An Empirical Study on User Perception of Electric Bus Integration into Public Transit Networks

Thisaiveerasingam Thilakshan[1,], Thusitha Sugathapala[1] and Saman Bandara[1]*

[1]University of Moratuwa, Moratuwa, 10400, Sri Lanka
thilakshant.21@uom.lk*

Abstract. Electric buses have emerged as a notable sustainable solution in transportation, garnering considerable attention for their potential to address environmental concerns. The global impetus towards adopting electric buses has witnessed exponential growth, with numerous countries integrating support for electric bus deployment into their national policies. This study evaluates user perceptions regarding the adoption of electric buses, focusing on individuals utilizing both current private and public transit modes. Recognizing passengers as primary stakeholders, their acceptance of electric buses holds significant importance for the efficacy of such initiatives. The objective is to incentivize a transition from private to public transit modes without compromising the existing user base. To achieve this, a questionnaire survey was conducted among potential users to ascertain their perceptions and offer insights to policymakers and authorities regarding pertinent concerns and avenues for enhancement. Employing a Likert scale, the survey assessed the significance of various factors and attributes associated with electric bus adoption. Subsequently, Multi-Attribute Utility Theory (MAUT) was employed to analyze the gathered data, accounting for multiple criteria and subjective user preferences. The study's findings reflect a predominantly positive inclination towards adopting electric buses, underlining the importance of meticulous planning and implementation to prevent any disruption or deterioration of the existing transit network.

Keywords: *electric buses, MAUT, user perception, sustainable transportation, electrification*

1. Introduction

Climate change is a pressing global issue, and the transportation sector is a significant contributor to air pollution. In many developing nations, the absence of targeted policies exacerbates this challenge. Various strategies are being pursued globally to mitigate transportation-related emissions, including modal shifts, electrification, adoption of low-carbon fuels, demand management, and enhancements to transport infrastructure. Electrification, especially of vehicles, is widely acknowledged as a cleaner alternative, leveraging renewable energy sources. However, transitioning private vehicle users to public transit, particularly buses, remains a considerable obstacle. Despite their essential role, public buses contribute significantly to emissions. This study focuses on the global adoption of electric buses (e-buses), recognizing their environmental benefits while also highlighting the complexities involved in their initiation and implementation. A notable barrier is the lack of comprehensive tools for evaluating e-mobility interventions, which hampers progress in this field.

The study adopted a mixed-methods approach, combining qualitative and quantitative methods to investigate the factors influencing the choice of electric buses (e-buses) as a vehicle option.

Initially, an exhaustive literature review was conducted to identify existing research on variables impacting e-bus adoption and their applicability to the Sri Lankan context.

The transition towards electric buses within public transportation systems presents an opportunity to foster sustainable urban mobility and mitigate emissions. Nevertheless, implementing electric buses encounters a spectrum of technical and non-technical impediments necessitating systematic assessment and prioritization. Technical obstacles encompass infrastructure readiness, compatibility of charging systems, and grid capacity constraints. Overcoming these hurdles demands strategic planning and investment in infrastructure development.

A systematic survey questionnaire was distributed to a representative sample of potential electric bus (e-bus) users in Sri Lanka to gather empirical data. The survey encompassed demographic information, current transportation preferences, perceptions of e-bus features, government incentives, availability of charging infrastructure, environmental consciousness, and other relevant factors influencing decision-making. Additionally, in-depth interviews and focus group discussions were conducted to capture qualitative insights into participants' motivations, concerns, and experiences related to adopting e-buses.

Furthermore, the study places particular emphasis on public acceptance, which is influenced by educational campaigns and positive user encounters. Engaging diverse stakeholders such as transit authorities, bus operators, utility providers, manufacturers, and community representatives is essential. This collaborative approach enables a thorough understanding of network dynamics, operational requirements, and practical deployment considerations, thereby improving the viability and effectiveness of electric bus integration efforts. This study focuses on the perceptions of the primary stakeholders, the commuters who will use the service, to gain insights into the success of electric bus adoption.

2. Literature Review

Mutter (2019) states urban buses represent optimal candidates for electrification due to their adherence to predictable routes, thereby positioning electric buses as a strategic solution for curbing carbon emissions. In parallel, HCN (2021) advocates for the prioritization of safe and dynamic public transport systems, underscored by substantial investments in zero-carbon infrastructure.

