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PUBLIC TRANSPORT SATISFACTION AND OPPORTUNITIES FOR A GREEN TRANSITION IN THE CITY OF KRAGUJEVAC (SERBIA)

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Abstract: This study examines the prospects for a just and sustainable transition of the public transport system in Kragujevac, a mid-sized Serbian city facing increasing environmental, social, and mobility challenges. Positioned within the broader context of the Western Balkans' alignment with the European Green Deal and Serbia's decarbonisation commitments, the paper investigates how user perceptions, service satisfaction, and public acceptance influence the feasibility of introducing electric buses as a low-carbon mobility solution. Building on international and regional literature on just green transition and sustainable urban mobility, the study analyses primary survey data to evaluate users' readiness for cleaner transport technologies and to identify service quality gaps that may hinder or facilitate this transition. The findings demonstrate that public acceptance of electric buses is high, but that support for greener mobility is conditional on improvements in service frequency, reliability, comfort, and fare policy. These results underscore the need for an integrated transition strategy that combines technological innovation with social equity and service quality enhancements. The paper concludes by outlining theoretical contributions to just transition studies in mid-sized and post-socialist urban contexts, as well as practical implications for local policymakers, transport operators, and city planners. Limitations and directions for future research in the Western Balkan region are also discussed.

Keywords: green transition, public transport, electric buses, questionnaire survey, service quality, travel satisfaction.

Introduction

The EU is determined to achieve carbon neutrality by 2050 and to position itself as a global leader in the transition to net-zero emissions. The European Green Deal (EC, 2019) frames this objective as a comprehensive transformation that extends beyond emissions reduction to encompass structural changes in energy systems, production patterns, and mobility practices, with particular atten-

tion to expanding renewable energy, lowering greenhouse gas output, and fostering sustainability across transport and agriculture (see also Kekkonen et al., 2023). Special emphasis is placed on concretizing the adaptation of policies related to climate change and the determination of transitional climate goals (energy and transport) until 2030, aligned with the increased ambitions of the EU which poses an important task and challenge to the Western Balkans (WB) region (EC, 2019).

The WB economies remain heavily reliant on carbon-intensive technologies – particularly coal-based energy and related industrial activities, making the transition toward renewable energy sources both economically and socially complex. Structural vulnerabilities such as limited economic diversification, high employment concentration in fossil-fuel sectors, and pronounced regional disparities increase the risk of adverse socioeconomic impacts, including unemployment, labor displacement, and local economic decline (RCC, 2021; World Bank, 2023). Against this backdrop, the region faces a central challenge: how to phase out coal and other carbon-intensive technologies without triggering severe socioeconomic consequences – an issue well documented in the literature on just and equitable transitions (ILO, 2023; OECD, 2023).

Developing this question for the purposes of this study was motivated by the need to connect the macro-level challenge of just energy transition with one of its most visible and impactful sectors – transport. In the WB region, transport is both a major contributor to emissions and a sector where decarbonization can deliver immediate public-health and environmental benefits. Assessing how cleaner transport technologies can be introduced in Kragujevac without causing socioeconomic disruptions therefore represents a concrete and policy-relevant operationalization of the broader regional transition dilemma

Recognizing the need to map the path towards carbon neutrality by 2050, Serbia acknowledges road transport as the dominant mode contributing significantly to greenhouse gas emissions and air pollution. In this context, and as part of the broader regional strategy, the Western Balkans aims to increase the share of more sustainable modes of transport, support multimodality, and gradually discourage road transport, thereby contributing to emission reduction and a just green transition (TC, 2023).

While international studies have extensively examined electric bus adoption and sustainable mobility in large cities (Avenali et al., 2024; Yildiz et al., 2024; Jagiełło, 2025), there is limited research on mid-sized cities in Serbia, such as Kragujevac. Localized assessments of public perception, service satisfaction, and willingness to adopt greener transport technologies are scarce. This gap underlines the necessity of this research to inform policymakers about the feasibility of introducing electric buses in mid-sized urban contexts in Serbia and to identify critical service improvements that encourage public adoption.

The purpose of this study is to evaluate the current public transport system in Kragujevac and assess factors influencing public readiness for a transition toward greener mobility solutions, particularly the introduction of electric buses. The research is positioned within the broader context of Serbia's decarbonization and sustainable development goals and aims to identify key areas for improvement and provide recommendations to support policymakers in aligning local transport strategies with national environmental objectives. To support this aim, a survey was conducted to collect primary data on user perceptions, travel behavior, satisfaction with existing services, and attitudes toward the adoption of electric buses.

