

Green Public Procurement in Passenger Transport: Implications for Sustainable Urban Development

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Abstract

Urban passenger transport plays a central role in sustainable urban development, as it directly influences mobility, environmental quality, accessibility to public services and the overall quality of life in cities. In the context of increasing environmental pressure, traffic congestion and the need to reduce greenhouse gas emissions, local authorities are increasingly encouraged to integrate sustainability criteria into public procurement decisions. Green public procurement has therefore become an important policy instrument through which municipalities can promote low-emission technologies, improve the environmental performance of public services and support the transition toward cleaner urban mobility systems.

The specialized literature highlights the importance of green public procurement as a mechanism for promoting sustainable development and reducing the environmental impact of public services (Brammer & Walker, 2011; Meehan & Bryde, 2011; Lundberg & Marklund, 2013). Previous studies have examined the role of environmental criteria in procurement, the challenges faced by public authorities and the cost-efficiency of sustainable procurement practices, especially in countries with a stronger tradition in green public policies, such as Sweden, Norway, the Netherlands, the United Kingdom and Germany (Michelsen & De Boer, 2009; Aldenius & Khan, 2017). However, less attention has been given to applied case studies from Romanian urban transport systems, particularly regarding the way in which technical, financial-accounting and operational data can be used to evaluate the implications of green procurement in public passenger transport.

The present article focuses on the case of Cluj-Napoca, one of the first Romanian municipalities to implement a significant green procurement project in urban passenger transport through the acquisition of electric buses. The study analyzes the implications of this investment from an economic, environmental and social perspective, using technical, operational and financial-accounting information provided by the local public transport company. The research does not aim to provide a comparative European analysis or a statistical before-and-after evaluation, but rather an applied descriptive assessment of how green procurement affects the cost structure, environmental performance and quality-of-life indicators associated with public transport.

The main purpose of the article is to evaluate the implications of green public procurement in passenger transport for sustainable urban development, based on the case of Cluj-Napoca. In order to achieve this purpose, the article pursues the following objectives: first, to present the role of green procurement in the modernization of urban passenger transport; second, to analyze the technical and environmental advantages of electric buses compared with diesel buses; third, to assess the main cost-related effects of green procurement using available financial-accounting and operational data; and fourth, to identify the practical implications, limitations and possible financing directions associated with the continuation of green procurement policies in public transport.

Keywords: Green public procurement; sustainable urban development; passenger transport; low-carbon mobility; environmental policy

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Introduction

In the urban environment, and especially in urban agglomerations, public passenger transport is an essential element that connects the community to the strategic objectives of economic and social development (Burlacu & Neagu, 2007). It functions as a link between the economic and social needs of the community, having a significant impact on the quality of life (Ioniță et al., 2009).

The concept of quality of life is central to both national and community development strategies, and achieving this objective depends largely on how resources are allocated for economic and social development. The municipality of Cluj-Napoca is emerging as a social, economic and cultural community that has defined its development directions through a multidimensional plan. It aims at quality of life, stimulating innovation and creativity, economic competitiveness, urban development and spatial planning, as well as promoting identity and cultural diversity. Based on these coordinates, the city has earned several labels, such as “green city”, “healthy city” or “safe city”. In practice, Cluj-Napoca stands out as a pole of economic, social and cultural competitiveness, internationally connected, with an innovative, creative and competitive economic potential (ICC), thus consolidating its image as a smart city, according to the “smart city” development strategy (Aldenius & Khan, 2017).

The city's intense economic and social life is also reflected in its academic profile, which annually concentrates approximately 400.000 inhabitants during the university period. Thus, the concern of local public governance for increasing the quality of life indicators is justified and visible. These indicators include access to public services (education, health, culture), environmental quality, the efficiency of the public passenger transport system and the reduction of costs associated with daily life (Brammer & Walker, 2011).

