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### **Editorial Note**

This issue of *AYIKA* brings together a rich and timely collection of scholarship that underscores a central truth: in Africa, environmental questions are deeply political, and political realities are increasingly shaped by environmental change. The contributions in this volume reflect the growing complexity of this relationship, engaging themes that span governance, technology, security, sustainability, and identity across diverse African contexts and beyond.

A defining feature of this issue is its strong engagement with the role of digitalisation in advancing sustainability. From the systematic review on how digitalisation enables decarbonisation, to analyses of agri-tech adoption in Nigeria and South Africa, the volume highlights the transformative potential of technology in addressing environmental challenges. These contributions move beyond optimism, carefully examining the mechanisms and constraints that shape technological uptake. They remind us that digital solutions are not neutral; their effectiveness depends on policy frameworks, institutional capacity, and socio-economic conditions.

Equally prominent is the question of governance, particularly in relation to service delivery and institutional performance. The examination of water service failures in Gauteng Province offers a sobering account of how governance lapses can translate into environmental and public health crises. Similarly, the discussions on public service reform and parliamentary oversight reveal the persistent challenges of accountability and administrative effectiveness across the continent. Together, these studies point to a critical insight: sustainable environmental outcomes are contingent on capable, transparent, and responsive institutions.

The issue also engages deeply with questions of political order, security, and regional cooperation. Analyses of Zimbabwe's political history, hybrid regimes in Central Africa, and border conflicts involving Nigeria reveal how political instability and governance structures shape environmental management and development trajectories. The exploration of indivisible security within the SADC region further highlights the interconnectedness of peace, cooperation, and sustainable development. These contributions reinforce the idea that environmental sustainability cannot be pursued in isolation from broader political and security dynamics.

Another important strand in this volume is the emphasis on economic strategies and livelihoods, particularly in rural contexts. Articles on organic agribusiness, marketing strategies aligned with climate action, and the challenges faced by women in agribusiness illuminate the everyday realities of sustainability. They foreground the experiences of local actors, especially women entrepreneurs, whose resilience and innovation are often overlooked. By examining the socio-economic factors shaping revenue growth and participation, these studies contribute to a more inclusive understanding of development.

The volume also makes a significant intellectual contribution by foregrounding indigenous knowledge systems and alternative epistemologies. The exploration of

Ubuntu as a framework for regional governance offers a human-centred perspective that challenges dominant policy paradigms. Similarly, the critique of epistemic violence in transboundary conservation highlights the marginalisation of local knowledge and agency. These interventions are particularly important in rethinking whose knowledge counts in environmental governance and how more equitable frameworks can be developed. Urban spaces and cultural expressions are not left out of this conversation. Contributions on city branding in Harare and the intersection of art, space, and identity in Durban demonstrate how environmental and political dynamics are experienced and expressed in urban contexts. These studies expand the scope of environmental politics by incorporating cultural and spatial dimensions, offering fresh insights into how cities in the Global South are responding to climate change.

Notably, this issue also extends its analytical reach beyond Africa, with a study on urban climate initiatives in Brazil and a comparative examination of socio-economic vulnerability in Sub-Saharan Africa and the Pacific Islands. These contributions enrich the volume by situating African experiences within a broader global context, encouraging cross-regional learning and dialogue.

Finally, the inclusion of research on language and education, such as the study on tense substitution errors among Tshivenda-speaking students, serves as a reminder of the interconnectedness of knowledge production, communication, and development. It highlights the importance of education in shaping the capacity to engage with complex environmental and political issues.

Taken together, the articles in this issue reflect a vibrant and interdisciplinary field of inquiry. They challenge simplistic narratives and instead offer nuanced analyses that recognise the interconnected nature of environment and politics in Africa. As the continent continues to navigate the pressures of climate change, population growth, and political transformation, the insights presented here are both timely and necessary. This volume invites scholars, policymakers, and practitioners to think more critically and act more collaboratively. It is our hope that the conversations sparked within these pages will contribute to more just, sustainable, and context-sensitive approaches to environmental governance in Africa and beyond.

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## TABLE OF CONTENT

1. How Digitalisation Enables Decarbonisation: A Systematic Review Of Mechanisms, Pathways, And Boundary Conditions  
*Misheck Musaigwa, Innocent Simphiwe Nojiyeza*  
6-27
2. Lapses in Water Services Management Within Gauteng Province- A Scoping Review Of Hammanskraal Water Woes  
*M. Diedericks, S. Sikwela, G.M. Solomons*  
28-57
3. Soldiered Democracy and Peace: The Smithan Syndrome Of Politics And Administration In Zimbabwe, 1965–2018  
*Timothy Chibuike Anyanwu, Kelechi Johnmary Ani*  
58-76
4. Aligning Marketing Strategies with Climate Action and Sustainable Development Goals in South Africa  
*Gugulethu Mhlanga and Andrisha Beharry-Ramraj*  
77-98
5. Agri-Tech And Livestock Management: Economic And Policy Drivers Of Digital Adoption In Nigeria And South Africa  
*Olukayode Idris Lasisi, Bisiriyu Abiodun Taleat, Muslim Akinbola Akintola Kedibone Phago*  
99-119
6. Indivisible Security And Sustainable Development In The Sadc Region: Assessing Stability And Cooperation Among The Drc, Rwanda, And Uganda  
*Masila Joshua Masipa*  
120-134
7. Reforming Public Service In Africa: Strategies, Challenges And The Future  
*Kazeem Oyedele Lamidi, Costa Hofisi*  
135-156
8. Organic Agribusiness In Rural South Africa: Marketing Strategies Amid Stiff Competition  
*Ishmael Obaeko Iwara*  
157-16
9. Minimising English Tense Substitution Errors: A Case Of Tshivenda-Speaking Students At A South African University  
*Farisani Thomas Nephawe*  
168-185
10. Institutional Dynamics And Hybrid Regime: Liberal And Authoritarian Democracy In The Central Africa  
*Muhlya Tshombe Lukamba, Bisiriyu Abiodun Taleat, Eunice Chesa*  
186-206
11. Ubuntu Philosophy And Regional Governance In Africa: A Human-Centred Framework For Regional Integration And Sustainable Development  
*Onuk Bulus Ojem, Phemelo Olifile Marumo*  
207-226

12. Nigerian Border Conflict With Neighbours And Implications For Regionalism  
***Kelechi Johnmary Ani***  
**227-239**
13. Epistemic Violence: Transboundary Conservation's Subjugation Of Basubiya  
Eco-Missiology And Riverine Agency  
***Phemelo Olifile Marumo, Sethunya Michael Gaarekwe***  
**240-262**
14. Strategies To Mitigate The Challenges Faced By Women In Agribusinesses In  
Rural Uphongolo, Kwazulu-Nata  
***Ndlangamandla, Wiseman Siboniso***  
**263-283**
15. In What Ways Do Intersecting Socio-Economic Factors Shape Revenue Growth  
Among Rural Women Entrepreneurs in KZN, South Africa?  
***Lindokuhle Senamile Ntuli, Innocent Simphiwe Nojiyeza***  
**284-307**
16. Climate Change and Socio-Economic Vulnerability in Sub-Saharan Africa and  
Pacific Islands  
***Mandisa Jili and Andrisha Beharry-Ramraj***  
**308-328**
17. Transformative city branding in the face of climate change in the global south:  
A case of Harare  
***Kazaka Chiyambire***  
**329-349**
18. Mapping of urban climate initiatives in Brazil: promoting mitigation and  
adaptation in the transport sector  
***Ana Clara Vieira Pedrosa, Ana Clara de RourZ, Mateus Bernardino  
Mata, Andréa Souza Santos***  
**350-378**
19. Ancestral Voices in Modern Crises: Traditional Leadership and Climate  
Adaptation in Zimbabwe  
***Douglas Nyathi***  
**379-396**

