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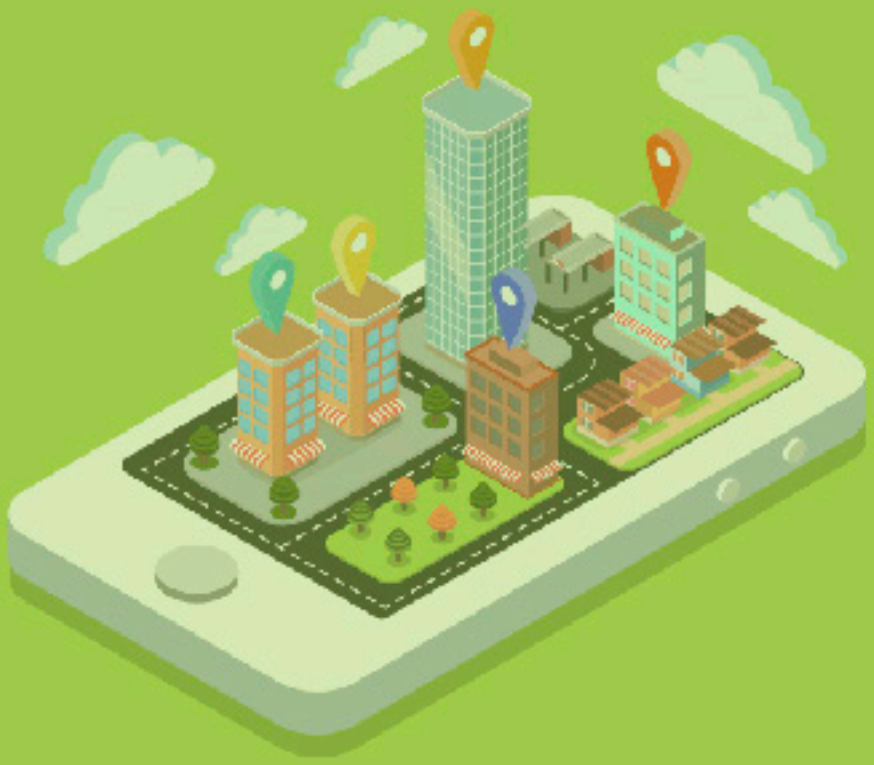

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Impact of Electric Public Transportation on Environmental Pollution in Urban Cities

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ABSTRACT

Urbanization and increasing reliance on fossil fueled public transportation has been one of the most significant causes of environmental pollution in the urban cities of Bangladesh, there is an urgent need to seek sustainable alternatives. This study aimed to study the influence of electric public transportation on environmental pollution by analyzing the effect of e-public transport service quality, adoption of electric public transport system, and government-support and traffic management efficacy on reduction in environmental pollution and sustainable urban mobility in city urban-related information in Bangladesh. This study used a quantitative cross-sectional research design and primary data were collected from 410 respondents through structured questionnaire as a five-point Likert scale. The sample size was calculated based on Cochran's formula, and data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. The implications of the results were that users tended to perceive electric public transportation quality, adoption level, government support and traffic management efficiency at high levels whereas environmental pollution reduction and sustainable urban mobility were perceived at very high levels. The results also indicated that better electric public mobility quality, increasing the development of public acceptance and more facilitative role from government assistance in conjunction with managerial traffic flow would effectively mitigate environmental pollution, consequently leading to urban mobility endurance. The authors suggested that proper implementation of relevant policies, combined with infrastructure development and integrated traffic management could help improve urban environment by providing a sustainable public transportation system based on electric mobility in Bangladesh.

INTRODUCTION

In developing countries, the rapid rate of urbanization and increasing levels of motorization have emerged as key factors for environments polluted in densely populated, urban locations (Amin & Rahman, 2019). South Asia continues to be one of the fastest urbanizing regions in the world, with major urban centers such as Dhaka, Chattogram, Khulna, Rajshahi, and Sylhet experiencing significant growth in terms of population increase, economic activities, and transport demands (Gupta & Kumar, 2023). Urbanization has played a key role in economic development of the past century but it also magnifies many environmental problems, especially air pollution, greenhouse gas emissions and noise pollution as well as traffic congestion (Kurani, 2025). Due to a strong reliance upon the fossil fuel-based operation, especially diesel- and gasoline-powered public and private vehicles, this sector is acknowledged as one of the major contributors to urban environmental degradation (Chavan, 2024). Thus, enhancing the ecological integrity of urban transport systems has emerged as a key policy focus for governments across different continents (qizi, 2024). Transportation emissions are a first major component of these particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen oxides (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and carbon dioxide (CO_2; which also has profound negative impacts on environmental quality and the populations that abut elevated emissions) (Liu *et al.*, 2024). In developing countries, these problems can be worsened by the use of aging vehicle fleets, weak emission standards, inadequate traffic management and growing congestion (Prasetyanto *et al.*, 2023). This causes chronic exposure to poor ambient air conditions in cities, resulting in respiratory illnesses, circulatory diseases, lower productivity and impaired quality of life. As a result, sustainable transport has become an integral aspect of creating clean cities and helping long-term environmental sustainability (Kondratenko *et al.*, 2025). After the Electric public transportation mechanism has been considered for a long time as an effective way of reducing world local weather pollution from shipping. Direct emissions from electric buses, electric metro systems, electric trams and battery-powered public vehicles are considerably lower than those from conventional diesel-powered transport (L. Zhang, 2025). Accelerated by advances in battery technology, charging infrastructure, renewable energy integration, and intelligent transportation systems, electric mobility has taken off in most countries. Sustainable cities like Shenzhen, London, Singapore, Oslo and Amsterdam have shown that large-scale electric public transport can lead to major reductions in greenhouse gas emissions, better urban air quality, lower noise pollution and much