Moreover, Wang et al. (2020) shed light on the ecological ramifications stemming from bus emissions, thereby accentuating the imperative for transitioning towards innovative energy sources to ensure long-term environmental sustainability. Thilakshan et al. (2023) present a contemporary examination of electric buses' integration and operational efficacy within Sri Lanka's existing public transit infrastructure. Concurrently, Polom and Wisniewski (2021) underscore the promise inherent in embracing electric propulsion within public transportation to tackle the sustainability dilemmas prevalent in urban settings.

Michael et al. (2022) aim to identify key factors influencing consumers' readiness to embrace electric vehicles. Employing a quantitative approach, data was gathered from 172 residents of Bengaluru through an online survey using a snowball sampling technique. The research revealed several variables impacting the adoption of electric cars, including financial constraints, vehicle performance concerns, inadequate charging infrastructure, environmental preservation, societal

implications, and public awareness of electric vehicles. Findings from Oliveira et al. (2022), attitudes toward electric vehicles, and their emotional impact emerged as pivotal determinants influencing the intention to use such vehicles. Despite respondents exhibiting positive attitudes toward the adoption and potential purchase of electric vehicles, apprehensions persist regarding charging infrastructure availability, charging duration, vehicle range limitations, and other obstacles such as initial purchase costs.

Shabarien et al. (2023) evaluate service quality elements for customer satisfaction among electric bus users in Bandar Pengerang, employing Customer Satisfaction Index analysis. Key factors examined include affordability, safety, comfort, and accessibility. Additionally, descriptive analysis informs strategies for enhancing public transportation operations. Kolhe et al. (2022) investigate post-purchase consumer behavior regarding the adoption of electric bus services in public transportation within Pune. It aims to leverage the widespread adoption of electric vehicles and their favorable environmental impact to advocate for green marketing strategies aimed at reducing harmful carbon emissions. The research endeavors to convey a persuasive message advocating for public transport utilization over private vehicle usage as a means of environmental conservation.

Pasaribu et al. (2015) employ both quantitative and qualitative methods to investigate urban public transport needs and user interactions in Indonesia. Initial observations inform the development of a questionnaire administered to public transport users, aiming to discern their perceptions of a design-oriented electric light bus. Results indicate a preference for sophisticated interior and exterior designs, enhanced security features, large transparent windows, and well-lit interiors. Moreover, users perceive the futuristic EV light bus as closely aligned with their information technology needs, particularly for active engagement with social media during transit.

Fung (2006) challenges predominantly normative definitions of civic engagement, arguing that value-based understandings of participation lack practical application. He advocates for a mechanistic approach, emphasizing that public participation should be analyzed through the specific mechanisms used in decision-making processes and the democratic values they support. In contrast, Arnstein's (1969) earlier work defines "citizen participation" as “having the real power needed to affect the outcome of the process”, highlighting a focus on the distribution of power within civic engagement.

King et al. (1998) contended that while citizens should be actively engaged as stakeholders, they are typically the most distanced participants in decision-making processes. The authors proposed that citizens should be more centrally involved, emphasizing that significant benefits could be realized by enhancing their role within these processes.

It's important to consider public sentiment around electric vehicles (EVs) in general, as electric buses are a part of the broader EV landscape. In a study by Ferguson et al. (2018), a nationwide consumer survey conducted in Canada in 2015 explored people's opinions and preferences regarding electric cars. Based on this data, the researchers developed a discrete choice model with different consumer segments. For those more inclined toward internal combustion engine (ICE) vehicles, key traits include sensitivity to purchase prices, skepticism about EVs, and resistance to change. In contrast, the hybrid-electric vehicle (HEV)-oriented group showed resistance to recharging, alongside a somewhat paradoxical mix of high environmental concern and continued acceptance of burning gasoline. The plug-in hybrid (PHEV)-oriented group, often

suburban-focused, displayed cautious optimism about recharging, viewing their next vehicle purchase as a likely upgrade to an eco-friendly option. Younger, more impressionable consumers were drawn to the benefits of EVs, such as quick acceleration and lower maintenance costs.

