DECARBONIZING PUBLIC TRANSPORT: POLICY UPTAKE AND BARRIERS IN NAIROBI, KENYA

Kenneth Ndungu Murira.
Student, Master of Arts in Public Policy and Administration, Kenyatta University, Kenya.
Catherine Gateri.
Lecturer, Department of Public Policy and Administration, Kenyatta University, Kenya.

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ABSTRACT

Transport decarbonization in Nairobi has many challenges as a public transportation system that is highly dependent on fossil fuels increasing greenhouse gas emissions. While Kenya has made climate commitments in line with the Paris Agreement, very few measures of low-carbon forms of transport has taken root. This study investigated the factors affecting the implementation of the policies on decarbonization of transport in Nairobi focusing on the barriers, stakeholder awareness, and infrastructural readiness. Socio-Technical Transitions theory and Diffusion of Innovations theories were used to examine the low rate of adoption of electric vehicles (EVs), provision of non-motorized transport (NMT) infrastructure, and use of clean fuels in a city that contributed to a significant amount of transport emissions in the country. Research objectives were to analyze the institutional, policy, technical, and financial barriers to policy take-up, to analyze the awareness and the perception of public transport stakeholders, and to evaluate the adequacy of infrastructure for decarbonization. The study was done within the jurisdiction limits of Nairobi County, with close attention to its informal and fragmented public transport system. A mixed method design was used in which descriptive survey and exploratory designs were combined. Quantitative analysis using Statistical Package for the Social Sciences (SPSS) and the qualitative data was analyzed under thematic analysis. The sample was made up of 120 respondents made up of the SACCO leaders, bus drivers, fleet owners/ investors and industry experts who were selected purposively. The results showed that there is a significant relationship between independent variables (barriers to transport decarbonization, stakeholder awareness and perceptions, and infrastructure adequacy) and dependent variables (policy uptake for transport decarbonization) indicated by a significant level of 0.000. The correlation coefficient ($R = 0.762$) suggests a strong positive correlation between the predictors and the policy uptake. The study concluded that institutional, policy, financial and technical barriers collectively present a highly challenging environment for the decarbonization of transport in Nairobi. The prohibitively high upfront costs of electric vehicles, coupled with extremely limited access to affordable financing mechanisms, constitute the most significant financial barrier preventing transport operators from switching to a low-energy transport. The national government should create a special financing facility for the decarbonization of public transport addressing the high upfront cost of electric vehicles. This should include subsidies or grants for a percentage of the cost of purchase of electric vehicles, schemes of low interest loans made specifically for transport operators and tax incentive schemes, including tax (VAT) exemption on electric vehicles and charging equipment.

Keywords: Decarbonizing Public Transport: Policy Uptake and Barriers.

INTRODUCTION

Urban transportation has contributed significantly to greenhouse gas (GHG) emissions, accounting for about a quarter of the world's energy-related CO_2 emissions. Rapid urbanization in many Sub-Saharan African cities increases pressure on the environment and leads to urban air pollution, largely due to the reliance on fossil fuel-powered vehicles and inadequate public transportation infrastructure. The informal public transport system is the most widely used in Nairobi and is characterized by matatus (minibuses), motorcycles (boda bodas), and limited formal bus services. While all these systems are critical for urban mobility, they are, however, largely inefficient. Also, they are heavily dependent on diesel and petrol, which substantially increases the city's carbon footprint (Martins, 2025).

Climate change is an intricate challenge worldwide. Climate change is an acceleration of climatic temperatures, which is associated with permanent weather change of mean temperature, precipitation, and other environmental parameters, e.g., pressure and humidity. It includes abnormal weather conditions, diminishing ice on the planet, and increasing sea level (Leal Filho et al., 2021).

The Paris agreement aims to bring about a greater global response to the rising temperature of climate to restrain the increase of the average global temperature to less than 2 degrees Celsius, and also to exert efforts that would lead to a restraint of the rise to 1.5 degrees Celsius. It also works toward enhancing the government's ability to deal with the changes in the climate by balancing financial flows to meet low-carbon and climate-resilient development pathways. Achieving these goals is associated with the mobilization and availing of large financial resources, as well as the implementation of a new technological and infrastructural platform (Abbass et al., 2022).

The transport sector is responsible for approximately 24% of the world's carbon emissions (Axsen, 2022). Climate change is caused by greenhouse gases formed mostly through the burning of fossil fuels, by trapping heat in the atmosphere. Even though there are a number of alternatives to low-carbon projects, fossil fuels are still widely used to obtain energy that sustains most transport activities. An amount of about 450 million barrels of crude oil is refined into gasoline, jet fuel, and diesel to serve the industry daily. The number of emissions because of transport has increased by roughly 2 % every year during the past 5 several decades (Rapson & Muehlegger, 2023).

It is estimated that today cities are the major contributors of carbon dioxide emission in the world with majority of the emissions caused by high-carbon vehicles using fossil-based fuels. The current travel demand of passengers is expected to increase by almost 75 percent in 2050, and the changes present a keen opportunity to consider re-designing the system of urban mobility to avoid serious long-term environmental and social effects (Haasz et al., 2018). With urbanization picking up speed in developing cities, transport emissions are likely to rise, unless some strict intervention measures are made. High population growth rates, motorization, and

rates of mobility demand are observed in cities in Africa, in turn presenting challenges and unstable levels of emissions due to congestion in the current transport systems.

An important element of the entire policy framework is the combination of financial rewards, regulatory norms, technological innovation and infrastructure to facilitate implementation. Government regulation, investments made by the industry, awareness among the stakeholders, and technological development need to be implemented in a coordinated manner, which is important to enable the decarbonization policies (Beccarello & Di Foggia, 2023).

The implementation of the decarbonization policies in the entire transport industry needs a holistic structure that integrates all of the regulatory requirements, market-based incentives, technological innovation, and industrial policy support. Some of the regulatory policies include Fuel economy regulations, low-emission zones, and a ban on internal combustion engines, along with carbon taxes and congestion pricing that enable such practices to adopt clean technology in a more economically robust manner. Technology innovation and industrial policies also need to complement each other in the long-term change by establishing a market demand for low-carbon alternatives. To decarbonize quicker, governments are supposed to invest in green technology research and scale up and infrastructure (Ahman, et al., 2016).

Governments and non-governmental bodies (NGOs) around the globe have acknowledged the need to decarbonize the transport industry as a way of ensuring balance on planet earth. The decarbonizing of the transport system in China is done through combining policies that are built around the Avoid-Shift-Improve (A-S-I) paradigm and combines technical adjustment, regulatory instruments, economic incentives and behavior management (Shao et al., 2024). The avoid strategy is that of minimizing transport demand through dense urban development and telework so that people do not make unnecessary commutes. The Shift approach promotes that individuals change to transportation modes that emit fewer emissions, such as high-speed trains, bus rapid transit, and carpools, which results in the lesser reliance on using individual cars. The Improve strategy emphasizes the technical solutions, including the popularization of electric vehicles (EVs), hydrogen fuel cell vehicles (FCVs) and biofuels, stringent fuel economy standards and a ban on internal combustion engine-based vehicles. The transition relies on economic instruments in terms of fuel taxes, EV subsidies, and the construction of charging infrastructure so that cleaner technology is made more available (Zhang & Hanaoka, 2022).

The European Union (EU) targets to decarbonize its transport industry through regulatory measures and other structures to eliminate emissions from the transport industry by 2050. Industries such as transport remain some of the greatest emitters, and vehicle traffic amounts to about 12 per cent of the total emission of greenhouse gases in the EU. Transport emitting sectors have shot up by 21 per cent compared to 1990, even as other sectors decreased in the same period. The EU has responded to this by setting lower CO2 emission standards on vehicles (Haas & Sander, 2020).

