

User Acceptance and Satisfaction with 'Ogata' Electric Bus Services among Students and Staff at the University of Lagos

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abstract

Transportation is a very critical driver of all human activity. It is a sector that relies mainly on fossil fuels, which has made commuting within and outside the university campus more expensive because of the removal of fuel subsidies. In response to this challenge, the university management adopted renewable energy solutions, such as electric/solar-powered buses, which have gained global attention, to address the numerous issues hindering commuting among university students and staff. This study examined the operations of the Ogata Electric Bus at the University of Lagos, focusing on commuter usage acceptance, patterns, and satisfaction. Data were collected through a structured questionnaire from 370 respondents and analysed using SPSS version 26. The findings revealed that most commuters used the bus daily, primarily for academic purposes. Respondents expressed high satisfaction with cost ($M = 4.2$) and safety ($M = 4.1$), but only moderate satisfaction with comfort, accessibility, and convenience. The most pressing challenges identified were insufficient buses (59.5%), limited route coverage (48.6%), and irregular schedules (40.5%). Notably, the hypothesis tests confirmed that perceived cost-effectiveness significantly influenced patronage ($r = 0.62$, $p < 0.001$), and satisfaction differed significantly across commuter categories $F(2, 367) = 4.56$, $p = 0.012$. The study concludes that while the Ogata Electric Bus is an essential step toward sustainable transportation within Nigerian universities, its long-term success depends on addressing operational inefficiencies. The study recommends expanding fleet size, improving route coverage, strengthening maintenance capacity, and introducing supportive policies to enhance economic and environmental sustainability.

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1. INTRODUCTION

Commuting is an essential aspect of human endeavours. Transportation infrastructure supports this daily. This makes transportation a cornerstone of modern society, promoting economic growth, social inclusivity, and urban development. Efficient transportation systems are crucial to economic functioning and to ensuring equitable access to both critical and non-critical infrastructure (Litman, 2021). However, as cities and towns grow worldwide, the transportation sector faces increasingly complex challenges. The most significant challenge is the high cost of commuting within urban areas, mainly due to their heavy reliance on fossil-fuel-powered vehicles, which also contributes significantly to greenhouse gas emissions, air pollution, and noise pollution. It has also been found to have pronounced adverse effects in densely populated urban centres, where vehicle emissions significantly affect air quality and public health (IEA, 2020). In response, there has been a global shift toward sustainable transport solutions, particularly those powered by renewable energy.

Among these innovations, solar-powered buses have attracted attention as a bright, environmentally friendly alternative to traditional diesel and petrol vehicles. These buses either draw energy directly from solar panels mounted on the vehicle or are charged using electricity generated by solar photovoltaic (PV) systems. Moreover, because they emit no pollutants, solar buses are a

crucial component of green transportation strategies aimed at achieving sustainable, low-carbon cities (Zhang et al., 2019; Gao et al., 2020).

Solar-powered transport not only addresses environmental concerns but also offers significant economic advantages. Over the long term, such systems reduce dependence on imported fossil fuels, lower maintenance and operational costs, and contribute to energy security—especially in energy-importing countries (Chen et al., 2021). The twin advantages of environmental sustainability and cost-effectiveness make solar buses more attractive to governments at all levels seeking to modernise their public transportation systems to meet various targets, particularly the UN Sustainable Development Goals (SDGs) (UN-Habitat, 2022). Technologically advanced countries have made significant strides in developing and expanding solar- and electric-bus systems. For instance, Germany and China have led the world in integrating solar buses into municipal transit fleets (IRENA, 2021). In the United States, several cities have introduced solar-powered bus stops and charging systems as part of the broader smart-city initiatives. These experiences show that with the right mix of infrastructure, funding, and policy alignment, solar-powered public transportation can be both feasible and transformative. In contrast, developing countries, particularly in sub-Saharan Africa, the problem of low capital, poor technical knowledge, lack of adequate infrastructure for solar energy storage and distribution, and insufficient public awareness pose substantial barriers to widespread adoption and transition to renewable energy-based transport systems (Oyedepo, Akande & Fagbenle, 2020; Oluwafemi et al., 2023). However, unfolding trends show promise. The rapid growth of battery

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technologies, growing awareness of climate change, and declining PV panel prices have created an opportunity for countries like Nigeria to leapfrog traditional transport models and adopt clean energy alternatives.

Against this background, the University of Lagos Ogata Green Energy Bus project, located within an academic institution, represents an exceptional and promising initiative that seeks not only to minimise the university's carbon footprint but also to serve as a model of sustainable transportation solutions in Nigeria. The high mobility demand resulting from high population density in a controlled environment, as observed at the University of Lagos, provides a suitable setting for piloting renewable energy transport options and evaluating their performance. Based on the foregoing, this study aims to examine the user acceptance and satisfaction of the Ogata Electric Bus Services among students and staff at the University of Lagos.

Despite growing global interest in electrified public transport as a measure to mitigate urban air pollution, greenhouse gas emissions, and operating costs (Davis, 1989; Venkatesh, Morris, Davis & Davis, 2003), there is limited empirical evidence on whether electric bus services introduced on African university campuses actually meet user needs and gain sustained acceptance. Addressing this problem is essential to produce context-sensitive, evidence-based recommendations that increase ridership, improve service design, and maximise the environmental and social benefits of electrified campus transport (Parasuraman, Zeithaml & Berry, 1988; Venkatesh et al., 2003; Eboli & Mazzulla, 2007; Alsharif, 2025). At the University of Lagos, a newly introduced Ogata electric bus service promises cleaner, quieter, and potentially more cost-effective campus transportation. However, preliminary administrative reports and project briefs focus almost entirely on technical performance, procurement, and operational logistics rather than on how students and staff perceive, accept, and evaluate the service (Oni, 2015). User acceptance and satisfaction are critical: low perceived usefulness, poor perceived ease of use, perceived risk, or mismatch between service quality and user expectations can suppress ridership and undermine the environmental and economic benefits that electrification aims to deliver (Davis, 1989; Parasuraman et al., 1988; Eboli & Mazzulla, 2007; Alsharif, 2025).

