

ELECTRIC VEHICLES AND CHARGING INFRASTRUCTURE IN NORTH MACEDONIA: TENDENCIES AND CHALLENGES

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Abstract

This paper aims to analyze the transition of the automotive sector in North Macedonia, focusing on the increasing use of electric vehicles (EVs) and the associated challenges. In this context, a comprehensive analysis of the number of EV registrations in North Macedonia over a specific period is conducted, including their growth and the factors influencing this evolution.

Additionally, the EV charging infrastructure and the challenges involved in providing a sustainable and efficient infrastructure to support the use of these vehicles are examined. Beyond the technical and infrastructural aspects, the economic and environmental impact of EV use in the context of North Macedonia is investigated. A qualitative approach also encompasses the analysis of consumer perceptions and expectations regarding EVs and their influence on purchase decisions.

With such an encompassing analysis included in our study, we aim to provide a clear definition of the processes and challenges of EV adoption in North Macedonia, identifying opportunities for further development and necessary improvements in infrastructure and government policies.

Keywords: Electric Vehicles (EVs), charging infrastructure, environmental impact, economic implications.

1. Introduction

The challenges in the automotive sector are deeply associated with the need to address climate change. The transport sector has become of great interest recently as countries try to reduce the registration of the number of vehicles with internal combustion engines as much as possible. These challenges have committed to international climate agreements, aiming to reduce greenhouse gas emissions and enhance climate resilience. As part of these efforts, the promotion of sustainable transportation, including the adoption of electric vehicles (EVs), has become a critical component of the national climate strategy. Electric vehicle developments in developing countries, together with more developed economies where declared policies were initiated earlier, are of particular interest.

The use of EVs and the installation of related charging infrastructure can contribute to decreasing the negative effects induced by the transportation sector. EVs can ease air pollution, reduce dependence on imported oil, and allow larger exploitation of local renewable energy resources [1]. The possibility of using electrically-charged higher levels of vehicle automation and connectivity has also captured the attention of various stakeholders. Due to these considerations, the development of the EV market represents the focus of research activities in many countries. At the same time, national governments and local authorities are designing and implementing effective measures to foster the market for electrically charged vehicles.

The development of the electric vehicle (EV) market may greatly influence the transportation sector electrification. To obtain insights useful for designing effective policies, it is essential to observe real-life processes related to the establishment and development of the EV market.

The present paper addresses the application of EVs in traffic and EV charging points in North Macedonia. The analysis includes various timeframes, which provide insights within different developmental stages of the considered electric vehicle market.

2. Increase of electric vehicles in North Macedonia

The increased use of a private car is a major contributor to air quality problems and global climate change. The mobility has increased and it has had a negative impact on the quality of life of others.

Our transportation system is not on a sustainable path. Sustainable transportation strictly means a full concentration on measures aimed at avoiding long-term damage, although there is a good reason to adopt a definition that includes short-term disturbances to nature as well as negative effects on human health.

The countries of the Western Balkans, including North Macedonia, are struggling with the problem of pollution, and hence one of the possible measures in that struggle is the renewal of the vehicle fleet and the application of EVs. The transition to clean energy in the transportation sector is based on the use of electricity as a main fuel. As EVs become more widely used, the greenhouse gas emission is expected to fall.

This study shows the increase of electric vehicles registered in North Macedonia over the past decade. In 2012, there were only 7 registered EVs in the country, but by 2022, this number had grown to 476 [7]. From where the largest number is only in some municipalities: Kumanovo (32), Prilep (24), Bitola (18), Stip (13) and Ohrid (11). And of course, Skopje leads this trend, with 253 EVs registered only in Center, without including other municipalities.