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easier operating costs over the long term (Zhao, 2023). Lessons from these successful experiences abroad have motivated policymakers in both developed and developing economies to speed up the transition towards sustainable public transport systems. Environmental pollution from urban transportation is a rapidly increasing problem in Bangladesh. As urban populations grow rapidly and the demand on public transport services rises, there is greater reliance on diesel-powered buses, minibuses and other fossil fuel-based vehicles (Rahaman *et al.*, 2023). One of the densest megacities in the world, Dhaka regularly suffers unhealthy air pollution levels, much of it coming from transport emissions as well dying off industrial works and construction activity. Traffic congestion is the perennial urban nightmare, consuming fuel and idling vehicles for too long, exacerbating pollution (Fonseca *et al.*, 2022). In light of these complexities, the Government of Bangladesh has rolled out several initiatives supporting sustainable transport pilot programs on electric buses, incentives for EVs and an overarching policy environment aligned with national climate targets and development goals (Noman & Siam, 2025). However, the degree of use and implementation of electric public transportation are still at a nascent level, and there exist very little empirical evidence on their environmental effect within Bangladesh. Switching from conventional fossil fuel-driven transportation to electric public transportation provides environmental and socioeconomic amiabilities (Rajeshwar, 2024). Electric public transportation also provides benefits such as reducing air pollution in cities, lowering the reliance on imported fossil fuels, lowering operations and maintenance costs over time, reducing traffic noise pollution and helping achieve national climate targets (Shamsuddoha & Nasir, 2025). In addition, the deployment of electric buses on a large scale will encourage residents to use public transport instead of their own vehicles and thus help reduce traffic jams, increasing the efficiency of urban mobility systems as a whole (Kakkar *et al.*, 2025). These benefits are linked to the goals of the UN Sustainable Development Goals (SDGs), particularly SDG 11 with respect to sustainable cities and communities, as well as SDG 13 on Climate Action, and SDG7 regarding affordable and clean energy (Abdul Qadir *et al.*, 2024). While the interest worldwide in electric mobility is growing, previous studies have primarily focused on developing countries either separately or exclusively considering technological feasibility, battery performance, charging infrastructure, economic costs, or consumer adoption in developed countries (Akashdeep & Kumar Bansal, 2025). The findings of the study contributes to both theory and practice. Theoretically, the study contributes to the emerging literature on sustainable transport by providing empirical data from a developing-country context. On an applied level, the findings will provide useful information for policymakers, urban planners, mass transit agencies, environmental regulators and public transportation operators concerning question of very efficacy of electric proportion to really reduce pollution. In addition, the study offers some recommendations on how to expedite electric mobility and make it an integral part of the ongoing process for sustainable urban development in Bangladesh aimed at enhancing the quality of urban air, improving the planetary climate and meeting local and global climate objectives.

LITERATURE REVIEW

Transportation is ranked as the largest source of global greenhouse gas (GHG) emissions, which contributes to urban air pollution and fossil fuel consumption. Urban expansion is contributing to growing transport demand, leading to greater CD_3 emissions of CO_2, NO_2, SO_2, and $PM_{2\cdot10}$, and other toxic pollutants (Pontius & McIntosh, 2024). These emissions have a serious impact on environmental quality, public health and urban sustainability. As a result, governments around the globe are beginning to adopt electric public transport (EPT), which encompasses battery electric buses, electric trams, and other zero-tailpipe-emission public transport technologies to replace traditional fossil fuel-based transportation systems (Tepecik & Tepecik, 2025). Literature repeatedly states that electric public transport is fundamental to sustainable transport systems as it reduces dependence on fossil fuels while enabling cleaner, low-emission and greater energy-efficient transportation systems (Wassem *et al.*, 2024). Overall environmental benefits, however, do not only depend on vehicle technology but also on the sources of electricity generation, charging infrastructure and links to transportation management. Electric public transport, too, offers a strategic path to achieve the goals of sustainable cities, climate change abatement and carbon neutrality (X. Zhang *et al.*, 2025). Electric buses have no direct tailpipe emissions and considerably lower local air pollutants or traffic noise compared with diesel-powered ones. Moreover, life-cycle studies have indicated that electric buses, even at their present stage of technological maturity and market penetration, tend to outperform conventional diesel buses ecologically especially in regions with strong prospects for renewable electricity generation (Hao *et al.*, 2023). Quality of service continues as a principal provider of providing public acceptance and the use of public transport. The quality of electric public transport with respect to quality entails reliability, accessibility, safety comfort, punctuality as well as affordability along with operation efficiency is termed as the quality of Electric public transport (Suen, 2025). Quality transportation services promote the use of public transport and reduce dependence on private vehicles. Past studies show that reliability and frequency of service are major driving factors for passenger satisfaction and intention to use electric buses (Jena *et al.*, 2023). Electric buses are now deemed more appealing than the conventional diesel bus owing to its comfortable seat, lower vibrations, noiseless engine operation, cleaner interiors and better ride quality. The public are going to

