Decarbonizing Mobility in Rapidly Motorizing Contexts: Structural Constraints and Incremental Pathways for Low-Carbon Transport in Cameroon

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ABSTRACT

Sub-Saharan Africa is entering accelerated motorization, with urban populations projected to double by 2050, making transport a pivotal yet understudied climate mitigation sector. Cameroon exemplifies the challenges: urbanization exceeding 3.5% annually, a fleet of imported second-hand vehicles averaging over 15 years old, and informal paratransit handling 70–80% of urban motorized trips. Despite the 2021 Nationally Determined Contributions (NDC's) emissions reduction pledges, transport implementation lags due to governance silos and political-economic lock-ins. Employing socio-technical transitions theory and qualitative policy analysis, triangulating NDCs, development strategies, urban mobility plans, and international reports, this study identifies three barriers: (i) used vehicle import politics, where duties and broker networks sustain carbon-intensive fleets; (ii) fragmentation between environment and transport/urban ministries, yielding road-biased investments; and (iii) colonial-rooted urban forms favouring vehicle dependence. The NDC overlooks paratransit's regime centrality. Rejecting capital-heavy leapfrogging, the article advances incremental decarbonisation for lowincome contexts: paratransit cooperatives enabling fleet renewal; landuse integration shortening trips; phased import/scrappage reforms; electric two-wheelers for high-use segments. A National Transport Authority and international finance would operationalize this. Cameroon's case illuminates pathways for Global South cities, where aligning climate policy with informal mobility realities is essential.

Keywords: Transport decarbonisation, informal paratransit, socio-technical transitions, second-hand vehicles, Cameroon, Global South, incremental decarbonisation.

INTRODUCTION

Transport decarbonization is a central pillar of global climate mitigation, as the sector accounts for roughly 24% of energy-related carbon dioxide (CO_2) emissions worldwide, with road transport responsible for nearly threequarters of this total (Ogutu, 2025). While transport-related emissions have stabilized or declined in many highincome countries, they continue to rise rapidly in low and middle income countries (LMICs), driven by accelerated urbanization, rising motorization from a low base, and persistent deficits in affordable and reliable public transport (World Bank, 2023; Ogutu, 2025). This divergence raises a fundamental challenge for climate policy: how can countries that are still expanding basic mobility and accessibility pursue low-carbon transport pathways under conditions of constrained fiscal capacity, weak institutions, and pervasive informality (Sietchiping et al., 2012)? Dominant decarbonisation strategies such as large-scale electrification of private vehicles, congestion pricing, and capital-intensive mass transit are often premised on governance capacity, regulatory enforcement, and formalized transport markets that are only partially present in many LMICs, calling into question their relevance and effectiveness in rapidly motorizing contexts (AfDB et al., 2023).

Sub-Saharan Africa (SSA) exemplifies these tensions. The region’s urban population is projected to nearly double by mid-century, with much of this growth occurring in secondary and intermediate cities characterized by limited planning capacity and severe infrastructure deficits (UN-Habitat, 2020; World Bank, 2023). Motorization is accelerating rapidly, often in the absence of robust mass transit systems, producing what scholars describe as “compressed mobility transitions,” in which informal motorized modes expand within a short time horizon (Godard, 2011; Behrens et al., 2017). Cameroon offers a particularly instructive case within this regional

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context. Urbanization rates exceed 3.5% annually, with mobility in Douala and Yaoundé dominated by informal paratransit; shared taxis, minibuses, and motorcycle taxis, while formal public transport remains limited or absent on most corridors (Behrens et al., 2017; Tchawe, 2023). At the same time, the vehicle fleet is overwhelmingly composed of imported second-hand internal combustion engine (ICE) vehicles, many of which are older and more polluting than those permitted in their countries of origin (UNEP, 2020; Andersen, 2020). Although Cameroon's 2021 Nationally Determined Contribution (NDC) identifies transport as a priority mitigation sector, implementation has largely emphasized road infrastructure expansion and fuel taxation rather than systemic low-carbon mobility transitions (MINEPDED, 2021; IMF, 2024; World Bank, 2025).