More specifically, existing frameworks for technology acceptance (Technology Acceptance Model [TAM]/Unified Theory of Acceptance and Use of Technology [UTAUT]) and service quality/satisfaction (SERVQUAL/expectation-confirmation) have been widely applied in research on public transport in developed countries. Still, their explanatory power and antecedents have not been thoroughly tested for campus-scale electric bus pilots in Nigerian or similar West African contexts where infrastructure constraints, cultural travel norms and affordability concerns may change the relative importance of factors such as reliability, charging availability, fare fairness and perceived safety (Oliver, 1980; Parasuraman et al., 1988; Venkatesh et al., 2003; Olokesusi et al., 2018; Aiyegbajeje, 2023; Elias & Aiyegbajeje, 2025). The broader transport environment in Lagos is characterised by congested roads, dominance of informal paratransit, and intermittent public transit service, which shape user expectations and travel behaviour (Adebayo, 2015). It is therefore unknown whether models developed elsewhere capture the mix of technological, service, and contextual determinants that drive both initial uptake and continued use of the Ogata electric bus among University of Lagos students and staff. Therefore, this study examines the operational effectiveness of the Ogata Green Energy Bus initiative, focusing on user experiences, levels of patronage, and the perceived benefits and drawbacks of the system. It examines how factors such as cost, convenience, accessibility, comfort, and environmental awareness among students and staff at the University of Lagos shape patronage, and how contextual factors unique to the Lagos campus environment condition these relationships. The specific objectives are to examine the level of patronage of the Ogata electric bus, evaluate user satisfaction with the quality of service, including comfort, reliability, and safety, and identify the key challenges affecting the performance and adoption of the solar bus system. The study tested two hypotheses: (i) there is no significant relationship between the perceived cost-effectiveness of the Ogata Green Energy Bus and commuter patronage, and (ii) there is no significant difference in user satisfaction across different commuter categories (students, staff, visitors).

THEORETICAL SYNTHESIS AND JUSTIFICATION OF FRAMEWORKS

The transition toward sustainable urban mobility has accelerated the deployment of electric buses in many cities worldwide. Within university campuses, electric bus systems are increasingly being introduced to improve mobility efficiency, reduce carbon emissions, and promote environmentally sustainable transportation behaviour. However, the success of such innovations depends largely on user acceptance and satisfaction, particularly among the system's primary users. Existing studies (Olokesusi & Aiyegbajeje, 2017; Gao, Liu, & Zheng, 2020; Kumar, Patel, & Varghese, 2020; Li, Chen, & Zhou, 2020; Asare, Boateng, & Appiah, 2021; Chen, Liu, & Song, 2021; Mwangi & Odede, 2022; Alsharif, 2025; Elias & Aiyegbajeje, 2025) on electric mobility and public transport adoption have examined technological acceptance, service quality, and behavioural intentions, yet important theoretical gaps remain. Research on electric mobility adoption has frequently relied on behavioural and technology adoption frameworks such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). TAM, originally proposed by Davis (1989), explains technology adoption through two primary determinants: perceived usefulness and perceived ease of use, which shape users' attitudes and behavioural intentions toward a technological system. Similarly, the UTAUT framework (Venkatesh, 2015) expands technology adoption analysis by incorporating performance expectancy, effort expectancy, social influence, and facilitating conditions. These models have been widely applied to explain the adoption of smart mobility services, ride-sharing platforms, and intelligent transport systems.

Despite their explanatory strength, existing applications of TAM and UTAUT in transportation studies tend to focus primarily on technology adoption intentions rather than post-adoption user satisfaction and service quality experiences. Electric bus systems, particularly those operating within campus environments, are not merely technological innovations but also public transport services whose success depends on operational reliability, comfort, safety, and responsiveness to user needs. Consequently, technology acceptance models alone may not fully capture the multidimensional nature of user experience with campus-based electric mobility systems. To address this limitation, service quality research provides a complementary perspective. The SERVQUAL model developed by Parasuraman, Zeithaml, and Berry conceptualises service quality through five dimensions: tangibility, reliability, responsiveness, assurance, and empathy. This framework has been extensively applied in transportation research to assess passenger satisfaction and perceived service performance. However, some studies (Parasuraman, Zeithaml, & Berry, 1988; Eboli & Mazzulla, 2007; Seth, Arora, & Mathur, 2020; Aiyegbajeje, 2023) applying SERVQUAL to public transport focus primarily on traditional bus/rail air transport systems, with limited attention to technology-driven mobility services such as electric buses integrated with digital ticketing or smart mobility platforms.

A further theoretical gap lies in integrating perspectives on technology acceptance and service quality. Much of the literature (Eboli & Mazzulla, 2007; Seth, Arora, & Mathur, 2020; Aiyegbajeje, 2023) treats adoption and satisfaction as separate phenomena, whereas in emerging mobility systems, they are closely interrelated. Users may initially adopt an electric bus service due to perceived environmental benefits or institutional encouragement. However, continued use is strongly influenced by service quality and overall satisfaction with the transport experience. Consequently, examining only adoption or only service quality may not fully explain user behaviour. The campus mobility context also remains underexplored in the literature. Universities represent semi-controlled mobility environments where institutional policies, environmental awareness, and social influence strongly shape transport choices. However, most studies (Gao, Liu, & Zheng, 2020; Kumar, Patel, & Varghese, 2020; Li, Chen, & Zhou, 2020; Abdullah & Ismail, 2021; Asare, Boateng, & Appiah, 2021; Alsharif, 2025) on electric bus adoption focus on city-wide systems rather than micro-mobility ecosystems such as university campuses. Investigating user acceptance and satisfaction at the University of Lagos, therefore, helps fill this contextual gap while offering insights relevant to other universities implementing sustainable campus transport initiatives.

Given these theoretical and contextual limitations, this study adopts an integrated analytical framework combining TAM/UTAUT with SERVQUAL.