Literature review

Just green transition and sustainable mobility: international perspective

The term 'green transition' is now widely understood in the literature as a multi-dimensional socio-technical transformation that combines decarbonisation, circular economy, institutional reform, labour and skills adjustments, and the re-direction of finance toward low-carbon systems (Berisha et al., 2026). Treating the green transition as an umbrella concept helps capture interactions among sub-transitions (energy, materials, digitalisation, and governance), but it also creates definitional fuzziness that complicates comparisons across studies and policy evaluations. Systematic reviews therefore recommend treating the transition as a set of interacting processes with cross-cutting governance, social, and technological dimensions rather than a single linear pathway. A major strand of recent scholarship emphasises the centrality of justice, commonly framed as distributional and procedural justice, in shaping both the aims and legitimacy of transition policies (Moodie et al., 2026). Reviews and conceptual analyses show that 'just transition' thinking has broadened from a trade-union/worker focus to incorporate community rights, gender and intersectional concerns, and governance mechanisms for participation; however, scholars consistently note that justice is often inadequately translated into practice due to vague targets, weak metrics or limited institutional responsibility, producing an implementation gap between high-level rhetoric and measurable outcomes (Wang & Lo, 2021; Stark et al., 2023). Drivers and barriers frameworks in the empirical literature converge on a similar set of determinants: political and institutional capacity, regulatory clarity, financing availability and instruments, technological innovation, supply-chain readiness, and social acceptance. Where these align, transitions accelerate; where deficits exist e.g., weak governance, corruption, or insufficient institutional coordination, transitions are slower and may be inequitable. Comparative reviews and policy analyses therefore call for integrated policy mixes that combine incentives, regulation, and social protection tailored to local contexts (Muhire et al., 2024). A growing strand of peer-reviewed research warns that rapidly scaling mining for 'critical minerals' (lithium, cobalt, nickel, etc.) carries substantial environmental and social risks, water stress, land disturbance, pollution, labour and human-rights concerns, that can undermine the sustainability and legitimacy of the green transition unless addressed through stronger governance and responsible sourcing (Dou et al., 2023; Carr-Wilson et al., 2024). Overall, the literature is strong on what must change and on identifying levers (finance, regulation, technology), but weaker on integrated, place-sensitive prescriptions and standardized metrics that jointly track climate, circularity and social justice outcomes. Key research gaps are comparative studies focused on the Global South, evaluation of combined policy-mixes that link decarbonisation with social protection, and robust metrics to measure progress across environmental and socio-economic dimensions. Addressing these gaps is essential if the green transition is to be rapid, effective, and socially legitimate (De Felice & Petrillo, 2021; Stark et al., 2023).

This paradigm has been applied to the transport sector, emphasizing that sustainable mobility must balance environmental gains with social equity, energy security, and institutional capacity. Transitioning to low-carbon transport involves measures such as modal shift, fleet electrification, and enhanced public transit services, which together constitute a key pathway toward climate neutrality and urban sustainability. The 'avoid – shift – improve' framework remains a fundamental reference: first avoiding unnecessary travel, then shifting demand from private cars to public or active modes, and finally improving vehicle and fuel technologies (Collazos et al., 2024). Within this broader context, electrification of public-bus fleets has been identified as one of the most promising 'improve'

measures, offering the potential to reduce greenhouse gas emissions, enhance air quality, and lower noise and health externalities, provided electricity is sourced from low-carbon or renewable energy. Nonetheless, transitioning public transport systems toward sustainability requires more than technology: it engages urban planning, governance, financing, social acceptance, and service quality. This complexity underscores the importance of integrating Just Green Transition principles into mobility policy design, particularly in contexts where economic capacities, infrastructure, and institutional readiness vary significantly, such as mid-sized or post-socialist urban environments.

Two recent systematic literature reviews provide comprehensive insights into public transport usage and mode choice behavior. The first review (Sogbe et al., 2025) identifies key determinants of bus transport usage, highlighting service quality factors such as safety, security, comfort, reliability, and accessibility, along with first- and last-mile connectivity and social-symbolic influences. The authors emphasize the need for further research in developing countries to understand contextual challenges and inform policy. Drawing on a broad review of urban travel behaviour studies, Ranjan and Sinha (2025) show that decisions about transport mode are shaped by an interplay of personal characteristics, trip contexts, system-level performance, and wider environmental conditions. Their review also illustrates that these influences are not uniform across regions and evolve alongside changes in urban mobility systems, including the growing relevance of shared services, digital information tools, and automation-related technologies.

The academic literature on public-bus electrification has expanded substantially in recent years, offering both empirical evidence and structured frameworks for decision making. A recent comprehensive review analyzed 62 studies on European and global busfleet electrification, concluding that battery electric buses represent an important asset for cities aiming to decarbonize the transport sector. Under certain conditions, battery electric buses can be more cost-effective than diesel buses when considering total cost of ownership, externalities, and environmental benefits, though environmental gains are highly dependent on the carbon intensity of electricity generation (Ribeiro et al., 2024). Another empirical study modeling fleet transition suggests that switching to purely electric bus fleets can yield meaningful reductions in CO_2 emissions and air pollutants (Ye et al., 2024). However, the literature also highlights critical challenges, including high upfront capital costs, requirements for charging infrastructure, grid capacity constraints, and potential inefficiencies in low-demand or low-density routes. Moreover, electrification alone does not guarantee social welfare improvements if it is not accompanied by optimized service frequency, fare policies, and integrated urban mobility planning. Giagnorio et al. (2024) demonstrate that, under current cost structures, e-bus deployment might fail to yield net welfare gains without public subsidies or complementary policies.

While much of the research on electric buses and sustainable mobility focuses on large metropolitan areas, a growing number of recent studies examine mid-sized and smaller cities, which resemble the scale and constraints of many urban centers in the WB. These studies are especially relevant for assessing feasibility, user acceptance, and policy design in cities like Kragujevac. A recent study on Mediterranean cities shows that electrifying public transport can substantially reduce GHG emissions but also creates significant additional electricity demand depending on city size. Although environmental benefits are evident, economic analyses reveal that electric buses are not always the most cost-effective solution (Miraftabzadeh et al., 2024). A study of bus users in Oviedo (Spain) identifies the key determinants of public transport satisfaction in contexts where buses dominate the mobility system. Using survey data and Exploratory Factor Analysis, the authors find that comfort and information, service performance, and network integration are the three main satisfaction dimensions, with comfort and information emerging as the strongest predictor of over-

all satisfaction (Al Suleiman et al., 2023). Recent study analyzes the shift toward sustainable public transport in a small urban center by planning two new bus lines and comparing battery-electric and hydrogen buses. A Well-to-Tank assessment indicated that battery-electric buses are currently the most cost-effective option, while hydrogen buses remain competitive but face higher ownership costs and greater sensitivity to demand uncertainty (Di Martino et al., 2024). An analysis of smart mobility strategies in fourteen mid-sized Nordic cities shows that most measures focus on efficiency and environmental goals, while social sustainability, such as safety, inclusiveness, and quality of urban life, is largely overlooked. Many strategies relied on conventional solutions with vague, hard-to-measure goals and lacked clear implementation pathways, revealing weaknesses in feasibility and accountability (Müller-Eie & Kosmidis, 2023).

