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MONITORING OF THE IMPLEMENTATION OF THE EUROPEAN UNION'S SUSTAINABLE TRANSPORT DEVELOPMENT POLICY REGARDING THE USE OF LOW- AND ZERO-EMISSION FLEET ON THE EXAMPLE OF THE GÓRNOŚLĄSKA-ZAGŁĘBIOWSKA METROPOLIS (POLAND)

Summary. Nowadays, the majority of society decides to use individual transport for everyday travel, which negatively affects the congestion of cities. Nevertheless, in the transport policy of the European Union, public transport is becoming more and more important, which is reflected in strategic documents in the field of sustainable transport development. The effect of this action is to increase the attractiveness of public collective transport, which will also translate into a reduction in pollutant emissions. This article aims to verify the implementation of the European Union's sustainable transport development policy concerning the use of low- and zero-emission rolling stock in the Upper Silesian and Zagłębie

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Metropolis. As part of the work, the strategic documents of the European Union in the field of sustainable development of transport were analysed. In addition, the idea of establishing the Upper Silesian-Zagłębie Metropolis in the context of the policy of sustainable transport development was introduced and the public transport system functioning in the area of the Metropolis GZM was characterized.

Keywords: sustainable development, urban transport, emission standards, low-emission transport, zero-emission transport, emission standards, drive type

1. INTRODUCTION

Nowadays, the majority of society decides to use individual transport for everyday travel, which negatively affects the congestion of cities. People have to deal with the negative health effects caused by the pollution resulting from the increasing number of cars [1, 4, 20]. After all, over the last few decades, the level of human consciousness has been constantly increasing. Actions are being implemented to improve the quality of life of city dwellers without negative consequences for the lives of future generations [2, 13]. Public collective transport is becoming more and more important in the transport policy of the European Union, which is reflected in many strategic documents. The justification for such a position is the role of public transport as a factor regulating and stabilizing the division of transport tasks serving the implementation of sustainable development [16].

The aim of the article was to verify the implementation of the policy of sustainable transport development in the European Union in the field of the use of low- and zero-emission rolling stock in the area of the Upper Silesian and Zagłębie Metropolis. As part of the work, the strategic documents of the European Union in the field of sustainable development of transport were analysed. In addition, the idea of establishing the Upper Silesian-Zagłębie Metropolis in the context of the policy of sustainable transport development was introduced and the public transport system functioning in the area of the Metropolis GZM was characterized. The article consists of five chapters, after the introduction. The second chapter presents an analysis of EU strategic documents in the field of shaping the policy of sustainable transport development. The third chapter characterizes the tasks carried out by the Górnolska-Zagbiowska Metropolis in the context of sustainable transport development. The implementation of these tasks will contribute to achieving greater integrity, spatial, social and economic cohesion to ensure an appropriate level of quality of life for residents. The fourth chapter presents an analysis of the use of low- and zero-emission rolling stock in the area of the Upper Silesian and Zagłębie metropolis. The article ends with conclusions from the conducted analysis.

2. ANALYSIS OF STRATEGIC DOCUMENTS OF THE EUROPEAN UNION IN THE SCOPE OF SHAPING SUSTAINABLE TRANSPORT DEVELOPMENT POLICY

Public transport in Poland has been dominated for years by buses equipped with internal combustion engines, which emit harmful compounds into the atmosphere during operation during the combustion of fuels. In cities with heavy traffic, this is an important problem. Currently, internal combustion engines emit up to 70% of nitrogen oxides and up to 90% of other air pollutants in urbanized areas. The most harmful exhaust components include nitrogen oxides, carbon oxides, hydrocarbons, solid particles, sulphur oxides and aldehydes [14, 18, 24]. The negative impact of exhaust fumes on the environment required measures to minimize their

