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Low-Carbon Urban Transport and Inclusive Development: Governance, CO_2 Mitigation, and Social Welfare Outcomes in Abuja, Nigeria

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ABSTRACT
Urban transport systems are increasingly recognised as critical to development through their effects on productivity, environmental sustainability, social equity, and public health (UN-Habitat, 2023). This study examines how governance arrangements and innovation pathways in public transportation shape low-carbon and inclusive development outcomes in the Abuja, Nigeria. Specifically, it asks: (i) how public transport contributes to CO_2 mitigation; (ii) how affordability, accessibility, and safety influence social welfare; and (iii) how governance structures enable or constrain inclusive mobility transitions. A mixed-methods design was adopted, combining a 2025 household commuter survey (N = 358) with ten key informant interviews involving regulators, operators, and policy actors. Findings show that while public transport offers modest congestion and emission-reduction benefits, environmental performance remains weak due to ageing fleets, fuel inefficiency, and fragmented regulation. Low-income households, women, and persons with disabilities face persistent accessibility and affordability barriers. Strong support exists for fleet electrification, fare reform, and establishing a unified metropolitan transport authority. The study demonstrates that sustainable urban mobility in Abuja is primarily a governance and development challenge rather than technical one, informing low-carbon transport policy in rapidly growing African cities (World Bank, 2023).
Keywords: Urban transport governance; low-carbon mobility; social equity; CO_2 mitigation; public transport; Abuja

1. INTRODUCTION

1.1 Background: Urban Transport and Development Transitions

Urban transport systems occupy a central position in contemporary development debates due to their far-reaching impacts on economic productivity, environmental sustainability, social inclusion, and public health (Suleiman et al., 2025; Tanko et al., 2025; Al-Amin et al., 2025). As cities in the Global South expand rapidly, transport infrastructure and services increasingly shape labour market accessibility, energy consumption, land-use patterns, and exposure to environmental risks (IPCC, 2022; UN-Habitat,

2023). The World Bank (2023) estimates that urban transport accounts for over 20% of global energy-related CO_2 emissions, with emissions rising fastest in low- and middle-income countries where urbanisation is occurring most rapidly and governance capacity is often weakest. Consequently, the transition toward low-carbon and inclusive urban mobility has become a defining challenge of sustainable development policy (Yusuf et al., 2025; Magaji et al., 2025).

The climate–development nexus situates urban transport at the intersection of mitigation, adaptation, and equity objectives. On the mitigation side, transport systems directly influence greenhouse gas emissions through vehicle technology, fuel choice, modal share, and congestion levels (IEA, 2023). At the same time, transport determines access to economic opportunities, education, healthcare, and social services, making it a critical determinant of welfare and poverty reduction (UNDP, 2024). Where transport systems are inefficient, expensive, or unsafe, urban growth can exacerbate inequality, lock households into spatial disadvantage, and undermine productivity gains associated with urbanisation (Goulden & Sudmant, 2023).

In Sub-Saharan Africa, these dynamics are particularly pronounced. Cities in the region are growing at annual rates exceeding 4%, yet transport systems remain dominated by informal, road-based services operating under fragmented regulatory regimes (African Development Bank, 2024). While informal public transport often provides flexible and employment-generating services, it is frequently characterised by ageing vehicle fleets, poor environmental performance, safety deficiencies, and limited accessibility for women, older persons, and people with disabilities (Behrens et al., 2022; UN-Habitat, 2023). These structural features constrain the potential of urban transport to support inclusive and climate-resilient development.

Recent scholarship emphasises that sustainable urban mobility transitions are not merely technical processes involving cleaner vehicles or new infrastructure, but deeply institutional and political transformations (Schwedes et al., 2023; Pereira et al., 2024). Governance arrangements defined by regulatory frameworks, institutional coordination, financing mechanisms, and stakeholder participation shape whose mobility needs are prioritised, how costs and benefits are distributed, and whether innovations translate into inclusive outcomes (Banister, 2023). In settings with weak metropolitan governance, fragmented authority, and limited enforcement capacity, the adoption of low-carbon transport technologies alone is unlikely to deliver meaningful development gains.

Nigeria exemplifies these challenges. As Africa's largest economy and most populous country, Nigeria faces mounting urban transport pressures driven by rapid motorisation, inadequate public investment, and reliance on fossil-fuel-intensive road transport (World Bank, 2023). Urban congestion imposes substantial economic costs through lost productivity, increased fuel consumption, and air pollution-related health burdens (African Development Bank, 2024). Despite national commitments under the Paris Agreement and Nigeria's Nationally Determined Contributions (NDCs), the transport sector remains a major and growing source of emissions, with limited progress toward modal shift or fleet decarbonisation (IEA, 2023; Federal Ministry of Environment, 2024).

Within this national context, the Abuja Municipal Area Council (AMAC) offers a strategically important case. As the core of Nigeria's Federal Capital Territory, AMAC combines characteristics of a planned capital city with rapidly expanding peri-urban settlements, high levels of daily commuting, and pronounced socio-spatial inequalities (Oladipo & Agboola, 2022). Public transport provision in AMAC is shaped by a mix of formal bus services and a dominant informal sector, operating within a fragmented institutional environment involving federal agencies, FCT authorities, and private operators. These conditions make Abuja emblematic of governance-intensive urban transport challenges facing fast-growing African capitals.

Against this backdrop, understanding how public transport governance influences low-carbon and inclusive development outcomes in AMAC is essential for informing broader debates on sustainable urban transformation in the Global South.

1.2 Problem Statement: Governance, Climate, and Equity Gaps

Despite widespread recognition of the importance of sustainable urban transport, significant gaps persist between policy aspirations and on-the-ground outcomes in rapidly urbanising African cities. In Abuja, public transport continues to deliver uneven development benefits, reflecting systemic governance, environmental, and equity challenges.

First, from a climate perspective, public transport in AMAC has yet to realise its mitigation potential. While collective transport can reduce per-capita emissions by lowering private vehicle use, Abuja's public transport fleet remains predominantly diesel-based, ageing, and fuel-inefficient (IEA, 2023; African Development Bank, 2024). Weak emissions standards, limited inspection regimes, and fragmented oversight undermine environmental performance. As a result, congestion reduction gains are offset by high emissions intensity and poor air quality, contributing to negative public health outcomes (WHO, 2023).

