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ELECTROMOBILITY IN POLAND: CHALLENGES AND OPPORTUNITIES IN THE CONTEXT OF LEGAL REGULATIONS

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ABSTRACT: Purpose: This study analyses the impact of legal regulations on the transformation of urban bus fleets in Poland. Methodology/Approach: The research assesses municipal bus operators' readiness for zero-emission vehicles using fleet data, emission stats, and regulations. Findings: Significant disparities exist among cities in adopting zero-emission technologies, with leaders benefiting from financial support and laggards facing infrastructural and financial barriers. Research Limitations/Implications: The study is limited to cities with their own bus operators, which may not capture all transport models in Poland. Originality/Value: The study analyses Poland's urban transport sector within EU and national regulations using secondary data, assessing the impact of upcoming legislative changes on public transport operators.

KEYWORDS: environmental policy, public transport, zero-emission vehicles

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Introduction

The year 2015 can be considered the beginning of the operation of electric buses in Poland. The operator PKM Jaworzno was the first in Poland to introduce the Solaris Urbino 12 electric bus into operation (Wolański & Czerliński, 2024). Since then, they have been gaining popularity. This is related to regulations at both the EU and national levels.

Electromobility at the European Union level is regulated by Directive (EU) 2019/1161 of the European Parliament and the Council of 20 June 2019, which amends Directive 2009/33/EC to promote the use of environmentally friendly and energy-efficient vehicles in road transport. For Poland, the directive stipulates that between 2 August 2021 and 31 December 2025, at least 32% of newly ordered buses or vehicles used for public transport services must meet clean vehicle standards. From 1 January 2026 to 31 December 2030, this requirement increases to at least 46% for newly purchased vehicles. A threshold must be met at the national level.

In Poland, Directive 2019/1161 is implemented through the Act of 11 January 2018 on Electromobility and Alternative Fuels. According to the definition contained in Art. 2(1) of the Act on Electromobility and Alternative Fuels, a zero-emission bus may be a bus powered by electricity generated from hydrogen in fuel cells installed in it or equipped only with an engine operation cycle that does not lead to greenhouse gas emissions, i.e. a vehicle with an electric battery or network drive (trolleybus).

In 2021, the World Health Organization recommended a maximum level of 5 μg/m^3 for fine particulate matter for long term exposure in order to protect health (World Health Organization, 2021). As data of the European Environment Agency reveals, Polish cities are among those which are the most polluted (European Environmental Agency, 2024).

There is a project that from 2026, new public transport regulations will come into effect in Poland, requiring cities with over 100,000 residents to purchase zero-emission buses. The government regulations aim to promote sustainable transport and reduce the emission of harmful substances in urban areas (Council of Ministers, 2024).

The aim of the article is to analyse the impact of new, potential regulations on the transformation of urban bus fleets in Poland. The analysis is based on secondary data sources, including publicly available statistics and regulatory documents. The study focuses on cities with populations over 100,000 that have their own public transportation operators.

Electromobility and pollutant emissions

Public transportation is the primary source of human-made emissions of particulate and gaseous substances in PM2.5. Inhaling fine particulate matter (PM2.5) has been linked to significant health issues (Lee et al., 2017), for example cardiovascular diseases (Beckerman et al., 2012) or respiratory diseases (Li et al., 2018). According to the United States Environmental Protection Agency (2024), PM, which stands for particulate matter (or particle pollution), refers to a combination of tiny solid particles and liquid droplets that are suspended in the air. PM2.5 refers to particulate matter with a diameter of 2.5 micrometers or less.

In Poland, a report by the Polish Economic Institute (2019) indicated that approximately 43,000 premature deaths were recorded in Poland in 2019 due to the significant amount of PM2.5 particles in the air. The transportation sector is responsible for about 10.2% of PM2.5 emissions. Polish cities are among those which are the most polluted (European Environmental Agency, 2024). The table below shows levels of PM2.5 among selected Polish cities. Air quality is classified as good when the level of fine particulate matter does not exceed the annual value of 5 μg/m^3 set by the World Health Organization. It is considered fair for levels above 5 and up to 10 μg/m^3, moderate for levels above 10 and up to 15 μg/m^3, poor for levels above 15 and up to 25 μg/m^3, and very poor for levels equal to or greater than the European Union limit value of 25 μg/m^3.