## MAPPING OF URBAN CLIMATE INITIATIVES IN BRAZIL: PROMOTING MITIGATION AND ADAPTATION IN THE TRANSPORT SECTOR.

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### **Abstract**

*The climate emergency necessitates the rapid implementation of mitigation and adaptation strategies, particularly in urban transport, which accounts for approximately 47% of energy-related emissions in Brazil. This study aims to analyze how Brazilian cities are operationalizing climate actions by examining the "Urban Climate Initiative Mapping" from the Ministry of Cities. The research specifically investigates the stage of implementation of these actions, identifies synergies and trade-offs, and evaluates their alignment with Brazil's National Climate Plan and the Sustainable Development Goals (SDGs). The methodology employs a qualitative-analytical approach, utilizing a two-stage filtering process to isolate 26 transport-specific initiatives from a broader federal database. These initiatives were coded across three dimensions: intervention type, maturity level, and policy coherence. Key findings reveal that while most initiatives are in the initial or "ongoing" stages, specific projects demonstrate measurable impacts, such as the "Ecomilhas" platform, which has avoided 244,650 tons of CO<sub>2</sub>, and the LEED-certified Anália Franco Station, which reduced emissions by 214.61 tons. The analysis identifies a predominant focus on active mobility (bike lanes and sidewalks) and the early-stage electrification of bus fleets in cities like Curitiba and Camaçari. Furthermore, the paper provides evidence for the potential of upscaling and replication within the BRICS framework, citing the 2025 BRICS Ministerial Declaration and the BRICS Climate Partnership as guiding policy structures. It argues that Brazil's low-cost active mobility models are highly transferable to densely populated cities in countries like India and South Africa, which face similar structural gaps in transport capacity. The study concludes that while*

*institutional gaps in GHG accounting persist, these local initiatives offer a scalable foundation for resilient, low-carbon urban transition across emerging economies.*

**Keywords:** *climate change initiatives; mitigation; adaptation; transportation sector; Brazil*

## Introduction

The accelerating impacts of the climate crisis have intensified the urgency for cities worldwide to adopt comprehensive mitigation and adaptation strategies. Limiting global warming to 1.5°C requires a deep and immediate reduction in global greenhouse gas emissions. Urban areas, as the primary sources of these emissions and home to the majority of the global population, are both central contributors to and primary victims of the crisis. In this context, the transportation sector plays a critical role; it is one of the largest emitters of CO<sub>2</sub> and other pollutants while remaining highly vulnerable to the increasing frequency of extreme weather events, such as floods and heatwaves.

Brazil, as a leading emerging economy, faces the daunting challenge of balancing rapid urbanization with climate resilience. The domestic transport sector is particularly problematic, accounting for approximately 47% of energy-related emissions, driven largely by road-based passenger and freight transport. Over recent decades, the country has seen a marked trend toward private motorized transport, resulting in a decline of more than 30% in public transport ridership. This shift has created a "vicious cycle" where reduced demand raises costs, further exhausting a financing model that relies almost exclusively on fare revenue. While the national framework—including the National Policy on Climate Change (PNMC), the 2024 updated NDCs, and the National

Climate Plan (Plano Clima)—sets ambitious targets for carbon neutrality by 2050, local implementation remains hindered by institutional fragmentation, governance gaps, and significant spatial inequalities (Brasil, 2009, 2025a, 2025c).

This study engages with a robust body of scholarship concerning sustainable mobility transitions. Over the past fifteen years, the Institute for Applied Economic Research (IPEA) has produced critical diagnostics on Brazilian urban policy, emphasizing the need for integrated land-use and transport planning to address structural barriers (Carvalho, 2023; Carvalho et al., 2023). Furthermore, recent scholarship on "smart transportation" within the BRICS countries highlights how technological innovation and fleet electrification can mitigate environmental degradation, though progress remains uneven across the bloc (Lim et al., 2024). Despite these academic advances, a significant gap persists in the literature regarding the systematic mapping of how federal commitments are operationalized at the municipal level in the Global South.

The core research problem lies in the disconnect between national climate rhetoric and local practice. Despite the existence of the *Plano Clima* (Brasil, 2025c), we know little about how Brazilian cities are actually implementing transport-related climate actions. This knowledge gap is exacerbated by the absence of standardized methodologies for GHG accounting at the local level and a lack of quantifiable emissions data, which

prevents a precise measurement of the impact of individual municipal initiatives. Without understanding the maturity and coherence of these local actions, the potential for upscaling successful models remains untapped.

This paper seeks to analyze how Brazilian cities are advancing climate action in the transport sector by examining 26 initiatives identified in the “Urban Climate Initiative Mapping” developed by the Ministry of Cities (Brasil, 2025b). The research is guided by three primary questions: (I) What is the current stage of implementation of transport-related climate actions in Brazilian municipalities? (II) What are the primary synergies and trade-offs between these initiatives and the national *Plano Clima*? (III) How can these local models be replicated across other BRICS countries facing similar structural challenges?

This study contributes to the field by providing a multidimensional overview of multilevel climate governance and identifying replicable, low-cost pathways for resilient urban mobility. The manuscript is structured as follows: Section 2 details the qualitative-analytical methodology; Section 3 explores the regulatory and social dimensions of the Brazilian case; Section 4 provides a detailed analysis of the 26 measures; Section 5 discusses applicability to the BRICS context; and Section 6 presents the conclusions.

## Methodology

This study adopts a qualitative-analytical approach based on secondary data derived from the Urban Climate Initiative Mapping developed by the Brazilian Ministry of Cities (Brasil, 2025b). The mapping is a federal initiative designed to compile and systematize municipal-level climate

actions across Brazil, providing a national overview of local mitigation and adaptation efforts. It gathers information reported by municipalities, including sectoral classification, implementation status, and policy relevance, with the objective of supporting multilevel climate governance and strengthening coordination between local and national strategies.

The database covers a wide range of sectors—such as transport, energy, waste, and urban infrastructure—and reflects the growing role of cities in addressing climate change, particularly in a context where urban areas concentrate both emissions and climate vulnerabilities.

## Data Selection and Scope

From the full dataset, initiatives related to urban mobility and transport were identified through a two-stage filtering process. First, sectoral tags and classifications provided within the mapping were used to isolate mobility-related initiatives. Second, a qualitative screening was conducted to ensure substantive relevance to the research objectives.

The inclusion criteria comprised (i) explicit connection to urban mobility or transport systems; (ii) potential contribution to greenhouse gas (GHG) emissions reduction; and (iii) sufficient descriptive information to allow classification and comparative analysis. Whereas, exclusion criteria included; (i) initiatives exclusively focused on climate adaptation without mitigation co-benefits; (ii) actions lacking sufficient documentation; and (iii) measures not directly associated with urban mobility systems. This process resulted in a refined analytical sample, reducing the broader dataset to

a subset aligned with the study's focus on transport-related mitigation strategies.