need to embrace electric transportation if we want the benefits with regard to environmental issues (Seredynski, 2023). Adoption indicates how many citizens are willing and now also willing to use electric public transport rather than alternatives like a private car or some fossil fuel-powered mass transport. Theoretical models of technology adoption demonstrate that perceived usefulness, ease of use, environmental concern, service quality, social influence and perceived value have strong association with adoption decisions (Islam *et al.*, 2025). In several investigations, it has been shown that a rise in environmental awareness affects people's mobility choice to change toward cleaner transportation alternatives (Saha *et al.*, 2025). Understanding the impacts of vehicle emissions on the climate and health, electrified buses fare best if they replace diesel bus service with affordable, reliable, and accessible options. But in many developing countries, adoption is still stunted, due to limited availability of services, prohibitive charging infrastructure capabilities, low levels of awareness and operational uncertainties (Halimuzzaman, 2025). Electric three wheelers have seen the largest expansion of electric mobility in Bangladesh, proving their high acceptance rate from public due to lower operational costs and convenient mobility. Yet other researchers have discovered regulatory gaps, battery management issues, and infrastructure limitations that could complicate the further electrification of public transport (Roy *et al.*, 2026). Government intervention is the natural gateway that accelerates electric public transport. Types of policy support include financial incentives, investment into charging infrastructure, stipulations on emissions, awareness raising campaigns, funding for research and development courses of action in taxes and other fiscal plan strategies (policy-induced), institutional coordination (arts & sciences policy) (Yeung & Liu, 2023). Various international studies indicate that a robust government commitment is one of the most important success factors for deploying electric buses. Fuel consumption and pollutant emissions are increased by long travel times, frequent idling combined with stop-and-go traffic, and poor road management (Hassan *et al.*, 2024). Thus, the environmental benefits of electric public transport can be enhanced by contributing to improved traffic management. Dedicated bus lanes, route optimization and intelligent traffic management systems, with efficient scheduling and integrated urban transport systems enhancing operational efficiency together with passenger comfort (Yi *et al.*, 2025). Electric buses running in an accurate network can take CAD delay and better the system performance. But researchers also say that the urban transportation challenges cannot be solved by just replacing diesel buses with electric buses without institutional changes, integrated planning and proper governance (Aidam *et al.*, 2025). Thus, traffic flow optimization efficiency acts as a pivotal enabler that magnifies the environmental significance of electric public transport. For electric public transport, the main expected effect is the environmental pollution reduction. Unlike diesel buses, electric buses produce zero tailpipe emissions and are expected to cut particulate matter, nitrogen oxides, and carbon monoxide emissions in cities. It is also quieter, reducing noise pollution caused by road traffic (Chavan, 2024). Sustainable urban mobility focuses on offering high quality, efficient, low-cost and accessible transport in an environmentally sustainable manner with minimal environmental damage and better living in such environment (Li *et al.*, 2025). Electric public transport is one of the main strategies for achieving sustainable mobility because it combines environmental protection with economic efficiency and social inclusion (Leal Filho *et al.*, 2021). Instead of vehicle electrification, researchers go further by arguing that successful sustainable mobility cannot simply emerge but that investments in supporting systems such as governance, charging infrastructure and public participation must accompany investments in vehicle technology and renewables electricity generation (Anthony Jnr., 2023). A lot of relevant international research has been conducted on electric buses, electric vehicles or sustainable transportation in general, however several critical research gaps still need to be filled. Most previous empirical studies have been conducted in developed economies where transport infrastructure, electricity generation and policy environments vary significantly from those in developing countries (Mavlutova *et al.*, 2023). Second, many earlier studies point out the technological development, battery efficiency, energy need or economic feasibility much more than what public perceptions and behavioral drivers effect on environmental outcomes (Lättman & Otsuka, 2024). Third, most existing studies in Bangladesh are on electric three wheelers and prospects of electric vehicles or transport challenges separately with very little empirical evidence on the dominant form of public transport i.e. electric public transport, and its implications for environmental pollution in urban cities (Kovačić *et al.*, 2022). Lastly, very few quantitative studies have simultaneously accounted for the joint influences of electric public transport quality, public adoption, and government support and traffic management efficiency on environmental pollution reduction. Therefore, this study identifies those gaps and establishes a holistic structural model guided by theory with an empirical test using urban residents in Bangladesh as the unit of analysis. The conclusions are envisaged to add to the literature relating to transport and environment, while also offering practical insights for policymakers, transport authorities or urban planners wanting to employ electric public transport as a means of reducing environmental pollution. The objectives of the study are:

1. To investigate the effect of electric public transportation over environmental pollution in urban cities of Bangladesh.
2. To analyze of impact of electric public transport quality on the reduction of pollution in Nature.
3. To evaluate how civilizing the adoption of electric

public transportation, government support and traffic management efficiency on environmental pollution reductions.

4. To investigate the influence of environmental pollution reduction on sustainable transportation in urban cities of Bangladesh.

5. To determine the main drivers of electric public transport in relation to decreasing environmental pollution.

6. To promote electric public transportation as an act of urban mobility in Bangladesh for that sustainable solution.

MATERIALS AND METHODS

The study was conducted based on a quantitative cross-sectional research design to examine the effect of electric public transport system on environmental pollution in urban cities of Bangladesh. The primary data were collected through a structured 5-point Likert scale questionnaire from the users of public transportation, in which the scale varied from 1: Strongly Disagree to 5: Strongly Agree. The study determined the sample size using Cochran's formula for infinite population:

$$n = \frac{Z^2.p.(1-p)}{E^2}$$

Where n = sample size, Z = standard normal variety for 95% confidence level (1.96), p = estimated proportion of the population with the attribute being measured (p was presumed to be 0.5 since no prior information needed to be used) and E is margin of error (0.05) (Cochran, 1942). On the basis of these parameters, a sample size of 384 respondents was calculated as minimum. For increasing the reliability of results and handling incomplete responses, we then distributed 450 questionnaires reserving a convenience sampling method and retained 410 valid responses in final analyze. Descriptive statistics were conducted using Statistical Package for the Social Sciences (SPSS) version 26.

RESULTS AND DISCUSSION

The following section displays and interprets the empirical results of semi-structured interviews with ten industry professionals investigating how electric public transportation can affect environmental pollution within urban cities in Bangladesh. In this section, the analysis contains the characteristics of respondents and then the measurement model to test reliability and validity of instruments before explaining study constructs. Then, the study variables related model is tested using structural model. The findings are interpreted with reference to previous literature to elucidate their theoretical and practical implications in context of using sustainable urban transportation and environment sustainability for Bangladesh.

Demographic Information

Data on the demographic characteristics of the respondents was analyzed to describe the sample and ensure socio-economic representation amongst participants (Noori, 2022). As for the analysis, variables such as gender, age, education level, occupation, monthly income, city of residence and frequency of using public transportation and experience with the use of electric public transportation were included. Since demographic factors could be involved in travel behavior, environmental awareness and electric public

Table 1: Demographic Profile of the Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	248	60.5
	Female	162	39.5
Age	Below 20 years	32	7.8
	21–30 years	158	38.5
	31–40 years	121	29.5
	41–50 years	67	16.3
	Above 50 years	32	7.8
Education	SSC/HSC	71	17.3
	Diploma	42	10.2
	Bachelor's Degree	176	42.9
	Master's Degree	108	26.3
	Above Master's	13	3.2
Occupation	Student	79	19.3
	Government Employee	54	13.2
	Private Employee	156	38.0
	Business	72	17.6
	Others	49	12.0

Monthly Income (BDT)	Below 20,000	63	15.4
	20,001–40,000	129	31.5
	40,001–60,000	111	27.1
	60,001–80,000	59	14.4
	Above 80,000	48	11.7
City of Residence	Dhaka	165	40.2
	Chattogram	72	17.6
	Khulna	44	10.7
	Rajshahi	38	9.3
	Sylhet	33	8.0
	Barishal	22	5.4
	Rangpur	20	4.9
	Mymensingh	16	3.9
Public Transportation Use	Daily	214	52.2
	Several times a week	96	23.4
	Weekly	52	12.7
	Occasionally	35	8.5
	Rarely	13	3.2
Experience Using Electric Public Transportation	Yes	281	68.5
	No	129	31.5

transportation by the population, having an understanding of these characteristics is beneficial.

