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The attitudes of Polish representatives of the companies in the transport-forwarding-logistics sector towards the electrification of heavy road vehicles

Postawy polskich przedstawicieli firm sektora TSL wobec elektryfikacji ciężkiego taboru drogowego

Abstract. Since the Industrial Revolution, humanity has been developing at an unprecedented pace. The technological progress observed in recent centuries has significantly contributed to the development of the economy, science, and overall quality of life. A negative consequence of this turn of events is the global increase in atmospheric pollution, which leads to undesirable climate change. In response, the European Union and many countries have implemented several environmental protection measures, a key element of which is the development of electromobility, aimed at reducing pollutant emissions from road transport. This study aimed to identify factors influencing the growth of electromobility in heavy transport and to assess them with representatives of Polish companies in the transport-forwarding-logistics sector. The authors utilized quantitative and qualitative data collected through a survey conducted among representatives of Polish companies in the transportation and logistics sector to achieve this goal. The study shows that transport-forwarding-logistics entities are interested in electromobility. They point to both the advantages and disadvantages of electrifying the heavy transport sector. Among the most frequently cited benefits of electromobility, entrepreneurs emphasized creating a positive image for their companies and increasing market competitiveness. The primary negative opinions regarding this process centered on the high cost of purchasing electric vehicles, the limited benefits in terms of reducing transportation costs, and the inadequate public charging infrastructure. At the same time, some respondents suggested alternative solutions that could enhance the environmental friendliness of the transport sector, such as the use of hydrogen fuel cells or promoting the development of rail transport as the primary mode of long-distance land transport.

Keywords: electromobility, transport-forwarding-logistics sector, electric trucks, government policy

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Synopsis. Od czasów rewolucji przemysłowej ludzkość rozwija się w niespotykanym wcześniej tempie. Postęp technologiczny obserwowalny w ostatnich stuleciach znacznie przyczynił się do rozwoju gospodarki i nauki oraz poprawy jakości życia. Negatywnym skutkiem takiego biegu wydarzeń jest globalny wzrost zanieczyszczenia atmosfery, który prowadzi do powstawania niepożądanych zmian klimatycznych. W trosce o środowisko Unia Europejska oraz wiele innych krajów podjęły szereg działań dotyczących ochrony środowiska, wśród których istotnym elementem jest rozwój elektromobilności, mającej przyczynić się do zminimalizowania emisji zanieczyszczeń pochodzących z transportu drogowego. Celem opracowania było zidentyfikowanie czynników wpływających na rozwój elektromobilności w transporcie ciężkim oraz ich ocena przez przedstawicieli polskich firm sektora TSL. Do realizacji podjętego celu wykorzystano dane ilościowe i jakościowe uzyskane za pomocą badania ankietowego przeprowadzonego wśród przedstawicieli tych firm. Z badania wynika, że podmioty sektora TSL interesują się elektromobilnością i dostrzegają zarówno zalety, jak i wady elektryfikacji sektora transportu ciężkiego. Wśród najczęściej wymienianych zalet elektromobilności przedsiębiorcy podkreślali tworzenie pozytywnego wizerunku firmy oraz zwiększenie jej konkurencyjności na rynku. Natomiast negatywne opinie dotyczyły głównie wysokiego kosztu zakupu pojazdów elektrycznych, braku korzyści w zakresie obniżenia kosztów transportu oraz niewystarczającej publicznej infrastruktury ładowania. Jednocześnie niektórzy badani wskazali na inne rozwiązania zwiększające przyjazność dla środowiska sektora transportowego, takie jak wykorzystanie ogniw wodorowych lub wspieranie rozwoju transportu kolejowego jako podstawowej gałęzi transportu lądowego na duże odległości.

Słowa kluczowe: elektromobilność, sektor TSL, ciężarowe pojazdy elektryczne, polityka państwa

JEL codes: L98, R40, Q01

Introduction

The negative climate changes observed, particularly in recent years, are among the most serious problems for society as a whole. To minimize them, measures and initiatives are being taken to reduce the amount of pollutants emitted into the atmosphere, among which measures in the field of electromobility development can be distinguished. Zero-emission electric vehicles are expected to make a significant contribution to reducing emissions from the road transport sector, which is a primary source of pollution. According to Grauers et al. [2013, p. 10], electromobility is a road transport system based on vehicles powered by electricity. Some road vehicles are equipped with technologies that enable them to produce energy independently. Others consume energy supplied by an external electricity source, most often through the power grid. A slightly broader definition is provided by Zaniewska-Zielińska [2018, p. 63], who considers electromobility to encompass the entirety of issues related to the use of electric vehicles. These include both operational and technical problems related to EVs, as well as the infrastructure and technology for charging them. In turn, according to the Polish Association of Alternative Fuels [PSPA 2018, p. 50], it encompasses all issues related to EVs. It concerns both the operational aspects of cars, including the technology and electric drives used in them, as well as the charging infrastructure, and socio-economic and legal issues related to the design, production, purchase, and use of EVs.

The definitions cited clearly indicate the complexity of the issue, which encompasses not only the aspect of electric vehicles and their technology, but also complementary factors without which the development of electromobility would not be possible.

One of the key factors influencing the development of electromobility is government policy. At the EU level, focusing on the heavy-duty vehicle market, Regulation (EU) 2019/1242 of the European Parliament and of the Council on CO_2 emissions from new heavy-duty vehicles was issued on 20 June 2019. According to the regulation, trucks sold from 2025 onwards will have to emit 15 percent less CO_2 than the average emissions produced by trucks registered between 1 July 2019 and 30 June 2020, while vehicles sold after 2030 are planned to emit at least 30% less CO_2 compared to the agreed reference period [Regulation 2019, Article 1].

In turn, a turning point in the development of infrastructure enabling the proper electrification of heavy road transport was the European Union's adoption of the Regulation on Alternative Fuels Infrastructure (AFIR), which was initially presented as part of the "Fit for 55" package. The regulation, which applies to all EU Member States, requires countries to expand their charging infrastructure for both electric passenger vehicles and heavy-duty transport. The regulation came into force on 13 April 2024, imposing targets on Member States for 2025, 2027, and 2030 to ensure an adequate level of charging infrastructure for electric vehicles [Regulation 2023]. The targets set for public charging infrastructure for eHDVs are presented in Table 1.

The regulation also imposes the following targets on EU Member States for the development of infrastructure at secure and protected parking areas for heavy goods vehicles:

– By the end of 2027, each such location must be equipped with two public charging stations with a capacity of 100 kW or more each.
– By the end of 2030, each such site must be equipped with four public charging stations with a capacity of 100 kW or more each.

In addition to the mandatory targets mentioned above, the AFIR also imposes several other requirements, such as requirements for urban hubs analogous to those for parking areas, or the obligation for EU Member States to equip charging stations with the devices listed in the law to enable adequate customer service [PSPA 2023b, pp. 2–24].

In Poland, the policy for the development of electromobility was outlined in the 2017 Strategy for Responsible Development [RM 2017b]. As the document's name suggests, one of its assumptions was the postulate concerning the development of low-emission transport. As part of this document, an Electromobility Development Plan [ME 2017] was prepared, which included, among other things, proposals for developing electromobility by providing appropriate subsidies for potential buyers (both private and public) and creating easily accessible charging infrastructure. It also focused on the need to ensure the proper quality of energy networks and the social aspect, assuming the need to change the general public's opinion on electromobility [Zawieska 2019, pp. 10–11].