### ***Analytical Framework and Coding***

To ensure systematic analysis, a structured classification framework was developed. Each initiative was coded according to three dimensions; (i) type of intervention (e.g., active mobility, public transport improvement, electrification); (ii) stage of implementation (planned, ongoing, completed); and (iii) degree of alignment with national and international policy frameworks.

A visual coding system was applied, in which completed initiatives were marked in green and ongoing initiatives in yellow. This approach enabled comparative assessment of initiative maturity, thematic distribution, and policy coherence.

### ***Assessment of Alignment, Synergies, and Trade-offs***

The study evaluates how local initiatives align with the Brazilian Climate Plan (2024–2035) and the United Nations Sustainable Development Goals (SDGs). Alignment was assessed qualitatively by mapping each initiative against relevant mitigation strategies and policy targets.

Synergies and trade-offs were identified through interpretative analysis. Synergies refer to cases in which initiatives simultaneously advance emissions reduction, urban accessibility, and social inclusion (e.g., active mobility projects improving both climate outcomes and urban equity). Trade-offs were identified where implementation constraints—such as limited institutional capacity, funding gaps, or spatial inequalities—may

reduce the effectiveness or distributive benefits of climate actions.

### ***Validation and Reliability***

To enhance reliability, the coding process followed standardized criteria applied consistently across all cases. Where necessary, initiative descriptions were cross-checked with publicly available policy documents and institutional reports to ensure coherence and reduce classification bias. Although the study relies on secondary data, this triangulation contributes to analytical robustness.

### ***Limitations***

This study is subject to important limitations. First, the analysis depends on the completeness and accuracy of the Ministry's database, which may vary across municipalities. Second, the lack of standardized and quantifiable emissions data limits the ability to measure the precise mitigation impact of individual initiatives. Third, the qualitative nature of the assessment introduces a degree of interpretative subjectivity, particularly in evaluating synergies and trade-offs. Despite these constraints, the methodology provides a structured and replicable approach for analyzing the role of local initiatives within Brazil's climate governance framework.

### ***The Brazilian Case: Social, Technological, and Regulatory Dimensions Governance and Sustainability in the Transport Sector***

Brazil's climate governance architecture is grounded in the National Policy on Climate Change (Política Nacional sobre Mudança do Clima - PNMC), established by Law No. 12.187/2009 (Brasil, 2009) and

regulated by Decree No. 7.390/2010. The PNMC constitutes a milestone in integrating climate considerations into national development strategies, creating institutional mechanisms to advance mitigation and adaptation across all major economic sectors. Notably, it identifies urban mobility and transport as strategic levers both to reduce emissions and to strengthen the resilience of cities to climate-related impacts.

Building on this foundation, Brazil's Nationally Determined Contributions (NDCs), updated in November 2024, commit the country to reducing greenhouse gas (GHG) emissions by 59%–67% by 2035, which reaffirms the centrality of low-carbon transport systems, emphasizing the transition to electric mobility, the expansion of biofuel infrastructure, and the coordination of transport and land-use planning as critical pathways to decarbonization (Brasil, 2025a).

To operationalize these national goals, the federal government launched the National Climate Plan (Plano Clima), which organizes climate action into two overarching pillars, mitigation and adaptation, and establishes sector-specific guidelines, including dedicated Mitigation and Adaptation Plans for Transport and for Cities. Urban mobility is treated as a cross-cutting priority, with the plan orienting Brazil's long-term transition toward a carbon-neutral economy by 2050 while fostering inclusive growth, energy efficiency, and improved resilience to extreme climate events (Brasil, 2025c). The transport sector remains one of the country's most significant sources of CO<sub>2</sub> emissions, accounting for roughly 47% of energy-related emissions, primarily driven by road-based freight and passenger transport. Accordingly,

the Sectoral Plan for Urban Mobility and Transport under the Plano Clima prioritizes three strategic axes: (i) the transition to cleaner energy sources (such as biofuels and electric or hybrid vehicles); (ii) the promotion of active and collective mobility (walking, cycling, and high-capacity mass transit); and (iii) the integration of digital and systemic innovations for traffic management, operational efficiency, and emissions monitoring. These federal policies converge with the National Urban Mobility Policy (Law No. 12.587/2012), which reinforces sustainable and equitable mobility as core principles, in alignment with Sustainable Development Goal 11 (Sustainable Cities and Communities) (Brasil, 2012).

Climate mobility governance in Brazil operates through a multilayered coordination framework that combines federal strategic direction with decentralized implementation at the state and municipal levels. The Ministry of Cities, re-established in 2023, plays a central role by managing the Urban Climate Initiative Mapping and integrating transport, urban development, and climate agendas (Brasil, 2025b). Simultaneously, the Ministry of Environment and Climate Change (MMA) oversees the overarching governance of the National Climate Plan, ensuring alignment across sectoral actions and monitoring progress toward national targets (Brasil, 2025b).

At the federal level, climate governance is structured around sectoral committees and technical working groups, including the Executive Group on Climate Change (GEx-Clima) and the National Commission for Climate Change

(CNMC) (Brasil, n.d.-a). State and municipal governments play an equally critical role, supported by the decentralization framework established under the PNMC. Cities are encouraged and in many cases mandated to develop Municipal Climate Plans and Sustainable Urban Mobility Plans (Brasil, 2025c).

These instruments act as operational extensions of national climate commitments, translating NDC and Plano Clima targets into context-specific strategies. Despite these advances, persistent challenges remain, including gaps in technical capacity, the absence of standardized methodologies for GHG accounting, institutional fragmentation, and restricted access to long-term financing mechanisms, which often prevent projects from progressing beyond pilot or demonstration stages.

In terms of financing, Brazil has established innovative mechanisms such as the Green Climate Fund (Fundo Clima), managed by the National Bank for Economic and Social Development (BNDES). This fund supports projects in low-carbon transport, electric bus fleets, and infrastructure for active mobility. International cooperation particularly through the BRICS New Development Bank (NDB) also plays a growing role in supporting Brazil's sustainable transport transitions, providing loans for electric bus systems and sustainable logistics corridors (BNDES, n.d.).

Data monitoring and accountability mechanisms are also central to governance. The National Emissions Registry System (SIRENE) consolidates sectoral emissions data, while digital platforms maintained by the MMA and the Ministry of Transport track key indicators on mobility

performance, emissions reduction, and social equity. These monitoring tools are essential for increasing transparency, guiding decision-making, and ensuring that municipal actions remain aligned with national and international climate commitments (Brasil, n.d.-b).

Public policies in the transport sector are particularly important because they create the regulatory and institutional environment necessary for adopting new technologies and mobility alternatives that will directly affect the daily lives of millions of Brazilians. Well-designed policies provide clear parameters for the expansion of electric mobility, sustainable logistics, intelligent transport systems, and infrastructure for active mobility. Ultimately, these governance instruments shape not only the future of Brazil's transport sector but also its capacity to achieve the Sustainable Development Goals and secure a more just, resilient, and low-carbon urban future (Newman & Jennings, 2023; Nijhuis, 2013).