As can be observed, the analysed cities have moderate and poor air quality. Zielona Góra has the lowest levels among all the cities included in the study. However, it is still moderate, so the higher the recommended value.

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Table 1. Levels of PM2.5 among selected Polish cities

City	Fine particulate matter in μg/m³	City	Fine particulate matter in μg/m³
1, Częstochowa	21,9	16. Toruń	14,1
2. Gliwice	19,8	17. Bydgoszcz	13,7
3. Kraków	19,5	18. Płock	13,5
4. Katowice	18,2	19. Gorzów Wielkopolski	13,4
5. Bielsko-Biała	17,9	20. Gdynia	13,3
6. Lublin	17,7	21. Gdańsk	12,7
7. Poznań	17,7	22. Olsztyn	12,5
8. Tarnów	17,4	23. Białystok	12
9. Kielce	17,2	24. Elbląg	11,9
10. Włocławek	16,2	25. Szczecin	11,1
11. Rzeszów	15,2	26. Koszalin	10,5
12. Łódź	15,1	27. Zielona Góra	10
13. Warszawa	15		
14. Wrocław	14,9		
15. Opole	14,5		

Source: European Environmental Agency (2024).

Electromobility is increasingly regarded as a solution to the rising greenhouse gas emissions in the transport sector. However, it is crucial to note that not all countries within the European Union have access to low-emission electricity sources. Consequently, the environmental impact of electromobility may be less significant than initially expected (Adamczyk et al., 2023). Poland is among those countries where electricity generation in percentage terms is still mainly based on coal, accounting for almost 70% (Koshlak et al., 2024).

According to the definition adopted by the European Union, a clean vehicle is one that significantly reduces greenhouse gas emissions and pollutants compared to traditional vehicles. In the case of buses, this mainly includes zero-emission vehicles such as electric or hydrogen-powered buses, as well as those fueled by alternative fuels such as biomethane, CNG, LNG, or synthetic fuels. However, this definition excludes fuels produced from raw materials with a high risk of causing land-use changes, emphasising the EU's commitment to sustainable and environmentally friendly transport development.

Research methods and results

As discussed earlier, the project of the new regulations applies to cities with more than 100,000 inhabitants. GUS (2024) data shows that on 30.06.2024 there are 36 such cities in Poland. The number of cities was narrowed down to 30 in the study, only those with their own public transport bus company were taken into account. This seems to be the right approach, as purchasing buses is a financial burden for the commune or a communal company that is the public transport operator. In cities with their own carrier, decisions regarding purchases and fleet modernisation are usually made at the local level, which allows for a detailed analysis of the decision-making processes and the barriers and challenges related to the introduction of new regulations. In this study, the operating period of a combustion bus was assumed to be 15 years, which is consistent with the results of previous studies and observations regarding the service life of vehicles in public transport (Raposo et al., 2019). Table 1 provides a list of cities with populations exceeding 100,000 along with the number of buses in their fleets. In some instances, particularly in the Silesia and Zagłębie regions, two cities are listed together. This is due to the fact that their public transport operator is jointly owned by multiple municipalities.