Second, social equity outcomes remain constrained. Low-income households depend disproportionately on public transport, yet face rising fares, long travel times, and safety risks that limit effective access to employment and services (UN-Habitat, 2023; Pereira et al., 2024). Women and persons with disabilities encounter additional barriers related to harassment, poorly designed vehicles, and inadequate pedestrian infrastructure. These accessibility deficits translate into labour market exclusion, reduced economic participation, and heightened vulnerability, undermining inclusive development objectives (World Bank, 2023).

Third, governance fragmentation represents a critical institutional bottleneck. Transport responsibilities in AMAC are dispersed across multiple agencies with overlapping mandates and weak coordination. Regulatory enforcement is inconsistent, long-term planning capacity is limited, and mechanisms for stakeholder engagement are underdeveloped. Recent development research shows that such institutional fragmentation constrains policy coherence, inhibits investment in low-carbon innovation, and weakens accountability (Schwedes et al., 2023; UNDP, 2024).

Despite growing public discourse around green mobility and fare reform, there is limited empirical evidence linking public transport governance in Abuja to climate mitigation, social welfare, and institutional capacity outcomes simultaneously. Existing studies often focus narrowly on congestion or infrastructure provision, neglecting the broader development implications of governance arrangements. This gap limits the ability of policymakers to design integrated, development-oriented urban transport strategies.

1.3 Research Questions and Objectives

In response to these gaps, this study investigates how governance arrangements and innovation pathways within public transportation shape low-carbon and inclusive development outcomes in the Abuja Municipal Area Council.

The study addresses the following research questions:

1. To what extent does public transportation in AMAC contribute to CO_2 mitigation and environmental sustainability?
2. How do affordability, accessibility, and safety dimensions of public transport influence social welfare outcomes?
3. How do governance structures enable or constrain inclusive, low-carbon urban mobility transitions in AMAC?

Guided by these questions, the study pursues three core objectives. First, it assesses the environmental performance of public transport in AMAC, focusing on emissions, congestion reduction, and fleet characteristics. Second, it evaluates social welfare impacts by examining affordability, accessibility, safety, and their implications for labour market participation and urban health. Third, it analyses governance arrangements regulatory frameworks, institutional coordination, and stakeholder engagement to identify constraints and opportunities for inclusive low-carbon mobility transitions.

1.4 Significance and Contribution to Development Studies

This study makes several important contributions to development studies, urban governance, and climate policy scholarship. Conceptually, it advances the climate–development nexus by explicitly linking urban transport governance with CO_2 mitigation, social equity, and institutional capacity. While existing literature often treats these dimensions separately, this study demonstrates their interdependence in shaping development outcomes in rapidly growing cities (IPCC, 2022; Pereira et al., 2024).

Empirically, the research provides original sub-national evidence from Abuja, an under-studied but strategically significant African capital. By combining commuter-level survey data with stakeholder interviews, the study offers granular insights into how transport systems affect everyday welfare and environmental outcomes. This mixed-methods approach responds to calls for more grounded, policy-relevant evidence in Global South urban research (UN-Habitat, 2023; World Bank, 2023).

From a policy perspective, the findings inform debates on low-carbon urban transitions by highlighting governance reform rather than technological substitution alone as the primary lever for sustainable transport development. The study's emphasis on institutional coordination, fare reform, and inclusive planning mechanisms aligns with emerging development policy frameworks advocating just and equitable urban transitions (African Development Bank, 2024; UNDP, 2024).

Overall, the study contributes to development scholarship by reframing sustainable urban mobility in Abuja as a governance-centred development challenge, offering transferable lessons for other fast-growing African cities navigating climate change, inequality, and infrastructure constraints.

2. Conceptual and Literature Review

2.1 Urban Transport and Development: Productivity, Welfare, and Inequality

Urban transport systems are foundational to development processes because they mediate the spatial relationship between people, opportunities, and services. Development theory has long recognised that economic growth and welfare gains associated with urbanisation depend not only on population agglomeration but on the connectivity that allows labour, goods, and knowledge to flow efficiently (UN-Habitat, 2023; World Bank, 2023). Transport therefore functions as a core social overhead capital, shaping productivity, labour market access, and the distribution of welfare within cities.

Recent development scholarship emphasises that transport systems influence productivity through multiple pathways. Efficient public transport lowers travel times and costs, expands effective labour markets, and increases firm-level productivity by improving worker reliability and reducing congestion externalities (Gouldson et al., 2023; Venables, 2024). Conversely, unreliable or exclusionary transport systems erode productivity by increasing absenteeism, constraining job matching, and reinforcing spatial mismatch between low-income residents and employment centres. Evidence from African cities shows that transport costs can consume 20–40% of household income among the urban poor, crowding out spending on food, education, and health (African Development Bank, 2024).

Urban transport also operates as a powerful determinant of welfare and inequality. Development outcomes are shaped not merely by the presence of infrastructure, but by its accessibility, affordability, safety, and reliability (UNDP, 2024). Where public transport is inadequate or inequitable, urban growth may intensify socio-spatial inequality, locking poorer households into peripheral locations with limited access to services and economic opportunities. This dynamic is increasingly recognised as a structural feature of urban poverty traps in the Global South (Goulden & Sudmant, 2023).

Recent empirical studies highlight that inequality in urban transport access has cumulative development effects. Peripheral residents experience longer commuting times, reduced labour market participation particularly among women and greater exposure to pollution and traffic-related injury risks (Pereira et al., 2024). These burdens translate into lower lifetime earnings, poorer health outcomes, and constrained intergenerational mobility, reinforcing patterns of exclusion despite overall urban economic growth.

In Sub-Saharan Africa, the developmental role of transport is further mediated by informality and governance weakness. Informal public transport systems often fill critical mobility gaps, but operate under precarious conditions marked by volatile fares, ageing vehicles, and limited regulatory oversight

(Behrens et al., 2022). While these systems provide flexible employment and services, they frequently reproduce inequality through unsafe conditions, gender exclusion, and environmental externalities. As such, urban transport becomes not only a technical or infrastructural issue, but a development governance challenge.

From a development studies perspective, the key insight is that transport does not automatically generate inclusive growth. Its impacts depend on how systems are governed, financed, and integrated into broader urban development strategies. Abuja's experience reflects this tension: rapid urban expansion has increased mobility demand, yet governance arrangements have struggled to align transport provision with productivity, welfare, and equity objectives. Understanding this disjuncture requires embedding transport analysis within wider debates on development transitions, state capacity, and distributive outcomes.