The following studies provide context-specific insights from Serbia, illustrating practical experiences in electric bus operations and sustainable urban mobility. One study investigates factors affecting electricity consumption of electric buses under real operating conditions on Belgrade's EKO 1 line. The findings identify and rank key factors influencing energy use, providing insights for route operation planning, energy efficiency analysis, and optimization of operating conditions for electric buses (Mišanović et al., 2023). A recent study examined the adoption of electric buses in the City of Niš, highlighting public transport's role as a major fossil-fuel consumer and contributor to harmful emissions. Despite challenges such as higher costs and perceived lifestyle impacts, e-buses are recognized as the cleanest technology, producing zero local emissions and improving air quality. The study employed multi-criteria decision-making methods to rank six electric buses available in Serbia, identifying the most suitable option for the city's public transport system (Petrović et al., 2025).

The studies reviewed collectively provide substantial insights into public transport satisfaction, mode choice, and electric bus adoption in various urban contexts. In mid-sized and post-socialist cities, such as those in Southeastern Europe and the WB, user attitudes toward electric buses reflect a combination of factors, including energy mix, urban form, social conditions, economic considerations, and institutional frameworks. Taken together, these findings highlight that electric bus adoption is a promising but complex strategy, its success depends heavily on local context and must be embedded in broader policies addressing service quality, fiscal support, and network planning.

Just green transition in policies and practices in Serbia

Following its commitment to EU climate objectives, Serbia endorsed the Green Agenda for the WB at the Sofia Summit in 2020 and adopted the corresponding Action Plan at the Brdo Summit in 2021. These commitments initiated a gradual decarbonisation process and the formulation of policy measures aimed at enabling a just green transition (Živanović et al., 2026). Key legislative milestones include the adoption of the Law on Climate Change and a new energy law framework, notably the Law on Renewable Energy Sources and the Law on Energy Efficiency and Rational Use of Energy.

In the area of climate, energy, and mobility, Serbia has since adopted a broad set of strategic documents, including the Integrated National Energy and Climate Plan (2021–2030, with a 2050 outlook), the Spatial Plan of the Republic of Serbia (2021–2035), the Long-Term Building Renovation Strategy, the Sustainable Urban Development Strategy, and the Climate Strategy and Action Plan. Further policy development is ongoing, with the Ministry of Mining and Energy preparing a long-term Energy Development Strategy and an Integrated Energy and Climate Plan extending to 2050.

Complementary legislation addressing other pillars of the Green Agenda has also been enacted, covering circular economy, environmental protection, depollution, biodiversity conservation, and sustainable agriculture. Overall, the decarbonisation pillar has progressed most substantially,

reflecting its central role in Serbia's green transition framework.

These policy developments have enabled the implementation of numerous nationally supported programmes and projects related to the just green transition, often in cooperation with EU partners. While most initiatives remain concentrated at the national level, regional and local implementation has advanced in major urban and economically stronger areas, particularly in Belgrade and Vojvodina, as well as in Serbia's larger cities in the national context – such as Novi Sad, Niš, Kragujevac and Subotica – which are commonly classified as mid-sized cities in international urban typologies.

Just green transition in policies and practices in the city of Kragujevac

In comparison with most Serbian local governments, the city of Kragujevac demonstrates a relatively advanced institutional and policy framework relevant to the just green transition. Over the past decade, the city has adopted several strategic and planning documents addressing spatial development, waste management, local economic development, and integrated urban development, many of which intersect with environmental sustainability and mobility objectives. In addition, a range of transport-related strategies and analytical studies have been produced to support data collection and long-term urban and transport planning.

A key challenge, however, is that many of these documents have already expired or are approaching the end of their implementation period. This creates a critical policy gap but also a strategic opportunity. The ongoing and forthcoming revision of local development and transport policies offers a timely entry point for systematically embedding just green transition principles, potentially positioning Kragujevac as a reference model for other Serbian municipalities.

Accordingly, this research focuses on the first pillar of the Green Agenda for the WB – decarbonisation, energy, and mobility – with particular emphasis on just transition dimensions within smart and sustainable urban mobility. This focus aligns with established theoretical perspectives highlighting the dual environmental and social benefits of sustainable mobility, including improved public health and urban liveability (Banister, 2008).

Research methods

Study area

The city of Kragujevac (urban settlement) is situated in the central part of the Serbian territory covering 835 km^2. With its approximately 170 thousand inhabitants, according to the latest Population Census 2022, Kragujevac urban settlement is the fourth-largest city in the country with the average population density of 205 inhabitants per km^2 (Statistical Office of the Republic of Serbia, 2025).

Kragujevac has a rising dependence on private cars, which contribute to congestion and parking pressure in the central area. Public transport is provided primarily through a network of bus lines operated by a single municipal company, with an aging diesel fleet. Given the city's ongoing efforts to improve service quality and reduce emissions, Kragujevac provides a relevant case for examining citizen satisfaction with public transport and assessing readiness for potential fleet electrification. The findings are therefore valuable not only for local decision-making but also for broader discussions on sustainable mobility transitions in medium-sized cities.

Like other mid-sized Serbian cities, Kragujevac experiences pronounced traffic pressures, particularly in its central urban areas. High traffic volumes and recurrent congestion contribute to longer travel times, increased fuel consumption, elevated air and soil pollution, and growing

user dissatisfaction. These challenges affect both private and public transport systems. Urban public transport, which relies exclusively on conventional buses, is further constrained by a compact and uneven urban structure, narrow street profiles, limited network permeability, and the absence of dedicated bus lanes along most routes.