Among public services, public passenger transport is one of the most appreciated services available to the community. It is operated by the local public transport company, organized as a joint-stock company under the authority of the local council and operating according to the principles of corporate governance (Buzoi-anu et al., 2024). Both public and corporate governance aim to satisfy the general interest of citizens to live in a clean and healthy environment, with the lowest possible living costs (Burlacu et al., 2024).

A constant concern of the authorities has been to provide quality public transport, which has been materialized, starting in 2012, by initiating an innovative project: the purchase of ecological electric buses. This project materialized between 2018 and 2024 by purchasing 50 electric buses, the financing being made from Swiss non-reimbursable funds, obtained in competition with other municipalities, based on the framework agreement signed between the Romanian and Swiss governments for environmental improvement and energy efficiency projects (Burlacu et al., 2023).

The interest in researching the implementation of this green project is all the greater, as the result was obtained through the research and development activity of the local public transport company. The project was presented both nationally and internationally, including at the UITP International TWG Conference in Leipzig (Germany) and in the online magazine “UITP Advancing Public Transport” under the title “Cluj-Napoca, First Romanian City with Electric Buses”. The number of dissemination events was significant, demonstrating the relevance and impact of the project.

This technical experience is now becoming an object of applied economic research, focusing on the evaluation of the economic, financial and social costs and benefits generated by the project. The identification of new sources and financing mechanisms is thus becoming essential for the continuation of green public procurement and for its expansion at national level. The research resulting from this project contributes to the substantiation of future directions for financing green public procurement, quantifying and qualitatively evaluating the costs and benefits obtained, in accordance with the principles of sustainable development.

1. Review of the scientific literature

The research tools used were mainly focused on identifying theoretical and applied coordinates in the field of green public procurement, with a focus on public passenger transport in urban areas (Rădulescu et al., 2025). From a qualitative research perspective, the central approach was represented by sustainable development models (Brammer & Walker, 2011; Meehan & Bryde, 2011), considered tools for the development and implementation of environmental public policies (Lundberg & Marklund, 2013). These works establish the essential objectives of green procurement, including environmental conservation. Green procurement appears as a reaction to climate change (Hickman & Banister, 2014) and, at the same time, as tools for achieving objectives related to reducing CO₂ emissions and improving environmental quality.

The most advanced practices in the field of green procurement are found in Nordic countries, such as Sweden and Norway, where experts are oriented towards respecting the quality criteria of public policies on green procurement (Michelsen and de Boer, 2009; Caraiani et al., 2015). Qualitative research on cost efficiency and their structural analysis can be found in the specialized literature in Sweden, where operational and statistical studies applied to urban transport are carried out (Vigren, 2015).

This concern is justified by the high level of social costs assumed by local authorities and communities to increase the quality of life (Poliak et al., 2025).

The specialized literature identifies as main factors in the analysis of public policies on green procurement: high procurement costs and the size of urban communities. At the same time, the research focuses on the analysis of the cost efficiency of public transport, including their structure – fuel costs, spare parts and maintenance – as well as on the assessment of the economic and social benefits resulting from green procurement.

Specialized studies on costs focus on their definition and classification, distinguishing between costs generated by public procurement and those resulting from the use of services, the latter being, as a rule, variable and proportional to the volume of activity. In the decision-making process, these types of costs can be analyzed by the ABC method (Activity Based Costing), which correlates production with production factors to determine the effective cost of an activity (Marron, 2003.).

Technological modernization, complex decision-making requirements and increased competition have led to a revolution in the methods of calculating the costs of products, works and services (Fătăcean, 2006). Information on costs, obtained from management accounting or cost calculation, allows the integration of managerial accounting within public transport, under the concept of sustainable accounting. It derives from the principles of sustainable development and integrates its three dimensions: economic, environmental and social (Ienciu & Achim, 2009).

The relevance of cost information in the context of green procurement is reflected in terms such as: the cost of green procurement, social costs and environmental costs (Profiroiu et al., 2020). Determining their value has been previously addressed in the Romanian accounting literature (Dumitrana, 2005), including in the framework of integrated financial reporting and green accounting (Caraiani et al., 2015; Dumitrana, 2006). Cost information generated by green procurement must be integrated into classical and integrated financial reporting, taking into account current challenges such as economic instability, limited natural resources, climate change, pollution and waste.

