European Research Studies Journal
Volume XXVIII, Issue 4, 2025

pp. 1122-1135

Transformation of Transport: The Case of The Electric Vehicle Market in Poland

Submitted 19/09/25, 1st revision 14/10/25, 2nd revision 26/10/25, accepted 20/11/25

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Abstract:

Purpose: *The study aimed to propose a multi-element method to assess EV growth dynamics using only publicly available data across four vehicle categories, compared with infrastructure development, based on Poland as a case study.*
Methodology: *The study analyzed publicly available data on EV numbers and charging infrastructure in Poland, using tools such as quarterly and year-over-year growth rates, market share by segment, average quarterly increase, charging points per 100 EVs, and correlation coefficient.*
Findings: *The analysis shows the major impact of EV market transformation in Poland. By 2025, passenger cars dominated with over 70% share, while motorcycles fell by 29 points. Trucks gained 3 points, and buses stayed low due to limited investment. Key drivers are financial support, model availability, and charging infrastructure growth.*
Practical Implications: *The results on Poland's EV market can support public policy in planning charging infrastructure and serve as a basis for strategic decisions by transport companies and providers.*
Originality: *The originality of the topic lies in its integration of all electric vehicle segments with an assessment of charging infrastructure in a single European Union country-Poland. This approach allows for an evaluation of growth dynamics over a defined time period.*

Keywords: *Electromobility, charging infrastructure, transport, electric vehicles, market analysis, transformation.*

JEL codes: *L91, Q55, O33.*

Paper type: *Research article.*

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1. Introduction

The topic of electric vehicles worldwide is widely discussed in both scientific literature and industry reports. Growing environmental awareness among road users, legal regulations limiting exhaust emissions, and the increasing importance of sustainable transport have made electric vehicles (EVs) one of the key elements in the global transformation of the automotive industry. Many research studies on electric vehicles focus solely on a selected vehicle segment.

The most frequently discussed area is electric buses, which are increasingly being deployed in large urban agglomerations around the world through public procurement programs (Folęga *et al.*, 2025; Yang *et al.*, 2022). In recent years, however, there has been growing interest in electric delivery vans and trucks as well (Anosike *et al.*, 2023; Albatayneh *et al.*, 2023). The development of this branch of transport is significant in terms of reducing emissions in the logistics sector.

Nevertheless, analyses of electric vehicle development often focus exclusively on a narrow research area, typically covering only a single selected city (Pikuła *et al.*, 2018; Gąsiorek-Kowalewicz *et al.*, 2025). Such a limited perspective results in conclusions that are local in nature and do not allow for generalization at the national level. Consequently, it is difficult to assess the actual level of zero-emission transport development across an entire country, as well as to compare the pace and efficiency of implementation across different regions.

It is also challenging to extrapolate these results globally, as the characteristics of individual urban centers do not reflect the complex social, economic, and technological conditions present in other countries and continents. The lack of a broader, multi-faceted approach thus limits the ability to identify systemic factors that could serve as the basis for developing universal strategies to support the growth of zero-emission transport at an international level.

Analyses of electric vehicle development increasingly also address issues related to market demand – that is, the demand for such means of transport. This demand is shaped by a range of factors, including policies subsidizing the purchase of zero-emission vehicles, the availability of charging infrastructure, and the growing environmental awareness of consumers. Legal regulations imposing restrictions on internal combustion vehicles in city centers also play a significant role, directly affecting the attractiveness of alternative propulsion solutions.

2. Literature Review

The literature emphasizes that demand for electric vehicles is not homogeneous and strongly depends on the market segment (Stopka *et al.*, 2025). For individual customers, operating costs, model availability, and vehicle range are decisive factors (Muratori *et al.*, 2021; Kim and Kim, 2021), whereas in the fleet and public transport

sectors, the total cost of ownership and anticipated long-term savings are most important (Borucka *et al.,* 2024; Kirchstein, 2021). For this reason, market research increasingly focuses on analyzing the preferences of different consumer groups, aiming to predict the pace and scale of electric vehicle adoption in various segments.

Macroeconomic conditions, such as electricity prices, fossil fuel costs, and the availability of raw materials necessary for battery production, are also significant (Yang *et al.*, 2022; Maisel *et al.,* 2023; Barman *et al.,* 2023). Fluctuations in these areas can influence demand dynamics, making it sensitive to changes in the economic and political environment (Borucka *et al.,* 2024).