2.2 Low-Carbon Urban Transitions: CO_2 Mitigation and Green Growth

Low-carbon urban transitions have emerged as a central pillar of sustainable development policy, particularly in the context of climate change mitigation and green growth strategies. Urban transport is a critical sector within this agenda, accounting for a significant share of global greenhouse gas emissions and local air pollution while also shaping energy demand trajectories (IPCC, 2022; IEA, 2023; Magaji et al., 2024; Imam-Binuyo et al., 2026).

From a development perspective, low-carbon transport transitions raise fundamental questions about growth, equity, and institutional capacity. Green growth frameworks argue that decarbonisation can be aligned with economic development through investment in cleaner technologies, infrastructure, and innovation (OECD, 2023). In urban transport, this includes fleet electrification, modal shift to public and non-motorised transport, and integrated land-use planning. However, recent scholarship cautions that green transitions are not inherently inclusive and may exacerbate inequality if governance and distributional concerns are ignored (Newell et al., 2023; UNDP, 2024).

In African cities, the mitigation potential of public transport is substantial but under-realised. Public and shared transport can reduce per-capita emissions by lowering reliance on private vehicles and improving spatial efficiency (IPCC, 2022). Yet empirical evidence shows that emissions intensity often remains high due to inefficient fleets, congestion, and weak regulatory standards (African Development Bank, 2024). Diesel-dominated vehicle stocks, limited fuel quality control, and poor maintenance regimes undermine environmental gains, particularly in cities like Abuja where motorisation is accelerating.

Recent development literature highlights the political economy of low-carbon transitions as a core explanatory factor. Transitions require coordinated investment, regulation, and institutional reform, which are frequently constrained in low- and middle-income countries by fragmented authority, fiscal limitations, and competing development priorities (Schwedes et al., 2023). As a result, low-carbon ambitions often remain aspirational rather than transformative.

Moreover, low-carbon transitions interact with development outcomes through employment and welfare channels. Investments in public transport and clean mobility can generate jobs, particularly in operations, maintenance, and associated services (ILO, 2023). However, transition pathways may also displace informal workers or raise costs through fare increases and technology adoption if not carefully managed. This underscores the importance of linking low-carbon strategies with social protection and inclusive policy design (Just Transitions, 2024).

In the Abuja context, the low-carbon challenge is not a lack of technical options but weak institutional pathways for implementation. Despite strong public support for cleaner fleets and congestion reduction, governance constraints limit investment mobilisation and policy coherence. Development theory thus points to the need for institutional frameworks capable of aligning climate mitigation with social welfare and economic productivity.

Critically, recent scholarship reframes low-carbon urban transport not as a linear transition to cleaner technology but as a contested development process shaped by power, distribution, and governance (Newell et al., 2023). This framing is central to understanding why mitigation outcomes remain limited despite growing climate awareness and policy commitments in countries such as Nigeria.

2.3 Governance and Institutions: State Capacity and Coordination Failures

Governance and institutional capacity occupy a central place in development theory, particularly in explaining variation in policy implementation and development outcomes across contexts. In the urban transport sector, governance encompasses regulatory frameworks, institutional coordination, financing arrangements, and stakeholder participation all of which shape system performance and distributional outcomes (UNDP, 2024; Hafizu et al., 2025).

Recent development studies literature emphasises that fragmentation and weak coordination are among the most persistent institutional constraints in rapidly urbanising regions (Pritchett et al., 2023). Urban transport frequently falls under multiple agencies with overlapping mandates, creating gaps in accountability and enforcement. Such coordination failures undermine long-term planning, discourage investment, and weaken service quality, particularly in metropolitan regions without unified transport authorities.

In the Global South, governance challenges are compounded by informality. Informal transport operators often function outside formal regulatory frameworks, limiting the state's ability to enforce safety, environmental, and labour standards (Behrens et al., 2022). While informality provides flexibility and employment, it also constrains institutional learning and system upgrading. Development scholars increasingly argue that effective governance requires not the eradication of informality but its strategic integration into regulatory and planning frameworks (UN-Habitat, 2023).

State capacity further conditions the ability to pursue low-carbon and inclusive transport policies. Weak fiscal capacity and limited access to long-term finance restrict public investment in infrastructure and fleet renewal (World Bank, 2023). At the same time, regulatory capacity deficits undermine emissions control, fare regulation, and service standards. These challenges are evident in Abuja, where overlapping federal and FCT-level institutions generate uncertainty and inhibit comprehensive mobility planning.

Recent studies stress that governance reform not technology alone is the decisive variable in successful urban transport transitions (Schwedes et al., 2023; Pereira et al., 2024). Cities that have achieved inclusive and low-carbon outcomes, such as Bogotá or Kigali, demonstrate strong metropolitan institutions, clear regulatory authority, and sustained political commitment. These cases underscore the development-theoretic insight that institutions matter for translating policy intent into outcomes.

From a development perspective, governance failures in transport reflect broader state capacity challenges rather than sector-specific deficiencies. Addressing them requires institutional innovation, coordination mechanisms, and participatory governance arrangements that align transport, land-use, and climate policy objectives.

2.4 Equity and Social Inclusion: Gender, Disability, and Affordability

Equity and social inclusion are increasingly recognised as central to sustainable development, and urban transport plays a decisive role in mediating inclusion (UN Women, 2023; World Bank, 2023). Transport systems shape who can access employment, education, healthcare, and social networks, making mobility a key dimension of social citizenship.

Gendered transport inequalities are particularly well-documented. Women tend to have more complex travel patterns, combining paid work with care responsibilities, and are disproportionately affected by unsafe, unreliable, or unaffordable transport systems (UN Women, 2023). In African cities, harassment, overcrowding, and poor pedestrian infrastructure constrain women's mobility, with measurable impacts on labour force participation and income (Pereira et al., 2024).

Persons with disabilities face even more acute exclusion due to inaccessible vehicles, inadequate stations, and poor urban design. Development research shows that transport exclusion of persons with disabilities compounds labour market marginalisation and increases poverty risks (WHO, 2023). Despite international commitments, accessibility remains inadequately addressed in most African urban transport systems.