### **Sustainable initiatives and challenges in the Brazilian Transport Sector**

The Institute for Applied Economic Research (IPEA) has produced several studies on urban mobility in Brazil over the past fifteen years, highlighting diagnosis, policy formulation, regulatory analysis, and the design of structural solutions for the transport sector, the main findings are herein summarized (Carvalho, 2023; Carvalho et al., 2023).

One of the core analytical axes examined in the reviewed studies concerns the Pact for Urban Mobility, developed in response to the 2013 social mobilizations. This policy framework prioritized public and non-

motorized transport through four main pillars: (i) subsidies and tax exemptions for public transport inputs; (ii) new operational financing models and mechanisms to address fare exemptions; (iii) governance and metropolitan management, including shared institutional arrangements among municipalities; and (iv) urban planning oriented toward active mobility and integrated land use and transport planning.

In this context, IPEA studies have shown that, despite the Pact for Urban Mobility as well as advances in research, diagnostics and policy proposals, Brazil's urban mobility system continues to face long-standing structural barriers that hinder both modernization and the shift toward more sustainable solutions. One of the central challenges is the strong dependence on private motorized transport, a trend that has intensified over recent decades with the rapid growth of car and motorcycle fleets and the decline of more than 30% in public transport ridership. This dynamic fuels a vicious cycle: reduced demand raises operating costs, which increases fares and further reduces the attractiveness of public transport, an obstacle to implementing modern, integrated and sustainable systems.

A second major challenge lies in the financing model, which relies almost exclusively on fare revenue. IPEA highlights the exhaustion of this model, which worsens inequalities and restricts the capacity to modernize fleets, expand networks or invest in new technologies and low-emission systems. The lack of consistent extratarriff funding sources, such as metropolitan mobility funds, congestion charges or structured subsidies, makes implementing

innovative solutions significantly more difficult.

Governance and institutional coordination remain major obstacles, particularly due to the weak integration among municipalities in metropolitan regions, which limits multimodal solutions and increases travel times and costs. These challenges are compounded by the heavy burden of negative externalities, such as congestion, air pollution, and traffic accidents, with especially high fatality rates involving motorcycles. In addition, the dispersed and unequal urban form of Brazilian cities, characterized by long distances between housing and economic opportunities, reinforces dependence on motorized transport and makes the implementation of sustainable models such as Transit-Oriented Development (TOD) more difficult.

Despite these challenges, there are important opportunities. A major strength is the robust base of technical studies, methodologies and planning instruments developed by IPEA, which offer valuable guidance for designing more integrated and sustainable mobility policies, including new funding models, modernized regulatory frameworks and improved governance structures. There is also growing potential for expanding public transport and active mobility, supported by IPEA's proposals for BRT corridors, light rail systems, integrated bus networks and cycling infrastructure. These modes reduce emissions, ease congestion and improve access to opportunities, particularly for low-income populations disproportionately affected by poor transport conditions.

Another promising perspective comes from advances in accessibility and spatial equity research. Recent

studies quantify disparities in access to jobs, healthcare and education, offering a solid evidence base for policies that prioritize investments where social impact is greatest and align with the Sustainable Development Goals. Digital technologies also open new possibilities: electronic ticketing, real-time data, integrated mobility platforms and app-based transport services can enhance operational efficiency, reduce costs and improve user experience. Additionally, non-transport policies such as telework, also studied by IPEA, can reduce traffic volumes and emissions.

Brazil stands at a crossroads: it faces significant structural obstacles, dependence on private vehicles, a fragile financing system, spatial inequalities and fragmented governance yet it also possesses a substantial body of knowledge, diagnostics and proposals that can guide a transformative agenda for the sector. Implementing new mobility solutions will depend on political commitment, a renewed federative pact for mobility and robust funding mechanisms to ensure service quality and universality. With these elements in place, Brazil has strong potential to advance toward more efficient, inclusive and sustainable urban mobility systems, aligned with contemporary development demands and global climate challenges (Nijhuis, 2013; Van Nunen et al., 2010).

**Analysis of Measures**

This study draws on the Urban Climate Initiative Mapping, developed by the Brazilian Ministry of Cities (Brasil, 2025b), which provides a comprehensive national overview of municipal-level climate actions in both mitigation and adaptation. From this dataset, all initiatives related to the urban mobility and transport sector were isolated for analysis, with particular emphasis on mitigation-oriented measures that directly or indirectly contribute to reducing GHG emissions and advancing sustainable mobility.

To support the analytical process, a synthetic classification table was created, organizing the selected initiatives according to the three analytical parameters described above. In this table, completed measures are highlighted in green, indicating full implementation and operational status, while ongoing measures are marked in yellow, denoting actions currently under execution but not yet concluded. This visual structure aims to facilitate a clear comparison of initiative maturity, thematic focus, and alignment with broader policy frameworks, enabling the identification of recurring patterns, existing gaps, and opportunities for scaling within Brazil’s national climate governance system.

| Measure (Name of Initiative and Brief Description) | Relationship with the UN (SDGs) | Synergy and Trade-off with the Climate Plan (Transportation) |
|----------------------------------------------------|---------------------------------|--------------------------------------------------------------|
|                                                    |                                 |                                                              |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Mobility in Transformation (Boulevard Beira Rio, Registro-SP)</b></p> <p>Transformation of urban space, expansion of infrastructure for pedestrians and cyclists (600 m of bike lanes, 1,400 m<sup>2</sup> of pedestrian areas), promoting more sustainable travel.</p> | <p>Strongly linked to SDG 11 (Sustainable Cities) by focusing on safe and inclusive infrastructure for active mobility.</p> | <p>Synergy: Strong. Mitigation project focused on Active Mobility, aligned with the goals of the Cities Sectoral Climate Plan. Contributes to modal shift (motorized to non-motorized vehicles).</p>                                                                                                          |
| <p><b>Construction of sidewalks in areas where they did not previously exist (Louveira-SP)</b></p> <p>Improvement of pedestrian infrastructure.</p>                                                                                                                           | <p>Related to SDG 11 (Sustainable Cities).</p>                                                                              | <p>Synergy: Contributes to encouraging active transportation (walking).</p> <p>Trade-off/Limitation: No direct relationship with GHG emissions reduction in isolation; it is an infrastructure improvement that should be included in a more comprehensive action plan with avoided emissions indicators.</p> |
| <p><b>Ecomilhas - Decarbonization through rewards</b></p> <p>Carbon management platform for corporate travel (Scope 3), which encourages the use of sustainable transport (public, active, electric, ethanol) through gamification and rewards. In progress</p>               | <p>Related to SDG 13 (Climate Action) and SDG 8 (Decent Work and Economic Growth).</p>                                      | <p>Synergy: Strong. Private initiative aligned with GHG management and reduction in Scope 3 emissions inventories. Has already contributed to avoiding 244,650 tons of CO<sub>2</sub>.</p>                                                                                                                    |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Routes accessible to Federal District Public Facilities</b></p> <p>Definition of priority locations for investments in accessibility, creating continuous and safe routes for pedestrians, especially people with disabilities and reduced mobility.</p> | <p>Strongly linked to SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable Cities and Communities).</p>                                              | <p>Synergy: Strong relationship with sustainability and accessibility.</p> <p>Trade-off/Limitation: No direct relationship with Climate Change Mitigation. It is suggested to migrate to the 'Sustainability without CM' category.</p>                                                                                                                                                                                                                                |
| <p><b>Lighting for the SP – 063 Cycle Path</b></p> <p>Installation of lighting on the SP-063 bike path to extend hours of use</p>                                                                                                                              | <p>SDG 7 (Affordable and Clean Energy)</p> <p>SDG 9 (Industry, Innovation, and Infrastructure)</p> <p>SDG 11 (Sustainable Cities and Communities)</p> | <p><b>Synergy:</b></p> <p>Improves safety and accessibility of low-carbon mobility infrastructure, reinforcing the mitigation potential of the <b>Transport</b> sector within the Climate Plan.</p> <p><b>Trade-off / Limitation:</b></p> <p>Potential increase in energy consumption and light pollution. The mitigation benefits depend on the use of efficient, low-carbon lighting technologies and on proper design to avoid unnecessary electricity demand.</p> |
| <p><b>Implementation of quiet areas in the municipality of Louveira</b></p> <p>Installation of calm zone signage in municipal schools</p>                                                                                                                      | <p><b>SDG 3</b> (Good Health and Well-being)</p> <p><b>SDG 4</b> (Quality Education)</p>                                                              | <p><b>Synergy:</b></p> <p>Strengthens adaptation and well-being objectives by improving acoustic comfort and safety in school environments, contributing to broader urban</p>                                                                                                                                                                                                                                                                                         |