Table 2. Buses across cities (cities in order form the most populated)

City	Number of buses (zero-emission)	City	Number of buses (zero-emission)
Warszawa	1391 (161)	Toruń	153 (10)
Kraków	621 (121)	Sosnowiec/Dąbrowa Górnicza	250 (25)
Wrocław	335 (13)	Kielce	145 (0)
Łódź	438 (25)	Gliwice/Zabrze	182 (18)
Poznań	307 (83)	Olsztyn	153 (0)
Gdańsk	270 (31)	Bielsko-Biała	138 (2)
Szczecin	196 (16)	Zielona Góra	93 (69)
Lublin	259 (43)	Rybnik	36 (20)
Bydgoszcz	140 (0)	Opole	115 (13)
Białystok	258 (20)	Tychy	165 (0)
Katowice/Chorzów	244 (28)	Gorzów Wielkopolski	81 (8)
Gdynia	85 (24)	Płock	103 (0)
Częstochowa	206 (20)	Koszalin	71 (0)
Rzeszów	224 (18)	Tarnów	94 (0)
Radom	122 (24)	Włocławek	53 (16)

The largest fleet of urban buses is operated by the carrier in Warsaw, which is linked to the fact that it is the largest city in Poland by population. It is noteworthy that several cities, including Warsaw, Kraków, Wrocław, Łódź, Poznań, Gdańsk, Szczecin, Bydgoszcz, Katowice, Częstochowa, Toruń, Sosnowiec, Olsztyn, and Gorzów Wielkopolski, have well-developed tram networks, which complement their bus services. Additionally, trolleybuses which are also zero-emission vehicles, operate in Gdynia (103 units), Lublin (108 units), and Tychy (28 units). The variation in the share of zero-emission buses in the fleets of different cities is notable. Analysing the percentage share of such vehicles, the leaders are Zielona Góra (74%), Rybnik (56%), Gdynia (28%), and Poznań (27%), where this share exceeds one-quarter of the total number of vehicles. There are also cities without any zero-emission buses. However, tenders have been announced or are planned in the coming months.

Table 3 presents the number of combustion vehicles by year of production. Vehicles 15 years old and older in 2026 have been grouped together. Additionally, the data for 2024 covers the period from January to October. This allows for an analysis of the number of vehicles that would need to be replaced each year if the proposed regulations were implemented.

In 2026, more than 2,000 vehicles are projected to reach or exceed 15 years of age, thereby necessitating their replacement based on the outlined assumptions. However, replacing over 2,000 buses in a single year is unrealistic given the financial, logistical, and supply chain constraints of public transport operators. Additionally, the assumption that all operators uniformly replace vehicles after 15 years does not reflect current practices. In reality, the decision to replace vehicles depends on factors such as operational efficiency, maintenance costs, and availability of funding. As a result, many vehicles remain in service beyond this benchmark, further complicating fleet modernisation plans.

It is worth examining the number of zero-emission vehicles purchased in subsequent years. This will allow for a comparison between the number of diesel and zero-emission vehicles being bought.

The table shows the share of zero-emission vehicles in total purchases for the years 2021-2024 (2024 – from January to October only).

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Table 3. Age Structure of Urban Bus Fleets in Polish Cities (by Year of Production)

Year of production	Amount of buses
2011 and older	2078
2012	368
2013	384
2014	261
2015	382
2016	297
2017	463
2018	597
2019	453
2020	245
2021	228
2022	93
2023	240
I-X 2024	47

