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With the current of change

Electromobility as an opportunity for local development

Local governments will have a key role to play in the implementation of model investments in transport. A particularly important element is the electrification of the bus fleet within the municipal public transport system or ensuring an adequate number of electric cars in municipal offices. This action deserves an in-depth analysis, in which municipalities should determine all costs and the resulting socio-economic benefits.

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Dariusz Kasperek



ENERGY, CLIMATE AND ENVIRONMENT

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1. Strategic objectives for the transport sector

The European Green Deal and the “Fit for 55” legislative package set the directions for Member States to take decisive action on greening transport. As demonstrated in the report named ***Blocked potential. How to harness the European Green Deal and Fit for 55 as opportunities for transforming the buildings and transport sectors at local level***¹, the Polish vision for the development of transport is largely focused on technological objectives, forgetting about key social issues. In the context of transport, the European Union especially emphasizes measures that have the objective of **making public transport more accessible in terms of space and price**. Another important aspect is the implementation of digitization in road and rail transport, as well as the promotion of sustainable public transport.²

In analysing the individual targets in this sector, decidedly the most ambitious is **the reduction of GHG emissions from transport by 90% by 2050**.³ Additionally, in the short term, i.e. a 17.8% reduction in CO₂ emissions from the non-ETS sectors is planned by 2030. In connection with the specified trajectory, the EU assumes that a technological transformation will be necessary, which will displace high-emission vehicles in favour of zero-emission transport. The development of electromobility is often specified as the solution, both for individual and public transport. According to the Sustainable and Smart Mobility Strategy,⁴ by 2030 there will be at least 30 million zero-emission cars on EU roads, with an appropriate charging infrastructure for cars driven by alternative fuels, or more precisely every 60 km for electric charging and every 150 km for refuelling with hydrogen.

In terms of the development of electromobility, the national targets are largely consistent with the EU challenges. According to the Polish Energy Policy to 2040 (PEP2040), **600,000 electric and hybrid vehicles** should be travelling on Polish roads in 2030 (whereby a very ambitious variant assumes that as many as 1 million electric vehicles will be registered in Poland in 2025). Both the PEP2040 and the Electromobility Development Plan emphasize the need to ensure sufficient and adequate infrastructure for charging vehicles driven by alternative fuels, namely **a total of 60,000 charging stations in 2030**. Also in terms of **zero-emission public transport**, PEP2040 sets targets for cities with more than 100,000 inhabitants, namely:

- from 2025, cities will only be able to buy electric or hydrogen-powered buses;
- full zero-emission public transport bus fleets will be achieved in 2030.

The update of PEP2040⁵ currently being planned assumes further support for the development of RES in all areas of the economy, including transport. The level of the ambition is also expected to

1 <https://wise-europa.eu/wp-content/uploads/2022/06/Blocked-potential.pdf>

2 European Commission, New transport proposals target greater efficiency and more sustainable travel.

3 European Commission, Sustainable and Smart Mobility Strategy.

4 European Commission, Sustainable and Smart Mobility Strategy, 2020.

5 Ministry of Climate and Environment, Assumptions to the update of Poland’s Energy Policy until 2040 of March 2022.



increase because of the war in Ukraine and the need to become independent of imports of oil and its products from Russia.

Unfortunately, despite the ambitious targets for the development of low-emission transport, Polish strategies generally treat other aspects related to the transformation of this sector superficially, with technological transformation being only one of its aspects. **Neither the lack of any reference to the issue of transport exclusion, which applies to more than 13 million people in Poland,**⁶ nor the lack of specific strategy for the development of zero-emission public transport, provides for sustainable transformation in this sector of the economy. Current government action is sparse and addressed more at technological transformation than at meeting the transport needs of the citizens by developing public services in this area. Therefore, it is important to combine the objectives that are already set regarding the **increase of RES in transport by 14% by 2030** with the development of available and zero-emission public transport and to eliminate the “white spots” on the map of public transport in Poland.