TAM and UTAUT provide a robust basis for examining users' perceptions of electric bus technology, including usefulness, ease of use, and social influence factors that affect adoption. SERVQUAL complements this perspective by assessing perceived service quality and satisfaction and capturing experiential aspects of bus operations, such as reliability, comfort, safety, and staff responsiveness. Incorporating these frameworks enables the study to examine pre-adoption perceptions and post-use service evaluations, offering a more comprehensive understanding of user behaviour toward the Ogata electric bus system at the University of Lagos. Together, these approaches contribute theoretically by bridging the gap between technology acceptance theory and service quality assessment in sustainable transport research, while empirically providing evidence from a developing-country university context where studies on electric mobility adoption remain limited.

2. LITERATURE REVIEW

Sustainable transportation refers to a mobility system that meets current societal needs without compromising future generations' ability to meet their mobility demands. It integrates environmental, economic, and social objectives by promoting efficient, clean, and accessible transportation modes that reduce carbon emissions, conserve energy, and support inclusive development (Litman, 2021). A sustainable transportation system must prioritise affordability, safety, and reliability while minimising negative impacts, such as pollution, noise, and congestion. According to the United Nations Environment Programme (UNEP, 2020), sustainable transport is central to achieving several Sustainable Development Goals (SDGs), particularly those related to climate action (SDG 13), sustainable cities (SDG 11), and affordable clean energy (SDG 7). On university campuses, sustainable transportation becomes even more critical due to the unique environmental and social dynamics at play. Academic institutions typically house a large population of daily commuters—including students, staff, and visitors—within relatively confined spaces. Thus, transportation systems must be not only efficient and reliable but also non-disruptive to academic activities and environmentally responsible (Zhou, Tan, & Zhao, 2021). Furthermore, universities often serve as role models for innovation and climate leadership, making them ideal environments for piloting sustainable mobility initiatives. On university campuses in developing countries, adopting solar-powered transportation aligns with both practical needs and broader sustainability goals. The controlled environment, relatively short distances, and fixed commuting patterns within campuses make them suitable testing grounds for clean mobility solutions. Institutions like the University of Lagos, through projects such as the Ogata Green Energy Bus, are beginning to explore how renewable transport systems can address daily mobility needs while supporting national climate change mitigation strategies.

However, realising the full potential of sustainable transport systems requires an integrated approach. This includes not only deploying solar-powered vehicles but also investing in supporting infrastructure (e.g., charging stations, maintenance workshops), establishing appropriate policies, and fostering user awareness. It also involves data-driven planning to ensure route efficiency, safety, and affordability, which are key issues that determine the long-term viability of such systems (Zhang et al., 2019; Oluwafemi, Oduwaye, & Abiola, 2023). The global push toward sustainable development and climate resilience has accelerated the integration of solar-powered transportation systems, particularly in institutions such as universities, which serve as innovation incubators and policy influencers. In both developed and developing countries, higher education institutions are increasingly adopting solar-powered vehicles, solar charging stations, and innovative mobility platforms as part of their broader green campus strategies (IRENA, 2021; Zhou et al., 2021). In China, several universities have incorporated solar-powered electric buses into their internal mobility systems to reduce emissions and promote environmental awareness. For example, Tongji University in Shanghai has implemented a green campus initiative involving electric and solar-powered buses, improving campus air quality and heightening students' environmental awareness (Zhang et al., 2019). Similarly, universities in India, such as the Indian Institute of Technology (IIT) campuses, have adopted solar mobility projects that combine rooftop PV installations with electric shuttle buses to provide intra-campus transport while offsetting carbon footprints (Kumar, Patel, & Varghese, 2020). In the Middle East, Venkatachalam et al. (2024) assessed the performance of solar-powered bus stops at various campuses of the University of Technology

and Applied Sciences (UTAS) in Oman. Experiences from Asia, the Middle East, and North America offer valuable models for adaptation in Nigeria and other African nations. Although the scale and resources may differ, the core principles of sustainability, user-centred design, and long-term cost efficiency remain applicable. The Ogata Green Energy Bus project at the University of Lagos can thus benefit from global lessons while being contextualised to local infrastructural, climatic, and behavioural conditions. The findings indicated that integrating rooftop solar panels with bright bus stops not only improved energy efficiency but also enhanced commuter comfort and reduced operational costs. The research emphasised the need for tailored design approaches based on regional solar irradiance and user patterns—factors highly relevant for campuses in sun-rich countries like Nigeria. In the United States, universities have combined policy, infrastructure, and community engagement to drive sustainable campus transportation. At Stanford University, the Marguerite shuttle system—a free campus bus network—is partially powered by solar energy and electric battery technology. Stanford's investment in clean-energy-powered fleets is part of a larger plan to achieve carbon neutrality, demonstrating how campus transit can align with institutional sustainability goals (Stanford Sustainability Office, 2022).

Mobility-as-access represents a significant paradigmatic shift in transport geography and planning, moving away from traditional mobility-focused frameworks toward a more people-centered understanding of transport systems. Early transport studies equated system performance with mobility—defined as the ease and speed of movement across space. However, this perspective has increasingly been criticized for overlooking the fundamental purpose of travel: pursuing desired activities and opportunities. As scholars argue, mobility is only a means, whereas accessibility—the ability to reach destinations—is the ultimate goal of transportation systems (Boisjoly & El-Geneidy, 2017). The intellectual roots of mobility-as-access frameworks trace back to the foundational work of Hansen (1959), who defined accessibility as the "potential of opportunities for interaction" across space. This definition shifted attention from movement itself to the distribution of opportunities and the effort required to reach them. Subsequent scholars expanded this idea, conceptualizing accessibility as the extent to which land-use and transport systems enable individuals to reach activities such as employment, education, and services. Within this framing, transport systems are evaluated not by speed or traffic flow, but by how effectively they connect people to opportunities. This concept has been successfully applied in the work of Albacete, Olaru, Paül, & Biermann (2017); Bantis & Haworth (2020); Handy (2020); Chen & Wan Zhang (2024); and Hadjidimitriou, Reggiani, Östh, & Mamei (2025).