Table 1. Requirements for charging infrastructure for the heavy-duty vehicle market imposed by the AFIR by 2025, 2027, and 2030

Tabela 1. Wymagania dotyczące infrastruktury ładowania dla rynku pojazdów ciężkich narzucone przez rozporządzenie AFIR – do roku 2025, 2027 oraz 2030

Network type	End of 2025	End of 2027	End of 2030
TEN-T core network	Equipping at least 15% of the road network with charging points with a total capacity greater than or equal to 1400 kW, but with the proviso that stations must be equipped with at least one charging point with a capacity greater than or equal to 350 kW.	Equipping at least 50% of the road network with charging points with a total capacity greater than or equal to 2800 kW, but subject to the requirement that stations be equipped with at least two charging points with a capacity greater than or equal to 350 kW.	Charging points with a total power greater than or equal to 3600 kW spaced no more than 60 kilometers apart, but subject to the requirement that stations be equipped with at least two charging points with a power greater than or equal to 350 kW.
TEN-T comprehensive network	Equipping at least 15% of the road network with charging points with a total power greater than or equal to 1400 kW, but with the proviso that stations must be equipped with at least one charging point with a power greater than or equal to 350 kW.	Equipping at least 50% of the road network with charging points with a total power greater than or equal to 1400 kW, but with the proviso that stations must be equipped with at least one charging point with a power greater than or equal to 350 kW.	Charging points with a total power greater than or equal to 1500 kW spaced no more than every 100 kilometers of the network, but subject to the requirement that the station be equipped with at least one charging point with a power greater than or equal to 350 kW.

Source: [PSPA 2023b, pp. 14–15]

Źródło: [PSPA 2023b, s. 14–15]

One of the most significant Polish strategic documents for the development of electromobility is the National Framework for the Development of Alternative Fuels, adopted on 29 March 2017. This document provides information on the current state of development of the alternative fuels sector and outlines assumptions designed to ensure its future growth and development. The document outlines targets for developing charging infrastructure, specifying the locations where charging stations should be installed, the conditions for constructing the infrastructure, and the requirements for ensuring the optimal quality of their operation. Targets have been set for the coming years regarding the number of such facilities in Poland and the number of electric vehicles on Polish roads, and mechanisms have been introduced to encourage the purchase of these vehicles. Among other things, it was decided that buyers of electric cars would not have to pay excise duty on passenger EVs and several other fees related to the purchase and use of a car, electric vehicles were allowed to drive in bus lanes, and the creation of parking spaces exclusively for electric cars was planned [RM 2017a, pp. 9–16, 19–27, 34–41].

The Act on Biocomponents and Liquid Biofuels, which introduced the Low-Carbon Transport Fund aimed at subsidizing entities responsible for developing charging infrastructure and supporting manufacturers and private and public entities using low-carbon vehicles, is of great importance for the transport-forwarding-logistics sector [Ustawa 2006].

The presented legal acts served as the basis for the adoption of the Act on Electromobility and Alternative Fuels on 22 February 2018. Currently, it is the basic legal document defining the rules for creating infrastructure for charging electric vehicles in Poland [Ustawa 2018].

The introduction of national mechanisms to support the development of charging infrastructure for heavy transport and subsidies for the purchase of eHDVs, similar to those introduced in Germany, France, Italy, the Netherlands, and Spain, is crucial for the growth of the Polish electromobility market in heavy transport.

Unfortunately, the Polish government has not yet introduced any support mechanisms for potential buyers of eHDV vehicles. The introduction of such programs is a key step in maintaining Poland's position as a European transport leader. As of the beginning of 2024, there are only about 100 electric trucks in use in Poland, but no publicly accessible charging stations for electric trucks have been built yet. As of the first quarter of 2024, sales of electric trucks in Poland are significantly lower than the European average – only 0.4% of new trucks purchased during this period are electric vehicles, compared to a European Union average of 1.9% [ACEA 2024].

Suppose Poland fails to comply with the regulations imposed by the European Union. In that case, it will gradually lose its value in the road transport industry, among other factors, due to the gradual introduction of clean transport zones by European countries, to which combustion engine trucks will not have access. As a result, they will be unable to operate on many routes. This situation will expose companies relying on conventional means of transport to economic losses due to a decline in fleet activity and a potential outflow of customers seeking companies offering comprehensive transport services. Currently, the most significant threat to the Polish heavy road transport market comes from Germany and France, where the development of electromobility in heavy road transport is at a much higher level than in Poland. This state of affairs will allow these countries to introduce zones with access only for eHDV vehicles in significant parts of their territory, thereby limiting competition from countries where the process of fleet electrification is still less advanced, without harming their own well-electrified transport market [Miniszewski et al. 2023; PSPA 2023a, pp. 31–42; PSPA 2024, pp. 8, 28].

Considering the above, the study aimed to identify factors influencing the development of electromobility in heavy transport and their assessment by representatives of companies in the TSL sector. In addition, the following questions were asked:

- How do representatives of Polish companies in the transport-forwarding-logistics sector perceive electromobility in heavy transport?
- To what extent will Polish companies in the transport-forwarding-logistics sector seek to implement the electrification of their heavy goods vehicle fleets?
- What advantages and disadvantages do representatives of Polish companies in the transport-forwarding-logistics sector see in electromobility in heavy transport?
- What is the significance of government action in introducing electromobility in the heavy transport sector?

Materials and methods

To achieve the research objective, a survey questionnaire was developed. The questions asked of respondents concerned areas such as: company characteristics, respondent knowledge of electromobility, respondent attitudes toward climate change, obstacles to the introduction of electromobility in companies, the advantages and disadvantages of electromobility in heavy transport, the essence of electromobility in terms of competition, and government measures to promote the development of electromobility in the transport-forwarding-logistics sector companies. The last question in the survey was open-ended, allowing respondents to expand on their answers to the previous questions and share their own observations.

The survey was conducted among 46 representatives of Polish companies in the transport-forwarding-logistics sector using a Google Forms online questionnaire. Responses were collected in the first half of 2024 via linkedin.com and the trans.eu transport exchange among people working in Polish companies in the transport-forwarding-logistics sector in positions such as:
- CEO (Chief Executive Officer);
- Managing Director;
- Chief Operating Officer;
- Chairman of the Board;
- Company owner or co-owner;
- Executive Director;
- Director;
- Member of the Management Board.

The data analysis methods used included descriptive statistics: frequency analysis, which involves counting the respondents' answers in the survey questionnaire for later presentation, and Spearman's rank correlation method, which aims to find statistical relationships in the survey results. This method is used to describe the strength of the correlation between quantitative and qualitative characteristics (provided that the response variants can be ordered). The formula for calculating the value of the presented coefficient is as follows:

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n\left(n^2 - 1\right)}$$

where:
d_i – difference between the ranks corresponding to the value x_i and the value y_i;
n – size of the studied population.

Spearman's rank correlation coefficient can take values from −1 to +1. The closer it is to +1 or −1, the stronger the correlation; the closer it is to 0, the weaker the correlation. To apply Spearman's rank method, the number of observations should be greater than 30 [Ręklewski 2020].