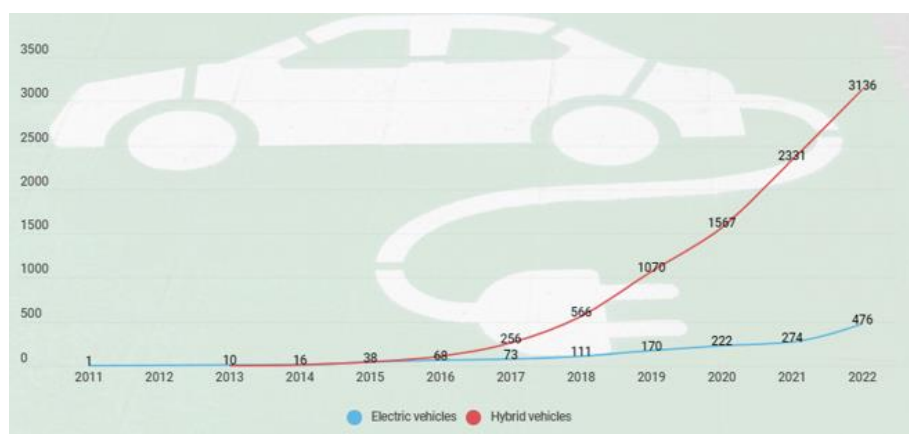


Figure 1. Hybrid and electric vehicles in North Macedonia [5]

The percentage of EVs among the total number of registered vehicles in North Macedonia increased from 0.001% in 2012 to 0.25% in 2022 [7].

The results of this study suggest that electric vehicle adoption in North Macedonia is on an upward trend, with a significant increase in the number of registered EVs and the percentage of EVs among the total number of registered vehicles.

Anyway, according to the State Statistical Office, this number still remains low when compared to other vehicle registrations in North Macedonia, with 217,106 petrol vehicles and 331,301 diesel vehicles registered in 2022 [7].

However, the overall adoption rate also remains low compared to other European countries, such as Norway, where EVs accounted for 54.3% of new car sales in 2020 [8]. Carmakers forecast that the production of EVs in Europe will multiply six-fold between 2019 and 2025, reaching more than 4 million cars and vans annually – or more than a fifth of EU car production volumes [9].

This refers to low-emission vehicles on European roads by 2025, because transport accounts for approximately one quarter of all greenhouse gas emissions in the EU, predominantly (72%) through road transport [11]. An essential part of reducing emissions from road transport is the

transition to alternative, lower-carbon fuels. Of these, the most common new source is electricity, particularly for passenger vehicles.

To further promote the adoption of electric vehicles in North Macedonia, the government could consider implementing a range of additional incentives. These could include offering free parking for EVs in city centers, which would provide a direct economic benefit to EV owners and make EVs a more attractive option for urban commuters.

At the moment, free parking for electric vehicles is provided only by three municipalities in North Macedonia: Strumica, Bitola, and Ohrid [5]. Unfortunately, Skopje, the capital city, currently does not offer free parking for environmentally friendly vehicles, despite previously having such an initiative.

Another significant reason for adopting electric vehicles in North Macedonia encompasses both economic and environmental benefits.

- Economic benefits – which include:
 - **Reduced fuel costs;**
 - **Lower maintenance costs;**
 - **Energy independence.**
- Environmental aspects:
 - **Produce ZERO emissions;**
 - **Increased energy-efficiency;**
 - **Reducing noise;**
 - **Reduced dependence on fossil fuels.**

3. Charging infrastructure development

Electric vehicles have been gaining traction globally as a sustainable transportation solution, and North Macedonia is no exception. The country has taken concrete steps to promote the adoption of EVs and develop the necessary charging infrastructure.

EVN Macedonia is the company that is actively involved in enhancing the EV charging infrastructure, it has also been actively developing a nationwide network of EV charging stations in cooperation with municipalities.

Following the global trends, EVN takes concrete steps towards wider adaptation of electromobility in North Macedonia. The most important prerequisite for increasing the usage of electric vehicles is the proper, developed charging infrastructure. In addition to charging in their homes, in order to be able to travel longer distances, electric vehicle owners also need chargers available in public areas. The chargers need to be placed in the drivers' direction of movement and at distances of up to 100 km from one another [10].