For instance, male respondents made up 60.5% of the sample size while female made up 39.5%, demonstrating representation from both sexes (Table 1). The majority of respondents (38.5%, 21–30 years old; 29.5, 31–40 years) indicated their age between the economically productive ages, thus were frequent urban public transport users. Younger adults tend to be more open-minded towards innovative and eco-friendly transportation technologies, thus providing a good basis for implementation of electric public transportation by assessing their perceptions. The majority of participants had a bachelor's degree (42.9%) as their highest educational attainment, followed by master's degrees at 26.3%. This rather high educational background appears to indicate that participants would have a fundamental basis of knowledge with respect to environmental concerns along with practices associated with sustainable transportation. People with a higher level of education have usually been analyzed as having greater environmental concern and more support for low-emission transport systems. By occupation, the largest numbers were private-sector employees (38.0%), students (19.3%) and business professionals (17.6%). The results showed that the majority of respondents are users of public transports which is a suitable condition for testing and assessing the handling services given by electric powered public transport solutions. As for the income distribution, most respondents had an income between BDT 20,001 and 40,000 (31.5 %), followed by those with an income between BDT 40,001–60,000 (27.1%). This distribution is representative of the middle-income urban population, constituting a large fraction of regular public transportation users in Bangladesh. So for this income bracket electric public transportation will be affordable and accessible. In terms of geographical distribution the respondents were from all over major metropolitan cities; however, most respondents belonged to Dhaka 40.2%, Chattogram 17.6% and Khulna 10.7%. The inclusion of an urban perspective improved the generalizability of results by including perceptions from some metropolitan areas where transportation demand and environmental challenges are notably different. The results also indicated that just over half of the respondents (52.2%) traveled daily by public transportation, whereas only a small amount (< 3 %) reported rare use. Due to their repeated travel experience, the frequent public transport users are well placed to assess service quality and operational performance as well as environmental impact. Lastly, 68.5% of the respondents answered that they have experience in using electric public transport while 31.5% did not. This means that many of the participants were directly exposed to electric public transport, thus able to make informed evaluations about its environmental advantages and operational characteristics. Overall demographic results show that the sample size was diverse enough and representative of electric public transportation users in urban cities of Bangladesh for assessing changes due to intervention based on environmental pollution (L. Zhang, 2025).

Electric Public Transportation Quality

The study applied Electric Public Transportation Quality methodology including with five indicators: reliability, accessibility to public transport, comfort, safety and punctuality. Thus, each statement is rated on a five-

point Likert-type scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Mean and standard deviation were calculated based on the way any respondent has perceived the quality of electric public transportation services in urban cities Bangladesh.

Table 2: Descriptive Statistics of Electric Public Transportation Quality

Statement	Mean	StandardDeviation	Interpretation
Electric buses are reliable.	4.18	0.73	High
Electric public transportation is easily accessible.	3.94	0.81	High
Electric buses provide comfortable travel.	4.22	0.69	High
Electric transportation is safer than conventional buses.	4.07	0.76	High
Electric buses are punctual.	3.98	0.79	High
Overall Electric Public Transportation Quality	4.08	0.76	High

On a general note, Table 2 highlights that the mean score of electric public transportation quality is highly perceived by respondents (M = 4.08, SD = 0.76). This indicates that respondents believed that electric public transport held the potential to deliver reliable, efficient, and user-friendly services which would encourage increased uptake of public transportation whilst promoting environmental sustainability. Of the five indicators, "Electric buses provide comfortable travel" had the highest mean score (M = 4.22, SD = 0.69), meaning comfort of passengers was the most important consideration in electric public transport. Compared to the conventional diesel buses, electric buses tend to generate less vibration and engine noise with much smoother acceleration that makes your travel very enjoyable. These attributes may motivate commuters to switch from cars to public transport, thus alleviating traffic congestion and car emissions. The second highest mean was "Electric buses are reliable" with 4.18 (SD = 0.73). The implication of this result is that the respondents think electric public transportation does have reliable services to meet commuter needs for long- and short-distance travel per day. Because passengers prefer to take the transport systems which are often not deviated from the schedule and do less breakdowns, service reliability shows a crucial role in public transportation usage. Safety perception by users was also positive with a mean score of 4.07 (SD = 0.76) for Electric transportation is safer than conventional buses. They generally agreed electric public transport is a safer mode than conventional diesel buses. Today, electric buses should offer advanced braking systems, better vehicle stability and safety technologies that bolster passenger confidence in the technology. The extent that improved safety contributes to enhanced user satisfaction ultimately will determine the public acceptance of sustainable transportation systems. Mean scores on Accessibility (M = 3.94, SD = 0.81) suggested respondents did consider electric public transportation reasonably accessible. However, this is a lower score compared to the scoring in 8 metrics and indicates that electric buses are still very limited in many cities and routes. Increasing service frequency, better charging infrastructure, and an expanded electric bus network could lead to even more accessibility. Likewise, Electric buses are punctual had a Mean of 3.98 (SD = 0.79), which confirms respondents with positive opinions on delivery service timely. While the result suggest satisfaction; there is a lot of opportunity to improve traffic management, dedicated bus lanes and scheduling systems will only improve operational efficiencies and customer confidence even more. In more general terms, results showed that respondents believe electric public transportation provides high-quality service in terms of comforts, reliability, safety, accessibility, and punctuality. Strong service quality should result in higher public transport modal share, and a decrease in reliance on fossil-fuel powered individual motor vehicles, thereby reducing urban environmental pollution. The findings align with previous studies which have shown the impact of service quality improvements on passenger coalitions, public transport patronage, and support for environmental sustainable transportation modes (Leal Filho *et al.*, 2021). Hence, improvement of overall electric public transportation services is crucial for sustainable urban mobility and long-term environmental goals the context of Bangladesh.