However, the case for electric buses is different. Unlike personal EVs, where usage is often limited to individuals or small groups, electric buses cater to a broad range of commuters. These passengers come from diverse backgrounds and have varying beliefs, needs, and expectations—making the shift toward electric buses a more complex and multifaceted challenge.

3. Methodology and Analysis

3.1 Identified Factors and Characteristics

There are many factors identified in terms of electric bus adoption within an existing public transit fleet. The specialty of this study comprises the individual assessment of private and public users to attain a clearer idea of the diverse perspectives in terms of adoption. There is a requirement amongst policymakers and authorities to validate the concept and understand the viewpoint of the end users.

There were several factors considered by passengers in using a public bus service. Factors include safety, affordability, reliability, passenger load, comfort, and accessibility which are considered in different proportions dependent on the passenger demographics.

The acceptance of the mode is crucial in influencing electric bus adoption. The presence of a clear adoption mechanism is important to facilitate smooth infusion without disrupting the existing transit ecosystem. Efficient remedies involve promoting public transit options that naturally encourage people to choose sustainable alternatives. However, transitioning to electric buses (e-buses) faces obstacles like high upfront costs, challenges in setting up charging stations, new technology, a lack of skilled workers, and insufficient data on e-bus operations.

By systematically tackling and reducing these challenges, authorities can enhance the implementation of electric buses, in line with the overarching objective of promoting sustainable and environmentally friendly urban transportation systems considering the concerns of the current and potential users of electric buses.

3.2 Data Collection

An online survey was designed to collect data and gather user responses for this research. The study's uniqueness lies in its focused analysis of both public and private transit mode users, aiming to achieve a diverse range of outcomes. The survey was structured into sections aligned with the key factors identified in the analysis of influences on electric bus adoption in Sri Lanka. It sought to assess participants' expectations and preferences, considering their demographic backgrounds and viewpoints related to each factor under investigation.

A total of 220 participants completed the survey, ensuring a 95% confidence level and a margin of error below 10%. The participant sample was evenly split, with approximately 50% representing public transit users and 50% representing private vehicle users. This balanced distribution enhances the reliability of the findings and ensures that both groups' perspectives are adequately captured in the research.

The questionnaire employed a Likert scale scoring method to gauge participants' expectations and preferences for each factor and attribute. Ratings ranged from 1 (least considered) to 5 (most considered), with values in between representing varying degrees of consideration. This method enabled a quantitative evaluation of user preferences and facilitated the identification of

significant factors and attributes influencing electric bus adoption. The set of questions focused on filtering a clear picture of the perspectives of the respondent groups, individually and collectively.

3.3 Multi-criteria Analysis (Multi-Attribute Utility Theory)

MAUT, Multi-Attribute Utility Theory, emerges as the optimal approach for analyzing user preferences in studies characterized by hierarchical factors and attributes. Its strength lies in its tailored capacity to manage multiple criteria, allowing users to assign weights or significance values to each factor or attribute. Moreover, it facilitates trade-off assessments, offers quantitative evaluations, and fosters transparent and efficient decision-making processes. With its versatility in accommodating diverse criteria, accommodating subjective preferences, and offering a structured framework, MAUT stands out as the ideal method for comprehensively analyzing user preferences in this study.

In the questionnaire, respondents are prompted to assess the importance of factors separately, alongside the importance of attributes related to each factor. This enables multi-criteria analysis. Simple Additive Weightage (SAW) is utilized to determine the importance of factors, while the Weighted Mean method is employed to gauge the importance of attributes. Within this study, 'mi' represents the frequency or count of weightage, whereas 'Wi' indicates the corresponding weightage value based on the Likert scale.