Meanwhile, in African contexts, the uptake of solar-powered transport within university settings remains limited but is gaining momentum. Universities in South Africa, such as the University of Stellenbosch and the University of Cape Town, have begun piloting solar energy for campus transportation, primarily through solar-charging infrastructure for electric bicycles and scooters (Abdullah & Ismail, 2021). Although these are on a smaller scale than global counterparts, they offer crucial lessons for gradual adoption. Universities are at the forefront of adopting solar-powered transport for several reasons. Firstly, they often have autonomy in campus infrastructure planning, allowing more experimental and innovative interventions. Secondly, student populations are generally environmentally aware and receptive to change, making the implementation of new mobility systems more acceptable. Thirdly, universities operate within confined and predictable geographical zones, which simplifies route design, demand estimation, and maintenance scheduling for transport systems (Zhou et al., 2021; IEA, 2022). However, successful implementation requires more than just infrastructure. Institutional support, including policy alignment, budget allocation, and stakeholder involvement, is crucial. Studies show that even well-funded projects may fail if they lack strategic integration with academic operations, maintenance planning, and end-user education (Bagherian, Nordoz, & Jafari, 2025). Therefore, the global experience emphasises the importance of not only deploying technology but also fostering a holistic ecosystem that sustains it.

In Nigeria, the transition toward solar-powered transport has been relatively slow. Still, it is gaining momentum, especially within academic environments where controlled mobility systems and sustainability mandates create fertile ground for experimentation. The Ogata Green Energy Bus project at the

University of Lagos is one of the few known initiatives integrating solar-powered mobility into a university setting. It represents a strategic effort to promote environmental sustainability while providing reliable, cost-effective transport for students and staff within the campus. Studies have highlighted several key barriers to adopting solar transport in Nigeria. These include the high cost of solar batteries and PV components, unreliable electricity supply for hybrid systems, and limited technical know-how for maintenance and repair (Akinwale & Aderemi, 2022; Oluwafemi et al., 2023). Additionally, the absence of clear policy frameworks for electric and solar vehicles, along with a lack of incentives for local innovation, continues to hamper scale-up efforts. Institutional inertia and resistance to change within public-sector agencies also delay the integration of clean transport (Nnaji, Okeke, & Ofoegbu, 2020). On the other hand, opportunities abound. Nigeria's high solar irradiance—averaging 5.5 kWh/m²/day—makes solar-powered transport systems potentially more viable than in many parts of Europe (Sambo, 2019). Moreover, the growing youth population in universities represents a tech-savvy, environmentally conscious user base that is more likely to adopt and support clean transportation solutions. Academic institutions, therefore, offer a strategic entry point for piloting and refining such innovations before scaling them into broader urban settings.

3. STUDY AREA

The study area for this research is the University of Lagos (UNILAG), Akoka campus (Fig. 1), situated in the Yaba Local Council Development Area of Lagos State, Nigeria. UNILAG is a major federal tertiary institution established in 1962 and located along the Lagos Lagoon, covering approximately 802 acres of land. The campus is bounded by Bariga to the west, Sabo-Yaba to the north, and the Lagos Lagoon to the east and south, making it a strategic location for urban mobility and transport innovation studies. The university community comprises over 60,000 students and staff who commute daily within and around the campus, creating significant

demand for intra-campus transportation. In response, UNILAG introduced the Ogata Electric Bus Service as part of its sustainable transportation initiative to reduce carbon emissions, enhance mobility, and promote environmental consciousness among the university population. The buses operate on designated routes within the campus, connecting key areas such as the Main Gate, the Senate Building, the Faculty of Engineering, New Hall, the Faculty of Education, and the Student Hostels. The choice of UNILAG (See Fig. 1) as the study area is particularly significant given its enclosed urban setting, high commuter density, and the university's commitment to adopting innovative, eco-friendly transport systems.

The operation of the Ogata Electric Bus provides an ideal context for examining user acceptance, satisfaction, and operational efficiency of electric mobility solutions in a controlled institutional environment representative of broader urban transport dynamics in Lagos. The Ogata electric bus system operating within the University of Lagos (UNILAG) campus is structured to ensure efficiency, safety, and user comfort. The service operates daily from 8:00 a.m. to 8:00 p.m., Monday through Saturday. Operational scheduling is organized into two distinct shifts per day, which helps to optimize fleet utilization, reduce driver fatigue, and maintain consistent service delivery across peak and off-peak periods. Regarding human resources, the system uses an inclusive staffing model, employing both male and female drivers. This recruitment pattern reflects a progressive approach to gender equity in the transportation sector, which has traditionally been male-dominated, while also enhancing service diversity and representation. The bus has a seating capacity of 13 passengers, with a strict no-standing policy. This design consideration is critical for safety, particularly given the electric drivetrain and campus-based operational environment where controlled passenger loads improve stability, energy efficiency, and ride comfort. The absence of standing passengers also minimizes risks associated with sudden stops or maneuvering within relatively confined campus road networks.