impact on the urban environment. Since the 90s of the last century, the automotive industry has been developing and implementing technologies to reduce the emission of harmful substances generated in internal combustion engines. The uneven development of technologies in the field of reducing pollutants in exhaust gases has led to the development of European Exhaust Emission Standards (EURO). Since 2000, the European Union has been gradually tightening the applicable emission standards. Since 2012, the EURO VI combustion standard has been in force, which assumes an 80% reduction in the content of nitrogen oxides in exhaust gases compared to the EURO V standard [5, 7, 12, 18, 23, 24]. Nevertheless, public transport seems to offer a more rational use of the natural environment [20] because it reduces fuel consumption, exhaust emissions [11, 14, 25] and noise. Sustainable transport emphasizes the control of emissions of harmful compounds in exhaust gases, and in the long term, the transition from transport using fossil fuels to one that will use renewable energy. In addition, it also assumes a reduction in the share of car traffic in urban space and an increase in the competitiveness of public transport [12, 17]. The concept of sustainable public transport combines high-quality transport with care for the environment [6]. For this reason, it is increasingly important that public transport vehicles have a source of power other than diesel or petrol.

Both the European Union and Poland, in strategic documents, define guidelines aimed at reducing the negative impact of exhaust gas emissions on the environment. Pursuant to Article 36, paragraph 1 and in connection with Article 86, point 4 [3], from January 1, 2028, a local government unit, with the exception of communes and poviats, whose population does not exceed 50,000, will be obliged to provide or commission a service public transport services to an entity whose fleet of vehicles used in the area of this unit includes at least 30% of zero-emission buses. In order to facilitate meeting the threshold described above in 2028, the Act provided for intermediate goals to be achieved earlier. One of the obligations provided for in the Act, concerning organizers and operators of public collective transport, is the provision by local government units referred to in Art. 36, sec. 1 (over 50,000 inhabitants), the share of zero-emission buses in the fleet of vehicles in use amounting to: from 01/01/2021 – 5%, from 01/01/2023 – 10%, from 01/01/2025 – 20% [21].

Another document prepared by the European Union on the subject of sustainable development is the European Green Deal. The European Green Deal was adopted on December 11, 2019 and aims to make Europe the first climate-neutral continent by 2050. The Green Deal is an integral part of the current Commission's strategy to implement the UN's 2030 Agenda for Sustainable Development and the Sustainable Development Goals. By acting together, the EU is able to put its economy and society on a new track towards greater sustainability [15].

In July 2021, the European Commission adopted the document “Fit for 55”, which is a set of policy proposals preparing the implementation of the European Green Deal. Below are the main assumptions of the “Fit for 55” package:

- reducing emissions in the transport sector by 90% by 2050,
- cheaper, more accessible, healthier and cleaner transport solutions for passengers,
- stronger support for intermodal transport,
- significantly increased role of railways and inland waterways in inland freight transport, 75% of which is now road transport,
- thanks to digitization, intelligent traffic management systems and automated and networked multimodal mobility,
- 1 million public charging and refuelling stations by 2025 to service 13 million zero- and low-emission vehicles,
- drastically reducing the level of pollution generated by transport, especially in cities [16].

3. TASKS CARRIED OUT BY THE UPPER SILESIAN-ZAGLEBIOWSKA METROPOLIS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT OF TRANSPORT

The Górnośląsko-Zagłębiowska Metropolis is a metropolitan association located in the Silesian Voivodeship. It was established on the basis of the Metropolitan Association Act of March 9, 2017 and associates 41 municipalities of the Silesian Voivodeship. This metropolis is focused on spatial, social and economic integrity and cohesion in order to ensure an appropriate level of quality of life for its inhabitants [8]. The metropolitan association performs public tasks in the field of:

- shaping spatial order,
- social and economic development of the metropolitan area,
- planning, coordination, integration, and development of public collective transport, including road, rail and other rail transport, as well as sustainable urban mobility,
- metropolitan passenger transport,
- cooperation in determining the route of national and voivodeship roads in the area of the metropolitan union,
- promotion of the metropolitan association and its area [9].

The Metropolitan Transport Authority was appointed by a resolution by the Assembly of the Upper Silesian and Zagłębie Metropolis in November 2017, and on January 1, 2019 it took over the duties of the three previous organizers of public transport (KZK GOP, MPK Tychy, MZKP Tarnowskie Góry). The combination of these public transport systems operating in Silesia and Zagłębie into one company made ZTM the largest transport organizer in Poland in many respects [26].