Consequently, the Weightage of importance for factors is calculated using Equation (1) [15].

$$\text{Weightage of importance for } \sum_i^n \text{ Factors} = mi \times Wi \quad (1)$$

To calculate the importance values of the attributes per person, Equation (2) is utilized, where 'wi' denotes the weightage value based on the Likert scale, and 'Yi' represents the frequency of the weightage.

$$\text{Importance value per person for attributes} = \frac{\sum_i^n Yi \times wi}{\sum_i^n Yi} \quad (2)$$

To determine the ranking order of the attributes based on their importance, utilize the final weightage obtained by employing Equation (3).

$$\text{Final Weightage} = Weightage\ of\ importance\ for\ Factors \times Importance\ value\ per\ person\ for\ attributes \quad (3)$$

3.4 Results

The survey effectively captured a broad range of demographic information, covering factors such as age, gender, and transportation preferences. Of the total respondents, 60% identified as male, while 40% identified as female. In terms of age distribution, the largest group (45%) was between 18 and 30 years old, 23% were in the 31-45 age range, and 16% fell between 46 and 60 years old, with the remaining respondents being over 60.

When looking at transportation choices, respondents were divided into two main groups: those who used public bus services and those who primarily relied on private vehicles. Among private vehicle users, 27% owned motorcycles, 39% had cars or jeeps, 16% owned vans, and the rest used other forms of private vehicles.

Table 8. Calculated Weightage for the factors of different groups

1.Factors	Grouping/Classification									
	2. General	3. Rank	Gender:Male	Gender: Female	Age: 18-30	Age: 31-45	Age: 46-60	Age: 4.>60	Public Bus Users	Private Vehicle Users
Comfort (AC/Seats/Noise etc.)	0.127	**2**	0.127	0.130	0.124	0.129	0.128	0.130	0.136	0.131
Safety (& Security)	0.124	**3**	0.125	0.122	0.120	0.121	0.123	0.122	0.127	0.129
Environmental Benefits	0.118	**6**	0.116	0.110	0.115	0.117	0.120	0.117	0.118	0.121
Reliability (Waiting Time / Information)	0.136	**1**	0.140	0.133	0.131	0.137	0.131	0.135	0.140	0.135
Affordability	0.120	**5**	0.133	0.121	0.126	0.131	0.127	0.127	0.128	0.121
Load Factor	0.121	**4**	0.112	0.098	0.117	0.098	0.101	0.108	0.106	0.116
Driving Behavior	0.115	**7**	0.114	0.117	0.113	0.113	0.115	0.120	0.117	0.119
Supporting Infrastructure Quality	0.111	**8**	0.107	0.115	0.116	0.109	0.110	0.113	0.109	0.111

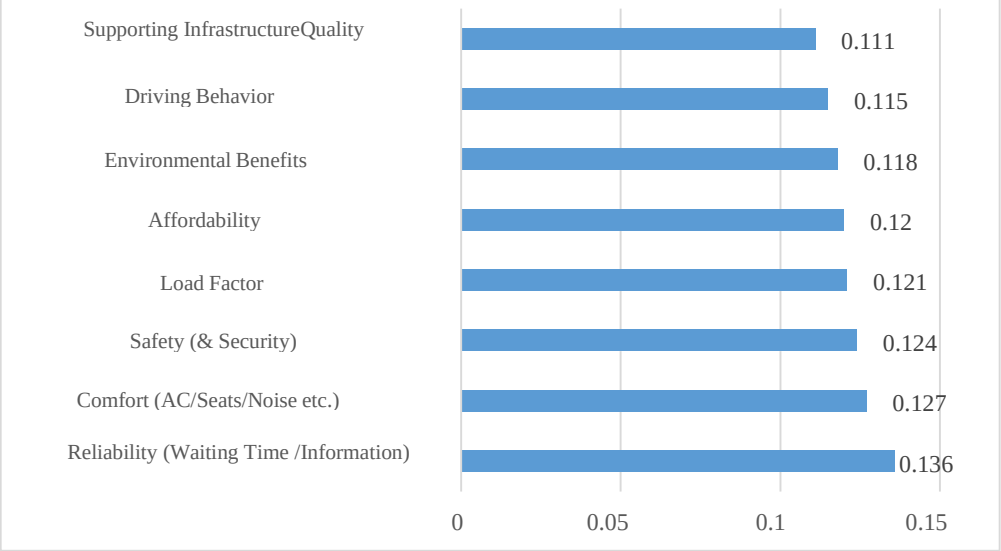

Fig. 1. Weightage of Importance in General Analysis

The majority of private vehicle owners (around 78%) were engaged in full-time employment, followed by a minor proportion of students. On the other hand, among public bus users, 69% were employed either full-time or part-time, while students and unemployed individuals made up the remaining segments. This demographic diversity provided a comprehensive view of the varying transportation habits and preferences among different user groups, allowing for a more nuanced understanding of the factors influencing transportation choices across different populations.

