs: Low, based on international experience, for initial research and start up activities, €1 million to €1.5 million should suffice.

Activity 9.1 Intensify research programs on E-Mobility , innovation, entrepreneurship, and competitiveness and support the industry	
Purpose	Strengthen human capital and create modern businesses.
Description	<p>Some possible activities include:</p> <ul style="list-style-type: none"> • Establishing a smart city research center • Initiating and designing upskilling programs for car mechanics to build competency in repairing EVs and reusing batteries, with involvement of local and international market players (e.g. EV dealers and original equipment manufacturers) and professionals to design a curriculum in line with industry standards and quality requirements • Introducing E-Mobility into curriculums of relevant universities, such as electrical engineering, automotive engineering, urban planning, and transportation engineering • Initiating E-Mobility -related research and development activities at universities and research institutes in collaboration with local and international industry players, including those participating in battery reuse and recycling. • Initiating a program for funding Serbian industry, start-ups, and small and medium-sized enterprises (planning to be active) in the E-Mobility market
Responsible authority	Ministry of Education, Science, and Technological Development

Timeframe: The program should start immediately and continue over years. Should be revised every few years.

6.5.10. Shifting to electric transportation modes (rail, trams, trolleybuses, e-bikes)

Current condition: Road transportation is the dominant mode of transportation in Serbia. Only a few cities have trams; the rest rely on bus fleets. Rail covers a small share of transportation.

Description or output: Improve railway services and electrify rail lines. Once performance is improved, promote trains as an environmentally friendly transportation mode. Promote the transition to public transportation in urban areas. Assess whether there is potential to introduce more tram lines.

Expected outcome: Less pollution and noise, greater livability, and better population health.

Costs: High - substantial infrastructure investments required for railway modernization and deployment and extension of tram lines. Public transportation services must be revisited, and service must be improved and adjusted to user needs.

Activity 10.1 Promote and electrify suburban railway system	
Purpose	Support shift to greener transportation modes.
Description	Reconsider opportunities for electrification of main corridors and enhancement of railway within urban areas (e.g., Belgrade, Niš, Novi Sad).
Responsible authority	Ministry of Transport, Construction, and Infrastructure
Activity 10.2 Extend urban railway systems	
Purpose	Support shift to greener transportation modes.
Description	Extension or re-deployment of tramway network could be assessed for cities where economically justifiable (e.g., Belgrade, Kragujevac, Paraćin-Čuprija-Jagodina linear corridor, Niš, Novi Sad, Subotica)
Responsible authority	Ministry of Transport, Construction, and Infrastructure
Activity 10.3 Finalize sustainable mobility plans	
Purpose	Support shift to greener transportation modes.
Description	Cities should complete sustainable mobility plans or modify existing plans to determine feasibility and viability of shifting to public transportation and increasing E-Mobility. Cities will harmonize plans with the national strategy and coordinate financial shares at the local and national levels.
Responsible authority	Ministry of Transport, Construction, and Infrastructure
Activity 10.4 Support public transportation	
Purpose	Support transition to greener transportation modes.
Description	Reassess public transportation services and adjust to user needs. Increase level of service and promote public transportation. Discourage use of private vehicles where high-quality public transportation is available.
Responsible authority	Local governments

Timeframe: These activities will take a long time to implement but preparatory planning activities should start immediately.

6.5.11. Decarbonizing electricity generation and ensuring power grid adequacy

Current condition: Less than one-third of total electricity generation is from renewable sources. Although some decarbonization measures have been introduced (e.g., green premiums), Serbia did not achieve its renewable energy targets for 2020.

Description or output: Spreading of E-Mobility and decarbonization should be parallel goals in every country and require synchronized measures. Mass EV adoption and decarbonization of electricity generation according to the renewable energy directive will require significant commitment from the government and the energy sector. Consequently, an updated, comprehensive decarbonization strategy, including E-Mobility development, is needed to maximize the benefits of E-Mobility adoption.

To allow for a large increase in EVs, the grid must be upgraded. The companies involved in charging infrastructure deployment highlight that finding a suitable location with sufficient energy supply for charging stations is complicated. In the absence of up-to-date information on grid conditions, it is difficult to evaluate grid adequacy. First, grid conditions must be comprehensively evaluated, and a progress report on the 2016 Energy Sector Development Strategy must be written. Then, a comprehensive grid development strategy must be developed in accordance with the E-Mobility and decarbonization strategy targets. In the medium term, pilot projects on smart charging, including bidirectional charging, must be implemented to prepare the grid for large-scale uptake of EVs.

Expected outcome: E-Mobility uptake and decarbonization acting as interactively accelerating forces. The grid is adequate and flexible to accommodate a higher rate of EV uptake. As the share of green energy increases, decarbonization becomes the key benefit of E-Mobility, and E-Mobility supports decarbonization.