The United Kingdom takes place among the global leaders in reducing domestic greenhouse-gas emissions, and its goal to achieve net zero in 2050 has gained a wide political consensus. The country is also engaged in the multilateral platforms, especially the Paris Agreement of 2015, and its transport-sector policy aligns with the COP26 decarbonization targets. The UK has been pursuing an integrated decarbonization plan for its transport system to achieve the country-specific policies and international agreements. The Transport Decarbonization Plan (2021) specifies the following as core measures: the elimination of all petrol and diesel vehicles by 2035, the emphasis on electric transport, as well as investments into the development of opportunities in public transport and cycling. The use of fossil fuels is discouraged by economic measures, which include the emissions trading scheme and fuel excise duties. Its strategy is to combine regulatory, economic, and technological options to have a net-zero transport by 2050 (Pareliussen et al., 2022).

The Global South is underway in terms of decarbonizing the transport industry through various technological, policy, and economic interventions. The move is significant as transport is a significant contributor to greenhouse gas emissions, with ranges spanning different regions from Sub-Saharan Africa (23% contribution) to the Middle East (26% contribution) to South America (37% contribution). The efforts of African countries to decarbonize the transport sector have been limited due to infrastructural challenges, price problems and lack of government incentives compared to other sectors. While several countries are looking at electric transportation, it is still limited because of high costs of cars and unstable electric networks. Cities like Nairobi and Lagos, on the other hand, are making new decisions like electrification of public transit and investments in non-motorized transport infrastructure (Emodi et al., 2022).

In light of climate change, the Kenyan government has adopted various national and sectoral policies which are aimed at reducing emissions and are being aligned with the commitments of country to the UNFCCC and its Nationally Determined Contributions (NDOs). Kenya's amended NDC details that the government desires to reduce total emissions by 32% in 2030, versus the BaU prediction of 143 MtCO2e by 2030 (Dixon et al., 2024).

These policies include the National Climate Change Action Plan (NCCAP) and the National Integrated Transport Policy. They all emphasize a shift toward decarbonization via mass transit systems, encouragement of non-motorized transport (NMT), electric mobility, improved fuel efficiency, along institutional changes. Infrastructure-led projects such as the Nairobi Bus Rapid Transit (BRT) and promotion of electric automobiles, including electric buses and electric motorcycles, are part of the wider agenda on climate action in Kenya (NCCAP,2023). Nairobi has begun integrating non-motorized transport and electric mobility strategies to help decarbonize its transport sector. According to research, over 40 percent of all trips made daily in the city are made by foot, rising to almost 65 percent among adults and 96 percent plus among school-going children from the informal settlements; yet, the pedestrian infrastructure is grossly inadequate with either very narrow sidewalks or no sidewalks at all, and there are hardly any safe street crossings. To counter this, the county government pursued the Non-Motorized Transport Policy (2015), shifted some funds from the road budget to sidewalk

construction and bike lanes, and—with National Climate Change Action Plan's support—has gone on to construct dedicated cycle lanes and pedestrian walkways alongside major roads and streets in Nairobi. This has targeted a reduce in emissions to 4.1 Mt CO2 by 2030. This thus represents a strategic switch to a low carbon and equitable approach to urban mobility that works for the population and also for the climate. These measures are in line with Kenya's commitment under the Paris Agreement and its ambition to have a low carbon, climate resilient transport sector by 2030 (Ruth et al., 2020).

Statement of the Problem

The transport sector in Kenya is emerging as one of the major sources of greenhouse gas emissions, threatening to undermine the country's climate mitigation commitments under the Paris Agreement. Total emissions in Kenya were 56.8 million metric tons of CO_2 equivalent in 1995; this figure rose to 93.7 million metric tons in 2015. Out of this, approximately 13% was emitted by the transport sector. Shockingly, the share is projected to increase to about 17% by 2030, given the accelerating motorization. Domestic air pollution emissions from transport had further increased by 59.4% from 7.74 $MtCO_2e$ in 2009 to 12.34 $MtCO_2e$ in 2019, with road transport accounting for about 97% of total transport emissions in 2019 (12.09 $MtCO_2e$ out of 12.43 $MtCO_2e$) (Dixon et al., 2024).

Nairobi, being at the core of Kenya's economic activity, urbanization, and motorization, has certain unique challenges in transport. Nairobi has most of the country's vehicle fleet, with much of the transport-related air pollution, congestion, and carbon emissions concentrated there. Vehicles registered in Nairobi are approximately 1.2 million (26.67%) out of the 4,588,770 registered vehicles in Kenya in 2022. In 2016, the entire GHG emissions of Nairobi were 4.7 MtCO2e with the highest share being the transport sector (NCCAP, 2020). By comparison to the national level of emissions, Nairobi-based emissions in Kenya comprise about 5 % of the national output.

The Kenyan government has set to reduce GHG emissions by 32% by 2030, including 3.46 $MtCO_2e$ from the transport sector. However, there has been slow progress in realizing that. The use of any electric vehicle was just 0.19% of the entire vehicle fleet in 2020, which slightly increased to 1.6% in January 2023, including just 3,753 electric vehicles, which is much lower than the 5% of the new electric vehicle registration target set by the government for 2025 (KIPPRA, 2024).

While there are national policies, strategic plans, and pilot projects fostering low-carbon public transport in Nairobi, the uptake remains discouragingly low. What is not established is why these interventions have failed to be widely implemented and supported by some key actors in the public transport scene. There is limited empirical evidence relating to the socio-technical factors, institutional dimensions, and infrastructural bottlenecks that either promote or inhibit policy uptake at the city level, especially within Nairobi's informal and highly fragmented public transport sector. This study aims to bridge this knowledge gap in the understanding of the dynamics of stakeholder awareness and infrastructural preparedness versus contextual

barriers against the backdrop of either adopting or resistance to the decarbonization intervention on the public transport sector within Nairobi.

Objectives of the Study

The study objectives were:

i. To investigate key institutional, policy, financial and technical barriers for the uptake of transport decarbonization policies in Nairobi County.
ii. To assess the extent of awareness, attitudes, and perceptions of the key stakeholders about the existing transport decarbonization policies and initiatives.

REVIEW OF RELATED LITERATURE

In this section, the literature review has been done on the research variables that the research is dealing with. Next, the chapter provides a brief review and synthesis of the studied literature and a conceptualization model that explains the interconnection between the major variables.

Theoretical Framework

This research was based on Socio-Technical Transitions (STT) theory and Diffusion of Innovation (DOI) theory discussed below.

Socio-Technical Transitions Theory

The social-technical transition theory (STT) is based on two assumptions: organizations are systems the dynamics of which are mutually dependent and at the same time, they are embedded within exogenous environments to which they are under constant pressure. STT explains how socio-technical systems evolve through one configuration to another. Success in technology hinges on a three factor of human agency, social structure and organization institution. The theory breaks down the socio-technical change into three hierarchical scales namely landscape, regime and niche, characterized by particular orders of scale and stability. Landscape is about macro-structural conditions, regimes involve institutional arrangements and niches are about specialized local practices involving actors (inter)acting (Geels & Kemp, 2007).

Socio-Technical Transition Theory offers a framework of understanding how complex systems like urban public transport undergo drastic changes from one stable state to another. Transition is conceived as being across three inter-related scales: the landscape, consisting of broad external pressures such as climate change, global decarbonization commitments, or national emission targets; the regime, or dominant technologies, institutional rules, infrastructure and established practice; and the niche, where radical innovations such as electric buses, battery-swapping technologies, or pilot policies emerge. According to Sorrell (2018), the theory assumes that transitions take place when niche-level innovations become prominent enough to destabilize and reconfigure the regime, usually under the sustained pressure of the landscape, like Kenya's Paris Agreement commitments.