In the area of the Upper Silesian and Zagłębie Metropolis, there are:

- 31 metropolitan lines,
- 377 normal bus lines,
- 19 night bus lines,
- 14 replacement bus lines for the tram,
- 1 free line,
- 22 tram lines,
- trolleybus lines [27].

The Górnośląsko-Zagłębiowska Metropolis and the Metropolitan Transport Authority implement the goals of sustainable development, which particularly contribute to the fulfilment of the 2030 Agenda issues related to improving the quality of life of residents, including counteracting low emissions, supporting energy efficiency, sustainable mobility, improving public transport, greening cities, protecting and increasing biodiversity in Metropolis GZM [10].

4. ANALYSIS OF THE USE OF LOW- AND ZERO-EMISSION FLEET IN THE AREA OF THE GÓRNOŚLĄSKO-ZAGLEBIOWSKA METROPOLIS

Public transport operators that provide transport services at the request of the Metropolitan Transport Authority currently have a fleet of 1,487 vehicles, of which 1,222 vehicles are powered by diesel, 144 vehicles are powered by compressed natural gas, 74 vehicles are hybrid

vehicles, and 47 vehicles are powered electrically. The figure below shows vehicles with the aforementioned power sources that carry out transport in the area of the Górnośląsko-Zagłębiowska Metropolis.

a)



b)



c)



d)



Fig. 1. Photos of buses with selected types of drive types in the area of the Upper Silesian-Zagłębie Metropolis, a) powered by diesel, b) electric, c) hybrid, d) powered by CNG gas
Source: own study

Figure 2 shows the number of buses providing transport services in the area of the Górnośląsko-Zagłębiowska Metropolis in terms of exhaust emission standards in 2020.

In 2020, vehicles meeting the Euro 5 (513 vehicles) and Euro 6 (512 vehicles) standards definitely prevailed. The smallest number of vehicles met the Euro 2 standard. 17 vehicles carrying out transport in the area of the Upper Silesian and Zagłębie Metropolis are electric buses.

Figure 3 shows the number of buses providing transport services in the area of the Górnośląsko-Zagłębiowska Metropolis in terms of exhaust emission standards in 2022.

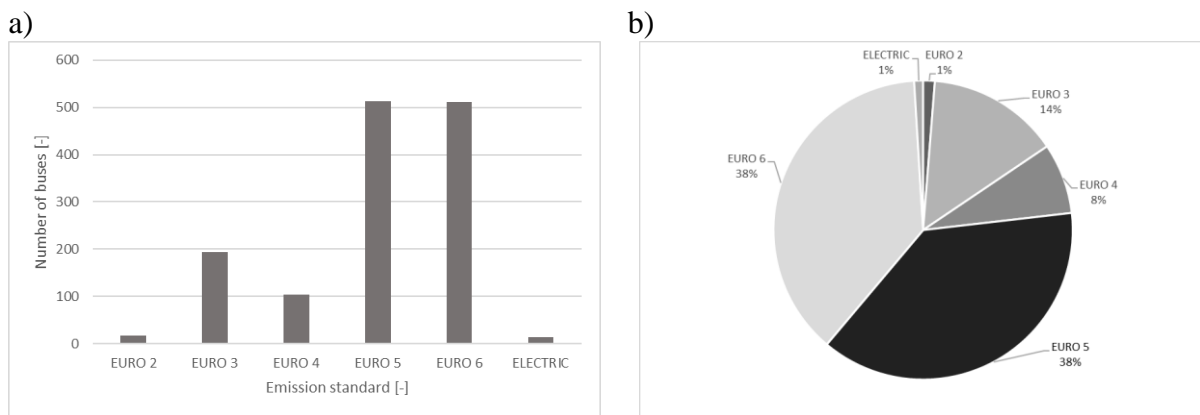


Fig. 2. Number of buses providing transport services in the area of the Górnślasko-Zagłębiowska Metropolis in terms of exhaust emission standards – as of 2020, a) number of vehicles, b) percentage share

Source: own study based on data received from the Metropolitan Transport Authority