Costs: High

Activity 11.1 Decarbonize the energy mix	
Purpose	Green the energy mix.
Description	Develop a plan or strategy to ensure that decarbonization goals by 2030, as described in the EU Renewable Energy Directive and including a 40% (up from 32%) share of renewable energy in gross final electricity consumption and a 13% share of renewable energy in transportation, are met.
Responsible authority	Ministry of Energy and Mining
Activity 11.2 Ensuring power grid adequacy	
Purpose	Create an environment that will enable installation of a charging network across the country to allow for greater EV adoption.
Description	<p>Comprehensively evaluate distribution grid conditions to obtain up-to-date information on capacity for accommodation of the charging infrastructure and additional renewable sources.</p> <p>Develop a grid development strategy considering previous reports and in accordance with planned E-Mobility and decarbonization strategies. Consider including at least the following definitions in the decarbonization framework and the grid development strategy: smart metering system, smart charging, bidirectional charging.</p> <p>Pilot and introduce time-based incentives for EV charging to motivate end users to charge their vehicles when the share of renewable energy in the electricity mix is at its daily peak.</p> <p>In the medium term, develop a regulatory and technical framework and launch pilot projects for controllable home and public charging solutions, including smart charging and bidirectional charging to balance electricity demand at peak times.</p>
Responsible authority	Ministry of Energy and Mining

6.6. Roadmap summary

Table 34 is a comprehensive list of all activities and the timeline. Not all activities are equally important at this stage. The most critical ones are marked green. All these activities except 1 and 2 are expected to continue, so only the time when an activity should start or be conceptualized is marked; arrows indicate they will continue until 2030.

Table 26: Roadmap summary – list of all activities and timeline

No.	Activity or action	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Establishing a governance structure and concept for the market model									
1.1	Designate leader and regulator for E-Mobility agenda									
1.2	Establish working group for E-Mobility									
1.3	Agree on concept for market model and approach to pricing and charging infrastructure deployment									
2	Developing an adequate regulatory framework									
2.1	Energy Law									
2.2	Law on Traffic Safety and Rulebook on Classification and Registration of Vehicles									
2.3	Law on Planning and Construction									
2.4	Law on Public Roads									
2.5	Law on Environmental Protection									
2.6	Law on Waste Management									
2.7	Law on Public Procurement									
3	Developing an adequate planning framework									
3.1	Integrated National Energy and Climate Plan and Action Plan for Energy Transition									
3.2	Action Plan for Energy Development Strategy									
3.3	Action Plan for Sustainable Urban Development Strategy									
3.4	National Multimodal Transport Strategy									
3.5	Waste Management Strategy									
4	Decarbonizing bus fleet									
4.1	Extend public service contract to a period of 12-15 years and include a clause on greening the fleet									

7. Conclusion and Final Recommendations

Serbia is at the beginning of its decarbonization journey. The challenges are excessive reliance on fossil fuels, especially coal in electricity generation; the abundance of old vehicles with high emissions and poor fuel economy; and the decreasing popularity of public transportation.

The obsolete fleet is unevenly represented throughout Serbia. Almost 96 percent of passenger cars did not meet Euro 6 emission standards in 2019. The situation in Belgrade is somewhat better but still unsatisfactory, with 82.7 percent of passenger cars not meeting Euro 6 standards. In 2018, the dominant means of urban public transportation in 50 cities was buses, of which 90.2 percent were powered by Euro diesel. Electricity generation in Serbia relies up to 50 percent on coal-fired thermal power plants, with 13 percent from renewable sources such as hydroelectric, wind, and solar. The national power utility company Elektroprivreda Srbije, which dominates the electricity market, owns all large generation facilities, with a share of 97 percent.

If deployed well, E-Mobility can contribute to decarbonization. In addition to reductions in local air pollution and GHG emissions, greater E-Mobility uptake would have additional benefits, such as less noise and pollution, grid balancing, and greater energy efficiency of the transportation sector. Considering the age of Serbia's fleet and the desired decarbonization targets, E-Mobility can help the country reach these goals, although given the energy mix, it should be deployed carefully, and pricing and charging strategies should be adjusted to yield maximum benefit.

E-Mobility practices in the European Union and neighboring countries were assessed and presented. The status of the most relevant E-Mobility enablers in Serbia was analyzed, and main constraints were identified. Based on market characteristics, various vehicle fleet decarbonization scenarios were assessed, and those that are most realistic for Serbia were selected to set targets for the proposed roadmap. In addition, following relevant EU directives and the local context, solutions for governance structure and the market model, including pricing and a charging strategy, were proposed. Finally, these recommendations were structured in the form of a roadmap that could be easily followed.