Affordability constitutes another critical equity dimension. Rising fares disproportionately burden low-income households, who already allocate a high share of income to transport (African Development Bank, 2024). Fare increases can trigger modal shift to walking or unsafe alternatives, reducing access to jobs

and services. From a development standpoint, affordability failures represent a distributional policy issue rather than an unavoidable market outcome.

Recent scholarship argues that equity concerns should be treated as core performance metrics, not secondary considerations, in urban transport policy (UNDP, 2024). Inclusive transport systems enhance economic participation, reduce care burdens, and improve public health outcomes, generating broad development gains.

2.5 Conceptual Framework: Governance and Development Outcomes

This study adopts a governance-centred conceptual framework linking public transport systems to development outcomes. Governance arrangements comprising institutional coordination, regulatory capacity, financing mechanisms, and stakeholder participation are treated as the primary independent drivers shaping transport performance.

Through these governance channels, public transport influences three interrelated development outcomes: (i) environmental sustainability and CO_2 mitigation; (ii) economic productivity and welfare; and (iii) equity and social inclusion. Governance quality conditions whether innovation pathways such as fleet upgrading or fare reform translate into inclusive and low-carbon outcomes or exacerbate inequality and inefficiency.

The framework therefore conceptualises sustainable urban transport not as a technical system but as an institutional and developmental process. This perspective aligns with contemporary development theory, which emphasises the centrality of state capacity, coordination, and distributive politics in shaping development trajectories.

3. Materials and Methods

3.1 Study Area: Development Significance of the Abuja Municipal Area Council

The Abuja Municipal Area Council (AMAC) constitutes the political, administrative, and economic core of Nigeria's Federal Capital Territory (FCT). As the locus of federal institutions, major commercial activities, and rapidly expanding peri-urban settlements, AMAC has emerged as one of the fastest-growing metropolitan regions in West Africa, characterised by significant demographic, spatial, and socio-economic transformations (World Bank, 2023; UN-Habitat, 2023). Its population growth estimated at over 5% annually has intensified mobility needs, infrastructural pressures, and spatial inequality, making mobility governance a critical development issue (National Bureau of Statistics, 2024).

AMAC's urban structure reflects a complex mix of planned districts and organically evolving settlements. While central districts benefit from better infrastructure, outer communities depend heavily on informal and semi-formal transport systems dominated by minibuses, shared taxis, and tricycles. This spatial heterogeneity produces uneven access to employment, education, and health services, reinforcing socio-economic disparities (UNDP, 2024; Adebayo & Agunloye, 2023).

From a climate-development perspective, AMAC is emblematic of urbanisation challenges across Sub-Saharan Africa. Rising motorisation, congestion, and inefficient vehicle fleets contribute to growing CO_2 emissions, poor air quality, and increasing public health burdens (WHO, 2023). Yet, as the administrative seat of national policy and an emerging transportation hub, AMAC holds substantial potential to pioneer low-carbon mobility transitions aligned with Nigeria's Nationally Determined Contributions and sustainable development frameworks (Federal Ministry of Environment, 2024).

These combined features rapid growth, governance complexity, socio-spatial inequality, and climate vulnerability make AMAC an analytically significant case for examining how transport governance shapes inclusive and low-carbon development outcomes. The study area therefore provides a strategic empirical entry point into broader development debates on urban mobility governance in the Global South.

3.2 Research Design: Mixed-Methods Justification

This study employs a convergent mixed-methods research design, integrating quantitative household survey data with qualitative key informant interviews. Mixed-methods approaches have gained prominence in development studies because they allow researchers to capture structural patterns while

also uncovering institutional processes, power relations, and lived experiences that shape development outcomes (Creswell & Plano Clark, 2023; Bamberger, 2022).

The choice of a mixed-methods design is informed by three considerations. First, sustainable urban mobility is a multidimensional development concern encompassing environmental, socio-economic, and governance dimensions. Quantitative data alone cannot fully explain institutional coordination failures, gendered access constraints, or policy gaps that emerge from governance processes issues better illuminated through qualitative inquiry (Schwedes et al., 2023; Pereira et al., 2024).

Second, development studies increasingly advocate methodological pluralism to address complexity and triangulate evidence across scales (UNDP, 2024). In the context of AMAC, where informal systems coexist with formal institutions, combining methods strengthens validity by integrating measurable mobility outcomes with stakeholder perceptions and institutional insights.

Third, mixed-methods are particularly suited for contexts characterised by data scarcity and fragmented administrative records, which are typical features of rapidly urbanising African cities (World Bank, 2023). Primary data generation therefore becomes essential for capturing the realities of public transport users, marginalised groups, and regulatory actors.

The study integrates quantitative and qualitative strands during analysis to ensure complementarity rather than simple parallel reporting. Quantitative results on affordability, accessibility, emissions-relevant variables, and welfare impacts are interpreted in light of qualitative findings on governance gaps, coordination failures, and institutional norms. This design aligns with JDS standards that emphasise linking micro-level evidence to macro-level institutional explanations in development research.

3.3 Data Collection: Household Survey and Key Informant Interviews

Household Commuter Survey

Primary quantitative data were collected through a structured household commuter survey implemented across the Abuja Municipal Area Council in 2025. The survey instrument was designed following established transport and development surveys, including UN-Habitat's Urban Mobility Assessment Framework (UN-Habitat, 2023) and the World Bank's Accessibility and Mobility Baseline Toolkit (World Bank, 2023). The questionnaire comprised five thematic modules: socio-demographic characteristics; travel behaviour and modal choice; affordability and expenditure; accessibility and travel time; and transport safety and environmental perceptions.

The survey captured key development-relevant indicators such as time poverty, labour market access, gendered mobility patterns, and household vulnerability. Trained enumerators administered questionnaires using computer-assisted personal interviewing (CAPI) tablets to reduce errors and ensure data quality. Data collection spanned four weeks and covered weekday and weekend travel to reflect variability in travel behaviour.

Key Informant Interviews

To complement the survey data, ten semi-structured key informant interviews (KIIs) were conducted with actors central to transport governance and operations in AMAC. Participants included officials from the FCT Transport Secretariat, Vehicle Inspection Office, Federal Road Safety Corps, union leaders, major operator associations, civil society representatives, and urban mobility experts.

Interview guides were structured around four domains: governance arrangements and institutional roles; regulatory enforcement and coordination; innovation pathways and fleet transitions; and equity and inclusion considerations. Open-ended questions encouraged elaboration on institutional constraints, political economy dynamics, and systemic challenges.