Adoption of Electric Public Transportation

Five statements indicative of respondent's preferences (to adopt electric public transportation), usage behavior, future intention, advocacy and integration of electric public transportation into their regular travel routines were used to measure the dependent variables. All items are answered using a five-point Likert scale, where 1 = Strongly Disagree and 5 = Strongly Agree. For assessing the level of public utilization of electric public transportation in urban Bangladesh cities, the descriptive statistics such as mean and standard deviation were performed.

Descriptive Statistics for the Adoption of Electric Public Transport The summary describes relevant statistics at this stage (Table 3). The overall mean of 4.08 (SD=0.77) indicated that the participants are highly accepted and willing to adopt electric public transportation. It is inferred that urban slash residences have an understanding of the merits of electric public transportation and are open to using it as an eco-friendly substitute option

Table 3: Descriptive Statistics of Adoption of Electric Public Transportation

Statement	Mean	Standard Deviation	Interpretation
I prefer electric public transportation whenever available.	4.19	0.72	High
I frequently use electric buses.	3.92	0.84	High
I intend to use electric public transportation in the future.	4.28	0.66	Very High
I encourage others to use electric transportation.	4.11	0.74	High
Electric transportation has become part of my regular travel.	3.88	0.87	High
Overall Adoption of Electric Public Transportation	4.08	0.77	High

for traditional fossil fuel based public transport. Out of the five indicators, future intention to use electric public transportation has the highest mean (M = 4.28, SD = 0.66). This result shows that the respondents were determined to use electric public transport more when it is more widely available. The high prospective adoption intention indicates that environmental awareness is rising and belief in the efficiency, comfort, and sustainability of electric transportation systems are gaining momentum with the public. It also implies that successful scaling from electric public transportation networks could drive ridership in urban Bangladesh even higher. The second highest mean score (M = 4.19, SD = 0.72) was for the statement "I choose electric public transport when available". The result shows that respondents preferred electric public transportation options rather than conventional ones when offered. Reasons to favor these include perceived environmental benefits, reduced noise, enhanced comfort and the anticipated quality advantages of electric buses. Concurrently, respondents indicated that they promote the use of electric transportation to others at 4.11 (SD = 0.74; Mean=4). Even so, this is a sign that respondents are not only personally accepting of electric public transit but also offering positive social pressures by suggesting family members, friends, and coworkers use it. Sustainable transport technology diffusion and adoption are greatly accelerated through positive word-of-mouth communication. Frequent use of electric buses (M = 3.92; SD = 0.84) The mean use was 0.75 down from 1, though on the whole respondents agreed that they use electric public transport frequently, which suggests that the relatively low mean indicates utility still limited by coverage and charging infrastructure as well as service availability. This finding suggests that expanding the fleet of electric buses and increasing active routes could significantly help adoption. Electric transport has become a normal part of the way I travel which received the lowest mean score at (M = 3.88, SD = 0.87). Although the overall score still falls within the high agreement category, this points to the fact that many respondents do not rely on electric public transportation in their normal commute yet. This result is not surprising because electric mass public transport services are still at the embryonic stage of introduction in Bangladesh and have yet to be rolled out across all modes of urban transport routes; however In summary, derived findings suggest that there is a substantial readiness among the public to switch to electric public transportation as respondents have responded favorably not just for present use but also for future sprouting of it. Preference, future intention, and advocacy have relatively higher scores than that of other factors indicate public acceptance is not the major barriers to successful implementation (Lättman & Otsuka, 2024). Like the provision of good infrastructure, a reasonably sized fleet to run on it, insurance cover with services altering depending on demand are perhaps more instrumental than goodwill turning into genuine travel behavior. The findings are in line with the literature where it is found that perceived environmental benefits, service quality, convenience and operational efficiency significantly improve electric public transportation adoption. They also back up claims that increased public uptake can help reduce reliance on traditional fossil fuel-driven cars, leading to less urban air pollution, greenhouse gas emissions and other road traffic environmental impacts. Thus, public policies that promote electric public infrastructure diffusion have a key role to enable the goal of sustainable urban mobility and environmental sustainability in Bangladesh

Government Support

Five indicators were utilized to check government support by asking the respondents their perceptions on whether there was an initiative being made for the promotion of electric public transportation, Infrastructure development, Investment, Policy implementation and Public awareness. Responses were reported within a questionnaire measured as 1 (Strongly Disagree) to 5 (Strongly Agree), using a five-point Likert scale. The characteristics of the average score for all items, and also the descriptive statistics such as the mean value, standard deviation were conducted to examine how much support for development and expansion of electric public transportation in urban cities of Bangladesh each government.

Descriptive statistics of the Government Support construct can be found in Table 4 The results are shown with the overall mean score of 3.95 (SD = 0.81) which shows that the respondents view actions for promoting electric public transportation in a positive way. These findings implies that policy actions and institutional efforts have played a role in strengthening public support for the transition toward an environmentally sustainable publicly

Table 4: Descriptive Statistics of Government Support

Statement	Mean	StandardDeviation	Interpretation
The government is promoting electric public transportation effectively.	4.03	0.78	High
There are sufficient charging stations for electric buses.	3.74	0.89	High
Government investment supports the expansion of electric public transportation.	3.98	0.81	High
Government policies encourage the use of electric public transportation.	4.12	0.73	High
Government awareness campaigns on electric public transportation are effective.	3.89	0.84	High
Overall Government Support	3.95	0.81	High