In the context of Kenya's transport sector, the dominance of fossil-fuel-based vehicles and insufficient charging infrastructure, with fragmented institutional coordination, constitutes regime-level inertia slowing the low-carbon diffusion alternatives. In contrast, electric mobility innovations to date have remained niche in nature, largely through the lack of infrastructure, regulatory gaps, and weak stakeholder engagement. With landscape pressures mounting—for instance, Kenya vows to cut transport emissions by at least 8% by 2030— alignment becomes even more pertinent across these levels. Thus, the STT theory provides a foundation for exploring how infrastructure development, policies, and social awareness have directed and defined the pace of transport decarbonization in rapidly urbanizing cities such as Nairobi.

Diffusion of Innovations Theory

Through the diffusion-of-innovations (DOI) theory, Everette M. Rogers explains how novelty is used to execute the spreading of innovations among the components of the strata (a system of bounded collection of individuals). Rogers identifies the chain of successive transmission of an innovation through the intended channels of communication, hence following a sequence of time steps in succession, i.e. awareness, interest, persuasion, choice, adoption, and confirmation. In line with that, the innovativeness continuum is divided into five categories of adopters (namely innovators, early adopters, early majority, late majority, and laggards) (García-Avilés, 2020).

The theory assumes the adoption as a process occurring through the stages of knowledge, persuasion, decision, implementation, and confirmation; adoption is influenced by some key factors such as perceived relative advantage, compatibility with existing systems, complexity, and trialability (Lekvall & Wahlbin, 1973). The extent to which the adopters can observe the innovation affects their decision on whether to adopt or reject it. Innovations are well accepted when they are believed to be useful, easy to implement, and observable in practice.

Applying the theory in Nairobi for decarbonizing the public transport sector could offer interesting insights into adoption patterns concerning electric mobility technologies and infrastructure for e-buses. One critical factor influencing the adoption process is the awareness of stakeholders. Without awareness and understanding of the benefits of electric vehicles, or with uncertainty concerning the reliability of electric vehicles, cost-saving, and long-term viability, the process of adoption can be delayed among critical stakeholders such as SACCO managers, matatu operators, and county officials. According to the theory, mass media can be particularly influential in creating awareness, while interpersonal communication, especially among early adopters, shapes attitude and promotes uptake through social influence.

In Nairobi, where electric vehicles are a new and unfamiliar concept, it is still difficult for the public and institutions to move from getting interested in the idea to actualizing it because of the limited sightings by the public on the road. Diffusion is more than just a matter of technology readiness; it is also about the flow of information, who decides to adopt first, and how perceptions are created and then reinforced within the transport channels. DOI helps in explaining why the adoption is uneven in pace and thereby underscores the importance of

demonstrative awareness campaigns and projects to lessen uncertainty and accelerate the shift toward low-carbon mobility options.

Empirical Review

Transport Decarbonization

Nakorji, Saleh, Wilfred, and Akadiri (2023) examined transport decarbonization in their study, Driving Decarbonization in Transport Sector, which used a mixed-methods approach, involving both qualitative policy document analysis and quantitative studies of the measures and effectiveness of decarbonization policies in the road transport sector. The sample population for the study included policymakers, stakeholders from the transport industry, and industry experts with respect to sustainable development. Their findings have shown that factors that highly influenced the application of transport decarbonization policies by different regions and jurisdictions were technology readiness, regulation framework and political commitment. The research found that decarbonization policies, involvement of the stakeholders and implementation of the mechanisms was fragmented which was an obstacle towards decreasing the carbon emission in the automobile industry. The study reveals the need for the introduction of integrated policy mechanisms, multi-sectoral cooperation, and specific approaches to accelerate the transition to sustainable transport systems. However, the study creates the opportunity for further analysis in terms of the detail specifics of what hinders or promotes the process of policy adoption.

Rapson and Muehlegger (2023) conducted the study “Global Transportation Decarbonization”. The authors conducted a qualitative policy frameworks and case studies assessment. Data collection included the retrieval of information in international databases, government reports, academic literature and the interviewing of the stakeholders. The findings of their study concluded that the transport decarbonization policies vary significantly across nations and transport modes, and they vary depending on the use of technology, regulatory regimes, market forces, and political determination. They enumerated several effective policies, including fuel economy policies, carbon pricing mechanisms, and financially backed green transport infrastructure that has reduced GHG emissions from the transportation sector. According to the findings of the presented research, there are significant shortcomings in global policy compliance, execution, and collaboration, which hinder the attainment of the high decarbonization targets.

Emodi, Okereke, Abam, and Diemuodeke (2022) carried out a systematic review on Transport Sector Decarbonization in the GS to assess the adoption of transport decarbonization policies. They examined a great number of scholarly publications, reports, and policy documents retrieved from the academic databases and the research repositories. The results of the research imply that such drivers as stakeholder attitudes, institutional development, economic growth, and technological adoption affect transport decarbonization strategies across the Global South. The gap in the study is that little literature touches upon the effectiveness of policy and implementation methodology, enforcement, and assessment, indicating the absence of research on this subject and more so in low- and middle-income countries where resources and expertise are limited.

Infrastructure Availability

Klibera et al. (2024) conducted a study focusing on the factors affecting the adoption of sustainable transport decisions in the Czechia, Hungary, Poland, and Slovakia economies. The study used a multinomial logit model using survey data to examine factors influencing daily mobility decisions. The results showed that environmental awareness played a very important role in promoting the use of alternative means of transport, but the vehicle was still the most preferred. The research further established that properly built and established public infrastructure was likely to influence its observance within the economies of the countries. Improved non-motorized transport infrastructure, for example, improved cycling lanes, had a significant effect towards transport decarbonization in Hungary. A gap of this study is its contextual gap since the findings are limited to the four nations, which have distinct socioeconomic situations. Therefore, this study seeks to explore similar dynamics, especially the influence of green infrastructure such as charging stations, NMT infrastructure, among others, on the uptake of decarbonization policies in fast-growing cities such as Nairobi.

Szumska (2023) evaluates the present situation of the electric vehicle (EV) charging infrastructure along highways in the European Union (EU). She analyzed the existence of charging stations and EU policies promoting zero-emission transport using a review-based methodology. The findings of the study were that there was an uneven distribution of charging infrastructure between Eastern Europe and Western Europe. Charging infrastructure was also dense in countries like Germany and the Netherlands whereas countries like Bulgaria and Romania simply had fewer of them with approximately less than 1 charging station per every 100 km of the Trans-European Transport connection. This is among the significant detrimental factors which make long-distance travelling of EVs quite challenging and reduce the possibility of EV use in poorly organized regions. This obstacle adversely affects the popularity of EVs and slows the EU process of transport decarbonization.

In their study, the centrality of infrastructure in decarbonizing global transport (2022) Wang-Helmreich, Obergassel, and Lah explore the ways of how infrastructure plays a critical role in decarbonizing global transport. They used policy review approach. They concluded with a call to pay much attention to investing in zero-emission transportation infrastructure, including electric car charging systems, high-velocity railways, and multimodal hubs facilitating active and public transport. They also stressed the importance of integrating transportation and energy systems to supply a steady supply of renewable energy for electricity and hydrogen-powered vehicles. The study also cited issues such as governance, budgetary constraints and societal resistance as some of the major roadblocks to infrastructure development that may delay efforts to reach net-zero transport emissions. A major contextual gap of the study was that it was unable to focus on a specific regional examination of infrastructure discrepancies, especially in developing nations where inefficient transit infrastructures and financial resources reduce the feasibility of de-carbonization initiatives at the scale needed to meet global emissions targets.