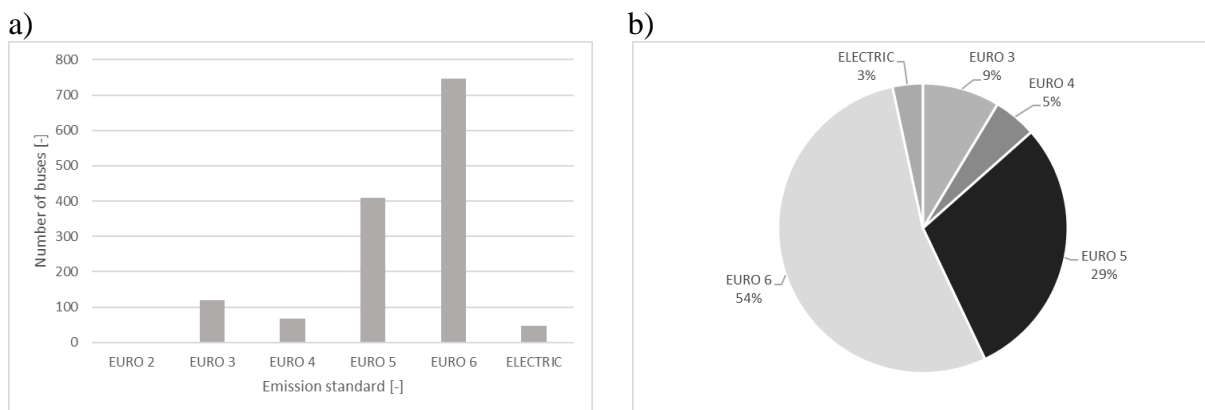


Fig. 3. Number of buses providing transport services in the area of the Górnślasko-Zagłębiowska Metropolis in terms of exhaust emission standards – as of 2022, a) number of vehicles, b) percentage share

Source: own study based on data received from the Metropolitan Transport Authority

In 2022, vehicles meeting the Euro 6 standard definitely prevailed (746 vehicles). It can also be noted that this year each vehicle met at least the Euro 3 standard. 47 vehicles carrying out transport in the area of the Upper Silesian and Zagłębie Metropolis are electric buses.

Figure 4 shows the number of buses providing transport services in the area of the Górnślasko-Zagłębiowska Metropolis in terms of exhaust emission standards in 2023.

In 2023, as in 2022, vehicles meeting the Euro 6 standard definitely prevailed (820 vehicles). 47 vehicles carrying out transport in the area of the Górnślasko-Zagłębiowska Metropolis are electric buses.

Figure 5 shows a comparison of the number of buses providing transport services in the area of the Górnślasko-Zagłębiowska Metropolis in terms of exhaust gas emission standards in all analysed years.

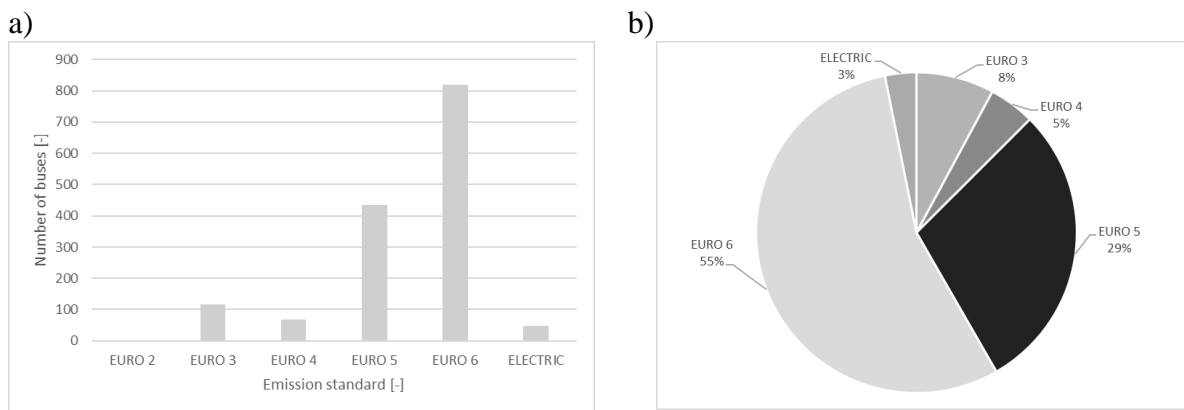


Fig. 4. Number of buses providing transport services in the area of the Górnośląsko-Zagłębiowska Metropolis in terms of exhaust emission standards – as of 2023, a) number of vehicles, b) percentage share