funded transport system. However, the aggregated score further suggests that more needs to be done in terms of strengthening public perceptions with respect to infrastructure development and implementation effectiveness. Expectation on the role of government to support electric bus development among five indicator, "Government policies promote usage of electric public transportation" received highest mean scores (M=4.12, SD = 0.73). The fact that respondents mention ADA as a key influence of government policies in focusing on electric public transportation suggests that this area should be targeted by such policies. It seems the combination of regulatory frameworks, financial incentives, environment policy and national transport policy created conducive policy atmosphere for acceleration of electric mobility in Bangladesh. There should be robust policy support to promote investment, innovation and accelerate the uptake of sustainable transport technologies. The claim "The government is effectively encouraging electric public transportation services" recorded the second mean score (M = 4.03, SD = 0.78). This finding indicates that respondents generally acknowledged the work done by governments to introduce and promote electric buses and other green transport measures. Pilot projects, policy discussions, and growing attention to green transportation may have contributed to improved public perception of the government's motivation for reducing the environmental pollution caused by transport. Likewise, mean scores for government investment to expand electric public transit yielded 3.98 (SD =0.81), revealing that respondents also felt that there was some degree of contribution of government investments made toward electric transportation network creation. Electric public transport relies on continuous investments in fleets, chargers, workshops and related technologies over time. Government awareness campaigns were given an overall mean score of 3.89 (SD = 0.84). Whereas, respondents largely agreed that awareness initiatives have resulted in some benefit, the lower score in this domain indicates potential need for further public education and outreach programs. The rapid growth in electric public transport and expanding spaces could be more accepted and empowered through increased knowledge of the economic, environmental and health benefits by individuals who yet do not know how much these technologies can help them embracing e-mobility. Of all the indicators, "There are enough charging stations for electric buses" had an ideal mean (M = 3.74; SD = 0.89). Respondents were moderately agree on this topic, which is a lowly rated concern concerning the availability and sufficiency of charging infrastructure. One of the main problems that affects deploying electric public transportation at scale in many developing countries, including Bangladesh is the availability of charging infrastructure. Thus, expanding charging networks and improving support infrastructure are essential to ensuring reliable service delivery through electric transportation systems and increasing public confidence. The overall perception towards electric public transportation, as a type of policy supporter and promotional feel supported by a number of means. But even, infrastructure expansion particularly growing number of charging stations is an area that has without a doubt received least focus. These findings suggest that broad government support beyond just policies is needed to fully implement electric public transportation, including financial investment, expansion of infrastructure and institutions, and raising public awareness. Previous research has shown that government support is a key factor behind the successful adoption of electric public transportation in align with these results (Yeung & Liu, 2023). Effective public policies, investment incentives, regulatory frameworks and infrastructure are widely recognized as critical to enhance the transition from traditional fossil fuel driven transport to electric

mobility. Hence, to ensure this transition favorable and faster moving policy support from government side is essential not only for accelerating the electrification of public transportation but also for improving environment pollution, urban air quality and sustainable urban development in Bangladesh.

Traffic Management Efficiency

Traffic Management Efficiency (TME): Based on five indicators which are based on the respondents' perceptions that whether electric public transportation can improve Traffic Flow, reduce congestion, improve transport scheduling, support urban transportation management and How much time is wasted due to travel delays. For each statement respondents chose on a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). In order to assess the effectiveness of traffic management with respect to electric public transportation in urban cities of Bangladesh, we recorded and evaluated the mean as well as standard deviation.

The descriptive statistics for the Traffic Management Efficiency construct is presented in Table 5. The mean score is 4.01 (± SD = 0.78) indicates that all other respondents agreed on most too many that the electric public transportation contribute positively for effectively managing urban traffic. The results from this study reveal that electric bus rollouts can maximize transport operations by facilitating better managed public transport

Table 5: Descriptive Statistics of Traffic Management Efficiency

Statement	Mean	Standard Deviation	Interpretation
Electric buses improve traffic flow.	4.06	0.76	High
Electric public transportation reduces traffic congestion.	3.91	0.84	High
Public transport scheduling has improved with electric buses.	3.98	0.79	High
Electric buses contribute to better urban transportation management.	4.15	0.71	High
Electric transportation reduces travel delays.	3.95	0.82	High
Overall Traffic Management Efficiency	4.01	0.78	High

services, minimizing congestion and improving urban mobility efficiency. Of the five indicators, the highest mean score (M = 4.15, SD = 0.71) was achieved by "Electric buses contribute to better urban transportation management". This implies that respondents felt electric public transportation could enhance urban transport management by optimizing vehicle operation, route planning, and delivery of services. Modernized electric buses also include sophisticated transportation technologies, including GPS tracking, digital ticketing and real-time monitoring systems that allow transport authorities to better control public transportation. The claim that "Electric buses make traffic flow better" had the second-highest mean score (M = 4.06, SD = 0.76). This finding implied that respondents regarded electric public transportation to be an important factor in better urban traffic circulation. A growing use of high-capacity electric buses will allow the amount of private vehicles on streets to be lowered, improving road efficiency and diminishing bottleneck effects in busy periods. Likewise scheduling of public transport has also improved (3.98 SD = 0.79) for electric buses. Overall, respondents tended to agree regarding the influence of electric public transport providing better scheduling and more regular services. Well-planned scheduling enhances service reliability and minimizes waiting times, motivating more people to use public transport which will lower traffic congestion. Electric transportation reduces travel delays was reported with an average mean of 3.95 (SD = 0.82). While respondents expressed positive views, the mean, though higher than overall travel time and speed but lower than ease of access shows that travel delays remain a problem in many cities. Poor road infrastructure, mixed traffic situations, inefficient functioning of the traffic signal in public transport systems, and inconvenience due to the absence of a dedicated bus lane or limited service can continue even after improving with electric public transit for parameters like travel time. The lowest mean score obtained by the indicator of "Electric public transportation reduces traffic congestion" (M = 3.91, SD = 0.84). Although respondents agreed with the statement overall, their relatively low score suggests that there is currently not enough electric public transport operating to significantly ease congestion in Bangladesh's major cities. While electric bus services are small and their fleet size and route coverage limited, it is apparent that the impact on total routes operated would be relatively low. In the near future, a well-designed electric base can significantly reduce road congestion by expanding electric buses networks, increasing route integration and dedicating public transport corridors. In general, the descriptive analysis shows that respondents rated traffic management efficiency related to electric public transportation relatively high. The results show that an electric public transport can deliver environmental benefits, as well as enhancing traffic operations, transportation planning and scheduling efficiency by furthering urban mobility. By improving travel reliability and reducing operational inefficiencies, effective traffic management makes public transport more attractive and contributes to a modal shift from private car. The results are in line with previous studies where they found that given a well-

managed traffic flow, the operational performance of electric public transportation is significantly increased and its environmental benefits maximized (Fonseca *et al.*, 2022). Thus, traffic management systems strengthening has to accompany the electric public transport system improvement in Bangladesh cities as a sustainable urban transport solution towards environmental pollution mitigation.