The report was prepared in 2022. While certain advancements have been made, all proposed activities and targets are still relevant and should be addressed to create flourishing transportation decarbonization and electrification ecosystem. To achieve the targets, the government of Serbia should immediately begin to define and regulate the E-Mobility market and increase the budget and scope of the subsidy program (including incentive programs for buses and logistics companies). In addition to the potential to reduce air pollution and improve livability, E-Mobility can provide benefits such as job creation in new businesses and research and innovation, although there are several challenges such as the coal-dominated energy mix, overall cost of EVs, stability of electricity prices, and the environmental impact of the E-Mobility lifecycle, for example, recycling old batteries. A SWOT analysis revealed that the E-Mobility market in Serbia is in the early stages of development and that there are various opportunities if E-Mobility is properly and systematically deployed and identified challenges are addressed in a timely manner.

At the time of this report, a governance structure and market model have not been established. No planning or strategic framework for the national policy has been established in terms of setting national targets for E-Mobility. The regulatory and legal framework is insufficient for the opening of a new electrified transportation market. The relevant EU directives have not been fully incorporated into national legislation. Research and scientific innovation projects are at an early stage of development. Training of personnel working with E-Mobility has not begun, and relevant educational programs have not been added to school curriculums. (Only the School of Electrical Engineering, University of Belgrade, has study modules addressing this matter under doctoral studies.)

An incentive program is in place but is not ambitious enough and does not have clear targets, but given its early stage of development, Serbia can learn from examples of other countries and adjust the market model, which will ensure maximum benefit from E-Mobility. Moreover, pricing and charging strategies can be adjusted to have a minimal negative impact to the grid, in particular given a high proportion of fossil fuels in the energy mix.

The roadmap is structured to help staff in relevant ministries and local authorities accelerate deployment of E-Mobility. An appropriate set of measures, typically input values, expected benefits, and appropriate timeframes, accompany each activity described. The roadmap proposes a timeframe for implementing the proposed activities based on the current situation and the level of internal capacity. Indicative costs are provided as well. Cost estimates show that the budget for the incentive programs must be substantially increased and the scope extended to drive decarbonization of transportation and adoption of EVs, including cars, buses, and trucks. Measures contained in the roadmap are grouped as follows: governance structure and selecting the market model; regulatory framework update; planning and strategic framework update; actions to promote decarbonization and electrification of cars, buses, and trucks; and deployment of a charging infrastructure network. The roadmap also addresses cross-cutting issues and proposes measures on social and public awareness; human capital, research and development, and technology; and the energy mix and adequacy of grid capacity. To update the regulatory framework, the roadmap identifies relevant laws that must be amended and maps out activities for the planning and strategic framework.

The immediate priority is to define the governance structure and the market model and incorporate them into national legislation. A properly designed market model would create clear definitions of roles, relations among sector players, responsibilities, and market entry and exit requirements, and as such will enable creation of a competitive and transparent environment that will ultimately make EVs affordable to many citizens. In parallel, the budget for supported incentive programs should be increased and principles clearly defined. Although all types of EVs should be supported, the primary focus and substantial resources should be dedicated to BEVs. The incentive programs should target renewal of the bus fleet as the area that could yield the maximum benefit. The government could consider having an umbrella program for renewing the bus fleet. Subsidies for passenger cars should continue and increase. Incentives for individuals and companies should be equalized, with the exception of taxi companies. Incentives should be offered for e-buses and e-trucks. The incentive programs should also include support for replacement of vehicles with emission standards of Euro 4 and below with vehicles with engines with higher emission standards. Incentives should correspond to clearly set targets (e.g., as defined under Scenario 4) and be regularly monitored. To facilitate EV adoption, a charging network should be developed as the number of EVs increases. Grid decarbonization should be synchronized with the increase in EV uptake. Human capital should be improved, research encouraged, and industry development accelerated.

The transportation decarbonization and E-Mobility development program is an ongoing, continuous, reversible process. The proposed roadmap envisages that, by 2030, Serbia will reach a 5 percent share of EVs while the number of vehicles with Euro 3 and below emission standards will be significantly reduced. It is reasonable to expect that a wave of new battery technologies will combine with rapidly growing hydrogen technology and enhanced combustion engines. To achieve the projected decarbonization targets, action should be taken right away. The decision on the governance structure and the market model should be made immediately. The complete process of incorporating selected approach into national legislation could be done within 6 months up to a year. The incentive scheme for passenger cars, buses, and trucks should be introduced aggressively and immediately. The tariff system should be carefully designed to limit damage from an increase in generation of electricity. If all activities are implemented as suggested, the expected benefits of the proposed actions will outweigh the cumulative estimated costs.

A Pathway to Decarbonization of the Vehicle Fleet in Serbia and the Role of Electric Mobility

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