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|                                                                                                                    | <b>SDG 11</b><br>(Sustainable Cities and Communities)                                                                                                                                                        | resilience actions within the Climate Plan.<br><br><b>Trade-off / Limitation:</b><br>Limited direct contribution to mitigation. Effectiveness depends on enforcement and complementary measures to manage traffic and noise sources in surrounding areas.                                                                                                                                                                                                                                                  |
| <b>Cycling Tourism Policy - Rural Tourism Cycle Route</b> Making cycle routes accessible to residents and visitors | <b>SDG 8</b> (Decent Work and Economic Growth)<br><br><b>SDG 11</b> (Sustainable Cities and Communities)<br><br><b>SDG 12</b> (Responsible Consumption and Production)<br><br><b>SDG 13</b> (Climate Action) | <b>Synergy:</b><br>Promotes sustainable mobility and low-carbon tourism, supporting mitigation in the <b>Transport</b> sector and generating local economic opportunities that align with climate-resilient development.<br><br><b>Trade-off / Limitation:</b><br>Requires adequate maintenance and monitoring of environmental impacts (e.g., increased flow of visitors in rural areas). Mitigation potential depends on replacing car-based trips with cycling rather than adding new transport demand. |

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| <p><b>Discover João Pessoa by Bike</b></p> <p>The proposal presents a possibility for decarbonizing tourism activities (one of the largest sources of GHG emissions) in the city by offering 12 cycling routes that cover the entire city. Traditional communities have been involved and manage the routes, which aim not only to be a decarbonization initiative, but also an alternative to ensure the social, infrastructure, and ecosystem resilience that make the routes attractive.</p>             | <p><b>SDG 8</b> (Decent Work and Economic Growth)</p> <p><b>SDG 11</b> (Sustainable Cities and Communities)</p> <p><b>SDG 12</b> (Responsible Consumption and Production)</p> <p><b>SDG 13</b> (Climate Action)</p> | <p><b>Synergy:</b></p> <p>Supports low-carbon tourism while fostering community-based economic opportunities. Reduces transport-related GHG emissions and enhances resilience by integrating social inclusion and ecosystem protection into tourism mobility.</p> <p><b>Trade-off / Limitation:</b></p> <p>The real mitigation potential depends on replacing conventional, high-emission tourism activities (e.g., vans, cars) with cycling. Requires strong governance and maintenance to prevent environmental pressure on natural and cultural areas along the routes.</p> |
| <p><b>CIMOB (Urban Mobility Travel Circuit)</b></p> <p>The proposal consists of teaching children to be pedestrians and cyclists and promoting the use of public transportation through education, art, joy, and play. The institution has a traveling traffic circuit called CIMOB, and the project's main objective is to promote the importance of active modes of transportation in school environments. In this space, preschool and elementary school students experience sustainable mobility as</p> | <p><b>SDG 3</b> (Good Health and Well-being)</p> <p><b>SDG 4</b> (Quality Education)</p> <p><b>SDG 11</b> (Sustainable Cities and Communities)</p>                                                                  | <p><b>Synergy:</b></p> <p>Strengthens long-term sustainable mobility culture by shaping healthier, low-carbon travel habits from an early age. Supports behavioral change that complements the mitigation goals of the <b>Transport</b> sector and enhances safety and inclusiveness in school environments.</p> <p><b>Trade-off / Limitation:</b></p> <p>Indirect contribution to GHG</p>                                                                                                                                                                                     |

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| <p>pedestrians and cyclists, accompanied by monitors specialized in appropriating the children's existing experiences, the object of the action, proposing democratic behaviors regarding healthy travel choices, generating discussions, and channeling actions that reflect short-, medium-, and long-term behavioral change.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>SDG 13 (Climate Action)</p>                                                  | <p>reduction, as impacts depend on long-term behavioral changes and broader infrastructure availability. Requires ongoing funding, trained staff, and integration with municipal mobility policies to remain effective.</p>                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>Bike paths and bike lanes</b></p> <p>The City of Vitória da Conquista, through the Secretariat of Urban Mobility, has intensified its actions aimed at promoting active and sustainable urban mobility through the maintenance, revitalization, and expansion of bicycle infrastructure in the municipality. The revitalization of horizontal and vertical signage on bike paths and lanes already implemented in the city ensures greater safety for cyclists and greater visibility of areas designated for the exclusive or preferential use of bicycles. In addition to maintenance, the City Government is also expanding the bike path network. One example is the construction of 300 meters of new bike lanes on an important city road, which will offer more comfort and safety for bicycle users, in addition to encouraging</p> | <p>SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).</p> | <p><b>Synergy:</b></p> <p>Improves safety, comfort, and reliability of cycling, increasing the attractiveness of zero-emission transport. Reinforces the Climate Plan’s mitigation potential by encouraging modal shift from motorized transport to bicycles, with co-benefits for public health, social inclusion, and urban quality of life.</p> <p><b>Trade-off / Limitation:</b></p> <p>Infrastructure expansion requires land, investment, and coordination with existing road networks. Mitigation benefits may be limited if car use does not decrease correspondingly or if maintenance is inconsistent over time.</p> |

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| <p>healthier and more sustainable lifestyles.</p> <p>These actions reflect the understanding that investing in cycling infrastructure is not only an improvement in mobility, but a cross-cutting strategy that positively impacts public health, the environment, social inclusion, and urban quality of life. The City remains committed to ensuring that bike lanes and bike paths are in good condition, promoting a fairer, safer, and more efficient transportation system for the entire population.</p> |                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>Bicycle path system in the municipality of Ponta Porã</b></p> <p>The municipality of Ponta Porã shares a land border with the city of Pedro Juan Caballero (Paraguay), and bicycle paths are being built along the international border that divides the two countries (Brazil and Paraguay), with completion scheduled for 2025. This project was also carried out with funds acquired by the Financial Fund for the Development of the River Plate Basin (FONPLATA).</p>                                | <p>SDG 9 (Industry, Innovation, and Infrastructure)</p> <p>SDG 11 (Sustainable Cities and Communities)</p> <p>SDG 13 (Climate Action)</p> | <p><b>Synergy:</b></p> <p>Promotes cross-border sustainable mobility, contributing to GHG mitigation by encouraging zero-emission transport between two interconnected cities. Supports regional integration, safer mobility, and equitable access to infrastructure.</p> <p><b>Trade-off / Limitation:</b></p> <p>Effectiveness depends on coordination between Brazil and Paraguay regarding safety, signage, maintenance, and traffic rules. Mitigation potential may be limited if cycling infrastructure is not paired with measures that</p> |