Interviews were conducted in English, audio-recorded with consent, and professionally transcribed. Interview duration ranged from 45 to 90 minutes.

Data Integration Logic

The convergent design enabled simultaneous data collection for both components. Survey data provided statistical insights into mobility patterns, environmental performance, affordability pressures, and welfare outcomes, while qualitative interviews illuminated governance obstacles, institutional fragmentation, and policy feasibility.

This integration ensures a multi-scalar understanding of sustainable mobility in Abuja, consistent with development studies' emphasis on linking structural patterns with institutional behaviour (Pritchett et al., 2023; UNDP, 2024).

3.4 Sampling and Sample Size: Representation Across Social Groups

Household Survey Sampling

A multistage sampling strategy was adopted to ensure representation across AMAC's diverse socio-spatial zones. First, enumeration areas were stratified into central, intermediate, and peri-urban strata reflecting development levels and mobility patterns. Second, random selection was applied within each stratum to obtain balanced spatial distribution. Third, systematic household sampling was conducted within selected clusters.

A total sample of 358 households was determined using Cochran's formula, adjusted for design effects and population heterogeneity (Israel, 2022). This sample size aligns with similar urban mobility studies in comparable African cities (Behrens et al., 2022; Adebayo & Agunloye, 2023).

Social Group Representation

Given the study's development focus, deliberate efforts were made to capture the experiences of socially differentiated groups. Sampling quotas were applied to ensure inclusion of:

- Women and female-headed households (minimum 40% of respondents)
- Low-income households (based on national consumption quintiles)
- Persons with disabilities (self-reported functional limitations)
- Residents of peripheral settlements, where mobility deficits are typically acute

These groups were prioritised because mobility experiences are strongly stratified by gender, income, and geography (UN Women, 2023; Pereira et al., 2024).

Key Informant Sampling

Key informants were purposively selected for their institutional knowledge, regulatory roles, or sectoral expertise. Snowballing was used to identify additional informants with insider perspectives on governance arrangements.

This sampling strategy enhances the credibility and transferability of qualitative findings by ensuring diversity across institutional positions and governance levels.

3.5 Data Analysis: Quantitative and Qualitative Techniques

Quantitative Analysis

Survey data were analysed using STATA 18. Descriptive statistics were generated to summarise socio-demographic patterns, modal shares, travel times, affordability indicators, and safety perceptions. Inferential techniques including logistic regression, ordinary least squares (OLS), and cross-tabulations were employed to examine relationships between transport variables and development outcomes such as labour market access, time poverty, and environmental perceptions.

Particular attention was paid to variables relevant to low-carbon transitions, such as fuel type, vehicle efficiency, trip frequency, and congestion exposure. These indicators were aggregated to infer emissions-relevant trends, reflecting methodologies used in recent low-carbon transport studies (IEA, 2023; African Development Bank, 2024).

Qualitative Analysis

Qualitative data were analysed using NVivo 14 following a thematic coding approach. Transcripts were coded inductively and deductively across themes including institutional coordination, enforcement capacity, affordability governance, gender inclusion, and fleet innovation pathways. Coding reliability was enhanced through peer review of selected transcripts.

Thematic analysis enabled identification of governance bottlenecks, coordination failures, political constraints, and implementation gaps issues often obscured in quantitative datasets but central to development governance research (Pritchett et al., 2023; Schwedes et al., 2023).

Integration

Findings were triangulated by comparing quantitative patterns with qualitative insights. Divergences were analysed to understand structural versus perceived constraints, strengthening the explanatory depth of the study.

3.6 Ethical Considerations

The study adhered to international research ethics standards as outlined by the Economic and Social Research Council (ESRC) and the American Political Science Association (APSA). Ethical clearance was obtained from the Abuja-based institutional review committee prior to data collection.

Respondents were informed of the study's purpose, its voluntary nature, expected duration, and their right to withdraw without penalty. Verbal and written informed consent was obtained from all participants, including key informants. Special safeguards were implemented for vulnerable groups such as women and persons with disabilities, ensuring respectful engagement and risk minimisation (UN Women, 2023).

Confidentiality was maintained through anonymisation of data, secure storage of digital files, and restricted access to research team members. No identifying information is reported. Data collection methods complied with GDPR-aligned data protection standards.

The ethical protocol ensured that the study upheld rights, dignity, and safety of participants, consistent with development research norms (UNDP, 2024).

4.1 Environmental Outcomes: CO_2 Emissions and Fleet Efficiency

The environmental performance of public transportation in the Abuja Municipal Area Council (AMAC) reflects a mixed development outcome, characterised by modest mitigation potential constrained by structural and governance limitations. Survey and interview findings indicate that public transport contributes to reduced per-capita emissions relative to private vehicle use, yet this benefit is significantly offset by fleet inefficiency, rising congestion, and limited regulatory enforcement.

Household survey data show that approximately 62% of regular commuters rely on some form of shared public transport for daily travel. This modal reliance suggests a non-trivial contribution to congestion reduction and emissions avoidance when compared to equivalent private vehicle trips, consistent with global evidence on collective transport efficiency (IPCC, 2022; IEA, 2023). However, respondents overwhelmingly reported long travel times and stop-and-go congestion, particularly during peak hours, which increase fuel consumption and emissions intensity.

Fleet characteristics constitute a major constraint on environmental performance. More than 70% of vehicles used in public transport services were reported to be over 10 years old, with diesel engines dominating operations. Key informant interviews confirmed weak vehicle emissions testing regimes and limited enforcement of existing standards. These findings align with recent African Development Bank (2024) assessments showing that ageing diesel fleets remain a principal driver of transport-related emissions and urban air pollution in African cities.

From a development perspective, the environmental deficit has tangible welfare costs. Respondents in high-traffic corridors reported frequent exposure to exhaust fumes and poor air quality, conditions linked to respiratory and cardiovascular risks (WHO, 2023). The persistence of these externalities undermines the health co-benefits typically associated with public transport investment and weakens the contribution of transport to low-carbon development pathways.

Nonetheless, results also reveal strong societal readiness for transition. Over 68% of surveyed commuters expressed support for cleaner vehicle technologies, including compressed natural gas and electric buses, while key informants identified fleet renewal as politically popular but institutionally constrained. The primary barrier to environmental upgrading was not public resistance or technological unavailability, but fragmented institutional mandates and financing constraints findings consistent with development literature that emphasises governance capacity as a critical determinant of climate outcomes (UNDP, 2024; Newell et al., 2023).