Despite the clearly specified **objectives in PEP2040** for the development of electromobility, these findings **are not binding at the local level**, which means that local authorities are not legally obliged to make investments that are consistent with the findings of this document. However, in the case of any investments in municipalities regarding electromobility, the local authorities have to comply with the provisions of the Act on electromobility and alternative fuels.⁷

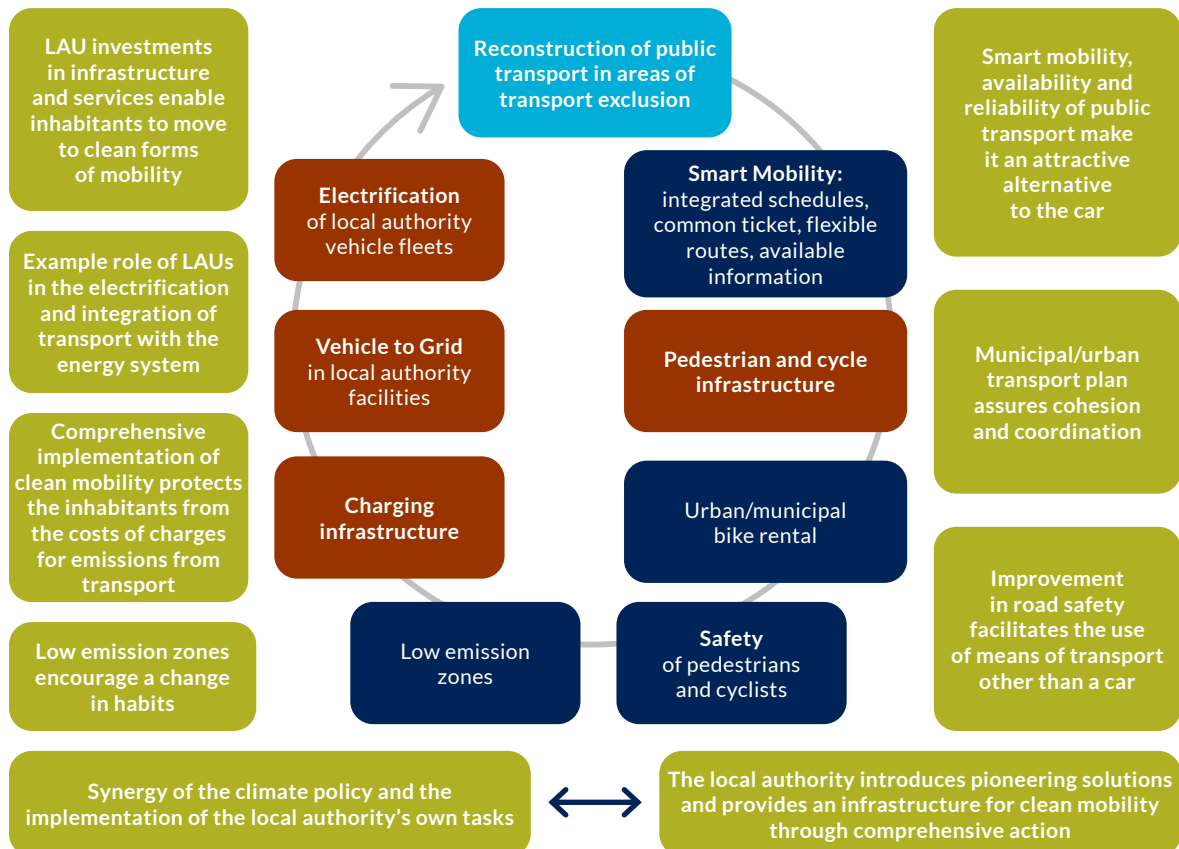
6 Jagiellonian Club, Public transport in Poland. Study of the decline, 2018.

7 Act on electromobility and alternative fuels of 11 January 2018 (Journal of Laws, No. 2018, item 317, as amended).

2. Model local authority investment in the transport sector

Local authorities will have a key role to play in implementing model investments in transport. As indicated in our report named *Blocked potential. How to harness the European Green Deal and Fit for 55 as opportunities for transforming the buildings and transport sectors at local level*, comprehensive investments will need to serve the obligations of both the technological transformation to reduce emissions of pollution and take into account “softer measures”, eliminating negative social phenomena such as transport exclusion. Of course, it is recommended that coherent and holistic strategies for the development of sustainable transport are created, which will support electrification at local level, strengthening the so-called micromobility, and creating clean transport zones, as well as improving road safety.