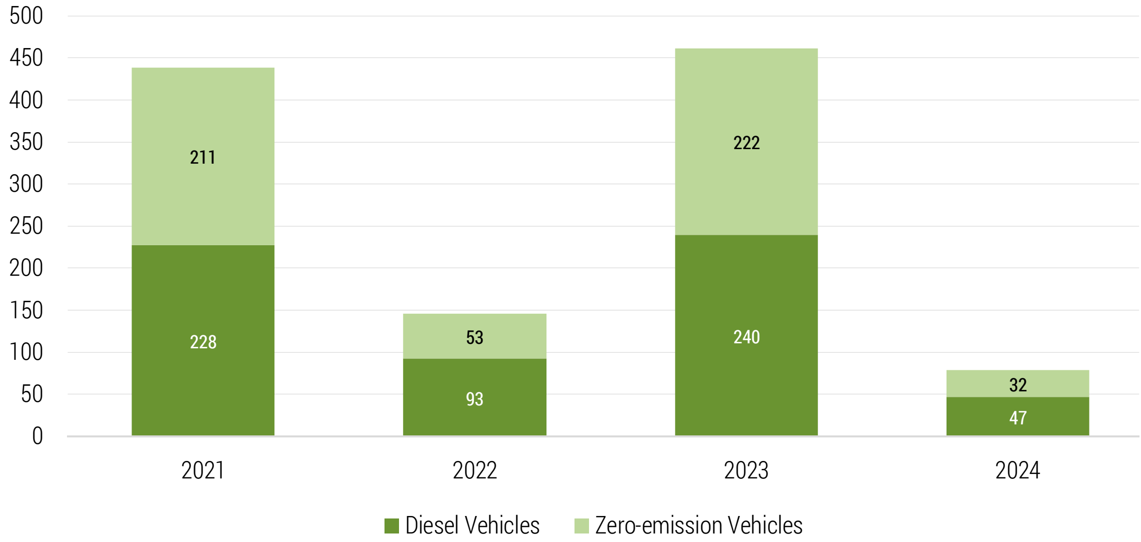

Figure 1. Share of Zero-emission Vehicles in Total Vehicle Purchases

The share of zero-emission vehicles in the examined cities exceeded 32% annually from 2021 to 2024. However, there is significant variation in the number of vehicles purchased in different years. Nevertheless, the quota mandated by Polish regulations in the Act has been achieved at the level of cities with over 100,000 inhabitants, but it is intended to be achieved nationwide.

It can be assumed that cities are capable of purchasing over 200 zero-emission vehicles annually. However, only in certain years would it be necessary to replace more than 200 diesel vehicles with zero-emission ones. In 2033, nearly 600 vehicles would need to be replaced (assuming a 15-year operational lifespan).

As highlighted in the IGKM report (2019), the purchase of an electric bus may cost twice as much as a diesel bus, while a hybrid bus can cost even three times more. It therefore seems that subsidies for purchases are essential.

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Green Public Transport (Zielony Transport Publiczny) is one of the programs supporting the purchase of zero-emission vehicles financed by the Polish government. The aim of the program is to reduce air pollution emissions by subsidising projects that decrease the use of emission-intensive fuels in transportation. The program provides funding for electric buses, trolleybuses, and hydrogen buses. Additionally, it includes training for drivers and mechanics, as well as the construction of necessary infrastructure (Green Public Transport, 2024).

So far, three editions of the program have taken place. In each edition, the beneficiaries were entities examined in this article. In the first edition, 30 entities received funding amounting to nearly 590 million PLN. In the second edition, 55 entities were funded with a total amount of 684 million PLN. The third edition is currently in the contract-signing phase. More than 2.7 billion PLN has been allocated to cover 716 electric buses, 144 hydrogen buses, 20 trolleybuses, and the required infrastructure, including training programs. Funding in the form of grants will be provided from the National Recovery Plan, known in Polish as Krajowy Plan Odbudowy, which is Poland's strategic framework for rebuilding and enhancing the resilience of its economy and society following the COVID-19 pandemic.

Among the analysed cities, beneficiaries of the first edition of the program included Wrocław, Opole, Szczecin, Włocławek, Gdynia, Toruń, Poznań, and Kraków. In the second edition, Rybnik and Warsaw were among the recipients. Additionally, the Upper Silesian Metropolis, a metropolitan area in southern Poland comprising multiple cities such as Katowice, Gliwice, Sosnowiec and Dąbrowa Górnicza, benefited from both editions of the program.

Therefore, it can be assumed that with half the budget, approximately 1.5 billion PLN, it would be possible to replace around 400 vehicles annually.

When replacing the fleet, aspects related to PM emissions are also important. According to IGKM data, only a small portion of the bus fleet in Poland consisted of vehicles with engines that did not meet Euro standards (1%) or only met the Euro 1 standard, which was in effect until 1996 (also 1%). Vehicles compliant with the Euro 2 standard made up 6% of the fleet, and engines meeting Euro 3 requirements were present in 14% of buses. The majority, 67%, were vehicles equipped with modern engines that met Euro 5 and Euro 6 standards (IGKM, 2024). In the analysed cities, the situation is similar.