Existing research on transport emissions in Cameroon and Central Africa has tended to focus on macro-level relationships between economic growth, energy consumption, and CO_2 emissions, or on localized air quality impacts in specific urban centers (Ogutu, 2025; UNEP, 2020). While valuable, this literature often treats transport systems as technical aggregates, paying limited attention to the institutional, political-economic, and spatial dynamics that reproduce carbon-intensive mobility practices (Goodfellow, 2015; World Bank, 2018). More broadly, transport-climate scholarship in SSA frequently applies analytical frameworks developed in highincome contexts such as the Avoid-Shift-Improve (ASI) or Enable-Avoid-Shift-Improve (EASI) paradigms without fully interrogating their assumptions regarding governance capacity, data availability, and the predominance of formalized mass transit systems (Sietchiping et al., 2012; SSATP, 2018; AfDB et al., 2023). As a result, core features of African mobility regimes particularly informality and the political economy of second-hand vehicle imports remain under-theorized in decarbonisation debates, despite their central role in shaping emissions trajectories (Behrens et al., 2017; UNEP, 2020).

This article addresses these gaps by examining the structural constraints and feasible pathways for transport decarbonisation in Cameroon under conditions of rapid motorization and entrenched informality. Drawing on socio-technical transitions theory, and specifically the Multi-Level Perspective (MLP), the analysis conceptualizes transport as a socio-technical regime shaped by technologies, infrastructures, institutions, everyday practices, and political economy (Geels, 2012; Köhler et al., 2019). The article advances the concept of incremental decarbonisation, defined as a transition pathway in which emissions reductions emerge through cumulative, lower-capital institutional, regulatory, and spatial reforms rather than rapid technological substitution. It argues that Cameroon's transport emissions trajectory is embedded in socio-technical lock-ins linked to the political economy of second-hand vehicle imports, fragmented sectoral governance, and infrastructural legacies rooted in colonial and post-colonial investment patterns (UNEP, 2020; World Bank, 2018; Ogutu, 2025). Consequently, effective low-carbon transitions are more likely to emerge from strategies that prioritize paratransit reform and gradual formalization, land-use and transport integration, and progressive fleet renewal, rather than from narrow technological leapfrogging narratives centered on private electric vehicles (Behrens et al., 2017; ITDP, 2022; AfDB et al., 2023). While empirically focused on Cameroon, the analysis has broader implications for rapidly motorizing cities across the Global South, where climate policy success will depend on its capacity to engage with, and strategically reshape informal mobility regimes rather than bypass them.

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Transport Decarbonisation in the Global South

Global assessments consistently show that transport contributes around one quarter of energy-related CO_2 emissions, with road transport responsible for the bulk of this share (Ogutu, 2025). Transport emissions in many high-income economies have begun to stabilize, but they continue to grow rapidly in low and middle income countries (LMICs), driven by urbanization, motorization from a low base, and insufficient investment in high-capacity public transport (World Bank, 2023). In sub-Saharan Africa, per capita emissions from transport remain low by global standards, yet recent decades have seen some of the fastest growth rates worldwide, prompting concerns that current infrastructure and fleet choices are creating "carbon lock-in" at relatively low income levels (Unruh, 2000; UN-Habitat, 2020).