Figure 1. Model comprehensive local authority investment in the transport sector



Source: WiseEuropa



A particularly important element of comprehensive investments is the **electrification of the bus fleet within the municipal public transport system** or the provision of an appropriate number of electric vehicles in the municipal offices. This measure deserves an in-depth analysis, in which municipalities should specify all the costs (related to the replacement of the fleet, the purchase of new buses and infrastructure) and the resulting socio-economic benefits. Electrification in local authorities will be one of the most costly elements of the comprehensive investments, where simultaneously, apart from additional financial outlays on the part of the municipality, it will be necessary to comply with the provisions of the Act on electromobility and alternative fuels and other strategic documents. Replacement of the fleet of buses with zero-emission buses is also consistent with the EU objective of achieving climate neutrality in cities by 2050. However, it should be emphasized that, in accordance with our proposed approach, the replacement of the fleet is not the only measure for assuring sustainable transport services at local level and should be supplemented with other activities.

3. Electromobility: responsibilities and objectives of local authorities

The main act of law that forces public entities to work towards promoting electromobility is the Act on electromobility and alternative fuels, implementing Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. The Act specifies a number of challenges for local authority units in terms of building charging infrastructure or replacing the vehicle fleet and imposes a schedule for their implementation.

One of the aspects regulated by the said Act is the provision of access to the charging infrastructure in public buildings and blocks of flats. The provisions of the Act are simultaneously a tool for achieving the objectives specified in the National policy framework for the development of the alternative fuels infrastructure,⁸ which envisaged the construction of 6,000 low-power charging points and 400 high-power charging points in 2020 in Poland's agglomerations. Unfortunately, as is already known – these objectives were not achieved.

The Act contains **targets dedicated to large** (over 100,000 inhabitants) **and medium-sized cities** with more than 50,000 inhabitants. These targets apply to:

- the assurance of an appropriate minimum number of charging points in cities depending on the number of inhabitants and registered cars;
- access to charging infrastructure at parking spaces;
- the provision of additional connection capacity which is needed for installing charging points at public buildings and parking spaces;⁹
- the assurance that there is an appropriate share of electric vehicles in the vehicle fleet supporting the government agency by 2025;
- the selection of contractors for public tasks, who have a specified share of zero- and low-emission vehicles (powered by natural gas) – the target for 2025 is 30% for such vehicles;
- the assurance of a 30% share of zero-emission or biomethane-driven buses in the fleet of vehicles used to provide public transport in 2028.

8 National policy framework for the development of alternative fuels, 2017.

9 Regulation of the Minister of Climate and Environment of 7 May 2021 on the method of setting the minimum connection power for indoor and outdoor parking spaces related to public service buildings and blocks of flats (Journal of Laws 2021, item 892).



Every three years, these cities are to prepare a cost-benefit analysis of the introduction of zero-emission public transport, presenting the costs, environmental effects and social impacts.

Additionally, **all entities that are required to apply the provisions of the Public Procurement Law are obliged to ensure minimum shares of low- and zero-emission vehicles of the total number of vehicles performing the commissioned tasks.** The Act presents an exhaustive list of services to which these limits apply, including, in particular, services related to **road passenger and freight transport, waste collection and mail delivery.**

The Act also introduces **low emission zones (LEZ)** into the Polish legal order. Local authorities may organize such zones within their territory to reduce air pollution from transport, but the Act does not provide for such an obligation. Only zero-emission vehicles or vehicles driven by natural gas, and specially identified vehicles, for which the municipality allows entry in a special resolution (e.g. residents' vehicles, vehicles of a specific EURO emission norm), may enter the zone. Depending on the decisions made by the municipality, other vehicles may enter the zone on condition that they pay an appropriate fee, which will be used to finance transport emission reduction measures, such as the purchase of zero-emission vehicles or co-financing of the purchase of bicycles.

All these objectives for local authorities arising from the provisions of the Electromobility Act are presented in detail in Figure 2.