Stakeholder Awareness

In the study "Taking Sustainability turn", Martin (2020) examines the perception of stakeholders on the electrification of motorcycles in Nairobi, Kenya. The research is based on the understanding of the perception of the stakeholders related to the electrification of motorcycles in the transport system of Nairobi City. The study employed a two-step methodology strategy. The first step was a survey which was carried out on motorcycle taxi drivers; however, the exact sample size is not stated. The study then combined the data with semi-structured interviews with specialists in electric mobility and urban planning.

The study findings are that some stakeholders, like environmental groups, recognize the possibility of low air and GHG emissions in the congested streets of Nairobi. Drivers, especially, are very concerned about the financial aspect. Including the initial cost of electric motorcycles, lack of charging stations, and the chance of higher maintenance compared to the conventional gasoline-run mode of transportation. The study concludes that a successful transition to electric transportation requires addressing these drivers' financial worries. The study emphasizes the fact that every relevant stakeholder, from policymakers to the taxi drivers be involved in the process of formulating successful policy proposals if they are to encourage the adoption of electric motorbike taxis. There are gaps in the sample's representativeness, which may not completely convey the complexity of stakeholder perspectives and interests in the electrification transition.

Zhang's (2022) study was on the impact of the engagement of the actors in the transport sector on decarbonization of the sector in Ireland. Data collection was through questionnaires and in-depth interviews with representatives from select transport companies. The study conducted proved an apparent institutional gap between policy and industry awareness. Although climate policies significantly incentivize the transition to low-carbon fuels, the responders articulated some objections. Among the issues raised were the high initial investment costs of electric cars, the fact that there is few charging stations prepared throughout Ireland, and potential range and convenience problems related to EVs compared to traditional internal combustion engines. The study concluded that the Irish government needs to address the stakeholders' concerns by providing tax breaks to lower the costs of acquiring electric vehicles. The study concluded that providing a more conducive environment will motivate and facilitate the decarbonization activities of the road transport industry. The gap is that the sample size is not stated; therefore, it is difficult to generalize the findings to wider stakeholders in the transport sector.

Paddeu (2024) used a qualitative method to investigate awareness and perceptions of urban freight decarbonization in the UK. Some participants demonstrated a thorough knowledge of the need for decarbonization initiatives. In contrast, some had a more limited knowledge of the problem. The study findings showed extensive uncertainty regarding the future development of urban freight. Stakeholders showed worries about the new technologies and policy measures. However, collaborations between stakeholders from different sectors, such as logistics companies, policymakers, and environmental organizations, were facilitated to a great extent by the research. Due to these collaborative efforts, individuals were enabled to come up with collective suggestions on potential methods of decarbonization of the urban freight sector.

Long-term intervention became widespread to convert the delivery vehicles to electric. The stakeholders stated the essentiality of the preparation of proper regulatory frameworks and the introduction of the financial toolset to sustain the required shift toward a more sustainable system in the city freight. The research gap is that there is no information regarding the precise composition of the represented stakeholder groups.

Barriers to Decarbonization

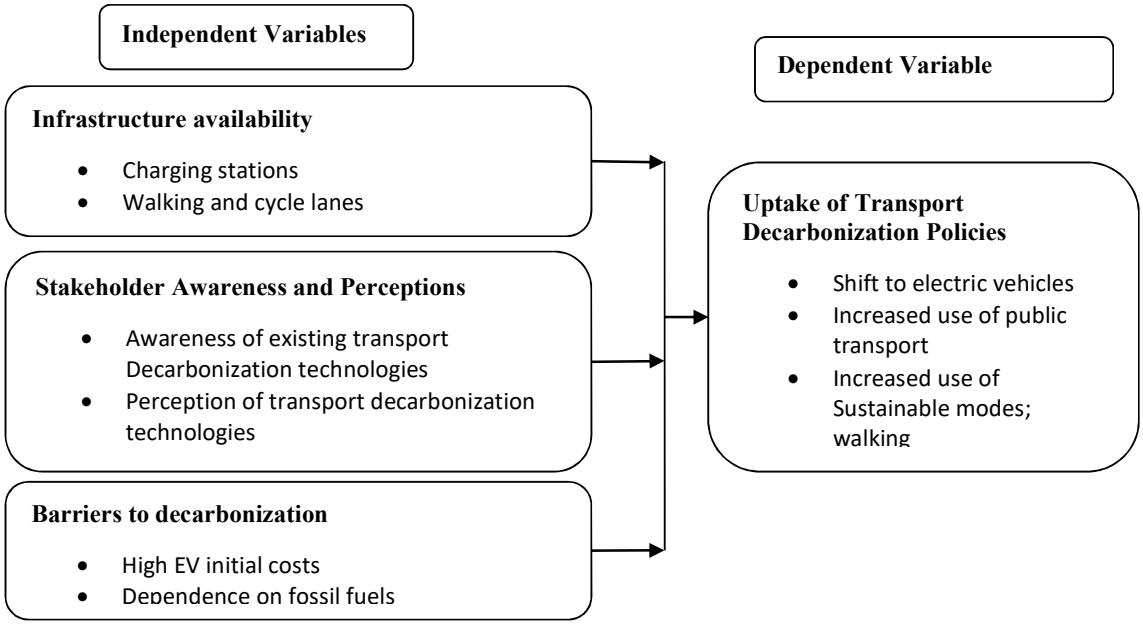
Adamashvili and Thrassou (2024) explored the challenges in the implementation of sustainable decarbonization and its infrastructure. They conducted a systematic literature review to examine barriers to the adoption of EVs. Some of their findings were battery limitations, lack of adequate charging infrastructure, and grid integration problems. The problem of inadequate charging infrastructure makes consumers wary of range and accessibility and thus discourages transition to EVs. Integrating EVs into pre-existing power grids, stresses the power networks leading to increased investments in smart charging solutions and grid expansion. These challenges influence transport decarbonization leading to slow uptake of EVs. One limitation of the study is a methodological limitation of only relying on existing literature, which fails to identify industry perspectives and practical challenges of implementation.

Briand et al. (2023), in their research titled Passenger Transport Decarbonization in Emerging Economies incorporated the long-term modelling and qualitative consultations with stakeholders to analyze and investigate the decarbonization of the transport sector. The research found that high upfront costs of EVs were the primary obstacles for passenger transport decarbonization. The study found a purchase of an EV is an investment of almost USD 10,000 when buying an entry level EV, thus stifling the EV penetration against the internal combustion engine cars. A lack of a clear financing strategy and poor investment in charging infrastructure contribute significantly to this challenge, particularly in the case of public transport providers and low-income private users. A methodological gap was identified in the study since traditional modelling often ignores social and economic feasibility.

Murphy (2024) conducted a secondary empirical synthesis to examine how fossil-fueled social practices hinder climate change mitigation efforts. He compiled and analyzed data from a wide variety of studies so as to document emissions from a range of everyday energy-intensive activities such as driving, flying, cruising, and digital consumption. In contrast with the social practice approach and tandem with ideas from the treadmill of production and social closure, Murphy examined how the increasing demand for these fossil-fueled activities, especially among rich populations, had overtaken gains in advancement of clean energy alternatives, and indeed found that despite the development of clean technologies, the dependence on fossil fuels on the global scale had remained stubbornly high because of the sheer volume of energy-intensive practices becoming increasingly normalized. Despite electric vehicles gaining traction globally, they only represented a small fraction of the global fleet. SUVs and pickup trucks, on the other hand, were eliminating any offsetting benefits from EVs on emissions by continuing to dominate new car sales. Commercial and private aviation kept growing, bringing about a considerable increase in emissions from these sectors. Murphy concluded that mitigation efforts had been impeded not only by structural and economic inertia but probably

also by a lack of public awareness as a consequence of personal practices. An empirical gap was identified. Murphy does not present research to validate the hypothesis that people do not know the dangers and effects of their fossil-fuel behavior.