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|                                                                                                                                                                                                                                              | SDG 17<br>(Partnerships for the Goals)                                                              | discourage high-emission transport across the border. Cross-border governance and operational challenges may slow implementation or reduce usage.                                                                                                                                                         |
| <b>CLEAN ENERGY FOR ALL!</b><br><br>Research project to promote the generation of Biofuel (H2) through the “Dark-Fermentation” process of microalgae biomass, establishing parameters for hydrogen production.                               | Related to SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation, and Infrastructure) | Synergy: Mitigation Potential. The Climate Plan includes the Energy and Transportation sectors.<br><br>Trade-off/Limitation: Experimental initiative that requires more technical detail (results, justification, phase) to assess mitigation potential relative to the Business As Usual (BAU) scenario. |
| <b>LEED BD+C Certification Project - Anália Franco Station</b><br><br>Registration of the Anália Franco Station (Metro) project to obtain LEED certification, focusing on sustainable construction, pollution prevention, and waste control. | Related to SDG 9 (Infrastructure) and SDG 11 (Sustainable Cities).                                  | Synergy: Mitigation through energy efficiency, with an estimated reduction of 214.61 tons of CO2.<br><br>Trade-off: The initiative is more related to the Energy/Buildings sector (as it is a LEED project)                                                                                               |

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|                                                                                                                                                                                                                                                                          |                                                                                       | than directly to the Transportation/Mobility sector, despite being a subway station.                                                                                                                                                                |
| <p><b>Sandbox.Rio (Eletroposto Carioca Project)</b></p> <p>Pioneering implementation of electric charging stations in public areas in Rio de Janeiro for electric mobility, operating in a controlled regulatory environment.</p>                                        | <p>Related to SDG 7 (Clean Energy) and SDG 9 (Innovation).</p>                        | <p>Synergy: Strong. Contributes to the energy transition and facilitates the adoption of electric vehicles, in line with mitigation in the Transportation/Energy sector. Has already generated an estimated 50 tons of CO<sub>2</sub> avoided.</p>  |
| <p><b>atrAI Bikes:</b></p> <p>More data for better cycling infrastructure – International research using sensors attached to bicycles to collect urban mobility data (distance from traffic, quality of bike lanes) and environmental data (temperature, fine dust).</p> | <p>Related to SDG 9 (Innovation) and SDG 11 (Sustainable Cities).</p>                 | <p>Synergy: Indirect potential. This involves research and data management that can support improvements in road safety and cycling infrastructure. To be considered mitigation, the potential for GHG reduction must be proven in application.</p> |
| <p><b>Construction of a bike path connecting the city center to the Bairro Alto Bonito neighborhood (Brejo de Areia-MA)</b></p> <p>Expansion of bike path infrastructure.</p>                                                                                            | <p>Related to SDG 3 (Good Health and Well-Being) and SDG 11 (Sustainable Cities).</p> | <p>Synergy: Aligned with mitigation in transportation (shift to non-motorized modes).</p> <p>Limitation: More information is needed for the catalog, such as</p>                                                                                    |

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|                                                                                                                                                                                                                                                    |                                                                                   | the square kilometers of bike paths and estimates of the number of users and emissions reductions compared to the BAU scenario.                                                                                                                                                                                          |
| <p><b>Sustainable Urban Mobility in Canaã dos Carajás</b></p> <p>Set of actions that includes 57 km of bike lanes, accessible sidewalks, LED lighting, construction of housing close to services, and implementation of public transportation.</p> | Strongly linked to SDG 11 (Sustainable Cities) and SDG 10 (Reduced Inequalities). | Synergy: Strong. A robust set of actions that contributes to GHG reduction by encouraging active transportation and mixed land use, reducing distances. It is recommended to detail GHG reduction estimates for greater robustness.                                                                                      |
| <p><b>Suzano Cycling and Active Mobility Plan</b></p> <p>Development of a plan to enable public authorities and society to adopt alternative, non-polluting, low impact means of transportation. Completed (Diagnosis performed)</p>               | Related to SDG 11 (Sustainable Cities) and SDG 13 (Climate Action).               | Synergy: Institutional synergy. It is a public policy (plan) that, once implemented, will have mitigation potential in the transport sector. Limitation: GHG reduction depends on the implementation of actions, requiring the allocation of financial resources and the setting of short-, medium-, and long-term goals |
| <p><b>Caminho dos Lírios: Regenerative Mobility and Sustainable Tourism in the Atlantic Forest (Juquitiba-SP)</b></p>                                                                                                                              | Related to SDG 11 (Sustainable Cities), SDG 13 (Climate Action),                  | Synergy: Mitigation by encouraging active transportation (cycle tourism). Synergy with adaptation and education.                                                                                                                                                                                                         |

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| Ecotourism/Cycling tourism in green corridors of active mobility, aiming to reduce dependence on individual motorized transport.                                                                                                                                                            | and SDG 15 (Life on Land).                                                        | Limitation: Need to estimate GHG reduction potential in a BAU scenario, quantifying vehicles replaced by bicycles or walking and kilometers of trails/routes.                                                                         |
| <b>Urban mobility (Camaçari)</b><br><br>Renewal of the public transport fleet with the acquisition of 30 new electric buses (via Novo PAC Seleções) and construction of terminals. In progress (Renewal/planning process)                                                                   | Strongly linked to SDG 11 (Sustainable Cities) and SDG 10 (Reduced Inequalities). | Synergy: Strong. Replacement of fleet with electric vehicles, directly related to the reduction of GHG and pollutants. Aligned with the New PAC. Limitation: Need to request data on the status of the process (bidding, acquisition) |
| <b>Sustainable Urban Mobility – Inter 2 and Electric BRT Projects, Better Walking, and Bicycle Plan (Curitiba)</b><br><br>Modernization of the Inter 2 and BRT lines with electric buses (New PAC funds), and improvement of infrastructure for active mobility (sidewalks and bike lanes). | Related to SDG 11 (Sustainable Cities) and SDG 13 (Climate Action).               | Synergy: Strong. Combines fleet electrification and encouragement of active mobility. Reinforces the importance of reducing GHG emissions from fossil fuels and is aligned with the goals of the Cities Sectoral Climate Plan.        |
| <b>Reformulation of Municipal Public Transportation in Rio Verde, Goiás</b>                                                                                                                                                                                                                 | Related to SDG 11 (Sustainable Cities) and SDG 10 (Reduced Inequalities).         | Synergy: Mitigation through fleet replacement and reduced fuel consumption.                                                                                                                                                           |