In the specific context of urban passenger transport, researchers have begun to interrogate how environmental criteria in procurement decisions can transform mobility systems Timm et al. (2025) analyze the implementation of green public procurement in public transport focusing on criteria evaluation and proposals and they find that standardized environmental metrics and multi-criteria decision frameworks enable procuring authorities to align contracts with sustainability objectives thereby encouraging adoption of low emission vehicles and clean energy technologies.

The specialized literature consulted highlights the complete path of cost information, from its creation to the reporting of costs specific to green procurement with social and environmental impact, within the framework of integrated reports addressed to stakeholders, including the community and users of public transport services (Burlacu et al., 2025).

Empirical studies of applied GPP in the transportation sector demonstrate tangible benefits for urban sustainability strategic use of green public procurement in the bus sector (2017) reveals that cities which integrate environmental performance requirements into bus procurement contracts report lower greenhouse gas emissions and improvements in local air quality this study also notes that such procurement practices can influence market behavior by signaling demand for greener technologies and incentivizing suppliers to innovate (Wang et al., 2020).

The broader literature on sustainable transportation underscores the theoretical foundations linking transport policy and urban sustainability with Hickman, (2024) resending a state-of-the-art review of sustainable transport research that articulates the multidimensional benefits of shifting toward low-carbon mobility and Kraus and Proff (2021) systematically reviewing criteria and measurement approaches in sustainable urban transportation and arguing that policy instruments including procurement criteria play a central role in achieving urban environmental goals

Additionally, institutional analyses highlight the importance of governance capacity and regulatory support for green procurement practices. Testa & Rizzi, (2020). provide evidence from a survey of local authorities

in Romania showing that administrative capacity public awareness and clear policy frameworks significantly influence the uptake of green procurement and that strengthening these dimensions can enhance the performance and consistency of procurement outcomes.

Collectively these studies illustrate that while the normative appeal of GPP as a mechanism for advancing sustainable urban development is well established the literature also points to persistent challenges including variability in criteria application heterogeneous institutional readiness and the need for robust monitoring and evaluation frameworks future research is therefore called to deepen understanding of long-term environmental socio-economic impacts and to refine methodologies for assessing the effectiveness of GPP interventions across diverse urban contexts (Marron, 2003).

2. Research methodology

This research is designed as an applied single-case study focused on the implementation of green public procurement in urban passenger transport in Cluj-Napoca, Romania. The case study approach was selected because Cluj-Napoca represents one of the first Romanian municipalities to introduce electric buses into the local public transport system through a green procurement project. The analysis aims to examine the economic, environmental, social and managerial implications of this procurement process, using available technical, operational and financial-accounting information.

The research design is documentary, descriptive and analytical. The study does not apply a mixed-methods design and does not include surveys, interviews or a comparative analysis of several European cities. Instead, it relies on secondary and institutional data obtained from the local public transport company, as well as on information from the specialized literature on green public procurement, sustainable public transport, environmental accounting and cost management. The purpose of this methodological approach is to provide an applied assessment of how green procurement affects the cost structure and sustainability performance of urban passenger transport.

The data used in the study are grouped into four main categories. First, the theoretical and contextual data were collected from the scientific literature on green public procurement, sustainable urban transport, public service management and cost efficiency. Second, technical data were used to compare diesel and electric buses in terms of comfort and environmental indicators, including noise level, emissions and energy consumption. Third, operational data were used to examine average annual mileage, fuel consumption and energy use.

The analysis was conducted in several stages. In the first stage, the relevant literature was reviewed in order to establish the theoretical framework of the study and to identify the main dimensions through which green public procurement can influence sustainable urban development. In the second stage, the Cluj-Napoca case was selected and described, with emphasis on the acquisition of electric buses and the role of the local public transport company in implementing this green procurement project. In the third stage, technical and environmental indicators were analyzed comparatively, focusing on the differences between diesel and electric buses. In the fourth stage, available operational and accounting data were examined in order to identify the main cost-related effects of green procurement, especially those related to fuel consumption, energy use and direct operating expenses. In the final stage, the findings were interpreted in relation to the objectives of sustainable urban development and to the literature on green procurement and cost efficiency in public services.