Conceptual Framework



RESEARCH METHODOLOGY

The study employed a mixed-methods research design, including descriptive survey research and exploratory research. These designs are strategically aligned with the study objective of examining the uptake and barriers to implementation of transport decarbonization policies in Nairobi County. Kothari (2004) considered descriptive design appropriate when the nature of the study was to systematically describe characteristics of a population or phenomenon under study. Hence, the descriptive survey shall describe and quantify the level of awareness, infrastructural adequacy, and perceived barriers among some major key stakeholders within the public transport sector. According to Saunders, Lewis, and Thornhill (2016), exploratory designs are to be used when researchers seek to clarify understanding of a problem, especially where little empirical evidence exists. The deep insight will focus on the complex and less-understood institutional and policy-related barriers.

The target population of the study included key actors in the public transport sector in Nairobi that were selected to provide comprehensive and multi-perspective information into the uptake of transport decarbonization policies. The population was divided into four different clusters based on their roles and relevance to the public transport ecosystem.

Cluster 1 was SACCO leaders. The group comprised of chairs, managers, and other executives from selected public transport SACCOs. They were saddled with a responsibility for

overseeing the operations and enforcing compliance and the implementation of the transport policies at the SACCO level.

Cluster 2 was bus drivers. They were the drivers that were working under the umbrella of the SACCO as well as those of the emerging electric bus companies. They represented the operational level of public transport and were influential in their ability to evaluate challenges and perceptions against adopting the low-carbon transport solutions.

Cluster 3: Fleet Owners and Investors. These were individuals or corporations that were paying for and operating bus fleets for public transportation. Their investment decisions have a significant impact on the transition to cleaner vehicle technology, such as electric buses.

Cluster 4: Industry experts. This cluster included policymakers from Nairobi County Government, consultants and representatives of electric mobility companies. Their inclusion was important to enable us to assess systemic enablers and constraints of transport decarbonization from a strategic and technical point of view.

The study adopted a purposive sampling technique for participant selection from the four stakeholder categories in Nairobi's public transport environment: SACCO leaders, bus drivers, fleet owners/investors, and industry experts. Purposive sampling is appropriate for collecting detailed information from individuals considered to be directly knowledgeable and experienced concerning the issues outlined in the study objectives (Creswell & Creswell, 2018).

The total sample size was 120 respondents. The sample size of 120 respondents was determined based on the Central Limit Theorem, which states that a sample size of 30 and above is sufficient for statistical analysis to attain a normal distribution and hence a parametric test can then be conducted like regression analysis (Anderson, 2010). Moreover, Roscoe (1975) states that 30 to 500 people in a sample is usually acceptable to most research.

The collection of data was done using a questionnaire. The instrument was used to draw both subjective and objective data of a representative and adequately large sample of the target population, which makes the future data statistically accurate enough to make a substantial inference (Abawi, 2014). In addition, the design of the questionnaire implies the presence of anonymity protection mechanisms for the participants.

Quantitative data were cleaned, coded and entered into the Statistical Package of Social Sciences (SPSS) version 26 for analysis. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were generated to summarize the demographic features and views of research subjects with respect to the research variables. To test the relationship between the independent variables (barriers to decarbonization, awareness of the stakeholders, and the adequacy of infrastructure) and the dependent variable policy uptake, the inferential statistical methods were used.

RESULTS AND FINDINGS

The researcher distributed a total of 120 questionnaires among the selected participants in the four stakeholder groups: SACCO leaders, bus drivers, fleet owners / investors and industry experts. Of these, 108 questionnaires were filled in and returned; the response rate was 90.0%, which is considered to be excellent for the study. This is consistent with the recommendations of Gephart and Saylors (2020) that states that a response rate of 50% is sufficient for analysis and reporting; a rate of 60% is good, while a response rate of 70% or higher is excellent. Therefore, the response rate obtained in this study can be classed as excellent.

Data on demographic data indicated that the distribution of the respondents according to their role in the transport sector and it can be noted that there is a relatively even distribution of the four stakeholder groups. SACCO leaders and fleet owners/investors made up 25.9% each of the sample, while bus drivers had their 25.0% and industry experts were 23.2%. This balanced distribution is important in capturing various viewpoints about transport system decarbonization policies in Nairobi.

Data on the Years of experience in the transport sector indicated that most respondents (32.4%) have 6-9 years of experience in the transport sector, followed by the respondents who have 3-6 years (25.9%) and 9-12 years (17.6%). This shows that quite a number of stakeholders working in the public transport sector in Nairobi have moderate to substantial experience.

Data on the types of fleets that are currently being operated by respondents gives important context to analyze barriers to decarbonization and infrastructure needs. The data collected for the study found that the overwhelming majority (approximately 94%) of the respondents drive or manage the diesel-powered buses and matatus. Only a small percentage of the respondents were involved in any way with hybrid or electric vehicles, and these were mainly as part of pilot or demonstration projects rather than full commercial operations (6%).

Barriers to Transport Decarbonization

The first objective of the study was to analyze the main institutional, policy, financial and technical barriers to the uptake of policies for decarbonization of transport in Nairobi. Respondents were asked to rate their extent of agreement with each statement relating to barriers to decarbonizing transport on a scale of 1 to 5, where 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree) and 5 (strongly agree). The results were as in Table 1.

Table 1 Descriptive Statistics on Barriers to Transport Decarbonization

Statements	n	Mean	Std. Dev
Government support for electric mobility is sufficient.	108	2.31	0.892
Access to loans or financing for electric buses is readily available.	108	2.18	0.847
Skilled mechanics for electric vehicles are widely available.	108	2.24	0.876
Transport regulations support the adoption of EVs.	108	2.47	0.921
The high cost of electric vehicles discourages uptake.	108	4.23	0.765
Average scores		**2.69**	**0.860**

Source: Field Data (2025)

The results in Table 1 show important information regarding barriers to transport decarbonization in Nairobi. The statement 'Government support for electric mobility is sufficient' yielded a mean of 2.31 with a standard deviation of 0.892, meaning that the majority of respondents disagree with this statement. This finding implicates significant institutional barriers in terms of lack of adequate government support to electric mobility initiatives. According to Bayode Akomolafe et al. (2024), lack of institutional support from government agencies is one of the main challenges of decarbonization in the transport sector in many African cities which impact policy coherence, resource allocation, and the establishment of enabling regulatory frameworks. The low mean score signals the perceptions of stakeholders that government interventions at present are insufficient for bringing about meaningful transition to low carbon transport.

Similarly, the financing of electric buses was rated with a mean score of 2.18 and standard deviation of 0.847 which was the lowest among all the barrier statements. This shows that there is a lot of disagreement between respondents in terms of accessibility of financial resources to purchase an electric vehicle. Financial barriers are one of the most critical barriers to transport decarbonization, especially in developing economies whose capital markets for green technology are not as well developed (Anam et al., 2025). The initial high capital costs of electric vehicles, combined with limited access to affordable financing mechanisms, are creating significant barriers to entry for transport operators, who are generally operating on thin profit margins (Alanazi, 2023).

The availability of skilled mechanics to work on electric vehicles was scored a mean 2.24 with the standard deviation of 0.876 that denotes the respondents consider technical capacity as a huge obstacle. This finding points to the technical and human resource limitations of the transport sector in Nairobi for the adoption of electric mobility. As Gicha et al. (2024) has noted, switching to electric vehicles requires special technical skills to maintain and repair, which are currently limited in most African cities. The shortage of trained people not only poses operation risks to fleet operators, but also the downtime and maintenance costs of vehicles also worry people, further hindering their adoption.