Research results

Characteristics of respondents

As shown in Table 2, more than half of the respondents work in a transport and forwarding company (52.2%). Respondents working in companies dealing exclusively with transport account for 39.1% of the respondents. By far the smallest number of responses was obtained from representatives of logistics companies, as they account for only 8.7% of respondents.

Table 2. Characteristic respondents
Tabela 2. Charakterystyka respondentów

Feature	Number	Frequency
Type of business activity		
Transport company	18	39.13
Transport and forwarding company	24	52.17
Logistics company	4	8.70
Period of operation of the company		
1–3 years	8	17.39
4–10 years	12	26.09
11–20 years	13	28.26
More than 20	13	28.26
Number of employees		
1–9	21	45.65
10–49	14	30.43
50–249	6	13.04
More than 250	5	10.87

Source: own research
Źródło: badania własne

The most numerous individual group is mature companies that have been on the market for over 11 years – responses to the survey in this category were obtained from about 56.52% of respondents. Most respondents work in micro-enterprises (45.65%). The remaining 54.3% of responses come from respondents working in small (30.43%), medium (13.04%), and large (10.89%) companies.

Knowledge about electromobility

The first group of questions concerned general issues related to electromobility. Since one of the reasons for implementing electric vehicles is their positive impact on the environment, the first question concerned the negative impact of climate change on humans and the measures taken to minimize it. The respondents' answers are summarized in Figure 1.

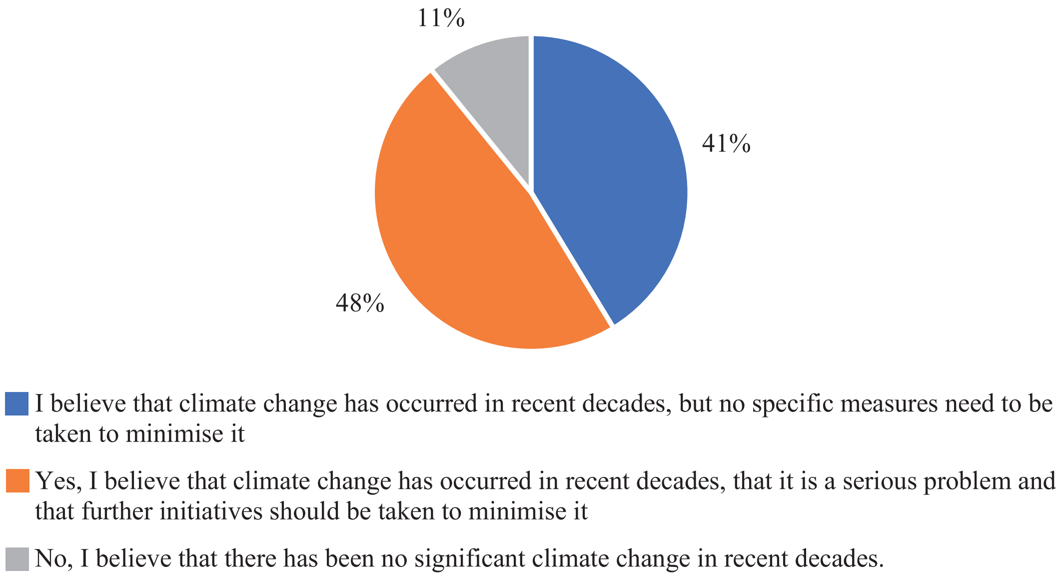

Figure 1. The impact of climate change on taking action to minimize it
Rysunek 1. Wpływ opinii nt. zmian klimatycznych na działanie podejmowane w celu ich minimalizacji
Source: own research
Źródło: badania własne

11% of respondents stated that there have been no significant climate changes in recent decades. However, less than 90% of respondents disagree – they claim that climate change has occurred in recent decades, but they are divided on the measures taken in this regard. Specifically, 41% of respondents believe that no specific measures are needed to mitigate climate change. In comparison, 48% believe that such measures are necessary. As can be seen, the groups of respondents presenting two opposing opinions are almost equal in size.

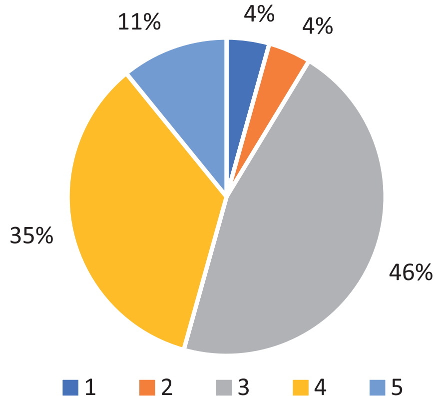

Figure 2. The respondents' knowledge of electromobility
Rysunek 2. Wiedza badanych na temat elektromobilności
Source: own research
Źródło: badania własne

Next, respondents were asked to assess their knowledge of electromobility (Figure 2). The respondents most often indicated the middle value – 46% of respondents marked "3". 35% of respondents classified themselves as having good knowledge of electromobility. 11% of respondents believe that their knowledge of the subject is excellent. Interestingly, only 8% of respondents rated their competence in electromobility as low or very low. These responses indicate that the topic of electromobility is not ignored among Polish companies in the transport-forwarding-logistics sector. Interestingly, the extreme ratings of "1" and "5" come only from micro and small companies, whereas representatives of medium and large companies tend to classify their knowledge as average or good.

Although almost half of the respondents agreed with the need to implement initiatives to combat adverse climate change, a significantly larger number of respondents answered "no" the question: "Do you think that the electrification of the truck fleet in transport-forwarding-logistics companies is necessary to reduce greenhouse gas emissions?". This indicates that, despite supporting various measures to combat climate change, many respondents do not perceive the need to implement specific changes, such as electrifying the truck fleet in transport-forwarding-logistics companies (Figure 3).

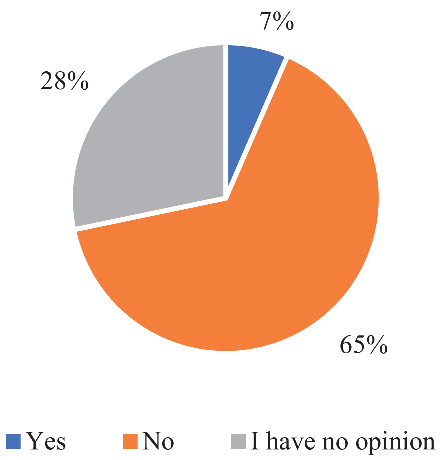

Figure 3. Electrification of the truck fleet and reduction of greenhouse gases

Rysunek 3. Elektryfikacja floty pojazdów ciężarowych a redukcja gazów cieplarnianych

Source: own research

Źródło: badania własne

The responses of respondents presented in Figure 3 show that the prevailing opinion among representatives of Polish transport-forwarding-logistics companies is that the fight against climate change (if necessary) should take place in sectors of the economy other than heavy transport.