Household survey data indicate an average mobility rate of 2.21 trips per inhabitant per day, corresponding to approximately 378,000 daily trips at the city level. The public urban and suburban transport network comprises 35 lines with a total operational length of about 642 km. Of these, 23 lines operate within the urban area (approximately 301 km), while the suburban subsystem includes 12 lines covering roughly 340 km. This network structure underscores both the scale of daily mobility demand and the operational complexity faced by the public transport system. The first departures in public city and suburban transport start at 03:50 am, and the last departure is at 11:15 pm. Peak periods are from 05:00 to 08:00 am, 12:30 to 04:00 pm, and 06:00 to 08:00 pm, during which the highest number of departures occur. Public city and suburban transport in Kragujevac operate with 65 vehicles in service, including 31 diesel-powered and 34 CNG-powered vehicles. Approximately 40% of the total daily mileage covered by diesel vehicles is within the central zone, totaling around 3,400 km per working day. In the entire central zone, there are approximately 4,000 marked parking spaces, representing potentially sufficient space for stationary traffic (PE Urbanism, 2023). Although most spaces are nearly permanently occupied by residential parking, the low parking fees and the presence of parking lots in the city center further motivate increased traffic into this zone.

The analysis of just green transition policies and practices in Serbia and Kragujevac underscores the importance of aligning urban mobility systems with sustainability goals while ensuring equitable access for all citizens. However, implementing these policies effectively requires more than just transport regulatory measures – it demands a deep understanding of public perceptions, satisfaction, and priorities. In mid-sized urban centers, where resource limitations and infrastructural constraints often intersect, engaging citizens becomes essential.

To explore this dimension, the next section presents the results of a survey conducted to assess user satisfaction with existing public transport, the perceived importance of public transport improvements, and preferences for introducing electric buses as a key element of the green transition.

Survey design and data collection

The purpose of the survey was to collect user-level data on travel habits, satisfaction with the current public transport system, and willingness to adopt electric buses. By identifying key issues and areas for improvement within the existing network, the survey provides the empirical foundation for assessing public readiness and supporting broader research objectives related to the potential introduction of electric buses in Kragujevac.

A total of 424 respondents participated in the survey, collected using a non-probabilistic convenience sampling approach that combined online self-administered questionnaires and field-based interviews:

- online survey: 257 respondents completed the questionnaire via a dedicated survey link disseminated through social media channels and direct email invitations;
- field survey: 167 respondents were interviewed in person at major public transport hubs, including central roundabouts and the busiest bus stations in different parts of Kragujevac. Surveys were conducted during both peak (7:00–9:00 and 15:00–17:00) and off-peak periods to capture variations in public transport usage. Interviewers administered paper-based forms, and respons-

es were later digitized for analysis.

This dual-method approach increased the accessibility of the survey and enabled the inclusion of individuals who may not have been reached through online channels. However, during the pilot phase it became evident that non-users of public transport were unable to answer the majority of questions, particularly those concerning satisfaction with service attributes, as these items require direct and recent experience with the system. Consequently, the questionnaire was intentionally designed to focus on the perceptions of current public transport users – the stakeholder group most directly affected by service quality and most capable of providing informed evaluations.

The willingness to adopt electric buses was assessed using a direct stated-intent question without presenting respondents with alternative transport investment scenarios. This approach was chosen because the survey was designed as a rapid assessment of potential acceptance among current public transport users rather than as a stated-preference experiment comparing multiple policy options. While such direct stated-intent formats are widely used in preliminary adoption studies, they do not enable evaluation of electric bus introduction relative to competing funding priorities or alternative infrastructure improvements. At the same time, this approach reflects the local socioeconomic and institutional context: in Kragujevac, as in many post-socialist cities, participatory planning practices are not yet systematically implemented, and residents typically have limited exposure to transport investment alternatives or opportunities to engage in decision-making processes. Accordingly, a simpler and more direct question format was selected to ensure clarity, accessibility, and meaningful interpretation of responses within the prevailing urban governance environment.

Given the non-probabilistic nature of the sampling, the findings do not claim full statistical representativeness of Kragujevac's entire population. Although the sample size (n=424) yields a 5% margin of error at a 95% confidence level, the results should be interpreted as indicative of public transport users' opinions rather than a comprehensive reflection of all residents' attitudes. The questionnaire was formatted as a concise single-page A4 instrument containing closed-ended items and a five-point Likert scale, allowing an average completion time of approximately five minutes.

All data were processed and analysed using SPSS software, enabling a structured comparison of online and field responses and supporting the evaluation of public sentiment regarding current service quality and prospective improvements, including the potential introduction of electric buses. The survey questionnaire employed in this study is available in the GreenFORCE Twinning project dataset (GreenFORCE, 2025).

Results

Sample characteristics

We have used frequencies and descriptive statistics to understand the distribution of responses for every survey question (Table 1).

The largest age group among respondents is the 26-45 years old category, comprising 41.5% of the total respondents. The second-largest group is the 46-65 years old category, making up 31.8% of the respondents. The 14-25 years old group represents 20.3% of the respondents. The smallest group is those aged 65 and older, accounting for 6.4% of the respondents.