Source: own study based on data received from the Metropolitan Transport Authority

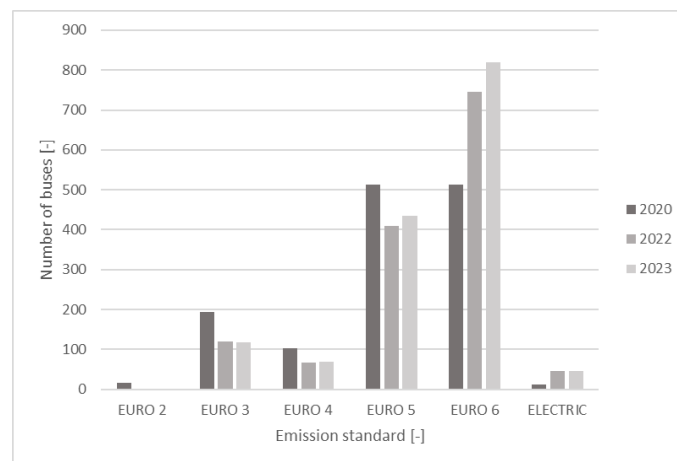


Fig. 5. Comparison of the number of buses providing transport services in the area of the Górnośląsko-Zagłębiowska Metropolis in terms of exhaust emission standards in the analysed years

Source: own study based on data received from the Metropolitan Transport Authority

In 2020, few buses operating in the area of the Górnośląsko-Zagłębiowska Metropolis met the Euro 2 emission standards. It should be noted that in the subsequent analysed years (2022 and 2023) operators resigned from rolling stock meeting this emission standard. It can be seen that the number of rolling stock meeting Euro 3 and Euro 4 standards is getting smaller every year, while the number of rolling stock meeting Euro 6 and electric rolling stock is gradually increasing. The number of rolling stock meeting the Euro 5 standard varies irregularly. This may be due to the fact that operators decide to replace the rolling stock with newer and more ecological ones, but not necessarily brand-new ones. The Metropolitan Transport Authority, when preparing tender procedures for the implementation of transport in public transport, indicates specific requirements for the operator's vehicles. And so, in accordance with the ZTM requirements, these requirements are tightened every year.

Figure 6 shows a comparison of the number of buses providing transport services in the area of the Górnośląsko-Zagłębiowska Metropolis in terms of the type of drive in 2020.

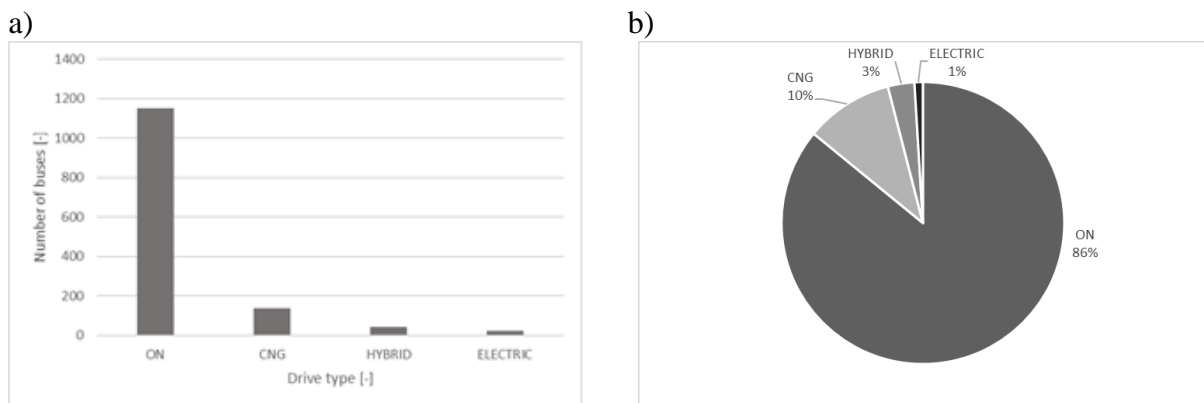


Fig. 6. The number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive – as of 2020,
a) number of vehicles, b) percentage share

Source: own study based on data received from the Metropolitan Transport Authority

In 2020, diesel-powered vehicles definitely prevailed (1,161 vehicles). The fewest vehicles were powered by electricity.