Regarding regulatory support, the statement "Transport regulations support the adoption of EVs" was rated with a mean score of 2.47 with a standard deviation of 0.921. While this score still suggests disagreement, it is relatively higher than other barrier statements, indicating that there are some regulatory frameworks but these are seen to be lacking. Policy barriers are often related to unclear or inconsistent policies and regulations, lack of enforcement mechanisms, and a lack of incentive structures to promote adoption of electric vehicles (Mesquita et al., 2025). The moderate disagreement points to the fact that although there may be some policy foundations, there is still a lot of things missing in building a comprehensive regulatory environment favorable to transport decarbonization.

The statement on cost barriers "The high cost of electric vehicles discourages uptake" had a high mean score of 4.23 with a SD of 0.765. This strong agreement shows that financial considerations, especially the high upfront costs of electric vehicles, are the most common

driver of the stakeholders as the biggest barrier against decarbonization. This finding is in line with research conducted by Mani and Maina (2024) who found that high acquisition costs was the main deterrent to the adoption of electric vehicles in the public transport sector in Kenya. The high capital expenditure on electric buses as opposed to conventional diesel vehicles, coupled with the unknowns of operational cost and vehicle life span, makes transport operators financially vulnerable.

When asked about other barriers that prevent the adoption of low-carbon transport solutions beyond those that were explicitly mentioned in structured questions, respondents identified a number of contextual and systemic challenges. SACCO leaders often cited issues of policy uncertainty and inconsistency as major deterrents. One respondent explained, "Government policies are constantly changing depending on who is in power." "We are afraid to invest heavily in electric buses and then have support programs cut or regulations change so that they are no longer favorable." Bureaucratic hurdles were also highlighted including another SACCO leader noting, "The process of importing electric vehicles involves too many government agencies with unclear requirements". Customs clearance, standards certification and licensing are complicated and time consuming, raising transaction costs."

Industry experts were able to identify systemic and institutional barriers that need to be addressed with a coordinated response. One expert pointed out, "There is poor coordination between government agencies that take care of transport, energy, environment and urban planning." Each ministry functions in silos and end up with fragmented policies which do not support integrated development of electric mobility. Another pointed to the lack of thorough planning for the entire life cycle "Nobody is really talking about what happens to used batteries." Without proper recycling infrastructure and disposal mechanisms we risk creating an environmental problem while trying to solve another." The issue of incumbent industry resistance was also raised with a respondent saying, "Fuel suppliers, diesel engine manufacturers, and conventional vehicle dealers have vested interests in maintaining the status quo."

Stakeholder Awareness and Perceptions

The second objective was to determine the extent of awareness, attitudes and perceptions of key stakeholders towards currently existing policies and initiatives in transport decarbonization. Respondents were asked about their awareness of government or county policies in promoting low carbon transport, followed by rating statements relating to stakeholder awareness on a scale of 1 to 5 where 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), 5 (strongly agree). The means and standard deviations were devised. The results were as follows presented in Table 2.

Table 2 Policy Awareness among Respondents

Awareness of Low-Carbon Transport Policies	Frequency	Percentage
Yes	47	43.5
No	61	56.5
Total	**108**	**100**

Source: Field Data (2025)

Table 2 shows that only 43.5% of respondents said they were aware of government or county policies that promote low carbon transport whereas 56.5% of the respondents did not know about any government or county policies promoting low carbon transport. This finding highlights a huge awareness gap among key stakeholders in the public transport sector in Nairobi. Among those who indicated that they are aware of the policies, the most frequently mentioned ones were the Nairobi Integrated Urban Development Master Plan and the National Climate Change Action Plan. However, specific provision and implementation mechanisms were not well known in detail. This awareness deficit serves as cause for concern because stakeholder knowledge and understanding are critical preconditions for successful policy implementation. According to Hudson et al. (2019), low awareness levels among transport operators are often due to poor consultation with stakeholders in the formulation of policies and poor dissemination of policy information through the right channels.

Table 3 Descriptive Statistics on Stakeholder Awareness and Perceptions

Statements	n	Mean	Std. Dev
A lack of information affects stakeholder perceptions significantly.	108	4.12	0.783
Attitudes towards decarbonization change with increased education.	108	4.18	0.791
Awareness campaigns improve understanding of policies.	108	4.25	0.812
Stakeholder engagement is critical for successful policy implementation.	108	4.31	0.798
Key stakeholders are interested in sustainable transport solutions.	108	3.87	0.854
Average scores		**4.15**	**0.808**

The findings presented in Table 3 give insights in the stakeholder perceptions on awareness and engagement on decarbonization of transport. The statement "A lack of information affects stakeholder perceptions significantly" was rated with a mean of 4.12 and standard deviation of 0.783 which showed substantial agreement on the negative impact of information deficits on stakeholder understanding and attitude toward decarbonization policies. This finding shows the importance of comprehensive information dissemination strategies in policy implementation. Research by Brenda-Andreea Piuaru et al. (2024) shows that information asymmetry leads to resistance to policy changes, in which the stakeholders are unable to make informed decisions about adoption of new technologies or compliance with regulations if they do not have the necessary information.

The statement "Attitudes towards decarbonization change with increased education" has a mean score of 4.18 and the standard deviation is 0.791, which implies strong recognition that education and capacity building could positively affect the attitudes of stakeholders. This finding is consistent with other research conducted by Mishra and Sahu (2024), which has found that well-tailored education interventions grounded in misconceptions and evidence-based information about the benefits of electric mobility can greatly change the attitude of stakeholders from resistance to acceptance. Educational programs that cover both the technical aspects of electric vehicles as well as economic benefits through the use of lifecycle cost analysis have proven to be especially useful in changing perceptions.

Regarding awareness campaigns, the statement "Awareness campaigns improve understanding of policies" was rated with a mean score of 4.25 and a standard deviation of 0.812, which was the second-highest among awareness-related statements. This means that there is strong stakeholder belief in the effectiveness of awareness campaigns in improving policy understanding. Targeted awareness campaigns to address knowledge gap identified earlier, using suitable communication channels and culturally relevant messaging are the keys to bridging the gap. However, the effectiveness of such campaigns depends on their design, frequency and ability to reach different groups of stakeholders through accessible media.

The statement "Stakeholder engagement is critical for successful policy implementation" was rated with the highest mean score of 4.31 with a standard deviation of 0.798. This is a strong consensus that stakeholders have come to realize that meaningful involvement in policy processes leads to greater success in implementation. Effective stakeholder engagement ensures that policies are informed not only by the ground realities, operational constraints and practical considerations that may otherwise be ignored by policy makers. Osinakachukwu et al. (2024) highlight that inclusive stakeholder engagement processes that offer real opportunities for input and co-creation of solutions result in more positive rates of policy acceptance and compliance.

Last, the statement "Key stakeholders are interested in sustainable transport solutions" got mean score of 3.87 with standard deviation of 0.854. While still showing relative agreement, this relatively low score when compared to other statements of awareness shows some ambivalence or conditional interest in sustainable transport. This finding may reflect the tension between abstract support for sustainability and the more concrete issues of costs, problems in operation and viability of business. Stakeholder interest in sustainable solutions is also often higher when clear business cases can be demonstrated, risks can be mitigated and mechanisms for supporting solutions provided.
Regarding the attitudes and perceptions among stakeholders that have supported or slowed progress in transport decarbonization, respondents gave a range of answers that reflect the complexity of the social relations that affect the uptake of policies. SACCO leaders identified supportive and resistant attitudes in their organizations. One of the respondents noted "Younger members of SACCO are more receptive to electric vehicles as they understand technology and are sensitive about climate change." However, older members are skeptical and resistant, preferring to stick to what they know." Another noted the influence of early adopters saying "A few progressive SACCOs have shown interest in piloting electric buses". If they are successful, others will follow. "Hearing success stories from peers is more convincing than statements from the government."