Therefore, market forecasts regarding the demand for electric vehicles should take into account a broad global context, rather than merely local or regional specifics. Only such an approach allows for the formulation of accurate conclusions regarding the directions of zero-emission transport development.

In addition to studies focusing on specific vehicle segments or particular cities, the literature also addresses technological aspects of electric vehicles. Examples include research on optimizing energy management in electric vehicles (Josephin Shermila *et al.,* 2025; Kozłowski *et al.,* 2024) and battery management systems using artificial intelligence (Poorani *et al.,* 2025; Lidong 2025).

Authors have also presented studies aimed at improving the accuracy of calculated operational reliability indicators for industrial electric motors (Gubarevych *et al.,* 2025). All of these issues are highly significant for ensuring the efficient operation of electric vehicles (EVs) worldwide. Despite numerous studies addressing specific segments or technological aspects, research of a cross-sectional nature is still lacking.

It is important to present an analysis covering the development of all electric vehicle segments—from passenger cars, through delivery vans and trucks, to buses, motorcycles, and mopeds—while also considering the full available charging infrastructure. It should also be noted that the development of electric vehicles is both a global and highly local issue, as the implementation of specific policies depends on the capacities and infrastructure of each country.

Poland, which is characterized by a slower pace of electric vehicle (EV) adoption, represents an interesting case in which local investments in electric buses and charging points will reflect global trends in this area. In summary, the existing literature on electric vehicles (EVs) mainly addresses economic, technical, and social aspects worldwide. However, research of a comprehensive nature—covering all possible electric vehicle segments and the associated charging infrastructure at the national level—is still lacking.

The aim of this study is to present an analysis of the development of electric vehicles in Poland in the years 2020–2025. The study is based on quarterly data from Q1 2020

to Q2 2025, covering the increase in the number of registered electric vehicles and charging stations and points. Four main vehicle categories were considered: passenger cars, trucks, buses, and motorcycles. This broad approach enables a cross-sectional analysis, allowing for the identification of differences in growth dynamics among segments and their contributions to the development of the national EV market.

The research assumption is that the development of electromobility in Poland does not progress uniformly and is subject to significant fluctuations depending on the vehicle segment. It is also assumed that, in Poland, the growth rate of the EV market remains strongly dependent on the expansion of charging infrastructure, the quantity and availability of which continue to constitute one of the main constraints. A specific hypothesis posits that the development of electric trucks and motorcycles is marginal compared to passenger cars and buses, which dominate the market structure.

The study employs a set of indicators to assess the dynamics of EV market growth. A quarterly growth rate indicator and a year-over-year (YoY) growth rate indicator were calculated to capture trends and seasonal fluctuations in electric vehicle registrations.

The analysis also considered the percentage share of each segment in the market and the average quarterly increase in the number of vehicles. Further, the number of charging points per 100 EVs was calculated, allowing for the assessment of infrastructure adequacy relative to the growth of the zero-emission vehicle fleet. Additionally, a correlation coefficient was used to determine the relationship between the number of registered vehicles and the growth of charging infrastructure.

The conducted study aims to provide knowledge about the current state of electromobility in Poland, highlighting the strengths and weaknesses of this process.

The analysis allows for the identification of relationships between the dynamics of the vehicle market and the development of infrastructure, as well as the assessment of which segments are developing most dynamically and which remain stagnant. The results can serve as a reference point for international comparisons and as a basis for formulating recommendations for public policy and investment activities.

In conclusion, it should be emphasized that the study is interdisciplinary in nature, combining economic, technical, and social perspectives. This approach allows for moving beyond the analysis of individual segments and enables a comprehensive assessment of the potential for electromobility development in Poland over a medium-term horizon.

3. Materials and Methods

Quarterly data from Q1 2020 to Q2 2025 were analyzed, covering the increase in the number of registered electric vehicles and charging stations and points. The data included four vehicle categories: passenger cars, trucks, buses, and motorcycles.