The Avoid-Shift-Improve (ASI) framework has become the dominant lens for conceptualizing transport decarbonisation, organizing interventions around avoiding unnecessary travel, shifting to more sustainable

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modes, and improving vehicle and fuel efficiency (Sietchiping et al., 2012). African policy debates have adapted this into the Enable-Avoid-Shift-Improve (EASI) model, which adds an "Enable" pillar to underline the role of institutions, finance, and capacity as prerequisites for effective implementation (SSATP, 2018). While ASI/EASI provide useful structure, critics note that these paradigms implicitly assume formalized public transport systems, robust data, and relatively capable state agencies, conditions that are often absent in rapidly growing African cities where informal paratransit and second-hand vehicle markets dominate mobility (Behrens et al., 2017; AfDB et al., 2023). This raises questions about how ASI/EASI can be operationalized in contexts like Cameroon, where state control over fleets, operators, and land use is partial and uneven.

Technological Leapfrogging and Second-hand Vehicle Lock-in

The idea that African countries might "leapfrog" directly to low-carbon mobility by bypassing prolonged dependence on internal combustion engine (ICE) vehicles through rapid adoption of electric vehicles (EVs), electrified two-wheelers, and digital platforms has attracted growing policy interest (AfDB et al., 2023). Proponents argue that falling battery costs, mobile-based payment systems, and emerging renewable power capacities could enable cleaner trajectories than those followed in Europe or North America (UNEP, 2021). However, empirical studies point to substantial barriers to such leapfrogging, including low average incomes, limited charging infrastructure, unreliable electricity supply, and the entrenched dominance of imported used vehicles in African fleets (UNEP, 2020; Bechstein, 2021).

UNEP's global assessment of used vehicle trade shows that between 2015 and 2018, most exported used light-duty vehicles went to LMICs, with Africa receiving a particularly high share of older, less efficient vehicles that no longer meet standards in originating markets (UNEP, 2020). Subsequent analyses indicate that used vehicles constitute a majority of new registrations in many African countries, effectively making the region a destination for the "end of life" segment of the global fleet (Andersen, 2020). This "second-hand leakage" locks cities into high-emission, low-efficiency vehicles for extended periods, especially where weak inspection regimes and constrained household incomes prolong operational lifetimes (UNEP, 2020; Ogutu, 2025). In addition, customs revenues and the livelihoods of brokers, importers, and informal traders create strong domestic constituencies that benefit from maintaining the current flows of used vehicles (Andersen, 2020). These political-economic dynamics mean that purely technological strategies such as subsidizing EVs without addressing used vehicle regulations are unlikely to deliver rapid or equitable decarbonisation in countries such as Cameroon.

Socio-technical Transitions, Informality, and Mobility Regimes

Socio-technical transitions scholarship provides a framework for understanding why deeply embedded systems, such as transport, change only slowly and often in path-dependent ways. The Multi-Level Perspective (MLP) conceptualizes transitions as interactions between three analytical levels: niche innovations, socio-technical regimes, and broader landscape pressures (Geels, 2012). Regimes comprising technologies, infrastructures, institutions, user practices, and cultural meanings tend to be stable because of interlocking investments, routines, and vested interests, while niches provide protected spaces for experimentation with alternative configurations (Köhler et al., 2019). Landscape developments such as climate change, international agreements, or macroeconomic shifts can destabilize regimes and open windows of opportunity for niche growth.

Critics of early MLP applications argue that the framework was developed mainly with industrialized contexts in mind and often underplays issues of informality, weak state capacity, and contentious politics that are central in many LMICs (Schalekamp & Behrens, 2013; Goodfellow, 2015). In African cities, informal public transport minibuses, shared taxis, motorcycle taxis functions as the de facto public transport system, providing most motorized trips in the absence of comprehensive formal networks (Behrens et al., 2017). Rather than temporary "gaps" awaiting formalization, these systems often constitute relatively stable regimes, reproduced by their role in employment generation, spatial coverage, and political brokerage (Goodfellow, 2015). This suggests that in contexts like Cameroon, socio-technical regimes are built around informal operators, second-hand import chains, and fragmented state agencies, and that low-carbon niches must contend with these entrenched configurations rather than displacing a coherent formal regime.