Figure 2. The most important responsibilities of local authorities resulting from the Electromobility Act

AREA	ARTICLE	DESCRIPTION	TO WHOM IT APPLIES	2020	2022	2025	2030
CHARGING INFRASTRUCTURE	Article 60	Minimum number of charging points installed up to 31 March 2021	municipalities of over 1 million inhabitants and at least 600k registered vehicles		1000		
			municipalities of over 300k inhabitants and at least 200k registered vehicles		210		
			municipalities of over 150k inhabitants and at least 95k registered vehicles		100		
			municipalities of over 100k inhabitants and at least 60k registered vehicles		60		
FLEET OF ELECTRIC VEHICLES	Article 35, para. 1 Article 68, para. 2	Share of electric vehicles in the fleet of vehicles used by the government agency	local authorities of over 50k inhabitants		≥ 10%	≥ 30%	
	Article 35, para. 2 Article 68, para. 3	Share of electric vehicles or vehicles driven by natural gas in the fleet of vehicles to perform tasks commissioned by the local authority			≥ 10%	≥ 30%	
	Article 36, para. 1 Article 68, para. 4	Share of zero-emission buses in the fleet of vehicles used for public transport			from 2021 ≥ 5%	from 2023 ≥ 5%	from 2028 ≥ 20%
				preparation of cost-benefit by the municipalities for the whole period every 36 months			
PARKING SPACES	Article 12 Article 12a	Multi-family housing with more than 10 parking spaces	investors, including local authorities municipalities of over 100k inhabitants	installation of channels for electrical conductors and cables at all parking spaces			
	Article 12a	Non-residential buildings with more than 10 parking spaces	investors, including local authorities	min. connection capacity = the product of 50% of the number of all parking spaces and ≥3.7 kW			
	Article 12	Public service buildings	municipalities of over 100k inhabitants	construction of 1 charging point per 5 parking spaces			
PUBLIC CONTRACTS	Article 68a	Share of buses driven by alternative fuels in public contracts	all entities subject to the public procurement law regarding road passenger and freight transport, waste collection and mail delivery			up to 2025 ≥ 32%	from 2026 to 2030 ≥ 46%
		Share of electric and hydrogen vehicles for transporting people and goods up to 3.5t					up to 2030 ≥ 22%
		Share of vehicles driven by alternative fuels for transporting goods of over 3.5t				up to 2025 ≥ 7%	≥ 9%

Source: WiseEuropa

4. Costs of buses

The current legal regulations require local authorities to meet targets for the organization of public transport and the replacement of the fleet with zero-emission buses. This measure will require additional investment because of the higher technical level of the vehicles and the related higher cost of purchase.

Investment in a modern zero-emission fleet should therefore be preceded by an in-depth analysis of possible solutions to choose the most efficient drive system for the specific conditions of the city and the region.