EVN, in cooperation with the municipalities, built a solid electric infrastructure throughout the country. As part of this project for the development of electromobility, EVN has installed over 40 EV charging points for electric vehicles in 18 cities [10]. Among them are the cities: Tetovo, Kicevo, Kumanovo, Veles, Gostivar, Struga, Ohrid, etc. 19 of them are in Skopje, which several chargers were installed on public areas but also on frequented locations such as hotels, restaurants, shopping malls [10].

The goal of the company is to promote sustainable transportation solutions. They are working on expanding the charging network to support the increasing number of electric vehicles on the roads. By collaborating with various stakeholders, including governments and businesses, EVN contributes to the development of a robust charging infrastructure that is essential for the widespread adoption of electric vehicles.

The ultimate policy objective is to make electric vehicle charging as easy as filling a conventional vehicle tank, so that electric vehicles can travel without difficulty right across the country and beyond [6]. To reach that aim, it faces the following interlinked problem: on the

one hand, vehicle uptake will be constrained until charging infrastructure is available, while on the other, investments in infrastructure require more certainty of vehicle uptake levels. Charging time depends on the vehicle's battery and charging point capacity. While 'slow' and 'normal' chargers are more adequate for home and office charging cycles, 'fast' and 'ultra-fast' chargers are more suitable for highways and main road networks. In Europe four chargers are available, as we can see in the table:

Table 1: Charging technology [14]

Charger speed and type	Power rating	Approximate time to charge*
Slow (single-phase AC)	3-7 kW	7-16 hours
Normal (three-phase AC)	11-22 kW	2-4 hours
Fast (DC)	50-100 kW	30-40 minutes
Ultra-fast (DC)	> 100 kW	< 20 minutes

In North Macedonia, EVN has installed Wallbe Pro chargers with a power output of 22 kW and a possibility to charge one vehicle and Wallbe Pro Plus with a power output of 2x22 kW where two vehicles can be charged simultaneously [10].

There are currently only two such fast chargers in our country, one of which is located near the Bogorodica border crossing at a gas station - at the entrance to Macedonia from Greece, with a power of 100 kW, and the other location is in the vicinity of the business premises of a vehicle importer in Skopje, where two fast turbochargers with a power of 320 kW are located [5].

Despite this progress, it is evident that the current infrastructure is in its nascent stages, and there is a pressing need for the introduction of faster charging solutions to minimize the waiting time for vehicle recharging.

Charging infrastructure for electric vehicles must provide simple charging, like charging conventional vehicles at gas stations. Because, limited charging infrastructure and limited model availability can be a challenge for electric vehicles in North Macedonia.

4. Policy and Regulatory Framework

Transitioning to electric drive and using energy from renewable sources can help in the decarbonization process globally. Wider usage of electric vehicles and charging infrastructure development depend on the legislative and regulatory framework. The primary driving force is the recognition of the common challenges the countries share in the implementation of key transport and infrastructure policies and programs.

The European Parliament and the Council of the European Union have adopted Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles in order to accelerate electric vehicle adoption [15].

The extensive background and research performed by EU and OECD countries will serve as a basis for our own national policy and regulatory program. This means a systematic open international exchange of experience and knowledge, which will facilitate the adoption of best practices and innovative solutions tailored to North Macedonia's specific context, ultimately enhancing the effectiveness and sustainability of our transport and infrastructure initiatives.

Each State is responsible for preparing and implementing its own domestic alternative fuels policy under the framework. This may include measures such as tax breaks or subsidies for the purchase of electric vehicles and the construction of charging infrastructure.

In North Macedonia, laws and regulations do not promote something specific in the transport sector, especially for electric vehicles. There is only a paragraph of the law which states: passenger vehicles that move only with an electric drive motor are not subject to motor vehicle tax [12].