The next question asked respondents whether they thought current regulations on exhaust emissions from heavy-duty vehicles were sufficiently restrictive (Figure 4). More than half of the respondents believe that current regulations are sufficiently restrictive and should not be changed. Another group of the respondents believes that less stringent regulations should be introduced because the current ones are too strict. The opposing view is held by 15% of respondents, who say that the current rules are insufficient and should be made more stringent. One person

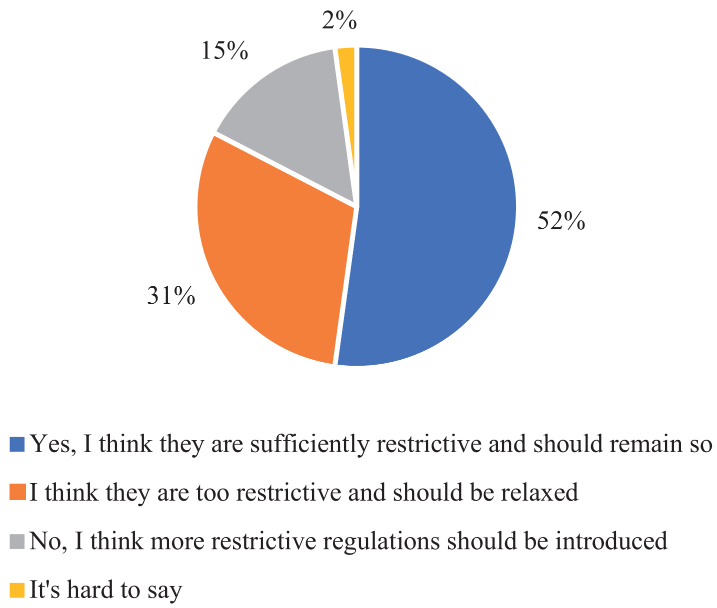

Figure 4. Strictness of regulations concerning exhaust emissions
Rysunek 4. Poziom restrykcyjności przepisów dotyczących emisji spalin
Source: own research
Źródło: badania własne

refrained from expressing a clear opinion. The answers to the question presented, when compared with the answers to the question presented in Chart 3, indicate that although the vast majority of transport-forwarding-logistics company representatives believe that the electrification of truck fleets is not necessary in terms of environmental protection, they are aware of the importance of appropriate regulations on exhaust emission standards – more than two-thirds of respondents believe that the current standards should not be relaxed or, moreover, should be made more stringent.

The last question in this section concerned the appropriateness of electrifying heavy goods vehicles. The respondents' answers are presented in Figure 5.

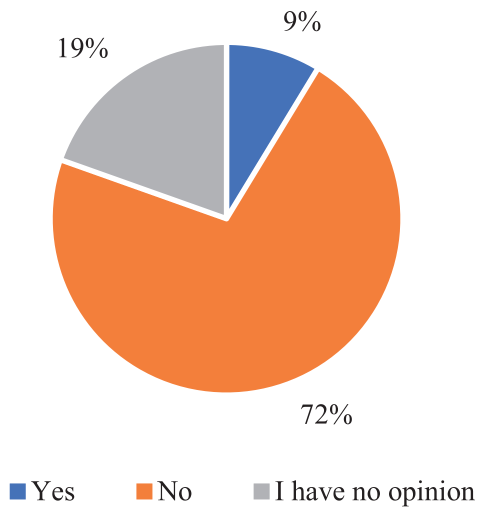

Figure 5. The validity of the idea of electrifying heavy transport
Rysunek 5. Słuszność idei elektryfikacji transportu ciężkiego
Source: own research
Źródło: badania własne

As can be seen, most respondents do not consider the idea of electromobility in heavy transport to be valid. 19% of respondents refrained from giving a clear opinion, choosing the option “Difficult to say”. Only 9% of respondents consider the idea to be valid.

Determinants for vehicle electrification in transport-forwarding-logistics sector companies

In order to learn the opinions of representatives of the transport-forwarding-logistics sector on the demand for electric vehicles, the first step was to determine whether companies in this sector were considering purchasing electric cars (Figure 6).

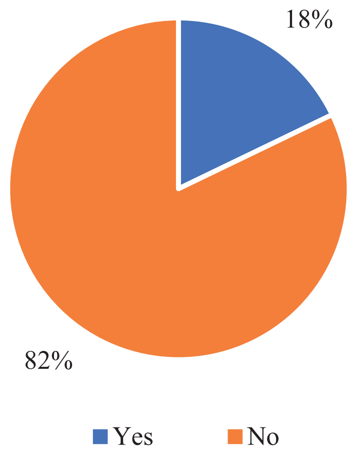

Figure 6. Intention to purchase an electric truck within the next 5 years

Rysunek 6. Zamiar zakupu elektrycznego samochodu ciężarowego w ciągu najbliższych 5 lat

Source: own research

Źródło: badania własne

As many as 82% of respondents declared that their companies do not intend to purchase eHDV vehicles in the next 5 years. Next, an attempt was made to determine what might be the reason for the lack of interest in this type of vehicle.

Subsequent questions, therefore, concerned the financial capabilities of companies to carry out the electrification of their truck fleets. The answers to the questions asked are presented in Figures 7 and 8.

The responses show that 78% of transport-forwarding-logistics companies believe that they cannot currently afford to electrify their fleets. Only 13% of respondents declared that their companies could currently afford it. The results

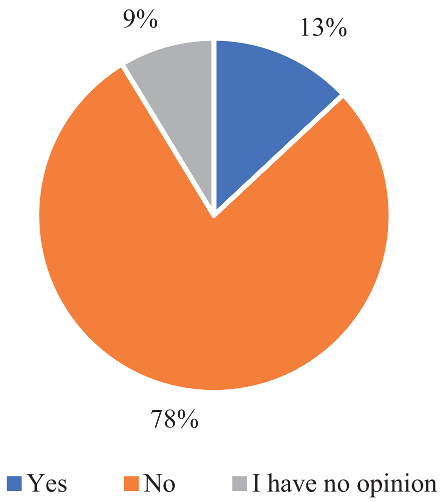

Figure 7. The company's ability to independently carry out the electrification of its vehicle fleet

Rysunek 7. Możliwości firmy w zakresie samodzielnego przeprowadzenia procesu elektryfikacji floty pojazdów

Source: own research

Źródło: badania własne

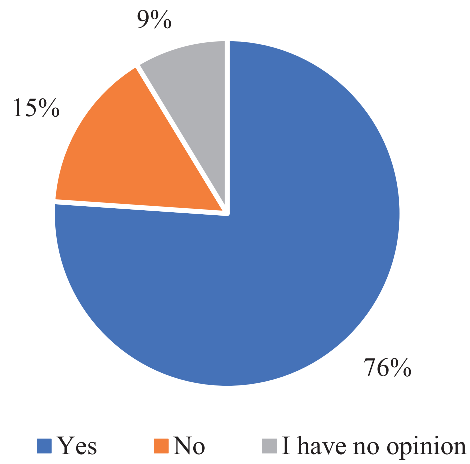

Figure 8. Vehicle fleet replacement and external support

Rysunek 8. Wymiana floty pojazdów a konieczność skorzystania ze wsparcia zewnętrznego

Source: own research

Źródło: badania własne

for question 8 are very similar: 76% of respondents said that their companies could only carry out the electrification process if they received adequate external financial support. In comparison, 15% believe that they would not need such support. The results indicate that to enable a rapid transition of the sector to electricity, the Polish government should introduce appropriate support instruments, as most companies lack the necessary resources to undertake this process independently. These instruments do not have to be limited to direct financial support, but can also include tax breaks or the expansion of charging infrastructure.