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| Implementation of a new system with minibuses (lower fuel consumption), smart ticketing, and social tariffs.                                                                              |                                                                                      | Limitation: Requires greater technical detail and an estimate of GHG reduction to quantify the impact of the new fleet.                                                                                                                                                                                                    |
| <p><b>Conquista 15 minutes (Vitória da Conquista)</b></p> <p>Improvement of public transport (exclusive bus lanes and expanded/modernized fleet) to reduce travel time and emissions.</p> | Explicitly aligned with SDG 11 (inclusive, safe, resilient, and sustainable cities). | <p>Synergy: Mitigation through improved and more efficient public transport, encouraging reduced use of private vehicles.</p> <p>Limitation: More detail is needed on the estimated GHG reduction and the status of implementation of bus lanes and vehicle replacements.</p>                                              |
| <p><b>Encouraging the use of public transport (Assis)</b></p> <p>Offering free public transport to the entire population.</p>                                                             | Related to SDG 11 (Sustainable Cities) and SDG 10 (Reduced Inequalities).            | <p>Synergy: Mitigation by encouraging public transportation and reducing individual use.</p> <p>Trade-off: No direct relationship with climate change, and the acquisition of a conventional bus fleet may lead to increased GHG emissions (depending on the fuel and the rate of replacement of individual vehicles).</p> |

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| <b>Walking Together (São Paulo)</b><br><br>Collaborative project with women from communities bordering the Pinheiros River to analyze walking routes, with a gender and race perspective, and co-construct solutions for access to public spaces. | Strongly linked to SDG 5 (Gender Equality), SDG 10 (Reduced Inequalities), and SDG 11 (Sustainable Cities and Communities). | Synergy: Mitigation potential by encouraging active transportation (walking).<br><br>Synergy with the guiding principle of the Climate Plan: Addresses Climate Justice and the inclusion of gender and race issues in climate policy. Requires GHG reduction estimate. |
| <b>Air Quality Program (PROAR) (Santo André)</b><br><br>Inspection of diesel-powered vehicles to measure smoke opacity and reduce vehicle air pollution.                                                                                          | Related to SDG 3 (Good Health and Well-being) and SDG 11 (Sustainable Cities).                                              | Trade-off/Limitation: The main focus of the initiative is air quality and air pollutants (smoke opacity), and it has no direct relationship with climate change mitigation (GHG) in the transport sector.                                                              |

The set of measures analyzed demonstrates a broad and multidimensional effort to advance sustainable urban mobility, climate mitigation, and social inclusion in Brazilian municipalities, reflecting strong alignment with the UN SDGs (United Nations, n.d.), particularly SDG 11 on sustainable cities and SDG 13 on climate action. The majority of the initiatives are still being developed and many focus on the expansion and qualification of active mobility infrastructures such as new bike lanes, revitalized pedestrian areas, accessible sidewalks, signage for quiet school zones, and cross-border cycling networks.

These interventions not only contribute to transforming urban space and promoting healthier, low-carbon transport options but also enhance public safety, gender-sensitive urban design, and social inclusion. Their climate mitigation potential emerges mainly through modal shift from motorized vehicles to walking and cycling; however, this potential depends on whether the new infrastructure actually replaces car trips. Some initiatives, such as cycle path lighting, also introduce trade-offs associated with increased energy demand, which can be mitigated by adopting efficient and renewable-based lighting systems.

Tourism-related cycling projects, including citywide cycle routes and rural ecotourism corridors, demonstrate how active mobility can integrate economic development, social participation, and environmental preservation. These actions support SDGs 8, 12, and 15 by generating local income opportunities, promoting responsible tourism, and reducing transportation emissions linked to visitor mobility. Nevertheless, their contribution to climate mitigation depends on whether cycling substitutes motorized tourism activities rather than creating additional transport demand. Successful implementation also requires strong governance to manage visitor pressure and ensure the maintenance of natural and cultural assets along the routes.

Public transport modernization constitutes another central axis of climate action within the group of measures. Projects involving electric bus fleets, restructuring BRT and Inter 2 corridors, installation of new public transport terminals, and improvements in service reliability and accessibility present some of the strongest and most direct mitigation impacts, given the significant potential for reducing fossil fuel consumption and greenhouse gas emissions.

These initiatives also reinforce the equity dimension of mobility policy by improving access to essential services and reducing travel time, aligning with SDG 10. However, their successful implementation depends on substantial financial resources, the availability of adequate charging infrastructure, regulatory stability, and long-term political commitment. More innovative service models, such as minibuss systems with smart ticketing and free-fare public transport programs,

contribute to increased ridership and reduced car dependence, although their climate impact depends on the composition of the vehicle fleet and effective integration with land-use strategies.

Education and behavioral-change initiatives complement the infrastructure-based measures by shaping long-term mobility habits and fostering a culture of sustainable and safe transport choices. Programs that engage children in mobility education, co-design walking routes with women in vulnerable communities, or create quiet zones around schools contribute to the development of more inclusive, safer, and more resilient urban environments. These initiatives are strongly aligned with SDGs 3, 4, 5, and 10 and address climate justice by placing marginalized groups at the center of mobility planning. Although their mitigation effects are indirect and long-term, they are essential for sustaining the transition toward low-carbon mobility and for ensuring that infrastructure investments translate into real behavioral shifts.

Innovation and energy-transition projects broaden the scope of action by introducing new technological pathways for decarbonization. Electric vehicle charging infrastructure, corporate mobility reward platforms, sensor-based data collection for cycling, hydrogen production research, and sustainable building certification for transit infrastructure all support SDGs 7 and 9 while contributing to the modernization of urban systems. Some of these initiatives, such as the implementation of public EV charging stations or corporate gamification for low-carbon travel, already demonstrate measurable emissions reductions.

Others, such as hydrogen research and data collection projects, are still in exploratory stages and require further evidence to accurately assess their mitigation potential. Mobility planning initiatives, such as municipal cycling or mobility master plans, provide institutional frameworks that can guide long-term investments and ensure coherence with climate commitments, though their impact ultimately depends on effective implementation.

Finally, regulatory and monitoring measures, such as diesel-vehicle smoke opacity inspections, strengthen environmental governance and improve air quality, contributing to public health and SDG 3. Although these measures do not directly target greenhouse gas emissions, they offer important co-benefits and indicate a broader commitment to regulating externalities from the transport sector.

Overall, the collection of measures reveals a strong convergence between local mobility policies and global sustainability agendas. Active mobility expansion, public transport modernization, behavioral change programs, technological innovation, and environmental regulation work in complementary ways to reduce emissions, improve urban quality of life, and enhance resilience (Newman & Jennings, 2023). The main challenges identified relate to the need for robust quantification of GHG reductions, long-term maintenance of infrastructure, financial viability of large-scale projects, and cross-agency coordination. Even so, the initiatives collectively demonstrate how municipalities can operationalize the principles of sustainable mobility and climate action through context-specific interventions that generate multiple

social, economic, and environmental benefits (Nijhuis, 2013).

### **Analysis of applicability to other BRICS' countries**

The BRICS is an international cooperation group formed by emerging economies with growing political, economic, and strategic relevance on the global stage. It was created in 2006 by Brazil, Russia, India, and China, and expanded in 2011 with the accession of South Africa. In 2024–2025, the bloc underwent its largest expansion, incorporating Saudi Arabia, Egypt, United Arab Emirates, Ethiopia, Indonesia, and Iran, bringing the total number of member states to eleven. This expansion resulted from the mandate established in the Johannesburg Declaration of August 2023 and reinforces BRICS as a key platform for economic development, political coordination, and the promotion of a more multipolar international order (BRICS, 2025c).