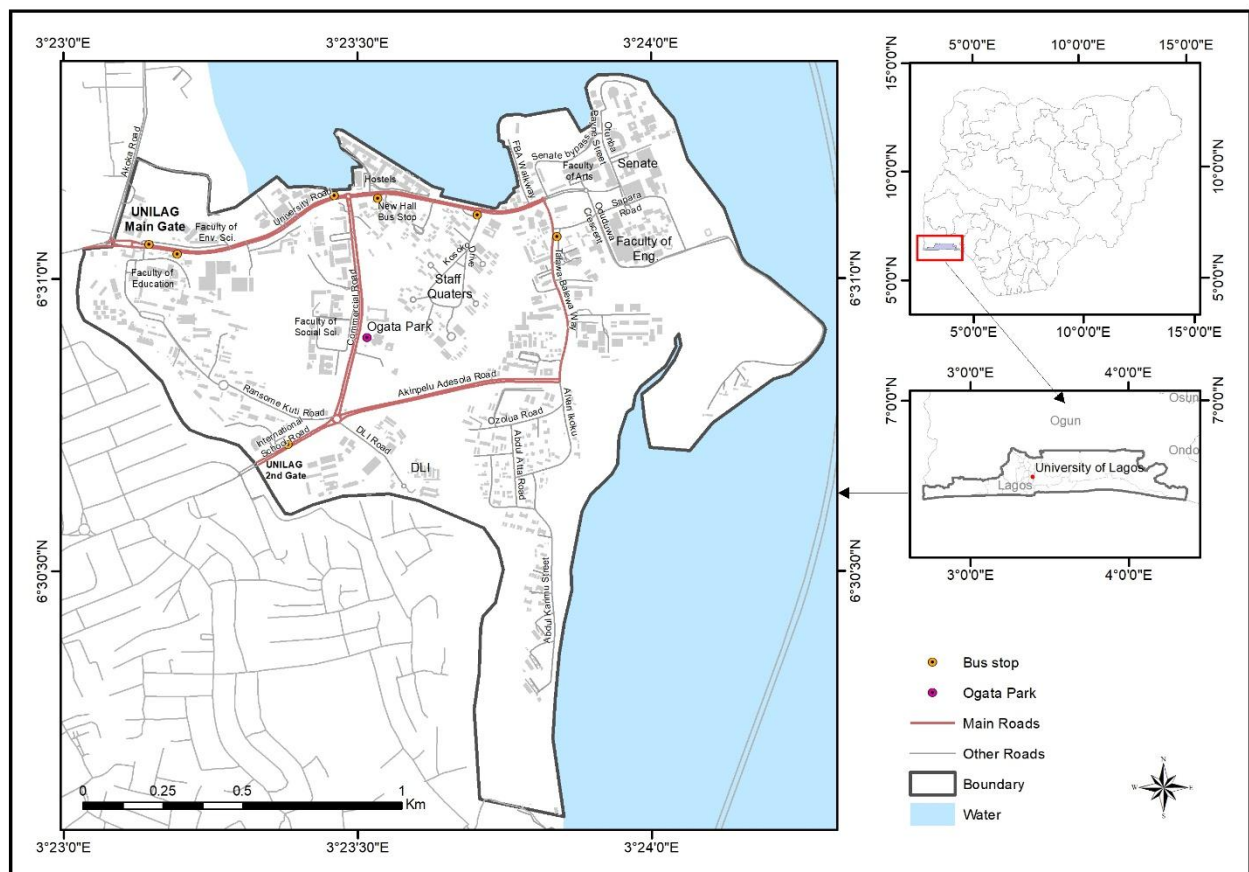


Fig 1: Map showing the Ogata electric bus route inside the University of Lagos, Nigeria
Source: Authors' Analysis, 2025

From an engineering and material standpoint, the bus interior features a shock-resistant fibre floor. This specialized flooring material is designed to absorb vibrations and mechanical impacts, thereby enhancing passenger comfort and reducing wear and tear on the vehicle structure. Additionally, it reduces cabin noise and improves durability under the frequent use typical of institutional transport systems. Overall, the Ogata electric bus integrates operational efficiency, ergonomic design, and safety-conscious engineering, making it a suitable model for sustainable intra-campus mobility in developing urban contexts. However, Ogata bus services have yet to be extended to the needs of people living with disabilities (PWD).

4. METHODOLOGY

4.1 Data collection procedure

The data for this study were obtained from both primary and secondary sources. Primary data were collected through a structured questionnaire focusing on the level of patronage of the Ogata electric bus; user satisfaction, including comfort, reliability, and safety; key challenges affecting the performance, acceptance, and adoption of the solar bus system; and the relationship between perceived cost-effectiveness and commuter patronage. The secondary data were sourced from the University of Lagos Registry to determine the study population. The study population comprises commuters (Students and Staff) who use the Ogata Green Energy Bus system at the University of Lagos. This includes undergraduate and postgraduate students, as well as academic and non-academic staff. The data collection targeted users of the Ogata electric buses. The University of Lagos is one of Nigeria's largest tertiary institutions, with an estimated student population of over 40,000, alongside more than 6,000 academic and non-academic staff (University of Lagos Registry, 2023). The bus system is an important mobility option on campus, connecting central locations such as lecture theatres, libraries, halls of residence, administrative blocks, and recreational centres. Focusing on this population is significant because it captures the diversity of user groups—including students who prioritise affordability and accessibility, academic staff who value timeliness and comfort, and non-academic staff who often rely on campus transport for daily commuting. By targeting this entire commuter population, the study ensures a holistic understanding of the bus system's operations and impact. Given the large size of the target population, it is impractical to study every commuter. Therefore, a stratified random sampling technique will be employed. Stratification was done along three key commuter groups: students, academic staff, and non-academic staff. Each stratum will then be randomly sampled to ensure representativeness. This approach reduces sampling bias and increases the accuracy of findings, as each group has unique mobility needs and perspectives (Kothari, 2004).

The sample size will be determined using Yamane's (1967) formula:

$$n_r = \frac{N}{(1 + N(e)^2)}$$

n_r

=

required sample size

N

=

estimated population (40,000 students) (6000 staff)

e

=

degree of error tolerance (5%)

Substituting the values yields approximate sample sizes of 281 for students and 141 for staff, giving a total of 422. This sample is adequate for achieving representativeness at the 95% confidence level and has been widely used in similar transport and commuter satisfaction studies (Bryman, 2016). However, at the end of the exercise, about 370 completed questionnaires were collected, yielding an 87.7% response rate. The proportional allocation method was applied to ensure that students—who constitute the majority of the population—are adequately represented, without excluding staff categories. Data were collected through a self-administered questionnaire distributed physically at strategic points across the campus, including bus stops, lecture halls, staff offices, and hostels. To encourage high response rates, respondents were assured of confidentiality and anonymity, and participation was entirely voluntary.