Therefore, we will focus only on Euro V and Euro VI. As mentioned earlier, transport is responsible for PM2.5 emissions, which are caused by fuel combustion. Additionally, emissions are also caused by tire friction on the road surface (tire wear, road surface abrasion, and resuspension of dust), as well as the wear of friction materials in the braking system – all these phenomena contribute to the emission of particulate matter (Trela, 2015).

Table 4. PM Emissions (g/km) from Bus Operations and Fuel Combustion by Vehicle Type

Bus Category	PM emission (g/km) resulting from fuel combustion processes
EURO V	0,056
EURO VI	0,006
Electric	0
Hydrogen	0

Source: Trela (2014).

Potential benefits of transitioning the fleet to zero-emission vehicles in the context of emissions from fuel combustion processes can now be calculated. These calculations are presented in Table 5.

The study revealed that replacing all EURO V and EURO VI buses in the analysed cities could result in a reduction of PM emissions by over 11000 kg. Assuming a bus lifespan of 15 years, the entire fleet would be replaced by approximately 2040.

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Table 5. Annual PM Emissions from Bus Operations: Parameters and Calculations

Parameter	Value	Unit	Notes
Annual mileage per bus	70505	km	Average annual mileage in Poland
PM emissions (EURO V)	3948.28	g/year	Per one vehicle
PM emissions (EURO VI)	423.03	g/year	Per one vehicle
Number of EURO V buses	2446	Units	
Number of EURO VI buses	3690	Units	
Total annual PM emissions	11218	kg	Calculated as annual mileage * PM emissions (g/km) * number of buses. Summed separately for EURO V and EURO VI.

Limitation

The analysis in the article focuses solely on emissions within urban areas, specifically those generated directly by the operation of buses. While electric buses produce no tailpipe emissions during operation, their overall environmental impact must also consider emissions associated with electricity production. In Poland, the energy mix is heavily reliant on coal, which accounts for approximately 70% of electricity generation. This means that the production of the electricity required to charge electric buses contributes significantly to greenhouse gas emissions and air pollution, such as particulate matter (PM), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

Emission values were derived from calculations presented in a previously published article by another author, serving as the foundational dataset for this analysis. While these data provided a solid basis for estimating potential benefits of fleet transformation, they may not fully reflect the most recent technological advancements or localised variations in bus operation conditions. This reliance on secondary data introduces limitations that could impact the precision of the results and suggests the need for further, more granular primary data collection in future research.

Future research should focus on evaluating the effectiveness of government support programs in accelerating the transition to zero-emission fleets. This includes assessing the adequacy of subsidies, grants, and infrastructure investments provided under initiatives such as Green Public Transport. Understanding the impact of these programs on fleet modernisation timelines, financial sustainability of operators, and overall emissions reductions is essential.

Conclusions

The transition to zero-emission vehicles in Poland's public transport sector shows significant progress, especially in cities with over 100,000 inhabitants. However, there is considerable variation in adoption rates between leading cities and lagging regions.

On November 15, 2024 MPK Poznań announced a tender for the delivery of brand-new, low-floor city buses with conventional drives. The order includes 21 such vehicles, with the possibility of expanding the order by an additional 15 units under an option clause. The financing will come from the carrier's own funds. Similar fleet expansions with vehicles featuring conventional drives are currently underway in the cities of Wrocław and Kraków. Both cities are acquiring 200 new city buses each with internal combustion engines, all through financial leasing arrangements (Transinfo, 2024). This probably indicates that cities are preparing for the implementation of new regulations while taking advantage of the opportunity to make one final purchase of conventional vehicles. Consequently, this extends the period during which internal combustion and other non-zero-emission buses will remain in operation.

The purchase of an electric bus is expensive, which necessitates financial support. There is a need to continue support programs enabling the replacement of approximately 400 buses annually. A long-term financial framework, including subsidies and incentive mechanisms, could facilitate the transition by preventing operators from delaying the purchase of zero-emission buses due to high costs.