Regarding monthly income, a significant portion of overall respondents in the private vehicle category reported earning between Rs. 100,000 and Rs. 150,000, accounting for 63% of this cohort. In contrast, the majority of public bus users, constituting 67%, indicated a monthly income falling within the range of Rs. 60,000 to Rs. 100,000. Commuting for work is the highest

travel purpose category (72%) among the overall respondents followed by commuting for education and recreation.

Approximately 80% of the respondents commute using their preferred mode of transportation on weekdays (Monday to Friday), with discretionary travel options available for recreational or supplementary work-related activities as needed. The respondents were provided with introductory information about electric buses through textual explanations and video links, aiming to enhance their comprehension of the subject matter.

The significance of various factors is determined by utilizing the Multi-Attribute Utility Theory (MAUT). Importance levels of these factors are assessed for each subgroup. Table I illustrates the computed weightage of importance assigned to the factors through analysis. Additionally, Figure 1 provides a graphical depiction of the calculated weightage of importance per unit in the overall analysis.

The outcome of the data analysis indicates the considerations of the passengers in a particular mode choice. The respondents have prioritized their expectations to consider electric buses as a viable mode choice for travel. The findings highlight respondents considering reliability, comfort, and safety in electric bus adoption for travel. Table 1 gives a clear difference in factors considering the two respondent groups individually for a better understanding of the electric bus scenario.

Participants were provided with a foundational understanding of the pertinent variables. Each fact is discussed in line with their importance from the weightage and the opinions of the respondents. Among these factors, reliability emerged as paramount due to the notable unreliability of Sri Lanka's extant public bus service. The timeliness of bus arrivals, seat availability updates, overall bus availability, and the provision of ancillary information are essential components for building public trust and encouraging greater use of any public transit system. These factors directly influence the convenience and reliability of the service, playing a crucial role in shaping commuters' perceptions and experiences. When public transit systems provide accurate and real-time information on bus schedules, seat occupancy, and route updates, they enhance operational transparency and create a user-friendly environment. This not only fosters confidence in the system but also increases the likelihood of sustained user adoption, particularly for new technologies like electric buses. Ensuring that these components are efficiently managed is key to promoting a seamless and attractive public transportation experience.

Presently, electric buses infiltrating the market possess technological capabilities and devices aimed at addressing the aforementioned concerns, thereby potentially enhancing the reliability of bus services.

Electric buses are manufactured with better features including noise reduction, seat comfort, air conditioning if needed, better suspension to ensure smooth travel, and a friendlier interior for diverse groups of people including children, women, and the disabled. Load Factor is an important concern, especially in urban routes. This impacts both quality as well as electric bus range.

Affordability is a key factor for transportation users, making it essential that the introduction of electric buses into existing systems aligns with current fare structures. Feedback from respondents highlights the importance of price sensitivity in their choice of transportation modes. The environmental benefits of electric buses offer a unique selling point, especially when

appealing to a wide range of demographic groups. Policy initiatives aimed at encouraging the adoption of electric buses are driven by the need to tackle environmental issues, particularly pollution, which is closely tied to transportation.

Analysis of public bus user survey responses reveals a notable absence of firsthand experience with electric buses among participants. The majority of respondents hail from urban locales (79%), with smaller proportions residing in suburban (17%) and rural (4%) areas. Notably, a considerable portion of respondents (71%) express limited concern regarding the environmental impact of conventional buses used in their daily commutes.

Key deliberations among policymakers center on fare considerations for electric buses, with only a minority (23%) indicating willingness to pay higher fares, while a substantial proportion (67%) reject such a proposition. Moreover, a significant majority (89%) express interest in amenities such as Wi-Fi, charging ports, and comfortable seating in electric buses.