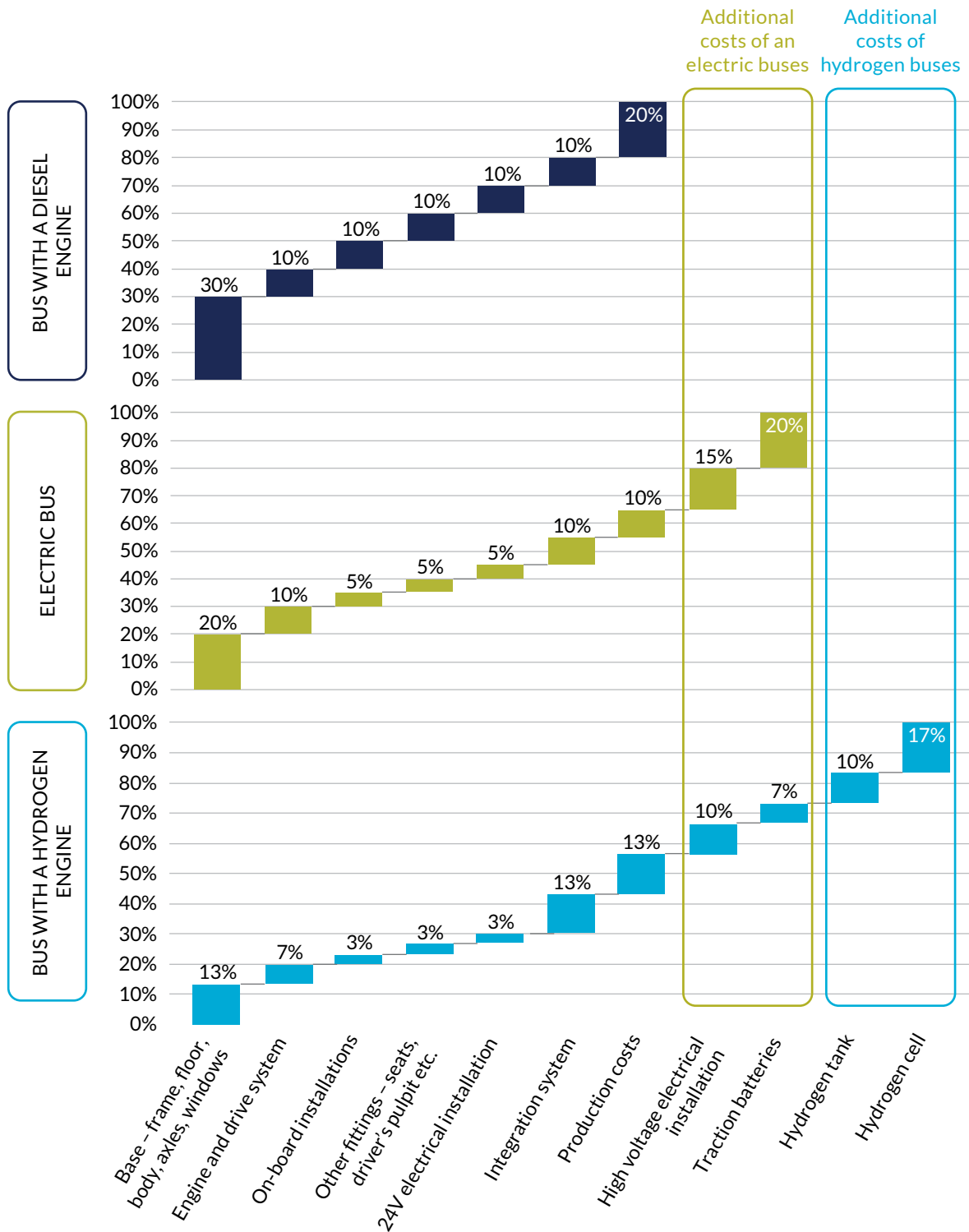
Zero-emission vehicles driven by electric motors are relatively more expensive to buy than conventional vehicles with diesel engines driven by diesel fuel. This arises directly from the use of different and more technologically advanced components – e.g. an electric motor, a traction battery pack, a high-voltage installation and an IT control system. In the case of a hydrogen bus, in addition to the high-voltage electrical installation, the additional components are the hydrogen fuel cell and the high-pressure hydrogen tanks. An additional and necessary investment in the introduction of zero-emission buses is also the infrastructure for driving the vehicles with electricity or hydrogen.

The cost of assembling both types of vehicles is higher because of the use of much more technically advanced subassemblies in zero-emission vehicles and the use of specialist software for the integration systems.

The estimated cost structure, in percentage terms, of individual subassemblies of the vehicles by type of drive, is presented in the chart below. In turn, if the total cost of purchase of the vehicle is presented and the cost of a bus with a diesel engine is assumed to be 100%, then the estimated cost of purchasing an electric bus will be approximately 250%, while that of a hydrogen bus will be 315%.



Chart 1. Proportions of the level of the costs of purchase of buses by drive used



Source: own study based on: Kasperek D. et al., Wybrane aspekty wdrażania do eksploatacji autobusów z alternatywnymi systemami napędowymi, 2022

5. Implementation of zero-emission transport in local authorities

The preparation for implementing zero-emission buses for urban transport should be preceded by a detailed analysis of the technical, economic and organizational aspects. This issue should be addressed in detail in the cost-benefit analyses prepared by the local authorities on the introduction of zero-emission transport. Investment in a modern fleet is related to the need to incur additional costs of modernizing or building new infrastructure accompanying these vehicles.

Among the most important aspects to be analysed is the transport task performed by the bus, the length of the lines served and the operating costs. The operation of the fleet must be optimized in terms of emissions and transport costs and these parameters need to be adapted to the required conditions.

The introduction of zero-emission buses should also take into account the infrastructural conditions that are specific to the city and region.

In the case of investments in electrically driven fleets, an important aspect is the method and source of supply of electricity to the bus. Of importance from the point of view of emissions of pollution is the provision of energy for charging from renewable energy sources – with the current energy mix and its emissions, the use of an electric bus is zero-emission locally, on the line served by the bus – the use of RES will enable the complete zero-emission operation of the bus. In practice, there are two possibilities of charging buses – the use of “slow” chargers at the depot or the additional provision of infrastructure for “fast” charging of the battery on the line served, e.g. at terminal stops. Investment in fast chargers at the terminal of the line requires that additional costs are borne, but these are not as high as in the case of hydrogen stations.