Concerns about financial viability influenced many of the attitudes with one SACCO leader explaining, "Most operators have a short-term survival mindset because the transport business has thin profit margins." They think more in terms of short-term cash flow than long-term gain, so it is very difficult to convince them to invest in expensive electric vehicles." Cultural perceptions also played a role with one respondent saying, 'There's a perception that electric vehicles are for wealthy people or corporate fleets, not for matatu operators.'. This puts up a

psychological barrier in which the operators don't see electric mobility as relevant to their context."

Bus drivers emphasized mixed attitudes in their occupational community. One driver stated, "There are drivers who are excited about cleaner and quieter vehicles and the electric bus is a step towards professionalization of our industry." Others fear they will lose their jobs to automation or do not have the skills to operate new technology." Peer influence was cited as being important, where another driver said, "If respected senior drivers are on board with electric vehicles and they share their positive experiences others will be more willing to adapt." "But, if influential drivers are against the change, then resistance spreads quickly." Concerns about training and support influenced attitudes with one of the respondents explaining, "Drivers want the assurance that they will receive proper training and that technical support is available when problems arise." Without these guarantees, the anxiety and resistance is high."

Fleet owners and investors referred to risk-averse behavior related to uncertainties in the business. One investor commented, "The transport sector in Kenya is very competitive and unpredictable." Investors are always more comfortable with known technologies than they are with experimental ones. Until electric vehicles show profitability on local levels, most of the investors will be cautious." Another highlighted the importance of government credibility such that, "Past government promises about incentives and support have not always materialized." This history is the source of skepticism about new initiatives. Stakeholders want to see actions and not only policy documents."

Infrastructure Adequacy and Accessibility

The third objective was to assess the adequacy and accessibility of infrastructure to support the shift to low-carbon public transport in Nairobi. Respondents were asked to rate their level of agreement with each of the statements regarding infrastructure availability on a scale of 1 to 5 where 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), 5 (strongly agree). The mean and standard deviations were developed. The results were presented in table 4.

Table 4 Descriptive Statistics on Infrastructure Adequacy

Statements	n	Mean	Std. Dev
There are enough EV charging stations across Nairobi.	108	1.94	0.821
Nairobi has adequate pedestrian and bicycle lanes that support clean mobility.	108	2.15	0.897
Public roads are ready to support electric bus operations.	108	2.68	0.934
Maintenance facilities for electric vehicles are available.	108	2.07	0.856
Average scores		**2.21**	**0.877**

Source: Field Data (2025)

The findings in Table 4 show large infrastructure gaps limiting the shift to low-carbon public transport in Nairobi. The statement "There are enough EV charging stations across Nairobi" got the lowest mean score of 1.94 with a standard deviation of 0.821, which indicates that there is strong disagreement among respondents. This finding creates a critical infrastructure gap that fundamentally limits electric vehicle adoption. According to Corti et al. (2024), one of the most important practical obstacles to the deployment of electric mobility is an insufficient network of charging infrastructure, which causes operators to experience range anxiety and makes

operations highly inflexible. The low numbers of charging stations throughout Nairobi mean that there is significant uncertainty in fleet operators when it comes to ensuring their ability to stay to their timetables, especially for routes spanning large areas in Nairobi.

The help of maintenance facilities for electric vehicle was graded on mean score 2.07 and standard deviation 0.856, also showing strong dis-agreement. This finding highlights the problem of technical infrastructures outside of charging stations. Specialized maintenance and repair facilities are necessary to maintain the operations of electric vehicles, and their lack thereby puts operations at significant risk (Jagani et al., 2024). The dearth of authorization service centers, unavailability of spare parts, and absence of diagnostic equipment particular to electric vehicles add to the difficulties for the ones wanting to adopt them. This deficit in infrastructure not only puts operational expenses at a much higher level due to extended downtime of vehicles, but also poses a concern in terms of long-term asset maintenance and residual value.

On supportive infrastructure for clean mobility, the indicator expressed as "Nairobi has adequate pedestrian and bicycle lanes that support clean mobility" scored a mean of 2.15 with a standard deviation of 0.897. This reflects the perception of stakeholders that the urban infrastructure of Nairobi does not sufficiently facilitate non-motorized transport and wider clean mobility efforts. While this study is focused on the electrification of public transport, the larger context of infrastructure is relevant as the decarbonization of the transport infrastructure requires multimodal integration. The lack of safe pedestrian walkways and dedicated bicycle lanes in combined with the limitation of alternative transport options not only illustrates the wider challenges of infrastructure planning in cities but also an integrated sustainable transport system.

The statement "Public roads are ready to support electric bus operations" received a mean score of 2.68 with a standard deviation of 0.934, the highest of infrastructure statements, although it was still very much in the range of disagreement. This is a relatively higher score and according to it, although road conditions and suitability for use of electric buses raise concerns, the perception is that the conditions are still not as serious as the lack of charging infrastructure and the maintenance facilities. However, the disagreement still reflects the concerns about the quality of roads, especially regarding things like potholes, poor drainage and road surface conditions that may impact the performance and lifespan of electric vehicles. Poor road conditions not only make electric vehicles dependent on more maintenance; they make the efficiency gains of electric vehicles less obvious.

Inferential Statistics

The researcher used regression to determine the relationship between barriers, the stakeholder awareness, infrastructure adequacy and the uptake of transport decarbonization policies in Nairobi City County. The results of Model Summary, the results of the Analysis of Variance (ANOVA) and the Regression coefficients are presented in the following sections.

Model Summary

The results of the Coefficient of correlation R and the coefficient of adjusted determination R^2 are presented in Table 5.

Table 5 Model Summary Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.762	0.581	0.569	0.247

Source: Field Data (2025)

The results as shown in Table 5 provide a model summary that there is a significant relationship in terms of the independent variables (namely barriers to transport decarbonization, stakeholder awareness and perceptions, and infrastructure adequacy) and the dependent variable (namely policy uptake in transport decarbonization). The correlation coefficient (R = 0.762) implies a very strong positive relationship in the predictors to the policy adoption. The R Square value of 0.581 shows that approximately 58.1% variation in transport decarbonization policy uptake is explained by these three factors. This finding is consistent with the studies done by Krishnan et al. (2025) which emphasize that thorough understanding of barriers, stakeholder engagement and infrastructure development are critical determinants of successful policy implementation in the transport sector. The adjusted R square of 0.569 verifies that the model retains big explanatory power even after considering the number of predictors.

ANOVA

An ANOVA was conducted at 95% level of significance. The findings of F Calculated and F Critical are shown in Table 6.

Table 6 ANOVA Results

Model	SS	df	MS	F	Significance
Regression	18.324	3	6.108	47.253	0.000a
Residual	13.241	104	0.127		
Total	**31.565**	**107**			

Source: Field Data (2025)

The significance of the factors influencing the uptake of policies for decarbonization of the transport sector in the city of Nairobi is revealed by the results of the Analysis of Variance Analysis (ANOVA) presented in Table 4.10. The F-value of 47.253 and a significance level of 0.000 show that the overall regression model is statistically significant, and therefore, the combined effects of barriers to decarbonization from transport, stakeholder awareness and perceptions, and infrastructure adequacy have a significant impact on the uptake of the policy. The very significant F-statistic demonstrates the importance of all these factors in determining the success of transport decarbonization activities in Nairobi.

Regression Coefficients

To determine the individual influence of independent variables on the dependent variable, regression analysis was conducted. The findings are illustrated in Table 7.