Despite a modest grasp of the technical intricacies of electric bus technology, a substantial majority (79%) of respondents emphasize the importance of range in bolstering confidence in mode selection. Moreover, awareness of government incentives

Efforts to promote the benefits of electric buses are deemed essential, with awareness emerging as a pivotal determinant of venture success. A notable proportion (72%) of public bus users express a willingness to transition from diesel to electric buses, provided both options are available for the same route, while a small minority (5%) exhibit reluctance to switch, with the remainder expressing uncertainty.

Private vehicle users predominantly hail from the Colombo district (80%), followed by the Gampaha district (13%), with an overwhelming majority (95%) residing in urban and suburban areas. Their preference for private vehicle usage is primarily motivated by considerations of convenience, comfort, and flexibility. While a minority (40%) express awareness and concern regarding the environmental impacts of their car usage, the majority exhibit limited concern in this regard.

A significant proportion (81%) of private vehicle users demonstrate awareness of the advantages of electric buses over diesel counterparts, citing benefits such as lower emissions and reduced noise pollution. Moreover, a substantial majority (72%) express a willingness to transition from driving their cars to utilizing electric buses for daily commuting or other travel needs, contingent upon factors such as convenience, accessibility, and reliability.

Among private vehicle users who have experience with public transportation (around 68%), the main concerns are reliability, safety, and accessibility, ranked in that order. Additionally, a significant majority (72%) feel that the current state of public transport is inadequate and in need of major improvements. A smaller group (17%) recognizes the existing quality of public transport but still advocates for enhancements.

One of the most striking findings is that 73% of respondents believe electric buses could significantly reduce traffic congestion. Many respondents also indicated that electric buses would become far more appealing if they were operated efficiently and with improvements focused on enhancing passenger satisfaction.

Regarding fares, 68% of private vehicle users are willing to pay slightly higher prices for electric bus services, as long as the cost increase remains within 25% of current diesel bus fares. Meanwhile, 22% prefer fare parity with conventional buses. Most respondents (89%) own conventional petrol or diesel vehicles for personal use, with a significant portion expressing

concerns about transportation costs. Specifically, 61% are very concerned, and 22% are somewhat concerned, about rising fuel and vehicle maintenance expenses. In contrast, 59% show little to no concern about parking fees or the availability of parking spaces when using their private vehicles.

Lastly, respondents were asked to rate their willingness to switch from private vehicles to electric buses on a scale of 1 to 5. This rating was based on various factors, including their overall perception of electric buses and public transportation, as outlined in Table 2.

Table 2. Rate of Willingness to shift to an Electric Bus from the Current Private Mode

Rate of Willingness	Percentage
1	5%
2	21%
3	31%
4	24%
5	19%

4. Discussion

A detailed analysis of the survey data reveals several critical themes and implications, offering insight into both the challenges and opportunities of transitioning to electric buses. One of the primary findings is the strong perception of electric buses as a solution for alleviating traffic congestion, with 73% of respondents highlighting this potential benefit. This aligns with existing research that emphasizes the role of electric vehicles (EVs) in addressing urban mobility issues and reducing the environmental impact caused by traditional internal combustion engine (ICE) vehicles.

The study goes beyond highlighting the environmental benefits of electric buses, such as reduced emissions and lower noise pollution, to reveal that successful adoption requires more than just technological improvements. Although respondents are generally aware of the positive environmental impact of electric buses, their willingness to use this form of public transit depends heavily on a range of other factors. Key considerations include the affordability of fares, the availability of amenities, and the perceived reliability and efficiency of electric bus services. These factors shape how users view electric buses as a viable alternative to conventional modes of transportation.

The research identifies private vehicle users as a crucial demographic in the shift toward electric buses. Many of these respondents showed a readiness to switch from private vehicles to electric buses, provided they are offered the right incentives such as affordable fares, convenience, and guaranteed service reliability. A significant portion of private vehicle owners expressed a willingness to pay slightly higher fares for electric bus services. This highlights a market opportunity for transit authorities to introduce electric buses with improved services that meet the expectations of private vehicle users, potentially capturing a segment of the population that has traditionally been more reliant on personal transportation.

However, the study also brings to light a major concern for both private vehicle owners and public transport users: the overall cost of transportation. Respondents expressed significant

concerns about the expenses associated with fuel costs and vehicle maintenance for private cars, underscoring the need for affordable and efficient alternatives. This suggests that policymakers must develop comprehensive strategies that not only focus on making public transit fares affordable but also address the broader economic implications of transitioning to electric transportation systems. The cost-effectiveness of public transportation, when compared to the financial burden of maintaining a private vehicle could be a key factor in encouraging greater adoption of electric buses.