Figure 7 shows the number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive in 2022.

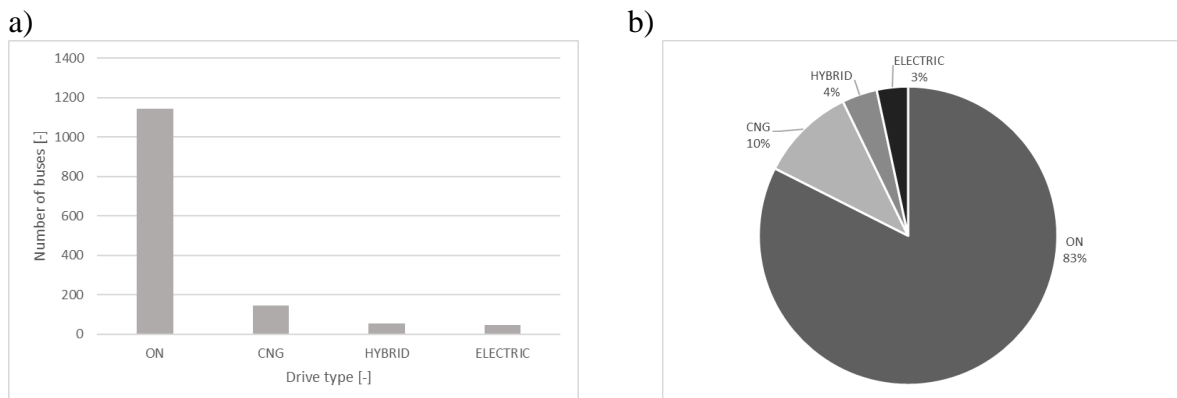


Fig. 7. The number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive – as of 2022,
a) number of vehicles, b) percentage share

Source: own study based on data received from the Metropolitan Transport Authority

In 2022, diesel-powered vehicles also prevailed (1,146 vehicles). The fewest vehicles, however, were powered by electricity.

Figure 8 shows a comparison of the number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive in 2023.

In 2022, diesel-powered vehicles also prevailed (1,222 vehicles). The fewest vehicles, however, were powered by electricity.

Figure 9 shows a comparison of the number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive in all analysed years.

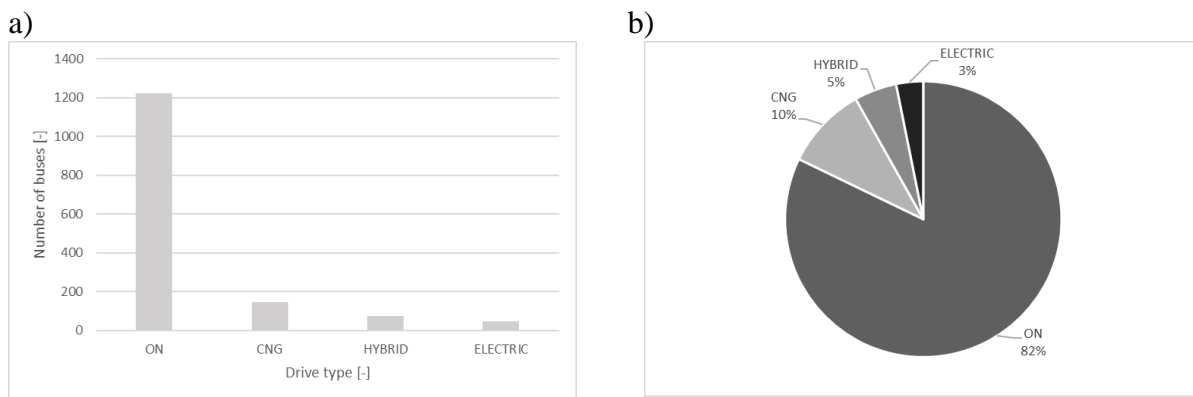


Fig. 8. The number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive – as of 2023,
a) number of vehicles, b) percentage share