Therefore, in the next part of the survey, respondents were asked about the issue of subsidies for electric vehicles (Figure 9).

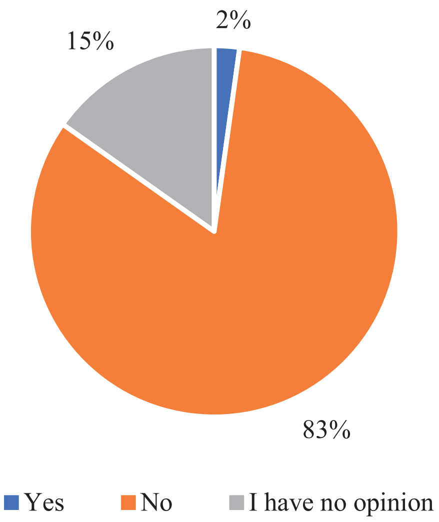

Figure 9. Level of subsidies for the purchase of electric trucks

Rysunek 9. Konieczność dofinansowania zakupu elektrycznych pojazdów ciężarowych

Source: own research

Źródło: badania własne

The respondents' answers are clear, indicating a very low level of funding for replacing rolling stock with electric vehicles. Only 2% of respondents stated that it was sufficient. Therefore, if the transport-forwarding-logistics sector entities were to invest their own funds, the purchase of such vehicles should affect the profitability of their operations, among other things, by reducing vehicle maintenance costs. Opinions on this subject are summarized in Figure 9.

The belief among Polish transport-forwarding-logistics companies that operating electric vehicles is cheaper would likely change the perception of this process among industry professionals to a more positive one. However, as can be seen in Figure 10, over 80% of respondents believe that costs will not decrease, and moreover, as many as 63% of respondents believe that costs will increase in the long term. Only 4 % of respondents believe that the electrification of the truck fleet will reduce the operating expenses of transport-forwarding-logistics companies in the long term. The responses presented are certainly one of the most important reasons for the negative perception of electromobility in heavy transport – many transport-forwarding-logistics companies, especially

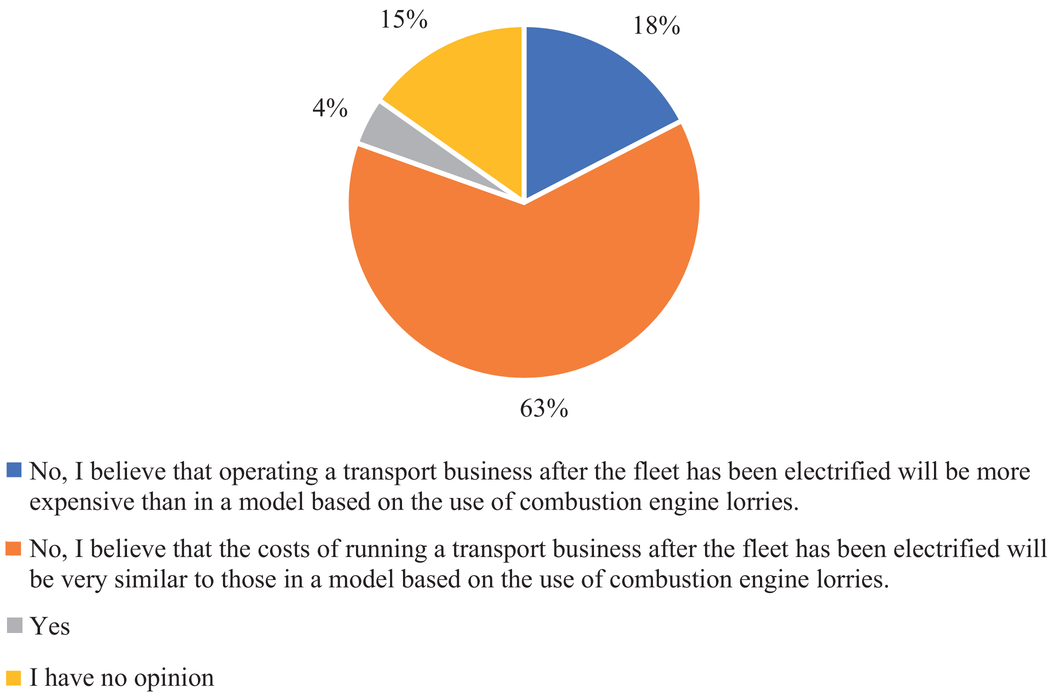

Figure 10. The process of electrifying the truck fleet in transport-forwarding-logistics companies and reducing transport costs in the long term

Rysunek 10. Proces elektryfikacji floty pojazdów ciężarowych w firmach TSL a redukcja kosztów działalności transportowej w perspektywie długoterminowej

Source: own research

Źródło: badania własne

small ones, are already struggling with low business profitability, so the prospect of even higher costs is certainly not optimistic for them.

However, the potential disadvantages of electromobility in heavy transport are not limited to operating costs. To determine which disadvantages are most important to respondents, they were asked to select up to three (some respondents selected more) of the most significant disadvantages of introducing electromobility in the transport-forwarding-logistics sector. The responses are presented in Figure 11.

Among the disadvantages of electromobility in heavy transport indicated by the respondents, the most common answers pointed to the high purchase costs of electric trucks and charging infrastructure, as well as the lack of adequate public charging infrastructure to enable efficient transportation processes. Next, the respondents equally often indicated that the reduction in time efficiency and range of the fleet, as well as the increase in transport costs, were disadvantages. Other important issues included changes in business operations (operating costs, vehicle and driver scheduling, investments, business strategies, insurance, and new challenges), the lack of adequate government support instruments, and the limited range of electric trucks available on the market. The problem of inadequate charging infrastructure is likely to be significantly accelerated by the AFIR. In contrast, the inconvenience of high purchase costs for electric vehicles and charging infrastructure could be minimized through appropriate government support programs, following the example of Poland's western neighbors, such as Germany, France, Italy, the Netherlands, and Spain.