4.2 Data Analysis

The data collected were analysed using both descriptive and inferential statistics. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise respondents' demographics, usage patterns, and satisfaction levels. This provides an overview of general

commuter perceptions. Inferential statistical tools, including Pearson's correlation and Analysis of Variance (ANOVA), were applied to test the two stated hypotheses. In contrast, ANOVA was used to assess differences in satisfaction levels across multiple groups. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 25, widely recognised for its reliability in social science research (Pallant, 2020).

5. RESULTS

5.1 Demographic Characteristics

The demographic distribution shows balanced gender representation, although slightly more males participated. The largest age group (59.5%) was 18–25 years old, reflecting the dominance of students in the university population. As expected, most respondents (75.7%) were students, since they make up the bulk of campus commuters. The remaining respondents comprised academic and non-academic staff, whose inclusion provided valuable insights into the transportation experiences and expectations of institutional employees. This distribution underscores the importance of tailoring transport services to student needs while considering staff expectations.

Table 1: Demographic Characteristics of Respondents (n = 370)

Variable	Category	Frequency	Percentage (%)
Gender	Male	200	54.1
	Female	170	45.9
	Total	370	100.0
Age	18–25 years	220	59.5
	26–35 years	80	21.6
	36–45 years	40	10.8
	46+ years	30	8.1
	Total	370	100.0
Commuter Category	Students	280	75.7
	Academic Staff	50	13.5
	Non-Academic Staff	40	10.8
	Total	370	100.0

Source: Authors' Analysis, 2025

5.2 Usage Patterns of the Ogata Green Energy Bus

More than half of respondents (56.8%) reported using the Ogata Green Energy Bus daily, suggesting it has become an integral part of campus mobility. Another 24.3% use it multiple times weekly, indicating regular but not daily reliance. The majority (67.6%) use the bus for academic purposes, such as attending lectures or visiting libraries, underscoring its role as an essential service for students. Administrative trips (18.9%) and social/recreational trips (13.5%) reflect the system's secondary role in serving other campus needs. The relatively small percentage of rare or non-users (5.4%) suggests widespread awareness and accessibility, though barriers still exist for a minority.

Table 2: Usage Patterns of Respondents

Variable	Category	Frequency	Percentage (%)
Frequency of Use	Daily	210	56.8
	2–3 times weekly	90	24.3
	Occasionally	50	13.5
	Rarely/Never	20	5.4
Primary Purpose of Use	Academic trips	250	67.6
	Administrative	70	18.9
	Social/Recreation	50	13.5

Source: Authors' Analysis, 2025

5.3 User satisfaction

Respondents expressed the highest satisfaction with cost (mean = 4.2), confirming that the Ogata Green Energy Bus is considered affordable compared to alternative modes. Safety also scored high (4.1), indicating commuters feel secure while using the service. However, moderate scores in

comfort (3.8), convenience (3.9), and accessibility (3.6) suggest areas where the service is underperforming. These findings highlight the need for improved route coverage, reduced peak-hour congestion, and better scheduling. The results align with previous research such as Akinwale and Aderemi (2022), which also found that affordability is a key driver of user acceptance of clean energy transportation systems in Nigerian universities.

Table 3: User Satisfaction with Ogata Green Energy Bus

Variables	Mean Score	Std. Dev.	Interpretation
Cost	4.2	0.85	High satisfaction
Comfort	3.8	0.92	Moderate satisfaction
Convenience	3.9	0.88	Moderate satisfaction
Accessibility	3.6	1.01	Moderate satisfaction
Safety	4.1	0.80	High satisfaction

Source: Authors' Analysis, 2025

5.4 Operational Challenges facing the Ogata Electric Bus System

The most critical operational challenge is insufficient buses (59.5%), indicating that demand often exceeds supply. Limited route coverage (48.6%) was also widely reported, suggesting that not all key areas of the campus are adequately served. Irregular schedules (40.5%) and maintenance issues (35.1%) further undermine user confidence in the system's reliability. A smaller proportion (24.3%) noted a lack of awareness campaigns, which could limit engagement among new users. These findings resonate with Oluwafemi et al. (2023), who identified inadequate infrastructure and poor maintenance as persistent barriers in Nigeria's renewable mobility projects.

Table 4: Operational Challenges Identified by Respondents

Challenge	Frequency	Percentage (%)
Insufficient buses	220	59.5
Irregular schedules	150	40.5
Limited route coverage	180	48.6
Maintenance breakdowns	130	35.1
Lack of awareness campaigns	90	24.3

Source: Authors' Analysis, 2025

5.5 Pearson Correlation between Perceived Cost-Effectiveness and Commuter Patronage

The first hypothesis, that there is no significant relationship between the perceived cost-effectiveness of the Ogata Green Energy Bus and commuter patronage, was tested using Pearson's correlation. The Pearson correlation revealed a strong, positive, and statistically significant relationship between perceived cost-effectiveness and commuter patronage ($r = .62, p < .001$). This indicates that as perceptions of affordability increase, bus use increases.

Table 5: Pearson Correlation between Perceived Cost-Effectiveness and Commuter Patronage

Variable	M	SD	1	2
1. Perceived Cost-Effectiveness	4.20	0.85	—	
2. Commuter Patronage Frequency	3.80	0.95	.62**	—

P-value < .001.

Source: Authors' Analysis, 2025

5.6: One-Way ANOVA for Differences in User Satisfaction across Commuter Categories

The second hypothesis, that there is no significant difference in user satisfaction across commuter categories (students, staff, visitors), was tested using a one-way ANOVA. The ANOVA test revealed a statistically significant difference in satisfaction across commuter categories, $F(2, 367) = 4.56, p = .012$. Post hoc Tukey tests showed that students were more satisfied with the cost, while staff valued comfort and reliability more highly. Visitors expressed lower satisfaction overall. Hence, the null hypothesis is rejected, suggesting that commuter groups differ significantly in their satisfaction levels.

Table 6: One-Way ANOVA for Differences in User Satisfaction across Commuter Categories

Source	SS	df	MS	F
Between Groups	8.24	2	4.12	4.56
Within Groups	663.12	367	1.81	
Total	671.36	369		

P-value is < .05.