Overall, the results indicate that public transport in AMAC currently delivers limited environmental gains relative to its potential. While collective mobility reduces per-capita carbon intensity, weak governance

and fleet inefficiency substantially dilute mitigation impacts, reinforcing the interpretation of sustainable mobility as a development and institutional challenge rather than a technical one alone.

4.2 Economic Outcomes: Affordability and Access to Productivity

Economic outcomes associated with public transport in AMAC are marked by pronounced distributional effects, particularly with respect to affordability, labour market access, and productivity-related mobility. The survey results indicate that public transport is economically indispensable for the majority of households, yet its cost structure and reliability impose significant burdens on low-income commuters.

Affordability analysis reveals that transport expenditures constitute a substantial share of household income, especially among poorer households. Approximately 41% of respondents in the lowest income quintile reported spending more than 25% of their monthly income on transportation. This level exceeds internationally recognised affordability thresholds and aligns with evidence that high transport costs exacerbate urban poverty traps in developing cities (World Bank, 2023; African Development Bank, 2024).

Fare volatility emerged as a central concern. Respondents reported frequent, informal fare increases in response to fuel price fluctuations and congestion. In the absence of effective fare regulation, these adjustments disproportionately affect informal workers and low-wage earners, whose incomes are unstable. Development economics literature links such cost volatility to reduced economic resilience and heightened vulnerability, particularly in contexts with limited social protection coverage (UNDP, 2024).

Access to employment and productivity gains was similarly uneven. While residents of central districts reported relatively predictable commute times and better access to formal employment, respondents in peri-urban settlements experienced significantly longer travel times—often exceeding 90 minutes per trip. Regression analysis indicated a strong negative association between travel time and labour market participation among women and young adults, echoing findings from recent studies on spatial mismatch and economic exclusion (Pereira et al., 2024; Gouldson et al., 2023).

From a productivity standpoint, unreliable public transport undermines both individual and aggregate economic performance. Employers interviewed informally cited worker lateness and absenteeism as recurring issues linked to transport unreliability. These patterns are consistent with recent urban development research demonstrating that inefficient mobility systems erode agglomeration benefits and dampen productivity growth (Venables, 2024).

Despite these challenges, survey results suggest that public transport remains a critical enabler of economic participation. Over 70% of respondents indicated that without public transport, they would be unable to access their current employment or livelihood activities. This finding underscores the dual role of public transport as both a lifeline for economic inclusion and a source of economic stress.

Notably, there was broad support for economic reforms. A majority of respondents favoured fare stabilisation mechanisms and targeted subsidies for low-income commuters. Key informants highlighted growing policy interest in integrated ticketing and fare reform, but stressed that implementation is impeded by fragmented revenue collection systems and limited fiscal coordination.

In sum, the economic results demonstrate that public transport in AMAC plays a vital but constrained role in supporting productivity and access to livelihoods. Its development impact is substantially shaped by affordability failures and spatial inequalities, reinforcing the argument that mobility governance is inseparable from questions of inclusive economic development.

4.3 Social Welfare Outcomes: Safety, Inclusion, and Health

Social welfare outcomes represent one of the starkest dimensions of inequality in AMAC's public transport system. Survey and interview data reveal persistent deficits in safety, accessibility, and inclusiveness, with disproportionate impacts on women, older persons, and persons with disabilities.

Safety concerns were widely reported. Nearly 54% of respondents indicated that they felt unsafe using public transport at least occasionally, citing reckless driving, overcrowding, and poor vehicle conditions as primary factors. Women respondents reported significantly higher levels of perceived insecurity, particularly during evening travel, reflecting gendered patterns of risk common in urban mobility systems (UN Women, 2023; ITF, 2022).

Road traffic injury risk remains a major public health concern. Key informants from regulatory agencies acknowledged weak enforcement of safety standards and insufficient driver training. These institutional gaps align with WHO (2023) evidence that road traffic injuries disproportionately affect low- and middle-income countries and impose substantial health and economic costs.

Inclusion outcomes were similarly uneven. Persons with disabilities reported severe accessibility barriers, including high vehicle steps, lack of designated seating, and absence of supporting pedestrian infrastructure. These barriers effectively exclude persons with mobility impairments from independent travel, reinforcing labour market marginalisation and social isolation—dynamics extensively documented in recent development and disability studies (WHO, 2023; UNDP, 2024).

Health impacts extended beyond injury risk. Respondents frequently reported fatigue, stress, and respiratory discomfort associated with long commutes and pollution exposure. Such conditions contribute indirectly to reduced wellbeing and productivity, reinforcing public health burdens already strained by rapid urbanisation (IPCC, 2022).

Despite these challenges, survey data indicated strong normative support for inclusive reforms. Over 72% of respondents agreed that public transport should prioritise safety and accessibility even if this required public subsidies. This reflects growing public recognition that social welfare outcomes are integral to sustainable urban development.

Overall, results indicate that public transport in AMAC currently underperforms as a tool of social inclusion. While it enables basic mobility, unsafe and inaccessible conditions undermine its developmental role, especially for vulnerable groups. These findings reinforce development studies arguments that transport systems must be evaluated not only by efficiency metrics but by their capacity to promote social wellbeing and inclusion.

4.4 Governance Perceptions: Institutions and Policy Support (≈500 words)

Governance perceptions among users and stakeholders offer critical insight into the institutional context shaping development outcomes. Survey responses revealed widespread dissatisfaction with transport governance, with only 18% of respondents expressing confidence in existing regulatory arrangements.

Fragmented institutional responsibility emerged as a dominant theme. Key informants described overlapping mandates between federal, FCT, and local agencies, leading to unclear accountability for planning, regulation, and investment. This fragmentation was consistently cited as a barrier to coordinated fleet upgrading, fare reform, and safety enforcement, corroborating recent development governance literature on coordination failures (Pritchett et al., 2023; Schwedes et al., 2023).

Despite low confidence in current arrangements, there was strong support for institutional reform. Over two-thirds of respondents supported the creation of a unified metropolitan transport authority, viewing institutional consolidation as essential for improving service quality and equity. Interviewees similarly emphasised the need for a single coordinating body with planning, regulatory, and financing authority.