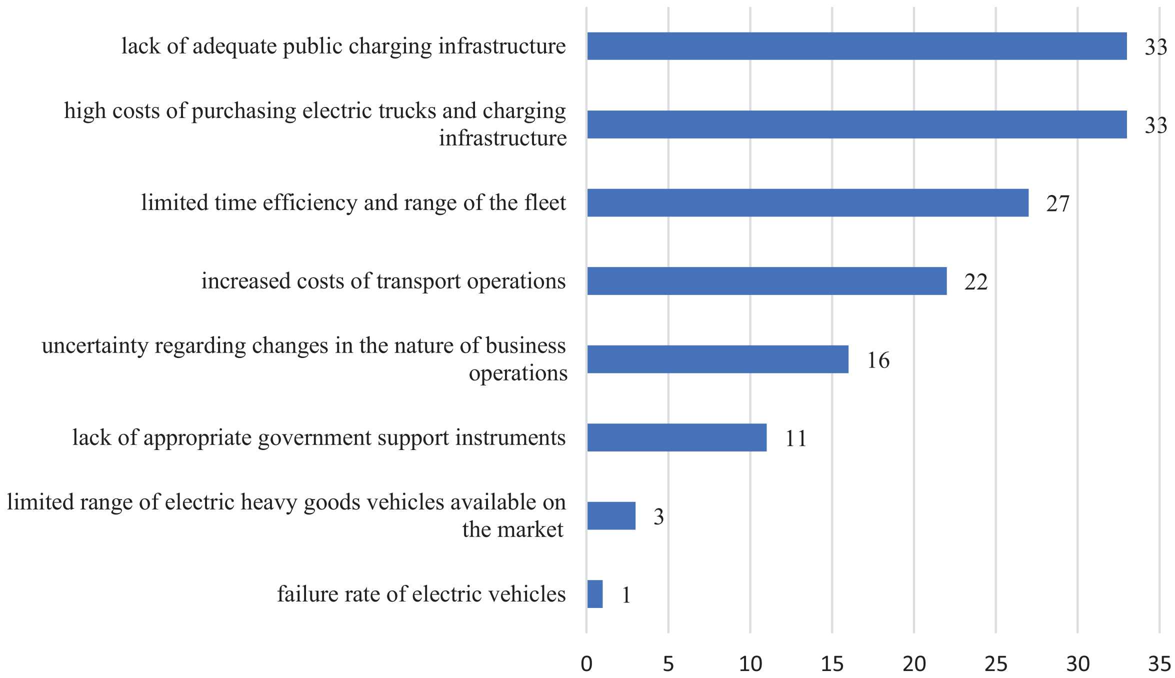

Figure 11. The main obstacles in the process of electrifying heavy-duty vehicles
Rysunek 11. Główne przeszkody w procesie elektryfikacji pojazdów ciężarowych
Source: own research
Źródło: badania własne

The concept of electromobility in heavy transport, apart from the disadvantages presented earlier, also has several potential advantages. To determine the benefits that representatives of the Polish transport-forwarding-logistics sector see in electromobility for heavy transport, the respondents were asked a question similar to the previous one, but this time concerning the advantages of electromobility (Figure 12).

The advantages most frequently mentioned by respondents were increased competitiveness of the company on the market, enabling cooperation with customers expecting eco-friendly transport, the possibility of entering clean transport zones, reducing greenhouse gas emissions, reducing expenditure on fuel for heavy goods vehicles, and the creation of a positive image for the company (Figure 12). These choices suggest that almost half of the respondents see advantages in gaining a potential market advantage precisely through the use of electromobility in companies. Other benefits that some respondents consider significant include reducing greenhouse gas emissions, lowering expenses incurred for the purchase of fuel for heavy goods vehicles, decreasing failure rates and maintenance costs for trucks, reducing the company's dependence on volatile fossil fuel prices, and contributing to greater energy independence in Poland. The least frequently selected option by respondents was improving drivers' working conditions.

Referring to the advantages most frequently chosen by respondents and their potential reasons, a question was asked about how, according to the respondents, their customers would perceive the offer of transport by eHDV vehicles and whether they would be able to obtain better terms of cooperation as a result (Figure 13).

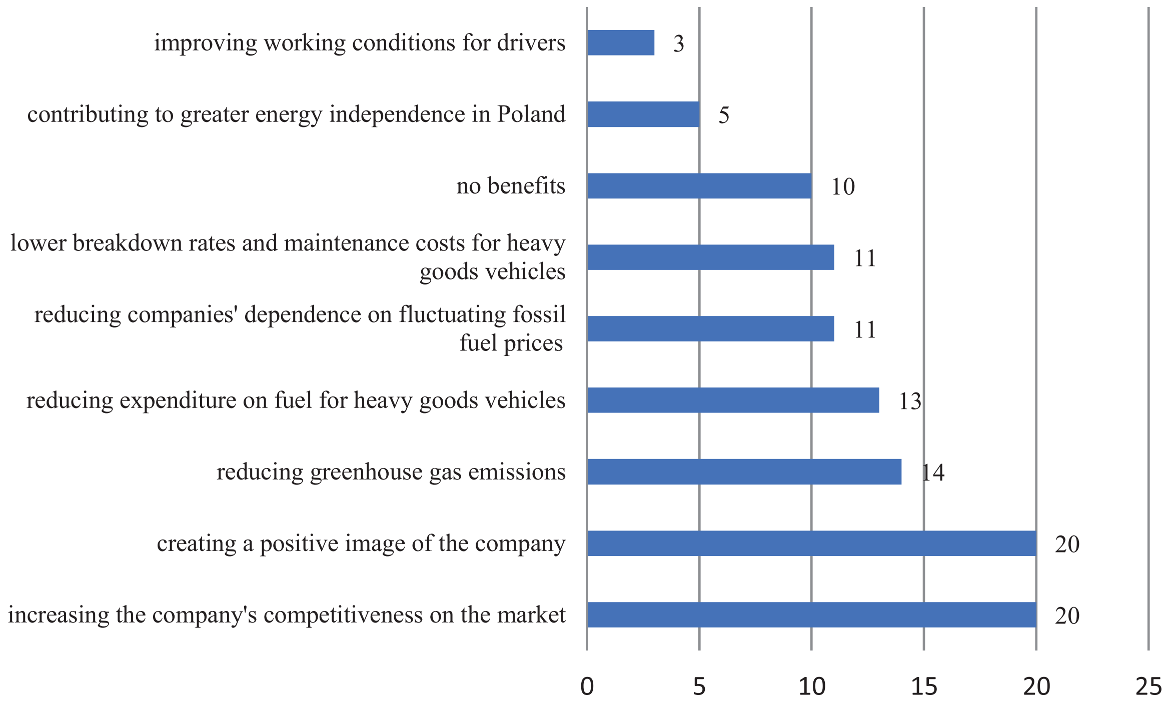

Figure 12. Potential benefits of fleet renewal

Rysunek 12. Możliwe do osiągnięcia korzyści wynikające z wymiany floty pojazdów

Source: own research

Źródło: badania własne

It follows from the above that currently the vast majority of transport-forwarding--logistics companies do not view positively the possibility of obtaining better terms of cooperation from customers in the name of environmentally friendly transport. 87% of respondents believe that their customers would not be willing to provide better terms of collaboration, with as many as 52.2% of all respondents believing that customers are indifferent to the type of vehicles used to transport their goods. 28.3% of respondents believe that customers would respond positively to the fact that eHDV vehicles are used for transport, but would not be willing to improve the terms of cooperation as a result. Only 13% of transport-forwarding-logistics company representatives believe that environmentally friendly transport using electric trucks would encourage the company’s contractors to offer more favorable terms of cooperation. 6.5% of respondents believe that customers would react negatively to such an idea, and therefore, they would certainly not be able to count on higher payments for their services; perhaps even their relationships with customers would deteriorate. As can be seen from the results presented, the existing barriers to the development of electromobility lie not only with service providers, but also with service recipients, the vast majority of whom are likely to seek contractors who are competitive in terms of price, high quality, and repeatability, without paying particular attention to the environmental friendliness of the service. From the above results, the development of electromobility in heavy transport must be conditioned not only by a change in awareness and investments on the part of transport-forwarding-logistics companies providing services, but also by the service recipients.