The following selected indicators were used:

1. Quarterly growth rate indicator, calculated using the formula:

$$YoY = \frac{wartość\ w\ kwartale\ bieżącym - wartość\ w\ tym\ samym\ kwartale\ roku\ poprzedniego}{wartość\ w\ tym\ samym\ kwartale\ roku\ poprzedniego} \times 100\% \quad (1)$$

2. Year-over-year (YoY) growth rate indicator, calculated using the formula:

$$YoY = \frac{wartość\ \ bieżąca - wartość\ z\ roku\ poprzedniego}{wartość\ \ z\ roku\ poprzedniego} \times 100\% \quad (2)$$

3. Percentage share of the four segments in the EV market

4. Average quarterly increase, calculated using the formula:

$$\bar{\Delta} = \frac{\sum_{i=1}^{n} \Delta_i}{n} \quad (3)$$

$\bar{\Delta}$ - average quarterly increase
Δ_i – increase in the i-th quarter (number of new vehicles)
n – number of quarters

5. Number of charging points per 100 EVs, calculated using the formula

$$W_{\frac{p}{100EV}} = \frac{P_ł}{EV} \times 100 \quad (4)$$

$W_{\frac{p}{100EV}}$ – number of public charging points per 100 electric vehicles
$P_ł$ – number of charging points
EV – total number of registered vehicles in the given quarter

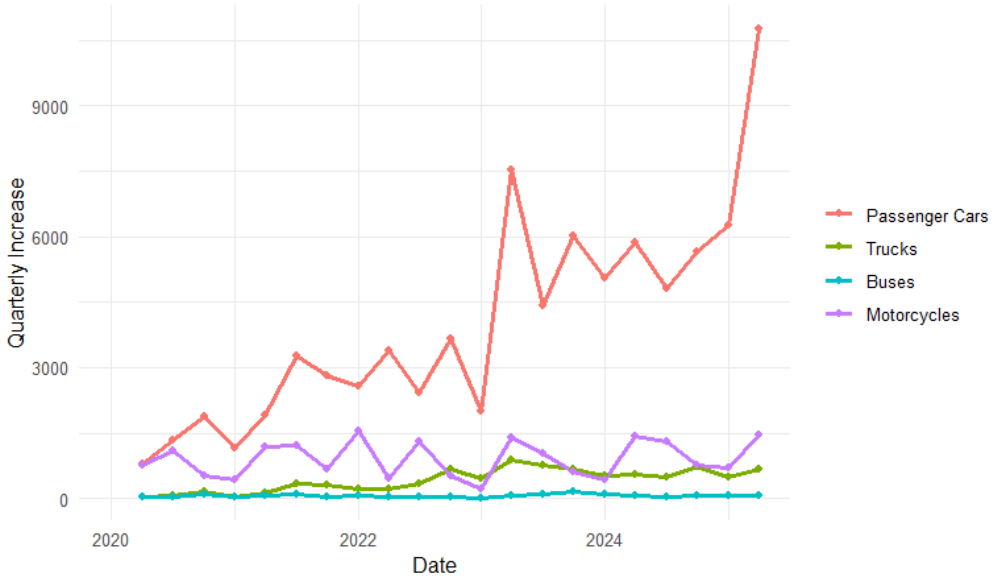
6. Correlation coefficient

4. Research Results

The results of growth dynamics for the analyzed vehicle categories are presented in Figure 1.

Passenger cars exhibited the highest growth dynamics, with the largest increase recorded in the second quarter of 2023 (+7,517 vehicles). The main reason for this significant increase was the still-active Polish program “Mój Elektryk,” which primarily aimed to provide financial support for individuals planning to purchase an electric vehicle.

Figure 1. *Electric Vehicle Growth Dynamics*



Source: *Authors' calculations.*

Overall, however, growth in this segment was highly irregular, with periods of very intensive increases alternating with declines in growth. Growth of electric trucks was somewhat more stable, though still characterized by noticeable peaks (e.g., Q2 2023 – 871 units, Q4 2022 – 674 units). The growth rate suggests a slow but systematic increase in the share of electric trucks within the freight transport segment.