Table 1. Characteristics of respondents, features of public transport usage and perception and attitudes towards electric buses

Respondents' characteristics	Freq.	Valid %	Features of public transport usage	Freq.	Valid %	Perception and attitudes towards electric buses	Freq.	Valid %
Age of respondent			**Frequency of public transport use**			**Advantages of electric buses**		
14-25	86	20.3	Daily	171	40.4	Yes	147	36.2
26-45	176	41.5	4 to 6 days a week	63	14.9	No	259	63.8
46-65	135	31.8	1 to 3 days a week	66	15.6			
65+	27	6.4	1 to 3 days a month	43	10.2	Willingness to use electric buses		
			Less than one day a month	48	11.3	Yes	376	89.7
Education level of respondent			I do not use it at all	32	7.6	No	43	10.3
Elementary school	12	2.9						
High school	346	82.6	**Most common purpose of travel**			**Opinion on additional transfer**		
University degree	61	14.6	Traveling to/from work	200	48.1	Yes	115	30
			Going to school/ university	61	14.7	No	268	70
Car ownership or access			Shopping	21	5.0			
Yes	249	58.7	Recreational reasons	35	8.4			
No	175	41.3	Visiting family/friends	34	8.2			
			Other reasons	65	15.6			
			Type of ticket					
			Single ticket	173	41.3			
			Monthly pass	206	49.2			
			I do not buy a transport ticket	40	9.5			
			Changing bus lines on journey					
			Yes, multiple times	67	16.0			
			Yes, once	79	18.9			
			No	272	65.1			
			Willingness to pay higher price for better quality					
			Yes	212	50.5			
			No	208	49.5			
			Amount willing to pay compared to current price					
			Up to 25% higher	167	77.3			
			Up to 50% higher	32	14.8			
			Up to 2 times higher	13	6.0			
			More than 2 times higher	4	1.9			

Source: author's calculations.

Among the valid responses the majority of respondents, 82.6%, have only completed high school. A significant minority, 14.6%, have obtained a university degree. A very small portion, 2.9%, have only completed elementary school. The high proportion of respondents with a high school education suggests that the survey sample predominantly consists of individuals with a moderate

level of education.

Most of the respondents (58.7%) have access to a car. This indicates that more than half of the survey participants either own a car or have the possibility to use one. The 41.3% of respondents without car access may be more reliant on public transport, making it crucial for the city to ensure that public transport services are efficient, reliable, and meet the needs of these users.

Also, the largest group, 40.4% of the respondents, use public transport daily; 14.9% of the respondents use public transport 4 to 6 days a week (frequent users); 15.6% of the respondents use public transport 1 to 3 days a week (moderate users); 10.2% of the respondents use public transport 1 to 3 days a month (occasional users); 11.3% of the respondents use public transport less than one day a month (rare users); 7.6% of the respondents do not use public transport at all (non-users). Over half (55.3%) of the respondents use public transport at least 4 days a week, indicating a high dependence on public transport.

Among the valid responses nearly half (48.1%) use public transport for commuting to/from work; 14.7% of respondents use public transport for educational purposes. Those are primary and secondary purpose. Among other purposes 5% of respondents use public transport for shopping; 8.3% use it for recreational reasons; 8.0% use public transport to visit family and friends. In addition to this 15.3% of respondents indicated other reasons for using public transport.

Significant portion of respondents (41.3%) use single tickets, while the majority (49.2%) use monthly passes. A smaller portion (9.5%) do not buy a transport ticket at all.

Among the valid responses the majority of respondents (65.1%) do not change bus lines during their journey; a smaller portion of respondents (18.9%) change bus lines once during their journey; a minority of respondents (16%) change bus lines multiple times.

Approximately half of respondents (50.5%) indicated a willingness to pay a higher price for improved public transport services, while the remaining 49.5% reported that they would not be willing to incur additional costs.

Of the number of respondents willing to pay higher price for better quality of public transport the majority (77.3%) are only willing to pay up to 25% higher than the current price. This, of course, suggests that a modest price increase is more acceptable to the majority. A smaller portion (14.8%) are willing to pay up to 50% higher, indicating that some respondents are open to a more significant price increase for better quality. Only 6% are willing to pay up to 2 times higher, and a fraction (1.9%) are willing to pay more than 2 times higher.

Descriptive statistics

A majority of respondents (63.8%) are not familiar or does not recognize advantages of electric buses. On the other hand, 36.2% of respondents see benefits or advantages in using electric buses.

A significant majority, 89.7% of the valid respondents, indicated they are willing to use electric buses. However, this result should be interpreted cautiously, as the sample largely reflects current public transport users rather than the wider population of Kragujevac.

Of all valid respondents that are willing to use electric buses only 30% indicated that an additional transfer would affect their decision to use electric buses. A majority (70%) of valid respondents indicated that an additional transfer would not affect their decision.

In the satisfaction section of the survey, respondents rated their public transport service satisfaction across 12 variables using a five-point Likert scale, ranging from ‘Not satisfied at all’ (1)

to 'Completely satisfied' (5) (Table 2).

Table 2. Descriptive statistics of user satisfaction indicators

Variable	Mean	StdDev	Variance
Satisfaction with frequency	2.812	1.280	1.639
Satisfaction with travel time	3.231	1.203	1.448
Satisfaction with comfort of waiting	2.383	1.344	1.805
Satisfaction with comfort of the journey	2.730	1.270	1.614
Satisfaction with availability of seats	2.706	1.224	1.498
Satisfaction with cleanliness	2.945	1.337	1.788
Satisfaction with information availability	3.131	1.385	1.918
Satisfaction with ease of connection	2.926	1.190	1.415
Satisfaction with station proximity	3.457	1.252	1.568
Satisfaction with safety	3.191	1.202	1.445
Satisfaction with environmental impact	2.854	1.202	1.444
Satisfaction with cost of transportation	3.153	1.268	1.607

Source: author's calculations.