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Incremental Decarbonisation as Conceptual Lens

Building on these debates, this article adopts incremental decarbonisation as a conceptual lens for examining low-carbon transport transitions in Cameroon. Incremental decarbonisation refers to pathways in which emissions reductions arise from cumulative institutional, regulatory, and spatial reforms such as fleet renewal, paratransit formalization, and land-use integration rather than from rapid, capital-intensive technological substitutions alone (Bechstein, 2021; AfDB et al., 2023). This perspective acknowledges three constraints that are typical of low-income, informalized contexts: limited fiscal space, high dependence on informal livelihoods, and path-dependent urban form (World Bank, 2021; Ogutu, 2025).

Rather than framing informality as an obstacle to be eliminated, the incremental decarbonisation framework treats informal systems as central leverage points. In MLP terms, it emphasizes how small-scale niche interventions such as cooperative-based paratransit reforms, gradual tightening of used vehicle imports standards, or corridor-level landuse- transport projects can incrementally reconfigure the existing regime from within under the influence of landscape pressures like NDC commitments and donor agendas (Geels, 2012; Köhler et al., 2019). In the Cameroonian case, this implies prioritizing politically and financially feasible measures that engage with, rather than bypass, the informal mobility regime: supporting structured paratransit formalization, designing realistic fleet renewal and scrappage schemes, and embedding climate objectives in urban development and transport planning.

Transport and Motorization in Cameroon: Contextual Background

Cameroon's urban system is highly concentrated, with Douala the country's main economic hub and port city and Yaoundé, the political capital, accounting for a large share of national GDP, formal employment, and inter-city transport demand (World Bank, 2021). Urbanization rates exceed 3.5% annually, and the urban population share is projected to reach 60% by 2035, outpacing infrastructure provision and creating intense pressure on mobility systems (UN-Habitat, 2020; World Bank, 2023). This growth is particularly acute in informal settlements and peripheral neighbourhoods, where access to affordable, reliable transport is essential for employment, education, and basic services (Tchawe, 2023).

Motorization has accelerated sharply over the past decade, with registered vehicles increasing by more than 50%, though private car ownership remains limited to higher-income households (World Bank, 2021). Instead, urban mobility is overwhelmingly provided by informal paratransit, including shared taxis (calandos), minibuses (taxis-brousse), and motorcycle taxis (benskin), which account for an estimated 70-80% of motorized trips in Douala and a similar share in Yaoundé (Tchawe, 2023; Behrens et al., 2017). These modes offer flexible, demand-responsive service and last-mile connectivity that formal systems struggle to match, but they typically operate with limited route regulation, poor vehicle maintenance, and high exposure to congestion and safety risks (World Bank, 2021).

The vehicle fleet is dominated by imported second-hand internal combustion engine vehicles, with average ages often exceeding 12-15 years at import and many continuing in service well beyond that (UNEP, 2020). Highsulphur fuels, weak inspection and maintenance regimes, and intensive usage in paratransit fleets contribute to elevated local air pollution and rising transport-related greenhouse gas emissions (Ogutu, 2025). Governance is fragmented across the Ministry of Transport (MINT), Ministry of Housing and Urban Development (MINHDU), and Ministry of Environment (MINEPDED), producing policy silos and inconsistent priorities between climate objectives, road expansion, and urban planning (IMF, 2024). Recent donor-supported initiatives, such as Sustainable Urban Mobility Plans for Douala and Yaoundé, have begun to articulate more integrated visions, but implementation remains constrained by limited municipal capacity and competing national priorities (World Bank, 2023).

METHODOLOGY

This study employs a qualitative policy analysis design to map the structural constraints and governance dynamics shaping transport decarbonization in Cameroon (Yin, 2018). Cameroon serves as a typical case of lowincome, rapidly motorizing African countries with high transport informality and substantial used vehicle dependence, rather than an outlier (World Bank, 2021).