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In addition, the establishment of dedicated funding programmes for medium-sized cities, which may have greater difficulties with the transition, could ensure smoother modernisation.

PM emissions resulting from the operation of buses can potentially be higher for electric buses than for diesel buses. This primarily stems from non-exhaust sources, such as tire wear, road surface abrasion, and resuspension of dust, which are independent of the engine type. While electric buses produce zero-emissions from the drivetrain, their typically higher weight due to batteries can lead to increased tire and road wear, contributing to higher particulate matter emissions compared to lighter diesel buses (Jiang et al., 2022). Future regulations should consider a comprehensive environmental impact assessment, not solely based on direct tailpipe emissions but also including total life-cycle emissions and infrastructure adaptation needs.

It should be emphasised that the research results indicate that it is not reasonable for the entire fleet to consist of non-combustion vehicles (Wolański & Czerliński, 2024). However, it appears that the legislator aims for the entire fleet to be zero-emission. This could increase the operating costs of public transport. It appears that a flexible regulatory framework that allows for a mixed fleet strategy – combining electric, hydrogen, as well as modern, low-emission diesel or hybrid buses – could ensure a cost-effective transition while maintaining quality of service.

References

Act from 11 January 2018. Act on Electromobility and Alternative Fuels. Journal of Laws 2018, item 317. https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317 (in Polish).

Adamczyk, J., Dzikuć, M., Dylewski, R., & Varese, E. (2023). Assessment of selected environmental and economic factors for the development of electro-mobility in Poland. Transportation, 51, 2199-2223. https://doi.org/10.1007/s11116-023-10402-3

Beckerman, B. S., Jerrett, M., Finkelstein, M., Kanaroglou, P., Brook, J. R., Arain, M. A., Sears, M. R., Stieb, D., Balmes, J., & Chapman, K. (2012). The association between chronic exposure to traffic-related air pollution and ischemic heart disease. Journal of Toxicology and Environmental Health, Part A, 75(7), 402-411. https://doi.org/10.1080/15287394.2012.670899

Council of Ministers. (2024, October 31). *Legislative and Programmatic Work Schedule of the Council of Ministers.* https://www.gov.pl/web/premier/projekt-ustawy-o-zmianie-ustawy-o-elektromobilnosci-i-paliwach-alternatywnych-oraz-niektorych-innych-ustaw5 (in Polish).

European Environmental Agency. (2024, October 31). *European city air quality viewer*. https://www.eea.europa.eu/en/topics/in-depth/air-pollution/european-city-air-quality-viewer?activeAccordion=fed434db-61d7-4b4b-b074-a728fa9c4480

Green Public Transport. (2024, October 31). *Zielony transport publiczny*. https://www.gov.pl/web/nfosigw/zielony-transport-publiczny-faza-i-2021 (in Polish).

GUS. (2024). *Population. Size and structure and vital statistics in Poland by territorial division in 2024. As of 30 June.* https://stat.gov.pl/en/topics/population/population/population-size-and-structure-and-vital-statistics-in-poland-by-territorial-division-in-2024-as-of-30-june,3,36.html (in Polish).

IGKM. (2019). *Raport o Gazomobilności.* https://igkm.pl/raport-o-gazomobilnosci-w-komunikacji-miejskiej (in Polish).

IGKM. (2024, October 31). *Komunikacja miejska w liczbach.* https://igkm.pl/statystyka/ (in Polish).