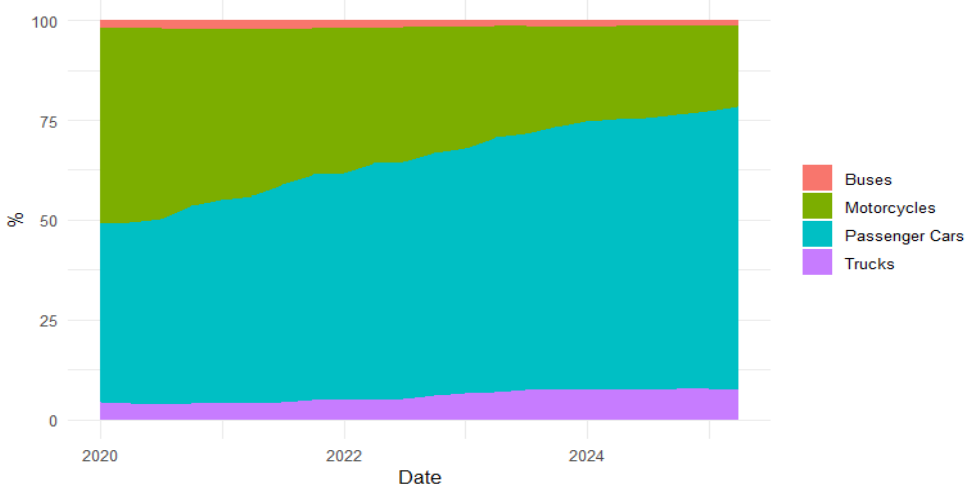
Buses exhibited the lowest growth dynamics, with quarterly increases of only several dozen units. One notable jump (173 units) occurred in Q4 2023. Motorcycles showed very high variability, with the largest increases recorded in Q2 2021 (+1,178 units) and Q2 2024 (+1,429 units). Seasonality was evident, with clear peaks in the second quarter of each year, likely reflecting the seasonal nature of motorcycle use in Poland.

Assessing year-over-year dynamics, passenger cars in the best quarters exceeded 100% YoY growth. High values were also observed for trucks, with record growth above 70% YoY. For buses, growth dynamics were low, often below +20% YoY. Motorcycles frequently exceeded 50% YoY growth, with strong seasonal fluctuations.

The next step involved analyzing the percentage share of each electric vehicle type. Changes in these shares reflect both technological development and shifting consumer preferences.

Analysis of market share dynamics allows for an understanding of which segments are developing most rapidly and the trends in the EV fleet structure. Changes in market structure over the study period are presented in Figure 2.

Figure 2. *Percentage Share of Electric Vehicle Types Over Time*



Source: *Authors' calculations.*

The share of passenger cars increased from approximately 45% in 2020 to over 71% in Q2 2025, representing a steady, almost linear upward trend. Since 2023, the growth rate has slowed somewhat, but this segment has continued to expand its share at the expense of motorcycles. The motorcycle segment recorded the largest decline in market share, falling from 49% in 2020 to 20% in 2025. The initial dominance of this segment likely stemmed from its price accessibility and easier adaptation of electric technology.

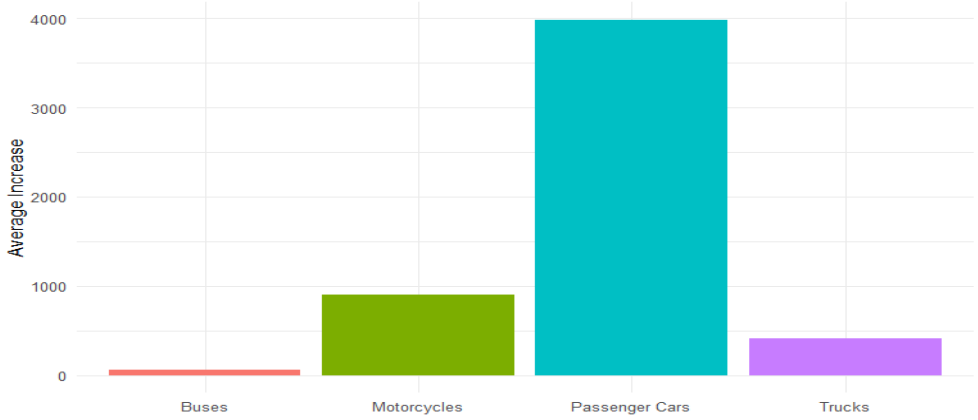
However, the rapid development of passenger cars and the lowering of accessibility thresholds reduced the market share of motorcycles. For trucks, the share increased from about 4.3% to over 7.3% in 2025. Growth was slow but systematic, and since 2022 the dynamics have been stronger, which may be attributed to the introduction of more models to the market and the increasing number of commercial fleets investing in electric vehicles. The share of buses remained within the range of 1.2–2.1%, with a slight downward trend. This was due to slower growth compared to other segments.