Source: own study based on data received from the Metropolitan Transport Authority

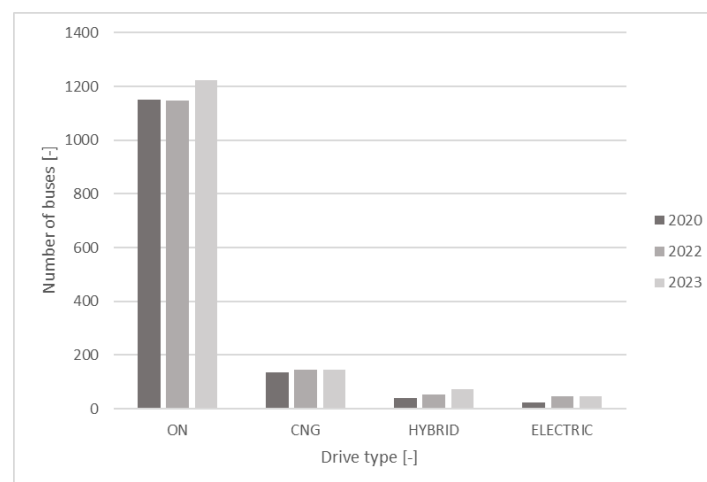


Fig. 9. Comparison of the number of buses providing transport services in the area of the Górnśląsko-Zagłębiowska Metropolis in terms of the type of drive in the analysed years
Source: own study based on data received from the Metropolitan Transport Authority

In all the analysed years, rolling stock powered by diesel oil prevailed in the area of the Górnśląsko-Zagłębiowska Metropolis. However, it can be noticed that the importance of low-emission rolling stock is increasing year by year. More and more buses are also powered by electricity. These activities contribute to the improvement of the quality of life of GZM residents. The development of electromobility translates into improved air quality and creates the prospect of creating new jobs in the industry created for the production of low- and zero-emission vehicles. These activities are in line with the 17 Sustainable Development Goals set out in the 2030 Agenda.

5. CONCLUSIONS

The aim of the article was to verify the implementation of the policy of sustainable transport development in the European Union in the field of the use of low- and zero-emission rolling stock in the area of the Upper Silesian and Zagłębie Metropolis. The analysis showed that the strategic documents of the European Union and Poland in the field of sustainable transport development policy did not include low-emission rolling stock, but only zero-emission rolling stock.

Pursuant to the Act of December 2, 2021 amending the Act on electromobility and alternative fuels and certain other acts, the share of zero-emission buses in the fleet of vehicles in use should be:

- from January 1, 2021 – 5%,
- from January 1, 2023 – 10%,
- from January 1, 2025 – 20%.

The analysis showed that from January 1, 2023, the share of zero-emission rolling stock in relation to the entire rolling stock operating in the area of the Górnośląsko-Zagłębiowska Metropolis is only 3.3%. This implies that both the target for 2023 and the one for 2021 have not been met. It can therefore be concluded that achieving a 20% share of zero-emission rolling stock in the area of the Metropolis in 2025 may be difficult to achieve.

The analysis also indicated that the number of rolling stock meeting the Euro 3 and Euro 4 standards is decreasing year by year, while the number of rolling stock meeting Euro 6 and electric rolling stock is gradually increasing. The number of rolling stock meeting the Euro 5 standard varies irregularly. This may be due to the fact that operators decide to replace the rolling stock with newer and more ecological ones, but not necessarily brand-new ones.

Due to the increasingly stringent requirements imposed by the Metropolitan Transport Authority on the vehicles of operators providing transport in public collective transport at the request of ZTM, the rolling stock utilized for transportation within the Górnolsko-Zagbiowska Metropolis is becoming increasingly ecological. This trend has a positive impact on the policy of sustainable transport development.

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