In the case of buses using hydrogen fuel cells, the possibility of building hydrogen refuelling stations and the conditions and cost of supplying that fuel become important. An additional aspect is the assurance of an adequate amount of fuel needed to operate the vehicles – the fuel can be produced on site, e.g. from electricity generated from RES, or purchased from an external entity. The additional infrastructure required to implement and operate a hydrogen bus fleet can amount to several tens of percent of the value of the vehicles.

6. Cumulative costs of buses

The cumulative costs of buses by the type of drive were calculated in the analysis. The costs of building charging infrastructure for electric buses and hydrogen fuel stations were not included. The investment costs for the charging infrastructure should be spread over several vehicles – fixed chargers at the depot and pantograph fast chargers can be used by several vehicles stationed at the depot or operating a given line. The costs of building a hydrogen fuel station are so high that it has been assumed that the investment costs and operational risks would be transferred to enterprises specializing in supplies of this fuel. The assurance of a supply of hydrogen and the maintenance of its low price are important factors in the case of vehicles driven by this fuel. This will be possible if the use of hydrogen in transport were to be increased and appropriate production technologies were to be available.

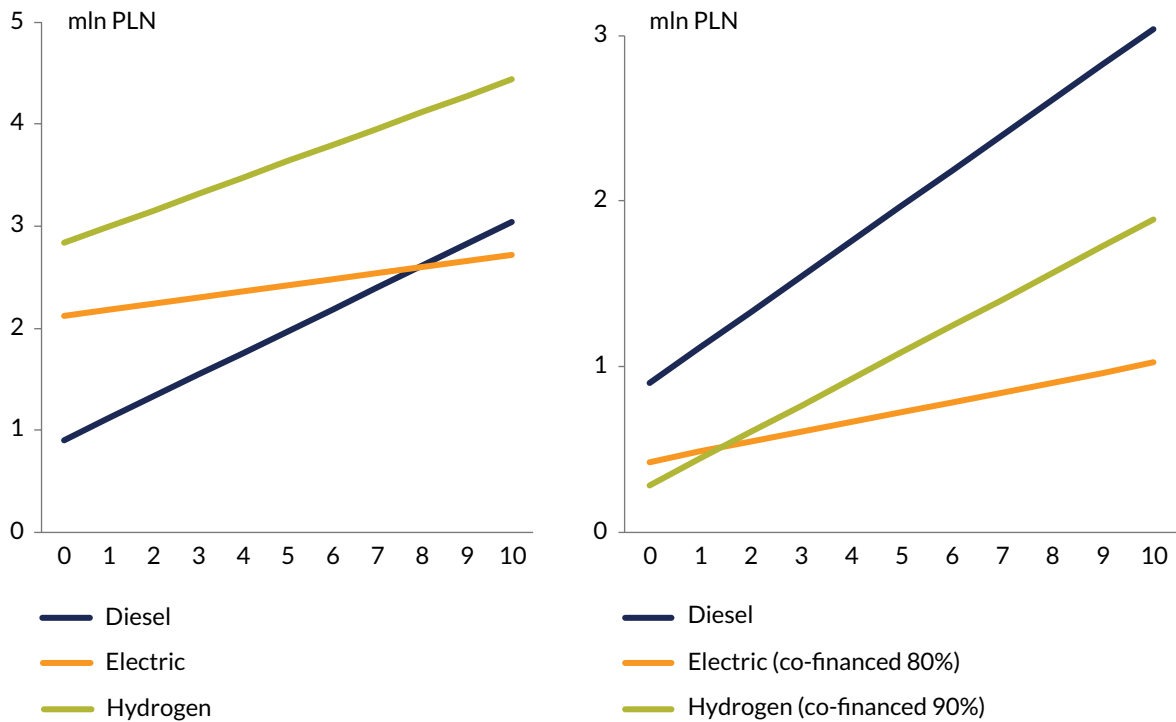
Two simulations of the cumulative costs of purchasing and operating diesel, electric and hydrogen buses have been presented below. The first simulation presents the costs taking into account the market price of buses and their operating costs over 10 years. The second simulation takes into account the receipt of the maximum possible support provided by the National Fund for Environmental Protection and Water Management within the framework of the Green Public Transport priority programme.