Policy legitimacy for reform appears relatively high. Respondents expressed willingness to accept regulatory changes and public investment if these improved reliability, safety, and affordability. This finding challenges assumptions that resistance from users or operators constitutes the primary barrier to reform. Instead, results point to institutional inertia and fiscal constraints as the central obstacles.

Importantly, governance perceptions varied spatially and socially. Residents of peri-urban areas reported the lowest levels of trust in institutions, reflecting long-standing service deficits. Women and low-income respondents were also more critical of governance performance, indicating that institutional failures reinforce existing inequalities.

Taken together, governance perception results underscore the central argument of this study: sustainable urban transport outcomes in Abuja are shaped more by institutional capacity and coordination than by technical feasibility. Reforming governance structures is therefore essential for aligning transport systems with low-carbon and inclusive development objectives.

5. Discussion

5.1 Interpretation of Findings: Development Implications

The findings demonstrate that public transport in the Abuja Municipal Area Council (AMAC) functions as a critical development intermediary, shaping environmental sustainability, economic participation, and social welfare outcomes. However, its developmental role remains deeply constrained by governance failures and institutional fragmentation rather than by a lack of technical options or public demand. This reinforces a central proposition in contemporary development studies: infrastructure systems do not produce inclusive growth automatically; their outcomes are mediated by political, institutional, and distributive arrangements (Pritchett et al., 2023; UNDP, 2024).

Environmentally, the results show that public transport delivers partial CO_2 mitigation benefits through reduced reliance on private vehicles, yet these gains are substantially eroded by ageing diesel fleets, congestion, and weak regulatory enforcement. This confirms recent arguments that mitigation outcomes in the Global South are better explained by governance quality than by modal share alone (IPCC, 2022; African Development Bank, 2024). From a development perspective, the persistence of high emissions intensity also creates negative health externalities that disproportionately affect lower-income communities, undermining human capital formation and productivity.

Economically, the findings highlight a dual dynamic. Public transport enables access to employment and livelihoods for the majority of low- and middle-income households, yet rising fares, long travel times, and unreliability impose significant economic penalties. High transport cost burdens exceeding international affordability thresholds for many households function as a regressive "mobility tax," reducing disposable income and reinforcing urban poverty traps (World Bank, 2023). The strong association between long commute times and reduced labour market participation, particularly for women, underscores the role of transport in shaping gendered economic outcomes, consistent with recent urban development research (Pereira et al., 2024; UN Women, 2023).

Social welfare outcomes reveal the most acute development deficits. Widespread safety concerns, poor accessibility for persons with disabilities, and high exposure to pollution signal that mobility systems in AMAC are failing as instruments of social protection and wellbeing. These findings support the argument that transport exclusion constitutes a form of capability deprivation, limiting individuals' ability to convert urban opportunities into improved life outcomes (Sen, 1999; UNDP, 2024). From a development standpoint, the consequences extend beyond mobility itself to health, education, and long-term productivity.

Importantly, governance perceptions strongly reinforce these interpretations. Public dissatisfaction is directed not at the concept of public transport or low-carbon reform, but at institutional incoherence and ineffective regulation. This suggests that the primary constraint lies in state capacity and coordination rather than social acceptance. The results, therefore, align with development theories emphasising institutions as the key determinants of whether infrastructure investments translate into inclusive outcomes (Acemoglu & Robinson, 2019; Pritchett et al., 2023).

Overall, the findings position sustainable urban mobility in Abuja as a governance-centred development challenge, in which environmental, economic, and social outcomes are tightly interlinked and jointly conditioned by institutional capacity.

5.2 Comparison with Global South Cases: Africa and Asia

Placing Abuja's experience in comparative perspective reveals both shared structural constraints and distinctive governance gaps. Across the Global South, rapidly urbanising cities face similar tensions between mobility demand, environmental pressures, and inclusion goals, yet outcomes vary significantly depending on institutional arrangements (UN-Habitat, 2023).

African cities such as Nairobi, Accra, and Dar es Salaam display patterns closely resembling Abuja's. Informal and semi-formal transport systems dominate, providing essential services but operating under weak regulation and with limited environmental upgrading (Behrens et al., 2022; African Development Bank, 2024). In Nairobi, for example, the prevalence of informal minibuses has sustained high emissions and safety risks despite high public transport usage, reflecting governance deficits rather than modal

choice per se. Similarly, Abuja's environmental constraints stem not from insufficient public transport use but from ineffective institutional oversight and fleet renewal mechanisms.

By contrast, some African cities illustrate the developmental potential of stronger governance. Kigali's relatively unified transport authority and enforced fleet standards have improved safety and emissions performance, even with limited fiscal resources (UN-Habitat, 2023). Bogotá's long-standing investment in Bus Rapid Transit demonstrates that institutional coordination and political commitment can deliver productivity, equity, and environmental gains simultaneously, albeit with ongoing challenges around affordability and labour conditions (Pereira et al., 2024).

Asian cases further reinforce the governance argument. Cities such as Seoul and Jakarta have achieved significant modal shifts and emissions reductions through integrated metropolitan transport authorities, fare integration, and sustained public investment (OECD, 2023). In these contexts, technological upgrading was embedded within broader institutional reforms, including clear regulatory mandates and cross-sector coordination. Conversely, cities where governance reforms lag despite technological advances continue to experience congestion, emissions growth, and inequitable access.

The Abuja case aligns more closely with African cities experiencing coordination failures than with reform-oriented cases. However, the strong public support observed for fleet decarbonisation and institutional reform suggests latent conditions for transition. Development studies scholarship emphasises that such "political moments" are critical windows in which institutional reform becomes feasible (Grindle, 2017; UNDP, 2024).

Comparatively, Abuja's challenge is therefore not exceptional but emblematic of a broader development pattern: where urban transport is treated as a fragmented sectoral issue, outcomes remain uneven; where it is governed as a metropolitan development system, transformative gains become possible.

5.3 Governance and Political Economy: Institutional Capacity and Constraints

The governance and political economy dimensions of Abuja's transport system provide a deeper explanation for observed development outcomes. Fragmentation across federal, FCT, and local institutions creates blurred accountability, regulatory gaps, and limited fiscal coherence. Such coordination failures mirror broader state capacity challenges commonly identified in development literature (Pritchett et al., 2023).