'Satisfaction with station proximity' had the highest mean score (M = 3.457), followed by 'Satisfaction with travel time' and 'Satisfaction with safety'. 'Satisfaction with comfort of waiting' recorded the lowest mean score (M = 2.383), well below the neutral value. 'Satisfaction with information availability' and 'Satisfaction with comfort of waiting' exhibited the highest standard deviations (SD = 1.385 and SD = 1.344, respectively), indicating a wider spread of responses. 'Satisfaction with ease of connection' had the lowest standard deviation (SD = 1.190), suggesting relatively consistent responses among respondents.Next section of the survey refers to what respondents consider or perceive as important regarding various aspects of public transport in Kragujevac across 12 variables using a five-point Likert scale, ranging from 'Not important at all' (1) to 'Very important' (5) (Table 3).

Table 3. Descriptive statistics of importance indicators

Variable	Mean	StdDev	Variance
Importance of frequency	4.361	1.014	1.028
Importance of travel time	4.283	0.991	0.983
Importance of comfort of waiting	4.084	1.188	1.411
Importance of comfort of the journey	4.638	0.702	0.493
Importance of availability of seats	3.981	1.179	1.389
Importance of cleanliness	4.413	0.939	0.882
Importance of information availability	4.453	0.974	0.949
Importance of ease of connection	4.198	1.038	1.077
Importance of station proximity	4.277	0.944	0.892
Importance of safety	4.483	0.943	0.890
Importance of environmental impact	4.205	0.997	0.994

Importance of cost of transportation	4.263	1.061	1.127

Source: author's calculations.

All factors have means above 4, indicating they are generally considered important by respondents. 'Importance of comfort of the journey' has the highest mean (M = 4.638), suggesting it is the most critical factor for respondents (next are 'Safety', and 'Cleanliness'). 'Importance of availability of seats" has the lowest mean (M = 3.981), indicating it is still important but comparatively less so compared to the other factors. 'Importance of comfort of waiting' and 'Importance of availability of seats' have higher standard deviations (SD = 1.188 and SD = 1.179, respectively) and higher variance, indicating a wider spread of responses around the mean. 'Importance of comfort of the journey' has the lowest standard deviation (SD = 0.702), indicating that most respondents have similar opinions about this factor.

Differences in willingness to use electric buses by user and travel characteristics

Group differences in willingness to use electric buses were examined using independent-samples t-tests or ANOVA, depending on whether statistical assumptions were met. First, mean willingness was compared between car owners/users and non-car owners/users using an independent-samples t-test, with results reported in Table 4.

Table 4. Independent samples test

Test Assumption	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)
Equal variances assumed	-0.114	417	0.909	-0.00344	-0.06282	0.05594
Equal variances not assumed	-0.113	364.34	0.910	-0.00344	-0.06301	0.05614

Source: author's calculations.

Levene's test for equality of variances indicated no violation of the assumption of equal variances ($p = 0.820 > 0.05$). The independent-samples t-test showed no statistically significant difference in willingness to use electric buses between car owners/users and non-car owners/users ($t = -0.114$, $p = 0.909$). While this result suggests similar willingness between the two groups within the sample, it cannot be generalized to the entire population due to the overrepresentation of public transport users in the sample.

Before conducting further group comparisons, homogeneity of variances was tested. All four tests indicated significant variance differences across the six groups representing different frequencies of public transport use (Levene's test, $p < 0.05$) (Table 5). Since the assumption of equal variances was violated and the data were not normally distributed, the Kruskal-Wallis test was applied as a non-parametric alternative to ANOVA for analyzing the differences in willingness to use electric buses among different groups (Kruskal & Wallis, 1952).

Table 5. Test of homogeneity of variances

	Levene Statistic	df1	df2	Sig.
Based on Mean	9.647	5	412	<0.001
Based on Median	2.917	5	412	0.013
Based on Median and with adjusted df	2.917	5	346.004	0.014

Based on trimmed mean	9.566	5	412	<0.001

Source: author's calculations.

Group sizes and mean ranks of willingness to use electric buses by frequency of public transport use are presented in Table 6.

Table 6. Frequency of public transport use and willingness to use electric buses

Frequency of Public Transport Use	N	Mean Rank
Daily	168	209.15
4 to 6 days a week	63	201.27
1 to 3 days a week	65	204.08
1 to 3 days a month	43	197.72
Less than one day a month	48	240.25
I do not use it at all	31	208.23
Total	418	

Source: author's calculations.

The Kruskal-Wallis test revealed statistically significant differences in willingness to use electric buses across the frequency-of-use groups ($p = 0.014 < 0.05$) (Table 7). Mean ranks showed variation between categories:

- Daily users: mean rank = 209.15;
- Users 1-3 days per month: mean rank = 197.72;
- Users less than once per month: mean rank = 240.25.

Since the p-value was below the significance threshold, the null hypothesis was rejected, indicating that willingness to adopt electric buses differed significantly among the frequency groups. This finding should be interpreted as reflecting patterns within the surveyed respondents and not necessarily the full population, as occasional or non-users of public transport were less represented.

Table 7. Kruskal-Wallis test for willingness to use electric buses by frequency of public transport use

	Willingness to use electric buses
Kruskal-Wallis H	14.255
Df	5
Asymp. Sig.	0.014

Source: author's calculations.

A similar analysis was conducted for the variable representing the most common purpose of public transport use. All versions of Levene's test (based on the mean, median, adjusted median, and trimmed mean) produced p-values below 0.05, indicating significant differences in variances across travel purpose groups (Table 8). Since the assumption of homogeneity of variances required for ANOVA was not met, the Kruskal-Wallis test was applied.

Table 8. Test of homogeneity of variances

	Levene Statistic	df1	df2	Sig.
Based on Mean	10.905	5	406	<0.001
Based on Median	2.548	5	406	0.028
Based on Median and with adjusted df	2.548	5	333.798	0.028

Based on trimmed mean	9.725	5	406	<0.001

Source: author's calculations.