According to the assumptions made¹⁰ and the analysis conducted, in the case of a lack of co-financing, the cumulative costs of purchasing and operating an electric bus will reach the same level as a diesel bus after 8 years of operation. The costs of purchasing and operating a hydrogen bus decidedly exceed the amounts incurred on electric and diesel buses over the whole of the period of analysis. If co-financing is provided for the purchase of the vehicles, the cumulative costs of the buses are lowest for the electric vehicle after the first year of operation. In addition, the cumulative costs of both an electric and a hydrogen bus are far lower than for a diesel vehicle.

¹⁰ For the purposes of the calculations, the price of diesel fuel was assumed to be: PLN 7.50 per litre of fuel, the price of electricity for charging: PLN 0.70 per kWh. The price of hydrogen was assumed to be approx. EUR 6 per kg of fuel according to the publication for 2025: Jovan DJ, Dolanc G. Can Green Hydrogen Production Be Economically Viable under Current Market Conditions. Energies. 2020.



Chart 2. Cumulative costs of buses by type of drive without co-financing (left) and with co-financing (right)



Source: own study



7. Co-financing of the purchase of electric buses

There have been three significant tenders for electromobility market in recent years for **co-financing electromobility, of a total budget of approx. PLN 2.8 billion, enabling the financing of approx. 800 electric buses and 150 hydrogen buses.**

BOX 1. Co-financing of the purchase of electric buses

The first major tender for the purchase of electric buses was organized by the **Centre for EU Transport Projects (CUPT)** within the Infrastructure and Environment Operational Programme. Local authority units, which were losing their social and economic functions, were able to apply for co-financing. In the tender, co-financing was granted to 13 municipalities, which received the maximum intensity of support of as much as 85% for the purchase of approx. 200 electric buses. The total amount of co-financing is PLN 460 million.

The National Fund for Environmental Protection and Water Management held two tenders in the **Green Public Transport priority programme**. In the first tender, with a budget of PLN 1.1 billion, 34 municipalities submitted applications for 176 charging stations, 322 electric buses, two hydrogen fuel stations and 102 hydrogen buses. In the second tender, with a budget of PLN 1.26 billion, 67 municipalities, mainly small and medium-sized towns, applied for co-financing for 340 electric buses and 48 hydrogen driven buses.

The National Fund for Environmental Protection and Water Management also held a tender in which it provided co-financing for preparing **Electromobility development strategies** in municipalities with populations of over 50,000. Co-financing was provided to 218 municipalities.

Electromobility co-financing programmes are very popular, which frequently forces financing institutions to increase their budgets. An increase took place both in the case of investment projects co-financed by CUPT (the budget was initially PLN 300 million, but was finally increased to PLN 460 million), and for preparation of the strategic documents – the National Fund for Environmental Protection and Water Management initially planned co-financing of at least 100 documents and a budget of PLN 10 million, but ultimately more than 200 documents were co-financed and the programme budget was PLN 12 million, which enabled the provision of co-financing to all municipalities that applied for funds. The popularity of the programmes for the purchase of zero-emission buses can also be evidenced by the fact that, in the case of the first tender in the Green Public Transport Programme, the funds in the continuous tender for three years were exhausted in the first two weeks in which applications were being received.

8. Conclusions

Local authorities are facing a number of challenges contained in the European Green Deal. The electrification of the vehicle fleet is a direction of development that cannot now be stopped – this is especially important in the context of the need to reduce the use of fossil fuels, especially oil from Russia. Simultaneously, coordinated steps taken at central and local level will translate into the more effective use of opportunities related to the reduction of the total cost of investment in the target solutions.

The objectives set by the European Union in the European Green Deal and the Fit for 55 package impose an ambitious approach to the decarbonization of transport and the use of clean mobility. As we presented in our study, Polish legislation reflects these objectives and decidedly translates the targets to the local level, obliging local authorities to take active measures. These measures should be correlated with an appropriate level of financial support in the fulfilment by the local authorities of their own tasks.