The objective of assessing economic and managerial implications is addressed through the analysis of fuel costs, spare parts expenses, personnel expenses and other operating expenses. The objective of evaluating social and quality-of-life implications is addressed through the discussion of improved comfort, reduced noise pollution, accessibility to public transport and the role of public subsidies in supporting transport services for different categories of users.

The study has a descriptive character and does not aim to establish causal relationships through statistical or econometric testing. The available data do not allow for a complete before-and-after impact evaluation, nor for the application of advanced quantitative models. Moreover, the internal information systems of the transport company do not allow the full disaggregation of operating expenses by type of vehicle, route, activity or operating time. For this reason, the analysis is limited to the available technical, operational and financial-accounting indicators.

3. Results and discussion

The research on green procurement activities was carried out by evaluating the sources of data and information coming from the technical-organizational and functional structures of the local public transport company, the company's activity level being quantified by the data provided by the technical service, while

the information regarding the impact study of the purchase of electric buses was obtained from the research and development department, and the financial and accounting data were made available by the economic department.

The primary data and information used in the impact study of green procurement came from the research and development department, which collaborates closely with the company's technical service, and the technical research and development department provided the information necessary to substantiate the economic and financial calculations and assessments related to green procurement, consisting of electric buses, as presented in Table 1, based on these data being the basis for the decision to purchase electric buses over classic ones, information resulting from studies and technical analyses carried out by the department.

The comparative advantage of electric buses consists in eliminating noxious emissions and in reducing energy consumption by 50% in terms of value, with a consumption of 0.94 lei/km, compared to 1.75 lei/km for classic buses, and another ecological benefit is the elimination of noise when stationary, the fact that they have a smaller number of seats being compensated by the consumer comfort index, these comparisons having been made since the initiation of the project regarding the acquisition of electric buses.

Table no. 1. Comparative data on comfort and environmental indicators, 2025

No crt.	Explanation	Diesel buses	Electric buses
1.	Number of seats	108	79
2.	Noise level	77db/86	0 Db/76.5 Db
3.	Emissions-hazard	CO2- 1.5g/kwh Monoxid 2g/kwh Particule- 0.02 g/kwh	0
4.	Energy consumption	0.4 l/km	1.63 kwh/km

Source: Cluj-Napoca Public Transport Company SA

At the time of the acquisition of the second batch of electric buses, consisting of 30 units, the impact study on energy consumption was detailed, highlighting that the value of energy consumption for Diesel buses was 3.19 times higher than for electric ones, the study being conducted in 2024, and the value ratio of energy consumption, comparing the two impact studies, increased in favor of electric buses, an aspect that formed the basis of the investment decision, as presented in Table no. 2.

Table 2. Opportunity analysis for green electric bus investments, 2025

Fuel expenses	U.M	Diesel bus	U.M	Electric bus	30*Electric	30*Diesel
Average consumption	l/100km	38	KWh/100km	135	4050	1.140
Average annual mileage	Km	53.870	Km	53.670	1.610.100	1.610.100
Fuel price	RON	8.80	RON	1,5	-	-
Average annual consumption	L	19.858	KWh	69.771	2.093.130	595.740
Average annual cost	RON	174.850	RON	104.656	3.139.695	5.245.500

Source: Cluj-Napoca Public Transport Company SA

From this table it can be deduced that fuel consumption represents the main structural element of the direct costs of the transport activity, fuel expenses, aggregated with those for spare parts, constituting elements generated by the technical operation of the bus fleet, to which are added the driver labor expenses, thus forming the direct costs of the transport activity, which are variable depending on the level of services provided. Fuel expenses were an essential and determining factor in making the investment decision for green procurement, the terms of average annual cost being used in the comparative analysis, relating either to the effective costs or to the standard cost, and the deviations between the average and the effective cost become relevant in the assessment of cost efficiency, especially when public transport companies have a diversified fleet of buses, new or with extended service life, as is the case in most local transport companies in the country.