Environmental Pollution Reduction

EPR was operationalized with five variables that asked respondents to rate perception level on how much they believed electric public transportation could reduce air pollution, greenhouse gas emissions, and noise at the micro-environmental level, improve the urban environmental quality from conventional diesel motor buses by eco-friendly devices (X. Zhang *et al.*, 2025). Respondents rated each of the statements using a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Descriptive statistics such as the mean and standard deviation were generated in order to explore the perceptions of respondents concerning the environmental advantages associated with electric public transportation.

Table 6 shows the descriptive statistics for the Environmental Pollution Reduction construct. The grand mean of 4.30 (SD = 0.67) shows a strong agreement rate among the respondents about the environmentally friendly characteristics of electric public transportation. The results indicate that urban respondents are convinced that implementing electric public transport had a great potential to reduce environmental nine hours load decays

Table 6: Descriptive Statistics of Environmental Pollution Reduction

Statement	Mean	Standard Deviation	Interpretation
Electric public transportation reduces air pollution.	4.34	0.65	Very High
Electric buses reduce greenhouse gas emissions.	4.26	0.69	Very High
Electric transportation reduces noise pollution.	4.18	0.73	High
Electric public transportation improves urban environmental quality.	4.29	0.67	Very High
Replacing diesel buses with electric buses benefits the environment.	4.41	0.61	Very High
Overall Environmental Pollution Reduction	4.30	0.67	Very High

in cities of Bangladesh. The mean and standard deviation for the five indicators are shown in Table 5, and the highest score of all five indicators was found for "Replacing diesel buses with electric buses is good for the environment" (M = 4.41, SD = 0.61). This is indicative that respondents clearly acknowledged the environmental benefits of the replacement of conventional diesel-buses with electric equivalent. Direct tailpipe emissions are eliminated with electric buses, which reduces harmful pollutants that drive urban air pollution: particulate matter, nitrogen oxides and carbon monoxide. That finding augurs well for the continued growth in public awareness of the environmental impact of fossil fuels for transportation, and how cleaner technologies may relieve that burden. Following this was "Electric public transportation reduces air pollution" which obtained the second highest mean score of 4.34 (SD = 0.65). Electric public transportation is regarded as helpful in cleaner air through decreasing conventional vehicular emissions, experts agreed strongly. Air quality improvement is especially necessary for transport, one of the main sources of air pollution in densely populated urban areas. Besides the positive impact to health and life expectancy of the population due to decreasing respiratory and cardiovascular diseases associated with poor air quality, cleaner air also impacts positively (or sustainability) on environment. Likewise, the mean score of "Electric public transport enhances the quality of urban environment" was 4.29 (SD = 0.67), which also suggested relatively strong agreement among respondents regarding these statements. That provides evidence that electric public transportation are believed to serve in the role of sustainable urban development The complementary benefits of reduced emissions, lower noise and cleaner transport systems lead to an overall better urban environment quality, creating a healthier and more liveable city. The carbon footprint of electric buses (M: 4.26; SD = 0.69) Respondents indicated that switching out fossil fuel-powered buses for electric ones can reduce carbon dioxide and other greenhouse gases, leading to climate change mitigation. The implication is that awareness of potentially sustainable public transport has increasing traction, thanks partly to the recognition most recently articulated by world leaders that public transportation can be key in providing low-carbon urban development practices to support global climate goals. Of all the indicators, "Electric transport reduces noise pollution" scored the lowest mean score (M = 4.18; SD = 0.73). While this value still implies a strong consensus, the lower number indicates that noise reduction was considered slightly not as important as air quality and emission reduction. This consideration could arise from the fact that the environmental effects of air pollution are increasingly talked about and more visible than noise due to traffic pollution. However, the fact that electric buses are almost soundless in operation and thus help to make cities more pleasant should not be underestimated.

In general, the respondents were strongly asserted that electric public transportation can reduce environmental pollution according to descriptive analysis. The remaining three indicators, which all showed high levels of agreement among participants, suggest widespread awareness of the environmental benefits correlated with electric bus ownership, comprising decreased air pollution; a reduction in greenhouse gas emissions; diminished noise pollution; and improvements in overall urban environmental quality. Given the promising results of these modeling studies, our findings illustrate that electric buses and trolleybuses have potentially important roles to play in delivering a cleaner, healthier and more sustainable urban future in Bangladesh. The results support earlier studies, which have consistently reported that electric public transportation mitigates transport-related emissions, improves urban air quality, reduces traffic noise and promotes environmental sustainability (Budjav, 2022). Research has demonstrated that electric-bus deployment can significantly reduce local air pollutants and greenhouse gas emissions compared with diesel-powered buses, while also helping the US meet its national climate-change mitigation commitments. Thus the extension of electric public transport along with cleaner energy infrastructure and sustainable transportation initiatives is a potential solution for environmental pollution mitigation and urban sustainability in Bangladesh.

Sustainable Urban Mobility

Five indicators were used to assess the contribution of electric public transportation in sustainable urban mobility, via evaluation of respondents' perceptions related to it are: 1) electric public transportation contributes more in long-term sustainability of urban cities; 2) Electric Public Transportation helps the society as a whole when it comes down to quality of life health benefits economic development, etc.; 3) By increasing electric public transportation, the cities become cleaner and greener city, thus increasing livability of an urban settlement over time by enhancing sustainability; 4) Electric Public Transport is one factor that achieve environmental goals given during National Environmental Policy 2023, Bangladesh; Each statement was rated on a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). This study calculated the descriptive statistics, such as mean with standard deviation, to evaluate the perceived role of electric public transport in sustainable urban mobility for Bangladesh.