It is evident that during 2020–2021 there was a significant shift in market share in favor of passenger cars, accompanied by a decline in motorcycles to below 40%. In 2022–2023, a dynamic increase in passenger cars above 60% is visible, as well as growth in trucks above 6%. The period of 2024–2025 shows stabilization of truck shares, further growth of passenger cars, and a decline in motorcycles to around 20%.

An additional measure that allows for the assessment of the growth rate of individual EV market segments is the average quarterly increase. This indicator enables the evaluation of long-term development trends for each segment, eliminating the impact

of short-term fluctuations. In this analysis, the results of average increases for the four vehicle categories are presented in Figure 3.

Figure 3. *Average Quarterly Increase by Vehicle Type*



Source: *Authors' calculations.*

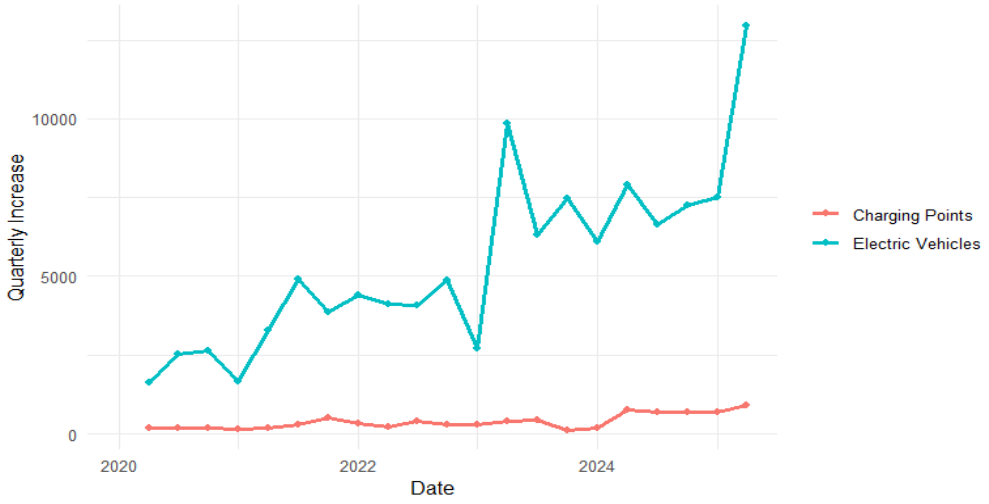
For passenger cars, the average quarterly increase amounted to 3,979 units. This segment is the clear market leader, confirming earlier findings regarding the growing dominance of passenger cars in the EV structure. Trucks recorded an average quarterly increase of 416 units.

Although the pace is significantly lower than in the passenger car segment, a stable growth trend persists, indicating the gradual electrification of freight transport. For buses, the average quarterly increase was 63 units, the lowest among all categories. This aligns with the relatively small share of buses in the EV market and the limited number of procurement projects carried out. Motorcycles recorded an average quarterly increase of 907 units.

This result is nearly four times higher than that of trucks and many times higher than that of buses, showing that this segment still plays a significant role in the market, although, as previously shown, its percentage share in the total fleet is declining.

The next step involved assessing the quarterly increases in charging stations and points, as well as the correlation of these changes with the number of newly registered electric vehicles in Poland as a whole. The relationship between the pace of charging infrastructure development and the increase in the number of electric vehicles is a key indicator of balance within the electromobility market. Analyzing these data makes it possible to determine whether the charging network is developing proportionally to the growth in demand. The results are presented in Figure 4.

Figure 4. *Comparison of Vehicle and Charging Point Growth*



Source: *Authors' calculations.*

The lowest increases in the number of charging stations were recorded in the early quarters, amounting to between 61 and 96 new stations per quarter in the years 2020–2021. Since 2022, investment has accelerated, for example Q3 2021 – 154 stations, Q4 2021 – 257 stations. Record increases were observed in 2023–2024: Q2 2024 – 419 stations, Q3 2024 – 398 stations. 2025 – no data – to be verified.

Thus, in the early years (2020–2021), the growth rate of stations was relatively aligned with demand—slower, but keeping pace with the increasing number of vehicles. From 2022 onward, a divergence became apparent: the increase in vehicles clearly outpaced the rate of charging station expansion.

The record growth in vehicles in Q2 2025 (+12,943 units) was primarily the result of the introduction of the new program "NaszEauto", which offered subsidies for the purchase of M1 category electric cars.