Source: Authors' Analysis, 2025

6. DISCUSSION

This study examined the operations of the Ogata Green Energy Bus at the University of Lagos, with particular emphasis on commuter usage patterns, satisfaction levels, operational challenges, and the system's perceived environmental and economic implications. Beyond its descriptive contribution, the study provides an empirical lens for examining the dynamics of renewable transport adoption in higher education institutions in developing countries. Universities represent semi-controlled mobility environments characterised by high commuter density, predictable travel patterns, and institutional governance structures. As such, they serve as important experimental spaces for low-carbon transport innovations. However, the findings suggest that the successful diffusion of such innovations is shaped not only by environmental aspirations but also by everyday functional considerations embedded in user behaviour and service delivery systems.

The results show that most respondents rely on the Ogata Green Energy Bus for daily mobility, particularly for academic trips such as attending lectures, visiting libraries, and accessing other educational facilities. This pattern underscores the structural importance of campus transport systems in enabling academic participation and institutional productivity. From a theoretical standpoint, this finding resonates with mobility-as-access frameworks in transport geography, which emphasise that transport systems primarily enable participation in socio-economic activities rather than serve as ends in themselves. The bus system, therefore, becomes embedded within the everyday rhythms of academic life, shaping the spatial accessibility of knowledge infrastructure across the campus.

Hypothesis testing provided deeper insights into the determinants of commuter behaviour and the theoretical mechanisms underlying technology adoption. The first hypothesis, which proposed no relationship between cost-effectiveness and commuter patronage, was rejected. The observed strong positive correlation indicates that affordability remains a critical determinant of adoption. While this finding aligns broadly with the Technology Acceptance Model (TAM) proposed by Davis (1989), it also invites a more nuanced interpretation. Within TAM, perceived usefulness and perceived ease of use are considered primary predictors of technology acceptance. In the context of the Ogata bus system, affordability can be interpreted as a functional component of perceived usefulness. However, the prominence of cost considerations in the findings suggests that economic rationality may play an even stronger role in shaping adoption decisions in resource-constrained environments than classical TAM formulations typically assume. In other words, in developing-country contexts where disposable income is limited, financial accessibility may not merely support usefulness but also serve as a foundational condition for technology acceptance.

The second hypothesis, which suggested no significant difference in satisfaction levels across commuter categories, was also rejected. The ANOVA results revealed statistically significant variations in satisfaction among students, staff, and visitors. Students generally reported higher satisfaction, largely because they strongly appreciated the service's affordability. Staff members, in contrast, placed greater emphasis on service reliability and comfort, while visitors reported lower overall satisfaction. These findings highlight the heterogeneity of commuter expectations and demonstrate that adoption drivers are socially differentiated. This observation challenges the implicit assumption of user homogeneity embedded in many technology acceptance frameworks, including TAM and even extended models such as UTAUT. Rather than a uniform user base responding similarly to technological attributes, the findings suggest that different user groups evaluate the service through distinct experiential and socio-economic lenses. Seth, Arora, and Mathur (2020) observed similar differentiation in their study of electric bus adoption in India, where commuter categories showed divergent priorities for cost, comfort, and convenience.

The dominance of student use further underscores the practical necessity of affordable, reliable mobility within university environments. Students typically constitute the largest commuter population on campus and often have more limited financial resources than staff members. This result is consistent with Li, Chen, and Zhou (2020), who reported that students predominantly use campus shuttle systems in the United States for academic mobility. Similarly, Asare, Boateng, and Appiah (2021) observed that students primarily adopted solar-powered tricycles introduced in Ghanaian universities. These patterns suggest that higher education institutions offer fertile contexts for testing clean mobility innovations because of their concentrated populations and predictable travel demand. However, they also highlight the importance of aligning service design with the mobility priorities of dominant user groups.

In terms of service quality, respondents expressed high levels of satisfaction with cost and safety but only moderate satisfaction with comfort, accessibility, and convenience. The service's affordability remains one of its most significant strengths, enabling broad accessibility across the campus population. This outcome reinforces the central argument of the Technology Acceptance Model that perceived usefulness significantly influences adoption behaviour. Empirical studies within the Nigerian context, such as Akinwale and Aderemi (2022), similarly identify affordability as a major predictor of clean transport adoption among urban commuters. High safety perceptions may also stem from the controlled nature of the campus environment, where regulated traffic flows and institutional monitoring reduce many of the risks associated with urban public transport systems.

Nevertheless, the moderate ratings for comfort and accessibility reveal structural weaknesses in the service's operational design. Overcrowding, long waiting times, and limited route coverage appear to undermine the overall service experience. From a service quality perspective, these shortcomings resonate with the SERVQUAL framework, which emphasises reliability, responsiveness, and tangibles as key dimensions of service delivery. While the Ogata bus performs strongly on the economic dimension of service value, deficiencies in reliability and responsiveness risk weakening user satisfaction over time. This tension between affordability and service quality highlights a critical trade-off that many renewable transport systems in developing contexts must navigate.

Operational inefficiencies emerged as a recurring theme throughout the study. Respondents frequently identified insufficient bus numbers, irregular scheduling, limited route coverage, and maintenance challenges as major constraints. These findings point to an important theoretical implication: the success of green transport innovations depends not only on technological feasibility but also on the institutional capacity to manage and sustain the system. The Ogata bus initiative may represent a technically viable clean energy solution, yet its effectiveness is ultimately mediated by operational governance and logistical management.

Comparable patterns have been observed across other developing-country contexts. Mwangi and Odede (2022) reported that solar-electric buses in Kenya experienced reliability problems during peak commuting periods due to limited fleet sizes and inadequate charging infrastructure. Similarly, Madonsela and Mokonyama (2018) noted that institutional and infrastructural constraints frequently hinder the implementation of electric mobility initiatives at South African universities. These parallels suggest that across much of the Global South, the sustainability of renewable transport initiatives depends less on the availability of green technologies and more on the strength of institutional arrangements, financial investment, and operational planning.