To improve the performance of the local public transport service, the information provided by the technical service should be integrated into a dashboard, which functions as a monitoring, measurement and control tool for performance, providing decision-makers with intensive and well-structured assistance with relevant information. The dashboard built on technical data should be a component of the general dashboard, developed in a coherent and pertinent manner, with a frequency as close as possible to the periodicity of the

strategic and operational decision-making process, whether weekly, monthly, quarterly, semi-annually or annually, and respect the principle of efficiency, through its ability to generate collective actions. Every manager needs such a dashboard updated as frequently as possible, which allows him to make the necessary decisions for planning the activity and correcting deviations from the plan, eliminating those deviations that could negatively affect the activity carried out. To be truly useful, the dashboard must include several indicators, a maximum of ten, that characterize the overall activity carried out.

In the activity of tracking, analysis and control of costs, consisting of expenses taken from financial accounting, various criteria are used to classify expenses that can be incorporated into costs, in this case using the structure by primary expense elements, according to Fătăcean (2012). From financial accounting, expense elements were taken into managerial accounting, classified according to their nature, to allow the calculation of the cost of the transport activity in calculation items, by destination, as highlighted in Table no. 2.

The determination of the cost of the public passenger transport service can currently only be carried out per conventional unit, respectively per kilometer, using traditional methods of calculating full costs, through the conventional distribution of indirect expenses. The ABC (Activity Based Costing) method cannot be applied, because the accounting information system does not allow the separation of expenses by activities, such as the transport activity itself, the maintenance and repair activity or other support activities. Also, the quantification of the company's activities in transport hours, repair hours, parking hours or bus movement hours is not carried out, so the calculation of the cost per trip or per bus cannot be performed. Under these conditions, the only method of calculating unit costs that can provide relevant information on the influence of green procurement on costs is the global method.

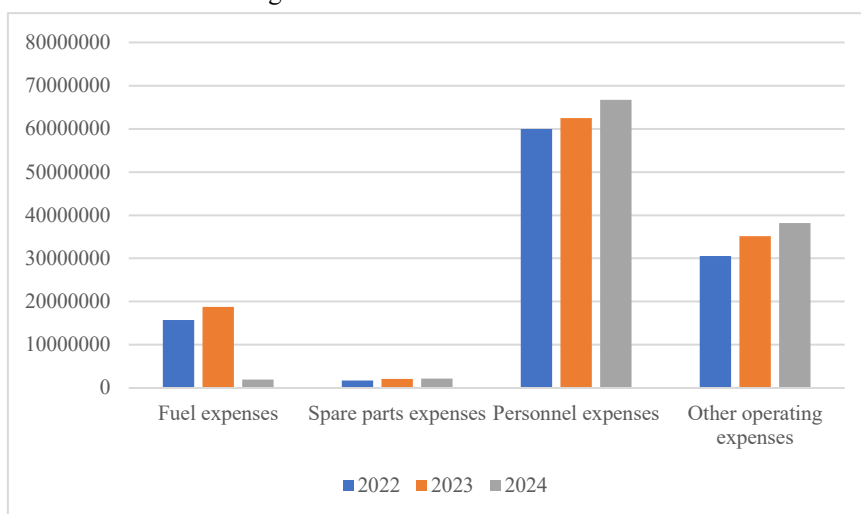


Figure no. 1. Managerial accounting expenses for calculating cost per km

Source: Source: Cluj-Napoca Public Transport Company SA

Social costs represent a component of local public governance and the social responsibility that the community has towards different social categories, the value of the community's financial effort constantly increasing from year to year, so that, in 2024, the value of transport facilities reached a level equivalent to the purchase price of a batch of 25 electric buses. This budgetary allocation highlights the fact that the municipality of Cluj-Napoca has sufficient financial resources to support ecological purchases, such as those of electric buses.