Group sizes and mean ranks of willingness to use electric buses by most common purpose of travel are presented in Table 9.

Table 9. Most common purpose of travel and willingness to use electric buses

Most common purpose of travel	N	Mean Rank
Traveling to/from work	200	207.13
Going to school/university	59	192.48
Shopping	21	224.74
Recreational reasons	35	197.27
Visiting family/friends	33	191.74
Other reasons	64	224.13
Total	412	

Source: author's calculations.

The Kruskal-Wallis results showed statistically significant differences in willingness to use electric buses among the travel purpose categories ($p = 0.028 < 0.05$) (Table 10). Mean ranks varied across groups, with key findings including:

- shopping trips: mean rank = 224.74 (highest willingness);
- visiting family or friends: mean rank = 191.74 (lower willingness).

Given the p-value below the 0.05 threshold, the null hypothesis was rejected, indicating that willingness to adopt electric buses differs significantly depending on the primary purpose of travel. Again, this variation describes differences within the survey sample and may not fully capture the preferences of car-dependent or non-users not adequately represented in the study.

Table 10. Kruskal-Wallis test for willingness to use electric buses by most common purpose of travel

	Willingness to use electric buses
Kruskal-Wallis H	12.506
df	5
Asymp. Sig.	0.028

Source: author's calculations.

Several limitations should be acknowledged when interpreting the findings of this research. First, the study employed a non-probabilistic convenience sampling method, which restricts statistical representativeness. The combined online and field-based approach resulted in a substantial overrepresentation of current public transport users. This outcome reflects both the locations where interviews were conducted (primarily at major transit hubs) and the results of a pilot study, which demonstrated that non-users were largely unable to answer satisfaction-oriented questions. This pattern is consistent with public transport satisfaction research more broadly, where only regular users can reliably evaluate operational attributes, leading to an inherent underrepresentation of non-users.

Second, because of this sampling composition, the results predominantly reflect the per-

ceptions of active public transport users. While this aligns with the study's primary focus on service quality and potential operational improvements, it limits the generalizability of the findings to the wider population of Kragujevac, including car-dependent residents and those who do not use public transport. Accordingly, conclusions regarding system-wide or population-level benefits should be interpreted with caution.

Third, willingness to use electric buses was measured using a single direct question rather than a stated-preference format contrasting alternative investment scenarios (e.g., increased conventional bus frequency, expanded parking supply, or road infrastructure improvements). As a result, the findings capture general openness to electric buses but do not provide insight into the relative attractiveness of competing spending priorities. This limitation is partly influenced by the local institutional context, where participatory planning and structured public consultation remain underdeveloped and residents typically have limited opportunities to evaluate policy trade-offs. Future studies should consider employing evaluation methods such as stated-preference or discrete choice experiments to assess how residents would prioritize different transport investments under more deliberative planning conditions.

Finally, the study would benefit from additional research employing stratified sampling or targeted data collection aimed specifically at non-users. Such approaches would strengthen generalizability and allow for a more comprehensive understanding of barriers to public transport adoption, perceived shortcomings in service provision, and broader mobility preferences – providing a stronger evidence base for evaluating potential reforms, including the introduction of electric buses.

Public transport performance from the user perspective

While survey responses indicate general support for improving public transport, they reflect a positive attitude toward modernization and service enhancements rather than a specific endorsement of electric buses. This framing allows for a more accurate interpretation of the results, highlighting openness to better and more sustainable transport options while recognizing variations in willingness across different user groups and travel purposes.

The high percentage of respondents with access to a car suggests a potential challenge in terms of parking space availability and traffic congestion, especially in the central zone. This highlights the importance of parking restrictions and other traffic management measures.

Together, the 18.8% of occasional public transport users and the 7.5% of non-users represent a key segment with significant potential for public transport growth. Targeted improvements in service quality, comfort, and reliability, supported by incentives or awareness initiatives, could help convert these individuals into regular users by addressing the barriers that currently limit their engagement with the system.

The predominance of work-related trips indicates that improvements in service quality will largely benefit the employed population. However, substantial shares of trips for shopping, recreation, and visiting family/friends demonstrate that public transport serves a wide range of mobility needs. The relatively high share of 'other' trip purposes (15.6%) also suggests there are additional usage contexts that may merit further exploration.

Ticket purchase patterns also reveal useful distinctions. The high share of monthly pass holders indicates a large base of frequent users who depend on reliable and consistent services. Meanwhile, the substantial proportion using single tickets reflects a mix of occasional users and poten-

tially those with more flexible mobility patterns. Approximately 9.4% who do not purchase tickets may point to fare evasion or informal access, though this requires further investigation. Differentiating between user groups is also valuable for revenue planning, as monthly pass users may have higher expectations regarding service quality and punctuality.

Route-level behavior indicates that most respondents do not transfer during their journeys, suggesting the presence of direct routes or a preference for minimizing transfers. However, nearly 35% of respondents rely on at least one transfer, underlining the importance of efficient, well-connected transfer points. For the 16% requiring multiple transfers, improved network coordination and interchange design could significantly enhance satisfaction.

Willingness to pay more for improved services was nearly evenly split, indicating that while many respondents value higher-quality services, others are price-sensitive or consider current service levels adequate. Nevertheless, the fact that about half of respondents are willing to pay up to 25% more suggests some scope for moderate fare adjustments if accompanied by visible quality improvements – such as increased frequency, reduced travel time, or improved comfort.

Regarding electric buses, the results suggest that respondents generally view modernization of public transport positively, and electric buses are mostly evaluated within this broader context. For those expressing hesitation, the issue appears more related to limited knowledge or lack of familiarity rather than clear opposition. Increasing public awareness about the benefits of electrification, such as lower emissions, may therefore help increase acceptance.