Jiang, R., Liu, Y., Hu, D., & Zhu, L. (2022). Exhaust and non-exhaust airborne particles from diesel and electric buses in Xi'an: A comparative analysis. Chemosphere, 306, 135523. https://doi.org/10.1016/j.chemosphere.2022.135523

Koshlak, H., Woźniak, D., & Zegarek, M. (2024). Renewable energy sources in Poland: support mechanisms, benefits, barriers for prosumers and private investors. Journal of New Technologies in Environmental Science, 8(1), 18-25. https://jntes.tu.kielce.pl/wp-content/uploads/2024/05/RENEWABLE-ENERGY-SOURCES-IN-POLAND.pdf

Lee, Y. Y., Lin, S. L., Aniza, R., & Yuan, C. S. (2017). Reduction of atmospheric PM2.5 level by restricting the idling operation of buses in a busy station. Aerosol and Air Quality Research, 17(10), 2424-2437. https://doi.org/10.4209/aaqr.2017.09.0301

Li, R., Zhou, R., & Zhang, J. (2018). Function of PM2.5 in the pathogenesis of lung cancer and chronic airway inflammatory diseases. Oncology Letters, 15(5), 7506-7514. https://doi.org/10.3892/ol.2018.8355

Polish Economic Institute. (2019). *Smog w Polsce i jego konsekwencje.* https://pie.net.pl/wp-content/uploads/2020/03/PIE-WP_5-2019.pdf (in Polish).

Raposo, H., Farinha, J. T., Ferreira, L., & Didelet, F. (2019). Economic life cycle of the bus fleet: a case study. International Journal of Heavy Vehicle Systems, 26(1), 31-54. https://doi.org/10.1504/IJHVS.2019.097109

Szumska, E. M., Jurecki, R. S., & Pawelczyk, M. (2020). Life Cycle Cost (LCC) Level of an Urban Transport Fleet with Differentiated Share of Buses with Alternative Drive Systems. Communications, 22(3), 68-77. https://doi.org/10.26552/com.C.2020.3.68-77

Transinfo. (2024, November 15). *MPK Poznań dokłada do koszyka 23 przegubowe autobusy diesla. Też z opcją.* https://transinfo.pl/infobus/mpk-poznan-doklada-do-koszyka-23-przegubowe-autobusy-diesla-tez-z-opcja/ (in Polish).

Trela, M. (2015). Emisja zanieczyszczeń i koszty zewnętrzne wynikające z eksploatacji elektrycznego autobusu miejskiego w Polsce w porównaniu do autobusu spalinowego. Logistyka, 3, 5289-5296. (in Polish).

United States Environmental Protection Agency. (2024, October 31). *Particulate Matter (PM) Basics.* https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

Wolański, M., & Czerliński, M. (2024). Elektromobilność-szansa czy problem? Studium przypadku polskiej komunikacji miejskiej. In M. Cichosz & M. Wolanski (Eds.), *Sektory mobilności i logistyki w nowych ramach działania* (pp. 145-159). Warszawa: Oficyna Wydawnicza SGH. (in Polish).

World Health Organization. (2021). *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.* https://www.who.int/publications/i/item/9789240034228

Rafał MIŚKO

ELEKTROMOBILNOŚĆ W POLSCE: WYZWANIA I MOŻLIWOŚCI W KONTEKŚCIE REGULACJI PRAWNYCH

STRESZCZENIE: Cel: Celem badania jest analiza wpływu regulacji prawnych na transformację flot autobusów miejskich w Polsce. Metodologia/Podejście: Badanie opiera się na analizie stopnia przygotowania miejskich operatorów autobusowych do wdrożenia pojazdów zeroemisyjnych na podstawie danych o flocie, statystyk emisji i obowiązujących regulacji. Wyniki: Istnieją znaczne różnice między miastami w zakresie wdrażania technologii zeroemisyjnych. Liderzy korzystają z wsparcia finansowego, podczas gdy inne miasta borykają się z barierami infrastrukturalnymi i finansowymi. Ograniczenia/Implikacje badawcze: Badanie obejmuje miasta z własnymi operatorami autobusowymi, co może nie uwzględniać wszystkich modeli transportowych w Polsce. Oryginalność/Wartość: W badaniu przeanalizowano sektor transportu miejskiego w Polsce w kontekście przepisów UE i krajowych, wykorzystując dane wtórne, oceniając wpływ nadchodzących zmian legislacyjnych na operatorów.

SŁOWA KLUCZOWE: polityka środowiskowa, transport publiczny, zeroemisyjne pojazdy