Table 7 Descriptive statistics of the Sustainable Urban Mobility construct. The mean score of 4.28 (SD = 0.67) simply signifies a very high degree of conformity with assertion regarding Electric Public Transportation will accrue sustainable urban mobility in Bangladesh. Findings indicate that respondents viewed electric transit as a key measure for creating eco-sensitive, effective and livable urban transportation systems. Thus the overall result is an increasing public valuation of electric mobility as a component of sustainable urban development. Evaluation of the electric public transportation indicators rank Nearest-neighbor score. Among the five group Indicators: "Electric public transport supports Bangladesh environmental aspiration" with highest mean score (M=4.36 SD=0.63). This result suggests that respondents were in solid agreement that the growth of electric public transportation is consistent with national environmental and climate goals. The switch to electric mobility is regarded as a significant approach to Green House Gas emissions reduction, urban air quality enhancements and fulfilling national commitments towards sustainable development and climate change mitigation. The second highest mean score (M = 4.33, SD = 0.65) was received for the statement "Electric transportation leads to cleaner cities" (SUM3). Without question, they acknowledged that electric vehicles could do wonders to make our cities cleaner and more livable by replacing conventional fossil fuel powered public transportation. Recovery vehicle emissions and a reduction of Air Pollutants will provide healthier Urban Habitats in addition to rendering cities more compact as well as more liveable. Likewise, "Increasing electric buses will make cities better" scored 4.29 (SD = 0.67), showing significant public support to extend sustainable electricity fueled public transport networks in cities. To improve public transport utilization, reduce reliance on private vehicles, and promote more optimum use of urban transport facilities, it was acknowledged by the survey respondents that increasing the availability and accessibility of electric buses can play a crucial role. This would contribute to the advancement of long-range urban sustainability. The mean score for the indicator, "Electric public transport network – supports sustainable urban

Table7: Descriptive Statistics of Sustainable Urban Mobility

Statement	Mean	Standard Deviation	Interpretation
Electric public transportation supports sustainable urban development.	4.25	0.69	Very High
Electric buses improve the quality of urban life.	4.17	0.73	High
Electric transportation contributes to cleaner cities.	4.33	0.65	Very High
Increasing electric buses will make cities more sustainable.	4.29	0.67	Very High
Electric public transportation supports Bangladesh's environmental goals.	4.36	0.63	Very High
Overall Sustainable Urban Mobility	4.28	0.67	Very High

development" was 4.25 (SD = 0.69). The finding shows that respondents viewed electric public transportation as an important component of sustainable city design. Green transport Innovative transport systems not only save energy and reduce pollution, but they also increase urban resilience and help maintain a proper balance in economic and environmental development. The lowest mean score (M = 4.17, SD =0.73) was calculated for the dimension electric buses improve urban quality of life among all indicators. While this is still a very large share of people in agreement, the relatively modest mean implies that the respondents were somewhat inclined to believe that improvements in quality of life are contingent upon various other supplemental factors in addition to cleaner means of transport such as reduced congestion levels, stronger infrastructure and public services and urban planning. Still, respondents seemed to agree that electric public transportation contributes to making cities more livable. Overall, the descriptive analysis showed that respondents had a strong perception of electric public transport as a key driver for sustainable urban mobility. Low-level disagreement on all indicators indicates the public believes electric public transportation can decrease environmental pollution, improve transport efficiency, and enhance urban sustainability furthering Bangladesh's long term environmental and development goals. These results should also assist in identifying the type of direction that could be supported via expanding electric public transportation schemes into a cleaner, more efficient and environmentally friendly urban transportation system for Bangladesh.The results further support previous studies that underscore the need to combine technological advances in sustainable transport with comprehensive public transportation solutions, supportive policy frameworks and active citizen engagement (Lättman & Otsuka, 2024). Previous research has pointed out that electric public transport helps produce cleaner cities, reduces greenhouse gas emissions, improves public health and enables more sustainable urban development when deployed at scale. Hence, investment in electric public transport infrastructure along with relevant plans and advocacy would be the key to sustainable urban mobility and environmental sustainability in Bangladesh.

Findings

• Electric public transportation quality positively (indirectly) affects environmental pollution reduction of urban cities in Bangladesh.

• The results indicate that the adoption of electric public transportation contributed positively to environmental pollution and environmentally responsible travel behavior.

• Through policies, building infrastructure, and investment into cleaner bus systems to mentioning a few areas of focus, government supported safer electric public transport enabling reduced pollution.

• Utilization to Improve Operational efficiency of Electric Public Transit Transportation and Environmental Pollution Mitigation in Urban Society through the Effective Management of Traffic.

• Protecting the environment created a substantial average impact on improving urban mobility sustainably by enabling cleaner, healthier and more efficient urban transport systems.

• In conclusion, these findings suggest that an expansion of electric public transportation can be considered a useful approach to pollution mitigation and sustainable urban development in Bangladesh.

Recommendations

• Electric public transportation services provided by the government should be more operative with larger buses running over bigger distances.

• The quality of electric public transportation must be improved, so that it is reliable, safe, comfortable and on time for people to use publicly.

• Electric public transportation systems will need to be supported by well-invested charging infrastructure, maintenance facilities, and smart transportation technologies.

• So, policymakers should bolster to enhance new monetary incentives, regulatory frameworks, and public–private partnerships and enable large scale adoption of electric public transportation in urban cities all over Bangladesh.

• Formulating public awareness campaigns to enhance knowledge of electric public transportism among citizens by highlighting its environmental, economic and health advantages seeks to motivate them regularly use it.

• City planners and transportation authorities must utilize smart transport systems, dedicated bus lanes, and route programming to ensure electric public transport is both an efficient and eco-friendly mode of travel.

• To achieve long-term environmental sustainability, greenhouse gas emissions reductions and sustainable urban mobility, governments should integrate electric public transport into national urban development and climate action plans.

• Those required future electric vehicles must also be built around a need for greater public transportation to utilize the benefits of both components equitably, where those stronger renewable energies with cleaner forms of electrical generation allow bigger environmental changes.

CONCLUSION

This current research paper investigates the relationship between electric public transport quality, electric public transport adoption, and government support and traffic management efficiency on environmental pollution in urban cities of Bangladesh. The results showed that all these factors positively affected pollution reduction in the environment and thereby significantly promoted sustainable urban mobility. The research underlines that, when transforming urban landscape by expanding electric buses acquisition to reduce air and noise pollution and decrease greenhouse gas emissions, as well as enhance

the quality of urban environment supporting eco-friendly urban planning behavior leading to lower pollutant emission vehicles. Moreover, robust government policies supported by appropriate infrastructure, effective traffic enforcement and growing public acceptance are critical to realizing the full potential of electric public transport for environmental and social benefits. Hence, it will not only aid in developing sustainable cities but will also enable Bangladesh successfully reach its targets for environmental protection during urban mobilization and climate change mitigation while improving the quality of life of citizens.

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