Moreover, the findings point to important implications for transit planning and policy formulation. Enhancing the attractiveness of electric bus services requires more than just deploying the vehicles involves creating a passenger-centered approach to improve the overall user experience. To maximize public acceptance, transit authorities need to prioritize operational efficiencies and service reliability, alongside ensuring accessibility for all user groups. Additionally, the integration of amenities that enhance comfort and convenience will be essential in positioning electric buses as a preferred mode of transportation.

Ultimately, this research emphasizes that a successful transition to electric buses will depend on a holistic approach. By addressing the economic, social, and operational factors that influence user decisions, policymakers and transit authorities can build a sustainable transportation model that is not only environmentally beneficial but also widely accepted by the public. This shift, in turn, can significantly contribute to the broader goals of urban mobility improvements and environmental sustainability.

5. Conclusion

In conclusion, our empirical study provides critical insights into the perception and acceptance of electric buses within public transit networks, revealing both opportunities and challenges associated with their integration. The research underscores the importance of understanding user preferences and addressing key factors such as fare affordability, reliability, and passenger comfort that influence the successful adoption of electric buses. The findings suggest that while technological advancements like emissions reduction and lower noise levels offer clear environmental benefits, they are not sufficient on their own to drive widespread adoption. Instead, the integration of electric buses must be paired with operational efficiency and passenger-centric enhancements to meet user expectations and attract a broad base of commuters.

One of the key takeaways from the study is the willingness of private vehicle users, a traditionally difficult demographic, to shift toward public transportation and consider transitioning to electric buses. This group demonstrated a readiness to pay slightly higher fares for electric bus services, as long as these fares remain competitive with those of traditional diesel buses. This signals a promising market potential for transit authorities looking to reduce reliance on private vehicles and promote more sustainable transportation options. Importantly, this shift among private vehicle users is contingent on the perceived convenience, reliability, and cost-effectiveness of electric buses, highlighting the need for transit agencies to focus on delivering consistent and high-quality services.

Furthermore, the research reveals that cost concerns remain a significant barrier for many respondents, particularly those who own conventional petrol or diesel-powered vehicles. Rising

fuel prices, maintenance costs, and the broader economic implications of owning and operating private vehicles were frequently cited as pressing concerns. However, the data also show a strong willingness among these individuals to adopt electric buses, provided that these services are accessible, reliable, and offer a financial advantage over continued private vehicle ownership. This finding reinforces the need for policymakers to implement comprehensive strategies that address both the direct costs of using public transportation and the broader economic pressures associated with transportation choices.

In light of these insights, policymakers and transit authorities are encouraged to prioritize both efficiency and user experience in the roll-out of electric buses. This includes ensuring that electric buses are operated in a manner that maximizes reliability and convenience, while also enhancing the overall passenger experience through modern amenities, accessibility improvements, and digital solutions for real-time service updates. By focusing on these elements, transit authorities can bridge the gap between the perceived benefits of electric buses and the practical concerns of commuters.

The study further emphasizes that the successful integration of electric buses into public transportation systems will require a holistic approach, combining technological innovation with thoughtful, passenger-centered planning. Environmental benefits alone, while important, will not be enough to drive the widespread adoption of electric buses. Instead, sustained public acceptance and use will depend on creating a seamless, affordable, and reliable transportation experience that meets the diverse needs of urban populations.

As public transportation systems around the world face growing pressure to become more sustainable and efficient, the lessons learned from this study provide valuable guidance for future transit planning. By leveraging the potential of electric buses and addressing user concerns proactively, policymakers have a unique opportunity to transform urban mobility, reduce traffic congestion, lower emissions, and create more livable cities. This transition represents not only a significant step toward achieving environmental sustainability but also a critical pathway to enhancing the overall efficiency and equity of public transportation systems.