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Data Sources

Primary data consist of key national and urban policy documents, including Cameroon's 2021 updated Nationally

Determined Contribution (MINEPDED, 2021), the National Development Strategy 2020-2030

(SND30), and Sustainable Urban Mobility Plans (SUMPs) for Douala and Yaoundé developed under the MobiliseYourCity initiative. Complementary sources include reports from the World Bank, IMF, UNEP, and regional programs such as SSATP, which provide diagnostics on motorization trends, fleet composition, and institutional arrangements.

Analytical Approach

Documents were analysed using hybrid deductive-inductive coding. Deductive codes drew from socio-technical transitions theory (e.g., regime lock-in, niche-regime interactions, institutional fragmentation) and transport decarbonisation literature (Geels, 2012; Behrens et al., 2017). Inductive codes captured emergent Cameroonian themes, such as fiscal dependence on vehicle imports and political accommodation of paratransit unions (Bowen, 2009). Coding focused on how policies problematize transport emissions, prioritize instruments, allocate responsibilities, and address informality.

Limitations

The analysis is limited by the scarcity of recent, disaggregated national transport GHG inventories, with available estimates relying on project-specific studies or regional extrapolations (Ogutu, 2025). Document-based methods cannot fully capture informal negotiations or implementation gaps. Triangulation across sources and interpretive caution mitigate these constraints.

Findings: Structural Drivers of Transport Emissions

Political Economy of Second-Hand Vehicle Imports

Second-hand vehicle imports constitute the majority of new registrations in Cameroon, with vehicles often averaging over 15 years old at entry (UNEP, 2020). Customs duties and related fees generate important public revenue, creating fiscal disincentives for stricter age or emissions standards (IMF, 2024). Dense networks of brokers, informal traders, and port operators further entrench this regime, resisting reforms that could disrupt import volumes (Andersen, 2020). The result is a carbon-intensive fleet locked into long-term high emissions, particularly in paratransit where vehicles face intensive use (Ogutu, 2025).

Institutional Fragmentation and Policy Decoupling

Climate policy is led by MINEPDED, while transport planning and road investments fall under MINT and MINHDU (MINEPDED, 2021). This produces weak integration, with NDC transport measures remaining highlevel while sectoral strategies prioritize road capacity expansion over demand management or modal shifts (World Bank, 2023). SUMPs introduce more holistic approaches but are only partially reflected in budgets and projects (World Bank, 2021). Fragmentation limits climate mainstreaming in transport decisions.

Informality as Constraint and Opportunity

Informal paratransit dominates urban mobility, providing essential service but using aging, inefficient vehicles with limited regulation (Tchawe, 2023; Behrens et al., 2017). Weak oversight constrains fleet renewal and clean technology adoption (UNEP, 2020). Yet informality also offers leverage: formalization through cooperatives and contracts could enable gradual improvements in efficiency and emissions while preserving livelihoods, as seen in Dakar and Kigali (ITDP, 2022).

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Discussion: Interpreting the Cameroonian Transition

Cameroon's motorization path from walking to informal paratransit differs fundamentally from high-income shifts from cars to mass transit, challenging technology-centric decarbonisation narratives (Behrens et al., 2017; AfDB et al., 2023). Through the MLP lens, the mobility regime is informalized, with lock-ins from used vehicle politics, governance silos, and path-dependent urban form (Geels, 2012). Incremental decarbonisation aligns reforms with these realities, using niches like paratransit cooperatives to reconfigure the regime gradually (Bechstein, 2021). Comparable successes in Dakar and Kigali support this approach (ITDP, 2022).