The table presents a detailed analysis of the expenses and costs related to the public transport activity, highlighting both direct and indirect expenses, as well as the unit costs per kilometer traveled. Direct expenses include fuel consumption, spare parts, direct materials and direct labor, and their total indicates the value of the resources actually consumed to provide the transport service. Indirect expenses include indirect labor costs and other indirect operating expenses, reflecting the resources needed to support the support and maintenance activities of the bus fleet. Total operating expenses represent the sum of direct and indirect expenses. Based on the average number of kilometers traveled, the table calculates the unit costs: direct materials cost per km, direct labor cost per km, total direct cost per km, indirect cost per km and, finally, total cost per km. This information allows for the comparison of cost efficiency between periods or types of buses and provides a basis for analyzing the impact of green procurement on the operational costs of the public transport service.

Conclusions

This study analyzed the implications of green public procurement in urban passenger transport, using the acquisition and operation of electric buses in Cluj-Napoca as an applied case study. The research aimed to assess how green procurement contributes to sustainable urban development by examining its environmental, economic, social and managerial implications. Based on technical, operational and financial-accounting data provided by the local public transport company, the study shows that green procurement can support the transition toward cleaner and more efficient urban mobility systems. The main contribution of the study consists in connecting green public procurement with managerial cost information and sustainable urban transport in the Romanian context. While the existing literature generally emphasizes the environmental and policy relevance of green procurement, this article contributes by showing how company-level technical and accounting data can be used to evaluate the practical effects of electric bus acquisition. Therefore, the research provides an applied perspective on the relationship between environmental objectives, operating costs, public subsidies and quality-of-life improvements in urban passenger transport.

The results confirm that electric buses generate clear environmental advantages compared with diesel buses. The analyzed data indicate the elimination of local pollutant emissions, lower noise levels and reduced energy consumption, which directly support the environmental objectives of sustainable urban development. These findings are consistent with previous studies emphasizing the role of green procurement in reducing the environmental impact of public services and promoting low-carbon mobility. From an economic and managerial perspective, the study shows that green procurement does not necessarily generate immediate profit, but it can contribute to cost savings, particularly by reducing fuel and material expenses. The comparison between diesel and electric buses highlights the relevance of energy consumption and operating costs in procurement decisions. At the same time, the analysis indicates that the financial sustainability of green procurement depends on continued public investment, access to external financing and the efficient use of subsidies granted by local authorities.

The practical implications of the research are relevant for local authorities, public transport operators and policymakers. First, procurement decisions should integrate not only acquisition costs, but also lifecycle costs, energy consumption, maintenance requirements and environmental benefits. Second, public transport companies should improve their internal information systems in order to monitor costs and technical indicators more accurately. Third, municipalities should consider reinvesting the savings obtained from lower fuel and spare parts expenses into future green procurement projects, thereby creating a self-reinforcing mechanism for sustainable fleet modernization.

The study also has several limitations. The available data did not allow for the application of advanced statistical or econometric models, nor for a complete causal evaluation of the impact of green procurement. The accounting and technical information systems of the transport company do not currently allow a detailed allocation of operating expenses by type of vehicle, activity or route. As a result, the analysis remained mainly descriptive and focused on the available technical, operational and cost-related indicators. Future research should extend the analysis to other Romanian and European cities in order to allow comparative assessment of green procurement practices in public passenger transport. Further studies could also use longitudinal data to evaluate the long-term effects of electric bus acquisition on operating costs, emissions, subsidies and passenger satisfaction. Another useful direction would be the development of more advanced cost-accounting models, including activity-based costing or lifecycle cost analysis, adapted to public transport companies. Finally, future research could integrate quantitative modelling and stakeholder-based qualitative analysis in order to better capture the economic, environmental and social impact of green procurement in urban mobility systems.

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ChatGPT (version 5.0) was responsibly used for language improvement. After this process, the authors reviewed and edited the content as needed and take full responsibility for the content of the present article.

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