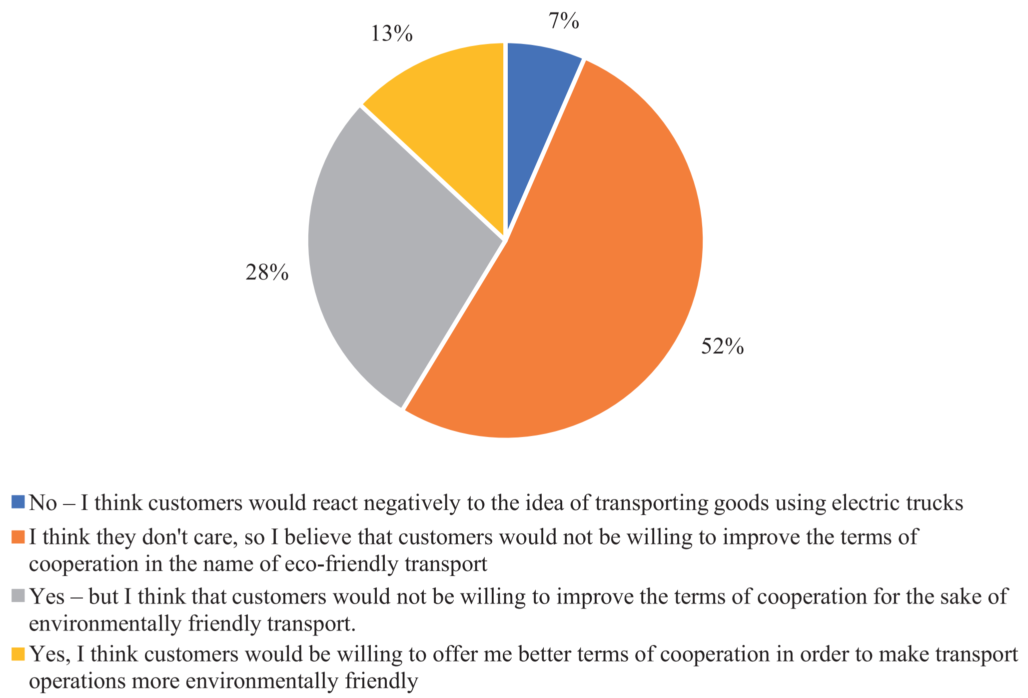

Figure 13. The impact of vehicle electrification on customer opinions
Rysunek 13. Wpływ elektryfikacji pojazdów firmy na opinie jej klientów

Source: own research
Źródło: badania własne

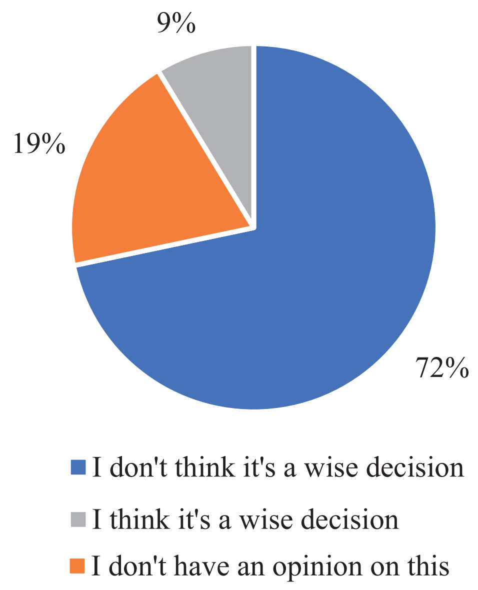

Figure 14. Opinion on the declaration by leading truck manufacturers (Scania, MAN, Volvo, Mercedes/Daimler, DAF, Renault, Iveco) to sell only electric trucks from 2040
Rysunek 14. Opinia na temat deklaracji wiodących producentów samochodów ciężarowych (Scania, MAN, Volvo, Mercedes/Daimler, DAF, Renault, Iveco) dot. sprzedaży wyłącznie samochodów elektrycznych od 2040 roku

Source: own research
Źródło: badania własne

Respondents were also asked for their opinion on the fact that a significant number of leading truck manufacturers have declared that they will only sell electric vehicles from 2040. The results are shown in Figure 14**.**

As can be seen, the vast majority of respondents, namely 71.7%, do not consider this decision reasonable (Figure 14). Only 8.7% consider this decision wise. The results presented indicate that respondents are reluctant to accept the possibility that they may not be able to purchase new combustion engine vehicles in the future.

The last question asked of respondents was an optional open-ended question, in which respondents were asked to provide a few sentences expressing their personal opinion on the process of electrifying heavy road transport. This question could provide a great deal of insight, as it gave respondents the freedom to express themselves and the opportunity to elaborate on their answers to previous questions, adding their own comments and opinions. More than half of the respondents decided to answer this question in various forms – from several sentences to one-sentence statements. Selected responses are presented in Table 3.

Table 3. Selected opinions on the electrification of the truck fleet
Tabela 3. Wybrane opinie respondentów na temat elektryfikacji floty pojazdów ciężarowych

Opinions
I'm not very enthusiastic about the electrification of transport. If electrification is profitable, the market will take it into account on its own. Regulatory enforcement primarily serves large corporations that can withstand significant market changes over the long term. Unfortunately, as is often the case at the beginning of any change, these methods are consistently favored, only to reap all the rewards later on. Please take a look at LNG in trucks and how it has ultimately turned out in recent years. I suspect that the situation may be similar here. Electric trucks operating in logistics centers, distribution, and fixed lines – I consider this a topic worth considering, and it may have great benefits. Long-distance transport is currently out of the question. I dare to doubt that the electricity grid can cope with so many trucks charging at night. The transport infrastructure itself is struggling, and we are considering a complete electrification of it. If anything, I think it would be wiser to provide electrical connections for working cold stores, or possibly switch to electric refrigeration units – this aligns perfectly with the idea of Lärmschutz. On the other hand, I consider hybrids to be an interesting direction for development.
The thesis that electrifying trucks will improve the situation is incorrect. Road transport has developed significantly due to the decline of electric rail transport and the implementation of Just-in-Time delivery policies, which support truck transport and bring financial benefits, but are a burden on the environment. The main transport should be carried out by rail powered by renewable energy sources, as should last-mile transport—technology allows for this, and it will reduce the number of (combustion engine) trucks on the roads. Combustion engine transport should be limited to the route between the railway station and the transshipment hub/warehouses or to routes where rail cannot be used (oversized loads). We should return to creating buffer warehouses at production plants and move away from the Just-in-Time approach. The technology to reduce emissions already exists – rail! I encourage you to speak with manufacturing companies, ports, and other relevant organizations – they will confirm that they are most interested in rail transport, not electric trucks.
In my company's business model (double driver shifts), trucks travel an average of 20,000 km/month. With such distances, electric trucks cannot replace combustion engine vehicles. Range and charging time kill the business model.
It's a utopia. Lack of infrastructure and a too-long charging process. Low battery capacity. The only way to move away from fossil fuels is to use hydrogen engines.