Taken together, the findings therefore contribute to a broader critical understanding of renewable transport adoption in developing-country contexts. While technological innovation and environmental sustainability remain central motivations for introducing systems such as the Ogata Green Energy Bus, the long-term viability of such initiatives ultimately rests on their ability to deliver reliable, accessible, and user-responsive services. Without addressing these operational and institutional dimensions, the transformative potential of green mobility innovations may remain constrained despite their environmental promise.

7. GLOBAL THEORETICAL IMPLICATIONS OF CAMPUS-BASED ELECTRIC BUS ADOPTION IN NIGERIA

The results provide empirical evidence from a Global South university context that extends the explanatory power of models such as the Technology

Acceptance Model and the Unified Theory of Acceptance and Use of Technology. While these frameworks emphasise perceived usefulness and perceived ease of use as key determinants of technology adoption, findings from the University of Lagos context may reveal that perceived cost-effectiveness plays a critical role in shaping acceptance of electric mobility services. This suggests that, in developing-country settings, contextual drivers such as infrastructure reliability, transport affordability, and environmental consciousness may complement or modify the core constructs of traditional acceptance models.

The study also extends the applicability of the SERVQUAL Model by demonstrating how service quality dimensions—reliability, responsiveness, safety, and comfort—operate within a shared electric campus mobility system. Evidence from the 'Ogata' service may indicate that charging reliability, trip frequency, and waiting time are particularly salient determinants of satisfaction in electric transit systems, thereby expanding traditional service-quality metrics used in transport studies.

By examining electric bus adoption within a large African university campus, the research contributes to global discussions on sustainable mobility transitions. The findings suggest that technology acceptance in emerging economies may be strongly shaped by institutional trust, service accessibility, and perceived environmental benefits, highlighting the need to adapt established models for rapidly urbanising regions. This insight helps in refining international frameworks for evaluating the adoption of electric public transport in similar contexts across the Global South.

8. CONCLUSION AND RECOMMENDATION

The study concludes that the Ogata Green Energy Bus represents a significant innovation in pursuing sustainable transportation at the University of Lagos. The findings indicate that the bus system is highly valued by the university community, particularly because of its cost-effectiveness (affordability). Students and staff generally recognised that the solar-powered bus offered an accessible and cost-effective means of transportation, aligning with broader sustainability goals. This dual benefit has positioned the Ogata Green Energy Bus not only as a practical solution for campus mobility but also as an essential symbol of the university's commitment to environmental stewardship. In this sense, the initiative reflects global trends toward renewable transport systems, as seen in regions such as Asia, Europe, and North America, where solar and electric buses are increasingly integrated into public mobility strategies. However, the study also reveals that operational inefficiencies pose serious challenges to the system's long-term viability and commuter confidence. An inadequate fleet size means demand often exceeds supply, leading to overcrowding and prolonged waiting times. Limited route coverage reduces the service's accessibility, leaving some parts of the campus underserved. Maintenance breakdowns and irregular schedules further undermine the system's reliability, thereby diminishing user satisfaction. Unless these operational shortcomings are addressed, the sustainability and acceptability of the Ogata Green Energy Bus will remain constrained, regardless of its environmental benefits. The study's findings further confirm the relevance of the Technology Acceptance Model (TAM) (Davis, 1989) in explaining commuter behaviour. According to TAM, technology adoption is shaped by perceptions of usefulness and ease of use. In this case, perceived usefulness reflected the cost savings and environmental benefits offered by the solar bus, while perceived ease of use reflected its accessibility, route coverage, and scheduling reliability. The results showed that while commuters appreciated the environmental benefits, these alone were insufficient to guarantee patronage. Instead, adoption was influenced by a combination of economic, practical, and environmental factors, with affordability and reliability emerging as critical determinants of user satisfaction. The Ogata Green Energy Bus has demonstrated its potential to enhance sustainable transportation within the University of Lagos. However, its long-term success will depend on addressing operational inefficiencies and ensuring that commuter expectations of cost, comfort, and accessibility are met. The study confirms that while green innovations are crucial for reducing carbon footprints and promoting sustainability, their adoption ultimately depends on their ability to deliver practical and user-centred benefits.

The study recommends strategic operational and communication improvements to enhance the effectiveness and user acceptance of the Ogata

electric bus system. First, route coverage should be expanded to ensure that all major activity nodes across the campus are adequately served, thereby improving accessibility and convenience for commuters. Second, the service's reliability can be strengthened by establishing a robust maintenance framework, including training technical personnel and ensuring the consistent availability of essential spare parts. In addition, integrating real-time passenger information systems, such as mobile scheduling applications or digital signage at bus stops, would reduce uncertainty about waiting times and improve the overall travel experience. Finally, sustained awareness and sensitisation campaigns are necessary to educate students and staff about the environmental and economic benefits of electric mobility, thereby further promoting positive attitudes and encouraging wider adoption of the system.

Limitations and proposed areas for future studies

The study is confined to the University of Lagos campus, limiting the generalisability of the findings to other Nigerian universities, African institutions, or broader urban transit systems. The unique characteristics of UNILAG, its size, demographics, and Lagos's urban infrastructure may not be representative of other contexts. A study limited to students and staff may

exclude other stakeholders such as campus visitors, contractors, and part-time users. Additionally, non-users of the Ogata bus service, those who opt for private transport or commercial alternatives, are typically underrepresented, potentially introducing selection bias.

The following areas of future study are proposed in this study. First, a comparative study across Nigerian universities that replicates the study at institutions such as the University of Ibadan, Ahmadu Bello University, or OAU would enable cross-institutional comparisons and help determine whether the findings are unique to UNILAG or applicable nationwide. Furthermore, future studies should target staff and students who do not use the Ogata service to identify behavioural, attitudinal, and situational barriers, thereby offering actionable insights to improve ridership. Another important area is integrating advanced theoretical models by combining TAM, TPB, and UTAUT, and considering other related models or approaches for more flexible and robust estimation of adoption behaviour. These limitations and future directions collectively point toward a richer, more contextualised research agenda that can strengthen the Ogata electric bus programme and inform broader electric mobility policy in Nigeria and Sub-Saharan Africa.

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