Pathways for Low-Carbon Transport in Cameroon

Effective mitigation pathways must be calibrated to Cameroon's fiscal constraints, institutional fragmentation, and the centrality of informal paratransit. Rather than capital-intensive infrastructure like metro systems or widespread private EV adoption, incremental decarbonisation prioritizes politically feasible, high-impact reforms that leverage existing mobility arrangements (AfDB et al., 2023; Behrens et al., 2017). The following priorities form a sequenced approach:

- **Integrate land-use and transport planning:** Shorten trip lengths by promoting compact, mixed-use development around high-demand corridors and informal transport hubs. Pilot zoning reforms in Douala and Yaoundé to densify peri-urban areas, reducing average trip distances by 15-20% through better residential-job matching (World Bank, 2021). Coordinate MINHDU and MINT to embed transport impact assessments in urban project approvals, drawing on SUMP diagnostics.

- **Formalize paratransit through cooperatives and contracts:** Transition informal operators into registered cooperatives with exclusive route franchises, enabling collective access to credit, training, and maintenance facilities. Model after Dakar's PETC system, where structured contracts improved service reliability and enabled gradual fleet upgrades (ITDP, 2022). Start with 2-3 high-volume corridors, targeting 20-30% formalization within five years to balance emissions gains with livelihood protection.

- **Implement fleet renewal and scrappage schemes:** Enforce phased import age limits (e.g., maximum 10 years by 2030) linked to mandatory scrappage of vehicles over 20 years old, funded by import duties and carbon finance. Prioritize paratransit fleets, offering vouchers for Euro 4/5-compliant used vehicles or CNG conversions as bridge technologies (UNEP, 2020). Aim for 25% fleet turnover in urban areas by 2035, reducing emissions intensity by 30% per vehicle-km.

- **Incentivize electric two-wheelers and small vehicles:** Deploy targeted subsidies and charging infrastructure for electric motorcycles and minibuses in paratransit cooperatives, leveraging solar-hybrid stations at depots. Avoid broad private EV promotion given grid constraints and affordability barriers; instead, focus on high-utilization segments where payback periods are short (AfDB et al., 2023). Pilot 5,000 units in Douala by 2028, scaling based on performance data.

These pathways emphasize sequencing: begin with regulatory tightening and cooperative pilots, then layer in financial incentives as capacity builds. Monitoring via digital ticketing and fleet registries would track progress against NDC targets (Ogutu, 2025).

Policy Implications

Structural decarbonisation demands institutional innovation beyond current silos. A National Transport and Mobility Authority reporting to the Prime Minister should coordinate MINEPDED, MINT, and MINHDU, with mandates for NDC-aligned planning, data collection, and performance-based budgeting (IMF, 2024). This body could oversee SUMP implementation, paratransit concessions, and import standards, reducing policy decoupling.

International climate finance is pivotal but must target incremental reforms over prestige projects. Article 6 carbon markets could fund scrappage and electrification credits from verifiable fleet reductions, while blended finance from AfDB and World Bank supports cooperative capitalization (AfDB et al., 2023). Bilateral donors should condition transport aid on land-use integration and informality engagement. Domestically, earmark 20%

of vehicle import revenues for a Low-Carbon Mobility Fund, financing renewals and charging while offsetting short-term fiscal losses.

Success metrics should include fleet age reduction, emissions per passenger-km, paratransit coverage rates, and accessibility for low-income groups. Annual reporting tied to SND30 would ensure accountability. These reforms not only advance NDC goals but also yield co-benefits in air quality, safety, and economic inclusion.

CONCLUSION

Transport decarbonisation in Cameroon hinges on reforming socio-technical lock-ins rather than substituting technologies. By cantering incremental pathways, paratransit formalization, fleet renewal via import controls, and land-use-transport integration policymakers can reduce emissions while sustaining accessibility and livelihoods in a rapidly motorizing context (Behrens et al., 2017; UNEP, 2020).The Cameroonian experience underscores broader lessons for Global South cities: climate strategies must grapple with informality as regime core, not aberration, and prioritize institutionally grounded reforms over idealized leapfrogging (AfDB et al., 2023; Goodfellow, 2015). Aligning NDC ambition with mobility realities through targeted, sequenced actions offers a pragmatic route to low-carbon transitions amid compressed development pressures.

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