Table 3 (continued)
cd. tabeli 3

Opinions
Heavy transport electrification technology is a developing field. Suppose advances in this area allow it to achieve the same or very similar performance to combustion engines. In that case, it will be an alternative and perhaps even the dominant method of heavy transport in the future.
For representatives of transport companies, it does not matter whether they use combustion engines or electric cars. Switching to electric cars will not be a problem if the technology (range, charging time) and infrastructure in Europe allow for the optimal use of electric cars. At this point, the purchase price of such a car and the poor charging infrastructure make it completely unprofitable.
It's too early for that, especially in our country. The first step should be to create a modern energy network and modern power plants (not coal-fired ones, which pollute the environment the most).
When it comes to electromobility in road transport, it only makes sense in services such as courier services, distribution services, and urban transport, rather than driving around in circles. When it comes to long-distance transport, it makes no sense due to the lack of infrastructure, difficulties related to compliance with drivers' working hours, and numerous other factors. I will leave financial and environmental issues unaddressed, as this requires a specific analysis for a particular company.

Source: own research
Źródło: badania własne

The opinions presented do not clearly indicate an aversion to the electrification of heavy goods vehicles, but rather highlight the problems associated with this solution, while suggesting the use of hydrogen and other fuels as alternatives to electric vehicles. In addition, attention was drawn to another issue, namely the source of energy. Until electric vehicles are environmentally friendly, it is difficult to call them environmentally friendly.

Selected relationships between the characteristics of the entities studied and factors influencing the development of electromobility

In order to find statistical relationships between variables, Spearman's rank correlation test was used. The results obtained are summarized in Table 4.

As shown in Table 4, there are only three cases of correlation between variables, namely:

- the number of employees and restrictive regulations concerning exhaust emissions – moderate correlation,
- the number of employees and the intention to purchase an electric truck within the next 5 years – weak correlation.
- the number of employees and the impact of vehicles – moderate correlation.

The fact that exhaust emission regulations are restrictive and do not require changes was supported by 41.43% of entities employing the smallest number of people and 66.67% of companies employing between 50 and 249 people. For other companies, the rates were 28.57% for those employing 10–49 people and 25.00% for those employing more than 250 people.

Table 4. Selected relationships between the characteristics of the entities studied and factors influencing the development of electromobility
Tabela 4. Wybrane zależności między cechami badanych podmiotów a czynnikami wpływającymi na rozwój elektromobilności

Variable	r_S	t	P
The validity of the idea of electrifying heavy transport			
Type of business activity	–0.11	–0.71	0.48
Period of operation of the company	0.04	0.23	0.82
Number of employees	0.15	0.99	0.33
Restrictive regulations concerning exhaust emissions			
Type of business activity	–0.13	–0.92	0.36
Period of operation of the company	0.20	1.37	0.18
Number of employees	0.38	2.70	0.01
Intention to purchase an electric truck within the next 5 years			
Type of business activity	–0.10	–0.67	0.50
Period of operation of the company	–0.12	–0.77	0.45
Number of employees	0.31	2.20	0.03
The process of electrifying the truck fleet in transport-forwarding-logistics companies and reducing transport costs in the long term			
Type of business activity	0.14	0.94	0.35
Period of operation of the company	0.11	0.74	0.46
Number of employees	–0.23	–1.62	0.11
The impact of vehicle electrification on customer opinions			
Type of business activity	–0.25	–1.74	0.09
Period of operation of the company	–0.13	–0.88	0.39
Number of employees	0.41	2.99	0.00
Opinion on the declaration by leading truck manufacturers (Scania, MAN, Volvo, Mercedes/Daimler, DAF, Renault, Iveco) to sell only electric trucks from 2040			
Type of business activity	–0.07	–0.43	0.67
Period of operation of the company	–0.03	–0.23	0.82
Number of employees	0.08	0.51	0.61

$p = 0.05$

Source: own research

Źródło: badania własne

In turn, as many as 80.95% of companies employing up to 9 employees, 64.29% of companies employing 10–49 employees, 60% of companies employing over 250 employees, and 33.33% of companies employing 50–249 employees do not plan to purchase an electric vehicle within the next 5 years.

Taking into account the latter correlation, in the three groups of surveyed companies (except for those employing more than 250 people), the most common statement was that the company's customers are indifferent to sustainability issues. On the other hand, representatives of companies employing the most significant number of people most often indicated that operating with electric cars would be perceived positively. Still, customers would not be willing to improve the terms of cooperation in the name of eco-friendly transportation.

Discussion and conclusion

The results of the study presented in this article are not representative, so detailed conclusions can only be drawn for the research sample. However, it can be assumed with some certainty that the relationships observed in the sample are consistent with those found in the entire transport-forwarding-logistics sector.

There are few studies on the electrification of heavy-duty vehicles, and this study offers a new perspective on how entrepreneurs perceive electromobility in the transport-forwarding-logistics sector. Previous publications have primarily focused on identifying barriers to the electrification of trucks, rather than on how these barriers can be managed [Konstantinou & Gkritza 2023], and on purchasing preferences related to vehicle characteristics [Buranelli de Oliveira et al. 2022; Ye et al. 2021; Liu et al. 2021].

The research indicates that the vast majority of respondents are opposed to the introduction of electromobility in the heavy transport sector, citing numerous disadvantages and fewer advantages and benefits associated with this concept. There are several reasons for this negative attitude, with respondents most often citing the high purchase costs of such vehicles and the lack of public charging infrastructure as the primary factors influencing their negative perception of using eHDVs in business. Entrepreneurs from the transport-forwarding-logistics industry show a great interest in the electromobility sector, even though only a small percentage plan to implement such solutions in the future. The vast majority of Polish companies from the transport-forwarding-logistics sector cannot currently afford to electrify their truck fleets, and the situation is exacerbated by the fact that the Polish government has not yet introduced subsidies for the purchase of such vehicles. This conclusion is consistent with the findings of Hargadon [2011], who pointed out that the market needs more "knowledge" and cooperation to enable the development of electromobility, as well as a government investing in new technologies to reduce the investment costs incurred by customers.

Nevertheless, opinions among transport-forwarding-logistics company representatives on the need to introduce such subsidies as soon as possible are divided. Almost half of the respondents believe that action should be taken to minimize climate change. A significantly smaller percentage of respondents see the need and justification for taking action in their business sphere, including fleet electrification, tightening emissions regulations, and introducing clean transport zones. The vast majority of entrepreneurs do not perceive the benefits of electromobility in terms of reducing transportation costs, which is undoubtedly a significant factor contributing to their negative attitude towards this concept. Hargadon [2015] came to similar conclusions, stating that the challenge for sustainable innovation is the lack of “knowledge”, not how to deal with this challenge.

Among the most frequently mentioned advantages of electromobility in the heavy transport sector, entrepreneurs emphasized the creation of a positive company image and increased market competitiveness. A large percentage of respondents see a potential benefit in the form of increased competitiveness for their company; however, this is not reflected in concerns about a decline in competitiveness if electromobility is not adopted in the future. A few respondents believe that this could put their company at a competitive disadvantage. Some respondents are sceptical about the actual environmental friendliness of this idea, pointing, among other things, to the short life span of batteries, which are difficult to dispose of, and the high environmental costs of production, while pointing to other solutions that support the environmental friendliness of the transport sector, such as the use of hydrogen fuel cells. Other researchers have also written about the validity of using hydrogen fuel cells in road transportation [Moriarty & Honnery 2019; Veza et al. 2025; Zhu et al. 2023]. Another concept presented in the studies was to support the development of rail transport as the primary means of long-distance land transport.

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