European countries provide subsidies for EVs, which makes them more applicable. For example, in Croatia in 2022, the subsidies amounted to approximately 10,000 euros for electric vehicles and 5,000 euros for plug-in hybrids. In North Macedonia, there are currently no subsidies provided by the government for electric vehicles. Although subsidies were approved in 2017, they were never realized.

5. Future outlook for EVs in North Macedonia

The transport sector in the Republic of North Macedonia is highly dependent on fossil fuel and is one of the largest contributors to the total energy consumption and CO₂ emissions in the country. The deployment of electric vehicles could be an attractive and transformative solution for reducing the total final energy consumption in the transport sector, to achieve a better air pollution situation, and to increase the use of renewable energy sources, at the same time benefiting the economy.

By 2030, it is projected that battery energy density will increase by 50% compared to current levels, while costs are expected to decrease by 30%. This will significantly improve the range and affordability of EVs, making them more accessible to a wider range of consumers. Additionally, the development of 350 kW charging technologies will reduce charging times from 30 minutes to just 10 minutes, making EVs more convenient for daily use.

North Macedonia has significant potential for solar and wind power. By leveraging these renewable resources to generate electricity for charging electric vehicles, North Macedonia can reduce greenhouse gas emissions and contribute to its energy independence and sustainability goals.

By focusing on technological advancements, supportive policies, and the integration of renewable energy sources, North Macedonia is well-positioned to accelerate the adoption of electric vehicles. These efforts will not only reduce the country's carbon footprint but also create new economic opportunities and improve the quality of life for its citizens.

Conclusion

The evolution of electric vehicle infrastructure in North Macedonia has shown significant progress over the past decade. The country has made commendable strides in expanding its network of charging stations, implementing various government incentives to promote electric vehicle adoption, and conducting strategic partnerships with international organizations to enhance infrastructure development.

Despite facing initial challenges such as limited charging infrastructure and range anxiety among consumers, North Macedonia has demonstrated a commitment to transitioning towards sustainable transportation.

Moving forward, a focus on continued investment in charging infrastructure, creating awareness campaigns to educate the public about the benefits of electric vehicles, and fostering collaborations with key stakeholders will be crucial for further advancement in the electric vehicle sector.

References

- [1]. C. Sudjoko, NA Sasongko, I. Utami, 2021. Utilization of electric vehicles as an energy alternative to reduce carbon emissions.
- [2]. Cingoski, V., & Petrevska, B. (2018). Promoting electric vehicles in Macedonia: economic and environmental implications.
- [3]. Tomic, M., & Vasic, M. (2020). " Electric vehicles and charging infrastructure in the Balkans.
- [4]. Emanuele Crisostomi, Robert Shorten, Sonja Studli & Fabian Wirth. Electrical and Plug-in Hybrid Vehicle Network: Optimization and Control.
- [5]. <https://www.skopje.in/post/slow-adoption-of-electric-hybrid-vehicles-in-macedonia-compared-to-other-countries>
- [6]. Božana Miljanić-Marušić, Saša Mujović. Implementation of the European Union Legal Framework for Electric Vehicles in Montenegro.
- [7]. State Statistical Office, 2023.
- [8]. International Energy Agency, 2021.
- [9]. 'Electric surge: Carmakers' electric car plans across Europe 2019-2025', Transport & Environment, July 2019.
- [10]. <https://emobility.evn.mk/with-us/Electromobility-with-EVN.aspx?lang=en>
- [11]. SWD (2020) 331 final, accompanying the document COM (2020) 789 final: 'Sustainable and Smart Mobility Strategy – putting European transport on track for the future'.
- [12]. Law on Road transport, "Official Gazzete of North Macedonia",
- [13]. Law on Road Traffic Safety, "Official Gazzete of North Macedonia"
- [14]. 'Recharge EU: How many charge points will Europe and its Member States need in the 2020s', T&E, January 2020.
- [15]. Directive 2009/33EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles, OJ L 120, May 2009, pp. 5-12.