Table 7 Results for Regression Coefficients

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	β	Std. Error	Beta		

(Constant)	0.412	0.156		2.641	0.009
Barriers to transport decarbonization	-0.387	0.041	-0.314	-9.439	0.000
Stakeholder awareness and perceptions	0.324	0.038	0.347	8.526	0.000
Infrastructure adequacy	0.298	0.043	0.316	6.930	0.000

Source: Field Data (2022)

A multiple regression analysis was conducted to establish the relationship between barriers, stakeholder awareness, infrastructure adequacy and policy uptake for transport de-carbonization in Nairobi. As shown in table 7, the multiple regression equation ($Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon$) becomes:

$Y = 0.412 - 0.387X_1 + 0.324X_2 + 0.298X_3 + \varepsilon$

Where:

Y = Policy uptake for transport decarbonization

X_1 = Barriers to transport decarbonization

X_2 = Stakeholder awareness and perceptions

X_3 = Infrastructure adequacy

The results in table 7 indicated that the value of 0.412 is a constant, which shows that when constant barriers and other stakeholder awareness and infrastructure adequacy were controlled for, there was a baseline level of policy uptake. This suggests that even with these variables controlled, there are other subfactors that influence the uptake of transport decarbonization policies in Nairobi.

Barriers to transport decarbonization: The unstandardized coefficient for barriers is -0.387, p-value 0.000. This shows that for every 1 unit increase in barriers, the policy uptake shows a decrease of 0.387 and therefore there is a high negative relationship with policy. The p-values ($p < 0.05$) confirm that this association is statistically significant, meaning that institutional, policy, financial and technical barriers seriously affect the adoption of transport decarbonization policies.

Stakeholder awareness and perceptions: The coefficient for stakeholder awareness is 0.324 and its p-value is 0.000 which implies a statistically significant positive relationship. This implies that an improvement in stakeholder awareness, attitudes and perceptions is positively correlated with an improvement in policy uptake. The standardized beta value of 0.347 suggests that it is a moderately large relative effect among other factors. This finding accords with research by Prior Filipe et al. (2022) which found that informed stakeholders are beneficial in supporting and participating in transport decarbonization initiatives with greater likelihood. Effective awareness-building is not just a way of getting better information, but also of influencing attitudes, by countering misconceptions and showing the tangible benefits of low-carbon transport options.

Infrastructure adequacy: Unstandardized Coefficient on Infrastructure adequacy was 0.298 with a p-value of 0.000, showing a positive contribution to policy uptake. The standardized beta coefficient of 0.316 indicates infrastructure development is important in facilitating transport decarbonization. Without appropriate infrastructure, effective implementation of decarbonization programs is not possible even if we have good designs and willing

stakeholders. The positive relationship confirms that infrastructures investments are key enablers for transport transition.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the results obtained from the study, several conclusions were made on the barriers, stakeholders' awareness and infrastructure adequacy that affect transport decarbonization policy uptake in Nairobi City County.

The study concluded that a combination of institutional, policy, financial, and technical barriers make the transport decarbonization environment very challenging in Nairobi. The prohibitively high upfront costs of electric vehicles coupled with severely limited access to affordable financing mechanisms are the most critical financial barriers which prevent transport operators from transitioning to low-carbon transport. Institutional barriers manifested through lack of sufficient governmental support, lack of clear regulatory frameworks fail to provide the enabling environment for the adoption of electric mobility. Technical barriers especially the acute shortage of skilled personnel and maintenance facilities is creating operational uncertainties which discourages investment in electric vehicles technology. However, challenges such as disjointed policy implementation, lack of coordination between government agencies and lack of a comprehensive incentive structure limit the effectiveness of existing interventions. The results showed that for transport decarbonization to make significant impact, it should be complemented by appropriate aligned institutional frameworks, clear regulatory guidelines, accessible financing mechanisms and systematic technical capacity building.

The study thus concluded that the awareness gaps seriously hamper the implementation of transport decarbonization policies in Nairobi. With over half of the key stakeholders not being aware of existing decarbonization policies and initiatives, the ground for successful implementation is still not very strong. This awareness deficit is caused by poor stakeholder consultation in the policy-making process and a lack of dissemination of the policy information through the appropriate channels. Nonetheless, voids like educational programs lacking in numbers, lack of demonstration projects and poor communication strategies made the efforts to raise awareness less effective. The conclusions derived from the study were that sustainable policy uptake depends on systematic awareness campaigns, specific educational interventions, and a genuine mobilization of stakeholders that goes beyond minding consultation, to ensure real involvement in the process of policy formulation and implementation. Stakeholders showed real understanding that the targeted education and awareness work positively in attitudes towards decarbonization, showing receptiveness to informed behavior change where this is properly communicated.

In addition, the study concluded that infrastructure inadequacy was critical in limiting transport decarbonization efforts in Nairobi. The lack of electric vehicle charging stations across the city has done little to address range anxiety and uncertainties in operational viability that make the adoption of electric vehicles commercially unviable for most transport operators. The limited dedicated maintenance and repair facilities adds to this by adding risks in operating these

vehicles, vehicle down time and maintenance cost. On the other hand, poor infrastructure planning, lack of investment in supportive infrastructures and absence of an integrated development of multimodal transport space limits the feasibility of electric mobility overall. Strengthening charging networks, developing the infrastructure for maintenance, improving the quality of roads and integrating support systems were thus considered to be indispensable for achieving the shift to low-carbon public transport.

Recommendations

Based on the outcomes of the study on decarbonizing public transport: policy uptake and barriers in Nairobi, Kenya, the following recommendations are made to improve the effectiveness of the policies as well as ensure sustainable transition to low-carbon public transport:

It is necessary that the country establishes comprehensive financial support mechanisms to respond to the huge capital costs that form the major barrier to the adoption of electric vehicles. This includes not only reviewing existing policies to address financing gaps but proper allocation of resources and implementation of incentive structures. Government should create a separate green transport finance facility that provides subsidies, low-interest loans and tax incentives specifically for the public transport operators who are converting to electric transport. Such financial mechanisms should include tax exemption on value added tax on electric vehicles and charging equipment, accelerated depreciation allowances, performance-based incentives to fleet conversion and developing partnerships with financial institutions to develop affordable leasing and hire purchase arrangements.

The County Government of Nairobi should focus on building and extending the electric vehicle charging infrastructure throughout the city. The county should conduct thorough route and demand analysis to find strategic locations where public charging stations can be located for maximum accessibility to public transport operators. Collaboration with the private sector investors, energy companies, and development partners can help in improving the resource mobilization and in faster deployment of infrastructure. The county should support the land provision process, minimize the permit application process and create operational standards for charging stations.

There is a potential to invest more in awareness-building and stakeholder engagement initiatives to address these knowledge gaps identified in this study. Both national and county governments should have comprehensive awareness campaigns targeted at transport operators, investors, drivers, and general public to spread information about what decarbonization policies are in place and what support mechanisms are there as well as benefits associated with electric mobility. These campaigns should use a variety of communication channels such as radio and television, social media, industry associations and community forums, to target different groups of stakeholders.

Capacity building programs need to be designed in collaboration with technical and vocational training institutions so that a skilled workforce can be built, capable of maintaining and running

electric vehicles. Regular stakeholder consultation forums should be institutionalized to ensure the active involvement of transport operators, SACCO leaders and industry experts in policy development, implementation planning and monitoring processes to ensure ownership and commitment towards the decarbonization targets.

Finally, some monitoring and evaluation (and continuous learning) mechanisms should be institutionalized to track progress of transport decarbonization initiatives to inform adaptation management. Transport sector stakeholders such as SACCO leaders, fleet owners and industry associations should come together and initiate peer learning networks through which experiences, challenges and innovations can be shared. These networks should undertake feasibility studies, record the results of pilot projects and disseminate lessons learnt to feed into collective decision-making regarding the adoption of electric vehicles.

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