The majority of respondents expressed willingness to use electric buses, but this should be interpreted primarily as openness to improvements in the system rather than strong support for the technology itself. For the 10.3% unwilling to adopt electric buses, targeted communication could help clarify concerns about cost, reliability, or service changes. Many respondents also indicated that an additional transfer would not discourage use of electric buses, although minimizing transfers or improving interchange design would still strengthen user satisfaction and system performance.

Satisfaction results show that station proximity performs relatively well, while comfort of waiting is rated significantly lower, indicating a clear service gap. High variability in ratings for waiting comfort and information availability suggests uneven service quality across locations, schedules, or route segments. Overall, the results highlight comfort at stops, comfort during trips, seat availability, and service frequency as the highest-priority improvement areas.

The importance ratings for service attributes confirm that users place strong expectations on public transport performance. Comfort during the journey emerged as the highest-priority factor, while safety and cleanliness also ranked highly, consistent with broader public transport research. Lower and more variable scores for waiting comfort and seat availability reflect inconsistent user experiences, possibly related to specific local conditions such as infrastructure quality or peak-period loading patterns. These findings suggest that improving both stop-level and in-vehicle comfort would generate substantial user benefit, while interventions aimed at in-vehicle comfort may produce the most universally appreciated gains.

Statistical analysis showed no significant differences in willingness to adopt electric buses between respondents with and without car access within the surveyed sample; however, this result should not be interpreted as applying to the wider population of Kragujevac because car users are underrepresented in the dataset.

The frequency of public transport use influenced attitudes within the sample: daily users and very infrequent users showed higher willingness, while moderate-frequency users reported lower levels. However, given the sample structure, this pattern should be understood as reflecting

differences among respondents rather than broader modal shift dynamics across the city. These differences suggest that communication and service-improvement strategies may need to be tailored to different user profiles, but stronger conclusions about modal shift potential would require data that also captures expectations and barriers among non-users.

Similarly, willingness varies depending on trip purpose. Respondents traveling primarily for shopping register the highest willingness, while those visiting family or friends display lower acceptance. This finding highlights different perceptions of modernization based on travel context within the surveyed sample, although broader generalization would require additional data on trip purposes among non-users and harder-to-reach groups.

Conclusion

This study examined the position of Kragujevac within Serbia's broader efforts to align national and local policy frameworks with the objectives of the European Green Deal and the Green Agenda for the Western Balkans. While national commitments provide an important foundation for decarbonization, the analysis shows that local implementation, particularly in the domain of urban transport, remains critical for translating strategic intentions into tangible progress. Kragujevac illustrates both the potential and the current gaps of Serbian mid-sized cities: several mobility and urban development strategies have laid groundwork for a just green transition, yet many have expired or require substantial revision to reflect contemporary sustainability goals.

The results of the survey indicate that public transport in Kragujevac has a solid base of regular users and that there exists a broad openness to modernization of the system, including the potential introduction of electric buses. Importantly, the findings emphasize that user support is rooted primarily in expectations regarding improved service quality, comfort, reliability, and safety, rather than in strong technology-driven preferences. This aligns with existing research on mobility transitions in European medium-sized cities, where behavioural change is more strongly associated with service performance and perceived accessibility than with the nature of vehicle technology itself. The results contribute to the theoretical understanding of just green transition processes by highlighting the importance of user-centred approaches in transport decarbonization, particularly in contexts where economic constraints, infrastructural limitations, and institutional capacity shape the feasibility of policy implementation.

From a practical standpoint, the study identifies several priorities for local policymakers. First, forthcoming local mobility plans should embed just transition principles, ensuring that improvements in transport services are equitable and accessible across demographic groups. Second, investments in comfort, frequency, safety, and infrastructure – along with clear communication regarding the benefits and operation of new technologies – may accelerate public acceptance of electric buses or other sustainable transport solutions. Third, successful implementation will require coordinated planning of charging infrastructure, operational adjustments, and funding mechanisms aligned with Serbia's broader decarbonization commitments. Municipal authorities may also consider promotional tools (e.g., introductory fares, integrated ticketing, real-time information) to encourage early adoption.

The Kragujevac case illustrates a wider regional challenge: how to advance low-carbon mobility in contexts marked by limited fiscal capacity, ageing transport fleets, political fragmentation, and uneven institutional readiness. The high public support for electric buses reflects societal openness to cleaner technologies, but also reveals a persistent gap between policy ambitions

and service realities. Bridging this gap requires not only technological investment but also long-term governance reforms, improved coordination between national and local authorities, and integration of mobility policies with energy, climate, and social welfare strategies.

Nevertheless, several limitations must be acknowledged. The survey sample, while adequate, does not fully reflect the city's car ownership structure or socio-economic diversity, which limits the generalizability of certain findings. The study also lacks variables that would enable deeper behavioural modelling, such as perceptions of accessibility barriers, attitudes toward pricing reforms, or constraints related to time. Finally, the research focuses on user perceptions rather than operational or cost-related analyses of electric bus deployment.

Future studies should explore longitudinal behavioural data following the introduction of electric buses, enabling assessment of actual modal shift rather than stated preferences. Comparative studies across mid-sized cities in Serbia and the region could provide deeper insights into institutional, social, and infrastructural determinants of successful green mobility transitions. Further research is also needed to integrate cost–benefit analyses and social equity indicators to support evidence-based decision-making as cities prepare for fleet electrification and broader decarbonisation efforts.

Overall, this research demonstrates that the transition toward sustainable mobility in Kragujevac is both feasible and socially supported, but hinges on service quality improvements and governance capacity. Embedding electric bus deployment within a just, user-centred, and institutionally coherent framework offers a realistic pathway for advancing the city's contribution to national and European climate goals.

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