Ultimately, the successful adoption of electric buses will be a benchmark for broader efforts to modernize public transit and create sustainable urban environments. By embracing a user-focused approach and addressing the economic and operational challenges identified in this research, transit authorities can ensure that electric buses play a central role in the future of public transportation. This research contributes valuable knowledge to this growing field, offering actionable insights for stakeholders aiming to implement sustainable transportation solutions that align with the needs and preferences of diverse populations.

Acknowledgment

The authors would like to extend their sincere gratitude to all the participants who participated in the ‘User Perception of Electric Bus Integration’ survey into Public Transit. Their valuable responses and insights have been instrumental in understanding user preferences, priorities, and challenges related to electric bus adoption. Their contribution has greatly contributed to identifying the key factors and attributes that influence the decision-making process when considering the shift to electric buses in Sri Lanka.

References

1. Mutter, A.: Obduracy and Change in Urban Transport— Understanding Competition between Sustainable Fuels in Swedish Municipalities. Sustainability, 11, 6092 (2019).
2. HCN (Health and Climate Network), Transport Systems That Protect Climate and Health, August (2021).
3. Wang, C., Sun, Z., Ye, Z.: On-Road Bus Emission Comparison for Diverse Locations and Fuel Types in Real-world Operation Conditions. Sustainability, 12, 1798, (2020).
4. Thilakshan, T., Sugathapala, A.G.T., Bandara, J.M.S.J., Implementation of Electric Buses into an Existing Public Transit Network: A Sri Lankan Perspective. Moratuwa Engineering Research Conference 2023 (MERCon) (2023).
5. Polom, M., Wisniewski, P.: Implementing Electromobility in Public Transport in Poland in 1990–2020. A Review of Experiences and Evaluation of the Current Development Directions. Sustainability, 13, 4009. https://doi.org/10.3390/su13074009, (2021).
6. Michael, S. K V. L. K., Hungund, S. S., Fernandes, M. Factors influencing adoption of electric vehicles – A case in India. Cogent Eng., vol. 9, no. 1, p. 2085375, doi: 10.1080/23311916.2022.2085375, Dec. (2022).
7. M. B. de Oliveira, H. M. R. da Silva, D. Jugend, P. D. C. Fiorini, C. E. Paro: Factors influencing the intention to use electric cars in Brazil', Transp. Res. Part Policy Pract., vol. 155, pp. 418–433, (2022).
8. Shabarien, M. S. Z. M., Abdullah M. F., Sufahani, S. F, Ahmad, W. N. A. W.: Customer Satisfaction Index On the Electrical Buses (Electrical Vehicle) In Malaysia: Case Study On the Affordability, Safety and Accessibility, International Journal of Renewable Energy Research (IJRER) Vol.13, No.2 (2023).
9. Kolhe, R. D., Sakhrekar, S., Gorde, S.: Electric buses in public transport: perception of the green marketing approach in Pune. Shodhasamhita vol. IX, Issue- I (XI) January – June (2022).
10. Pasaribu, Y. M., Sarumpaet, D.C.: Public perception on EV public light bus concept case study the city of Bandung. In:15th Joint International Conference on Electric Vehicular Technology and Industrial, Mechanical, Electrical and Chemical Engineering (ICEVT & IMECE) (2015).
11. Fung, A.: Varieties of Participation in Complex Governance. Public Administration Review, 66(s1). https://doi.org/10.1111/j.1540-6210.2006.00667.x (2006).
12. Arnstein, S. R.: A Ladder of Citizen Participation. Journal of the American Institute of Planners, 35(4). https://doi.org/10.1080/01944366908977225 (1969).
13. King, C. S., Feltey, K. M., Susel, B. O.: The Question of Participation: Toward Authentic Public Participation in Public Administration. Public Administration Review, 58(4). https://doi.org/10.2307/977561 (1998).
14. Ferguson, M., Mohamed, M., Higgins, C. D., Abotalebi, E., Kanaroglou P.: How open are Canadian households to electric vehicles? A national latent class choice analysis with

willingness-to-pay and metropolitan characterization, Transp. Res. Part Transp.Environ., vol. 58, pp. 208–224 (2018).

15. Rukhin, A. L.: Weighted mean statistics in interlaboratory studies. Metrologia, Tourism and Hospitality Management, 6(1), 1- 15. 46(3), 323 (2009).