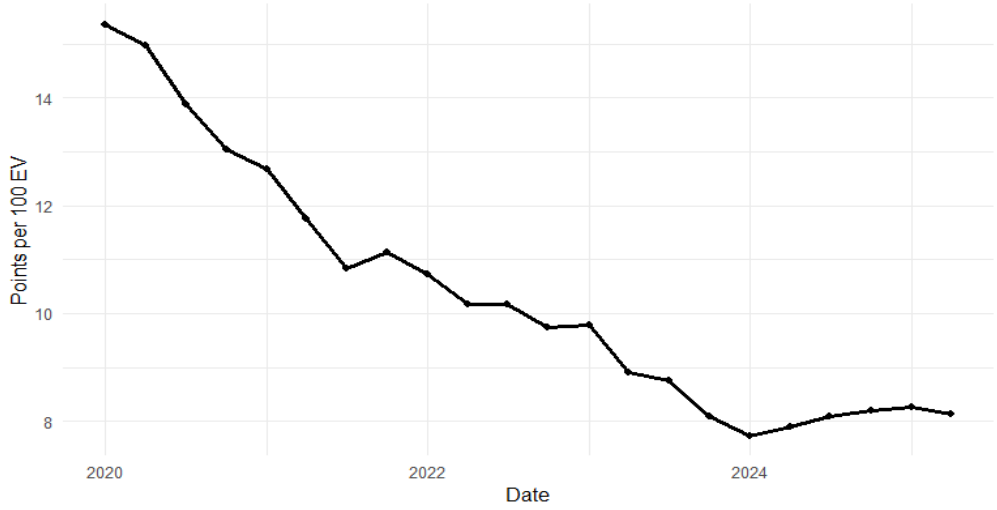
Nevertheless, as can be seen in
Figure ***4***, the electrification market has entered a phase of rapid EV fleet expansion, while the pace of charging station development – although increasing – is not proportional to the surge in demand.

The indicator of charging points per 100 EV is one of the best measures for assessing whether infrastructure is developing proportionally to demand. High values of the indicator reflect good charging availability, while low values indicate a potential risk of network overload.

At the beginning of the period (Q1 2020), the value of 15.35 points per 100 EV showed a very high level of availability in the early stage of market development.

Subsequently, a gradual decline occurred, reaching approximately 10.17 points per 100 EV in Q2 2022, which indicates that the EV fleet was growing faster than the number of charging points. The lowest values were associated with the dynamic expansion of the EV market, amounting to 7.74 in Q2 2024 and 7.90 in Q3 2024. This represented nearly twice lower availability compared to 2020. From Q4 2024 (8.09) to Q2 2025 (8.13), an increase was recorded, which may suggest that the pace of infrastructure expansion once again began to approach the growth rate of the fleet.

Figure 5. *Charging Points per 100 EV*



Source: *Authors' calculations.*

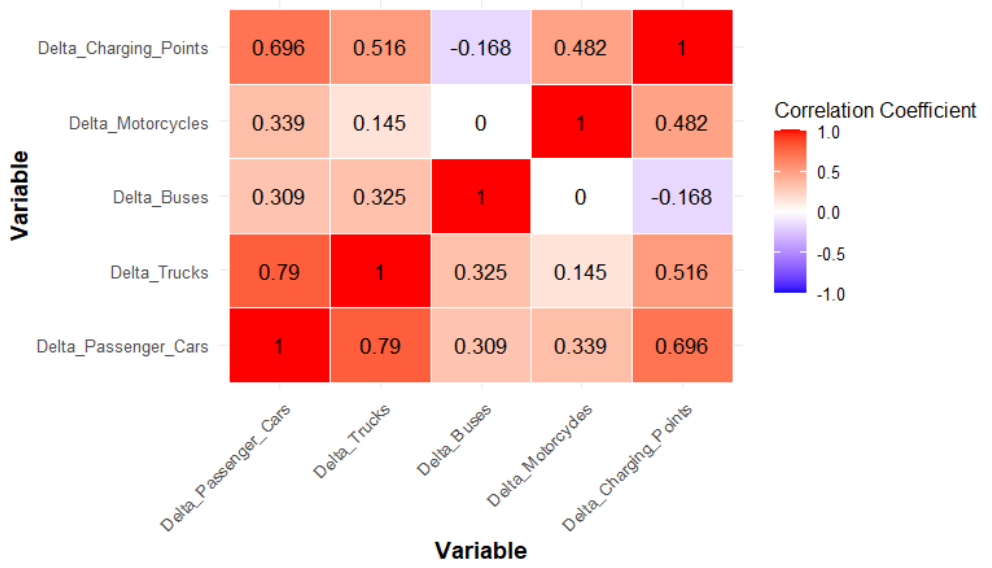
Next, a correlation matrix for quarterly increases was calculated in order to assess to what extent changes in the number of electric vehicles in individual segments are synchronized with each other and with the development of charging infrastructure.