Transport governance in AMAC is marked by overlapping mandates, short planning horizons, and weak enforcement mechanisms. These features undermine incentives for long-term investment in cleaner fleets and inclusive infrastructure. Operators respond rationally to fuel price volatility and congestion by raising fares and deferring maintenance, while regulators lack both resources and authority to impose consistent standards. This dynamic reflects a classic collective-action problem, where the absence of a coordinating institution prevents system-wide optimisation (UNDP, 2024).

Political economy constraints further complicate reform. Informal operators constitute important sources of employment and political support, making abrupt regulatory tightening politically sensitive. Development research cautions that reforms perceived as threatening livelihoods may face resistance unless accompanied by compensatory measures and stakeholder inclusion (Newell et al., 2023; Just Transitions, 2024). In Abuja, interviews suggest that resistance is less about opposition to reform and more about uncertainty regarding institutional roles and distribution of costs.

Fiscal capacity constraints also loom large. Public transport investment competes with other pressing urban needs, while access to climate finance remains limited by institutional fragmentation and weak project pipelines. This reinforces the argument that green investment outcomes depend as much on state capability and coordination as on global finance availability (African Development Bank, 2024).

Taken together, the political economy of transport governance in AMAC reveals why technical solutions have failed to scale. Institutional reform particularly the consolidation of authority and financing mechanisms emerges as a precondition for sustainable mobility transitions.

5.4 Alignment with SDG 11 and SDG 13: Development Frameworks

The findings have direct implications for the implementation of SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). SDG 11 emphasises access to safe, affordable, accessible,

and sustainable transport systems, with particular attention to vulnerable groups. The results demonstrate that AMAC's current transport system falls short on affordability, safety, and inclusion, undermining progress toward this target (UN-Habitat, 2023).

SDG 13 focuses on integrating climate measures into national and local policies. While Nigeria's climate commitments acknowledge transport emissions, weak sub-national governance limits effective implementation. The study shows that mitigation potential exists but is unrealised due to institutional constraints, highlighting the importance of local governance in translating global commitments into outcomes (IPCC, 2022; UNDP, 2024).

Critically, the results reinforce the interdependence of these goals. Climate action in transport cannot succeed without addressing equity and governance, while inclusive urban development requires low-carbon mobility pathways to avoid locking cities into unsustainable trajectories. This integrated understanding aligns with contemporary development frameworks advocating "just urban transitions" (African Development Bank, 2024).

6. Policy Implications and Recommendations

6.1 Governance Reform: Establishing Metropolitan Capacity

The central policy implication is the urgent need for governance reform. Establishing a unified metropolitan transport authority for Abuja would address coordination failures by consolidating planning, regulation, and investment functions. Such an authority should have clearly defined legal mandates, stable funding streams, and mechanisms for stakeholder engagement.

International experience shows that metropolitan authorities are pivotal to delivering integrated, low-carbon, and inclusive transport systems (OECD, 2023; UN-Habitat, 2023). For Abuja, institutional consolidation would improve accountability, facilitate fare regulation, and enable long-term planning aligned with climate and development objectives.

6.2 Green Investment: Fleet Decarbonisation Pathways

Fleet renewal should be prioritised through a phased decarbonisation strategy combining cleaner fuels, electrification, and vehicle efficiency standards. Access to climate finance through development banks and blended finance mechanisms must be linked to institutional reform to ensure absorptive capacity (African Development Bank, 2024).

Importantly, green investment should be accompanied by operator support mechanisms, including concessional loans and technical assistance, to avoid displacement and ensure a just transition.

6.3 Equity Measures: Fare Reform and Inclusion

Affordability and inclusion require explicit policy intervention. Fare stabilisation mechanisms and targeted subsidies for low-income commuters can mitigate the regressive effects of transport costs (World Bank, 2023). Universal design standards should be mandated to improve accessibility for women, older persons, and persons with disabilities, ensuring compliance with SDG 11 commitments.

6.4 Implementation Risks and Political Economy Considerations

Finally, reforms must account for political economy risks. Incremental implementation, stakeholder consultation, and compensation strategies for affected operators are essential to building political legitimacy. Without addressing distributional impacts, even technically sound reforms risk failure (Newell et al., 2023; UNDP, 2024).

7. Conclusion

7.1 Summary of Findings

This study examined public transport in the Abuja Municipal Area Council (AMAC) through a development lens, focusing on how governance arrangements shape low-carbon, inclusive, and welfare-enhancing outcomes. The findings demonstrate that public transport plays a central but constrained role in Abuja's urban development trajectory. Environmentally, public transport delivers some congestion reduction and emission-mitigation benefits; however, these are offset by ageing vehicle fleets, fuel inefficiency, and weak regulatory enforcement, resulting in limited CO_2 reduction potential. Economically, public transport remains essential for labour market access, yet high fares, long travel

times, and unreliability impose disproportionate costs on low-income households, reducing productivity and reinforcing urban inequality.

Social welfare outcomes are particularly uneven. Women, persons with disabilities, and low-income residents experience persistent barriers related to affordability, safety, and physical accessibility, with implications for health, time poverty, and economic participation. Governance analysis reveals that these outcomes are driven less by technological or demand-side limitations and more by fragmented institutional mandates, poor coordination across agencies, and inadequate investment frameworks. Importantly, strong public support exists for reform measures, including fleet decarbonisation, fare regulation, and the creation of a unified metropolitan transport authority. Collectively, the findings position sustainable urban transport in Abuja as primarily a governance and development challenge rather than a technical one.

7.2 Contribution to Development Studies

This paper contributes to development studies by repositioning urban transport as a core institutional determinant of low-carbon and inclusive development rather than a sectoral planning problem. Empirically, it provides rare sub-national evidence from a rapidly growing African capital, linking transport governance to environmental sustainability, economic productivity, and social welfare outcomes. Conceptually, the study integrates insights from development theory, political economy, and urban sustainability to demonstrate how infrastructure systems mediate structural inequality and capability outcomes (IPCC, 2022; UNDP, 2024).

The research advances debates on sustainable development by showing that climate mitigation in cities is inseparable from questions of equity, affordability, and state capacity. By foregrounding governance failures and institutional fragmentation, the study aligns with recent scholarship emphasising that development outcomes depend less on infrastructure abundance than on the quality of institutions managing it (Pritchett et al., 2023; African Development Bank, 2024). In doing so, it deepens understanding of SDG 11 and SDG 13 implementation challenges in the Global South.

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