Local authorities **will face a huge challenge in the preparation and implementation of the objectives set in the Electromobility Act** for the available fleet of government agency and municipal transport vehicles, the adjustment of car parks to the needs of electromobility and procedures for awarding public contracts. These measures must be included in the long-term financial perspectives of the municipalities and provided for in the procurement procedures. It is true that the Act does not contain any penalties for local authorities for not implementing these measures, but they should be implemented to the extent required of the local authorities by Polish law. The Act addresses the needs of the local authorities and the EU objectives. Importantly, the Act contains a proposal of a schedule of gradual changes, which are to minimize their impact on local authority budgets – their implementation and the need to achieve them in one year would be far more noticeable.

Undoubtedly, **modern and ecological public transport** can also be an attractive offering for the inhabitants of cities. This additionally shows the residents that the city is not cutting itself off from ecology and is trying to keep up with global trends. The use of zero-emission vehicles also has a quantifiable effect in improving the protection of the air, in particular by not emitting pollutants in the place where a bus is used, as well as reducing arduous noise. The planned imposition of an emission tax on fossil fuels in the Fit for 55 package (on the basis of a “mini ETS” system) will increase the costs of maintaining vehicles with combustion engines. An excellent alternative to becoming independent of the instability of fuel prices and the need to pay additional emission costs is to use electricity to drive buses, especially that which comes from RES. Already in the current conditions, especially taking into account the reduction in the investment outlay on the electric fleet through the receipt of subsidies for the purchase of vehicles, the cumulative costs of purchasing and operating electric buses allow for large savings of public money.



The efficient development of electromobility in the municipalities can be assured by appropriately prepared **strategic documents which will be consistent with the overall vision of the development of the municipality**. Equally importantly, these documents should go hand in hand with the EU strategic documents, especially in terms of decarbonisation of the transport sector, which provide a strong impulse for profound changes in the use of fuel and energy planning. The preparation of plans for building charging stations in the municipality and conducting cost-benefit analyses of the introduction of zero-emission transport into public transport, as well as taking into account the needs of residents during consultations on those documents, can constitute excellent grounds for the coherent and thought-out development of electromobility in the municipality.

One of the recommended solutions is also the **establishment of low emission zones in areas where admissible standards of emissions of pollution from transport are significantly exceeded**. The Act does not specify a rigid legal framework for such zones, so it is up to the local authorities to decide what this area will look like and how it can be used. However, it is worth emphasizing that the main task of the zones should be to decidedly reduce the traffic of vehicles with combustion engines and to promote zero-emission vehicles. In addition, it is worth considering whether the zones should be a place for promoting micromobility and for inhabitants to completely abandon private vehicles in favour of public transport.

As our analysis shows, a **holistic approach to the replacement of the public transport fleet** is important. Seemingly profitable solutions in terms of investment outlay are not necessarily economic in terms of operating costs in the long term. The current co-financing of the purchase of buses can play a decisive role in this respect. This can especially be seen in the case of electric buses. Hydrogen as a fuel for driving buses is not yet economically justified. However, when its purchase costs are lower and availability on the market is greater, it is possible that this fuel will be an excellent addition to the offering for local authorities. **The assurance of a source of cheap fuel is an extremely important aspect of the investment, which is often forgotten, e.g. when hastily deciding to obtain co-financing for hydrogen-driven buses without a reliable source of cheap fuel.**

Co-financing of the purchase of zero-emission vehicles is undoubtedly still necessary, as their popularity can testify. However, in our opinion, **the procedure for granting co-financing must change into a competitive one**. This procedure requires the preparation of more detailed analyses of electrification projects and consideration of all aspects of the investment. The schedule of all applications for co-financing, followed by their assessment according to predefined criteria, enables the award of co-financing to those projects which are the most comprehensive, thought-out and have the greatest impact on the environment.



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Other publications:

"Blocked potential. How to use the European Green Deal and the fit for 55 as an opportunity to transform the building and transport sectors at the local level",

Chrzanowski P., Fabiszewska-Solares J., Lewandowski W., Marszał K.; WiseEuropa, Warsaw 2022

"Coal's Swan Song. Systemic risks of delaying the restructuring of the mining and coal energy sectors in Poland",

Bukowski M.; WiseEuropa, Warsaw 2022

"The Necessary Step. The impact of mining restructuring on the economy and energy security",

Bukowski M., Śniegocki A.; WiseEuropa 2022