This approach makes it possible to eliminate the effect of the common upward trend (present in cumulative data) and focus on actual co-variability within the same periods. As a result, it becomes possible to better determine whether increases in specific segments occur simultaneously and to what extent infrastructure expansion responds to the current pace of EV fleet growth.

The strongest positive relationship was recorded between passenger cars and trucks, with a correlation of 0.79. This indicates that increases in registrations of passenger cars and trucks often occurred in the same quarters, which may suggest the influence of common market factors (such as subsidies, infrastructure development, or overall economic conditions). A moderately strong relationship (correlation of 0.696) was observed between passenger cars and charging points.

In general, increases in passenger cars were often accompanied by increases in charging points, although not always in perfect synchrony. Clearly, expectations for this relationship are considerably higher.

Figure 6. *Correlation Matrix for Quarterly Increases*



Source: *Authors' calculations.*

A somewhat lower but still moderate relationship (correlation of 0.516) was found between trucks and charging points, showing that increases in trucks were only partially correlated with infrastructure expansion. Other relationships were moderately weak (motorcycles – charging points: correlation of 0.482) or negligible (buses – charging points: correlation of -0.168; buses – motorcycles: correlation of 0.0).

5. Conclusion

The conducted analysis shows a clear transformation of the market – from the dominance of electric motorcycles at the beginning of the decade to the near hegemony of passenger cars in 2025. The factors influencing this shift undoubtedly include support policies, infrastructure development, an increasingly diverse market offering, and improved accessibility of models, primarily in the passenger car segment but also in buses and motorcycles.

Public support policies, in the form of special programs for the purchase of electric vehicles, have had a significant impact on the development of zero-emission transport in Poland. The first program, "Mój Elektryk" ("My Electric"), launched in November 2021, offered subsidies for the purchase of zero-emission passenger cars and delivery vans (Program "Mój Elektryk", 2021).

The subsequent program, "NaszEauto" ("OurEcar"), began accepting applications in February 2025 (Program "NaszEauto", 2025). Since 2022, a significant increase in the number of electric vehicles in Poland has been observed.

This trend has been shaped not only by support programs but also by vehicle availability on the market and the expansion of the charging infrastructure. A change in the profile of users has also been an important factor. Passenger cars now clearly hold a dominant position in the EV market, reaching over 70% share in 2025. At the beginning of the analyzed period, motorcycles also held a leading position, but their market share decreased by approximately 29 percentage points within five years.

Trucks increased their share by about 3 percentage points, suggesting growing interest in electrification within the transport sector. Buses maintained a low market share, which indicates the limited scale of investment in this segment despite municipal projects.

In summary, the development of the EV market in Poland is dynamic but still uneven. The fastest growth has been recorded in the passenger car segment, which, on the one hand, meets the needs of individual users, and on the other, benefits from the strongest institutional and market support.

The truck and bus segments are developing more slowly, which is linked to higher purchase costs, a limited range of models, and the need for additional investment in high-power charging infrastructure. Motorcycles, despite their initial advantage, have lost their position to passenger cars, reflecting both changing user preferences and the direction of transport policy.

The findings of the analysis show that the future of electromobility in Poland will depend on maintaining and further developing support programs, as well as on the systematic expansion of charging infrastructure. Of key importance will be adapting the network to the growing needs not only of passenger car drivers but also of fleet operators, public transport, and freight logistics. Poland therefore faces the challenge of ensuring the balanced development of all EV market segments so that the transport transition can encompass not only individual consumers but the mobility system as a whole.

From a broader perspective, the results indicate that Poland is following global trends in electromobility development, although the pace of change is slower than in the most advanced Western European countries. This may, however, create an opportunity to draw on the experiences of other states and avoid mistakes in the implementation of technologies or the design of support schemes. In the long term, the development of zero-emission transport in Poland will be a key component of the energy transition and the achievement of climate goals, while the observed changes constitute an important step towards a more sustainable economy.

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