Beyond national commitments, the BRICS community has an important responsibility to collectively uphold climate justice and establish more ambitious regulatory frameworks that support global environmental stability. As major emitters and rapidly growing economies, BRICS countries must expand the implementation of sustainable mobility policies, promote nature-based solutions, and accelerate transitions toward low-carbon transport systems. Strengthening environmental governance in this context is critical not only to curbing the rise in global temperatures but also to advancing the 2030 Agenda and the Sustainable Development Goals.

The BRICS Climate Partnership (2022) established shared guidelines for advancing low-carbon transport

systems, emphasizing knowledge exchange, renewable energy expansion, and the mobilization of international financing for urban mobility projects. These initiatives reflect a growing collective effort among emerging economies to reconcile rapid economic development with long-term environmental responsibility.

The 2025 BRICS Ministerial Declaration highlights strategic priorities; sustainable urban mobility, the transition to clean-energy technologies, bus fleet renewal, and the promotion of active mobility, which serve as a shared policy framework that can guide the transfer and alignment of actions across member and partner countries. Complementary technical notes from the working group emphasize the need for resilient infrastructure, multimodal integration, and cooperative mechanisms (such as the BRICS International Logistics Alliance) that would facilitate the joint adoption of practices and technologies (BRICS, 2025a, 2025b).

A comparative study on “smart transportation” in the main BRICS countries prepared by Lim *et al.* (2024), which is subject to the following analysis, identified that the transportation sector is among the leading contributors to carbon emissions across the BRICS countries, accounting for a substantial share of total greenhouse gas emissions. Continuous population growth and urban expansion intensify the demand for mobility, which in turn exacerbates environmental degradation and congestion. These challenges manifest unevenly across the bloc. China and India primarily struggle with severe air pollution and acute congestion in their megacities, whereas Brazil, Russia, and South Africa face structural gaps in

transport capacity alongside persistently high pollution levels.

Within this scenario, the adoption of electric vehicles (EVs) is widely recognized as a key strategy for reducing carbon emissions and improving air quality in urban environments. For the BRICS nations, fleet electrification represents a strategic opportunity to respond to the combined pressures of accelerated urbanization and environmental degradation. However, progress in implementation varies significantly across member countries.

China has emerged as a global benchmark, driven by a dual policy strategy combining supply-side industrial incentives with demand-side consumer subsidies. Government commitment to accelerating the transition is reflected in market indicators: by 2019, China already accounted for more than 40% of the global electric vehicle stock.

India, in turn, has experienced growing EV adoption under the impetus of the FAME program (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles). Nevertheless, the long-term success of FAME depends on the establishment of a broader enabling ecosystem, in which consumer subsidies are synchronized with large-scale investments in charging infrastructure and advanced traffic management systems. The absence of such coordinated development currently constrains the program’s full potential.

Brazil and South Africa, by contrast, exhibit a considerably slower pace of EV adoption. Local experts consistently identify key barriers, including the high cost of electric vehicles, still inaccessible to most consumers, insufficient charging

infrastructure, and the absence of strong and consistent government incentives capable of stimulating large-scale market uptake.

Beyond private vehicle electrification, intelligent public transportation systems constitute a central pillar of urban sustainability. These systems integrate technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data analytics to enhance operational efficiency, reduce congestion, and lower emissions. By offering competitive alternatives to private car use, smart public transport plays a decisive role in promoting greener, more inclusive, and better-connected cities.

An assessment of progress across the BRICS reveals uneven stages of development in this domain. China and Brazil stand out as reference cases in the implementation of intelligent public transport systems. China has achieved large-scale deployment of electric buses alongside extensive real-time traffic monitoring platforms, substantially enhancing network efficiency and environmental performance. Brazil, in turn, has become a global model through its Bus Rapid Transit (BRT) system, particularly the system implemented in Curitiba. Internationally recognized, this BRT network produced a reported reduction of approximately 25% in vehicular emissions at the time of its implementation, establishing a significant precedent in sustainable urban mobility. While Brazil's experience prioritized the optimization of collective transport, China's strategy has placed greater emphasis on large-scale fleet electrification and digitalized real-time traffic management.

In contrast, India and Russia continue to face substantial difficulties in scaling up intelligent transport initiatives. India has expanded investments in electric buses under the framework of its "Smart Cities Mission," yet implementation remains at an early stage, constrained by inadequate infrastructure and high upfront capital costs. Russia has advanced in improving the efficiency and modernization of its railway network, but remains behind in the deployment of electric buses and other sustainable urban transit alternatives.

The successful deployment of intelligent transportation systems across the BRICS requires the integrated adoption of multiple technological and modal components, including IoT, AI, Big Data analytics, electric buses, trams, railway networks, and Bus Rapid Transit (BRT) systems. However, technological availability alone is insufficient. The effectiveness and scalability of these infrastructures are intrinsically dependent on the existence of coherent and supportive urban policies, capable of overcoming structural barriers and aligning long-term public investment with environmental and mobility objectives.

Despite the clear opportunities associated with smart and sustainable transport, the transition within the BRICS is still constrained by a set of common structural obstacles that hinder large-scale implementation. These include financial limitations, institutional fragmentation, uneven technological capacity, and regulatory uncertainty. A systematic understanding of these constraints is therefore essential for the formulation of effective strategies capable of enabling a comprehensive

transformation of urban mobility across the BRICS countries.

In this context, the measures identified in the Brazilian Ministry of Cities analysis (Brasil, 2025b) can offer significant relevance and transferability to the evolving mobility and climate agendas of the BRICS countries. The Brazilian experiences with expanding cycling networks, integrating community-based tourism into active mobility, modernizing public transport fleets through electrification, and implementing behavioral-change programs provide replicable models that can be adapted to diverse socio-economic and geographic contexts.

The large-scale expansion of active mobility infrastructure in Brazilian municipalities—such as interconnected bike lane networks, pedestrian-friendly corridors, accessible sidewalks, school safety zones, and cross-border cycling routes—can be directly applied to densely populated cities in China, India, South Africa, Egypt, and Indonesia, where short-distance motorized trips remain dominant. These interventions are relatively low-cost, rapidly deployable, and highly effective in promoting modal shift, improving public health, and reducing emissions, especially when combined with inclusive urban design that prioritizes women, children, and low-income populations.

Among the suggestions mapped by the Ministry of Cities (Brasil, 2025b), there are several initiatives involving active mobility and tourism-oriented cycling corridors, which can be easily adapted to areas where sustainable tourism is emerging as a strategic economic sector, allowing active mobility to simultaneously support local income generation,

environmental preservation, and climate mitigation. Low-cost interventions such as sidewalk construction, safe school routes, or mobility education could produce immediate safety and accessibility gains, especially where infrastructure deficits are stark.

Electrification initiatives, including the deployment of charging infrastructure and the renewal of bus fleets, where industrial capacity for electric mobility is rapidly expanding and could accelerate domestic manufacturing and regional supply chains. Across all BRICS and partner countries, the Brazilian approach of linking mobility actions with social inclusion provides a powerful framework for ensuring that climate-aligned mobility transformations are both equitable and context-sensitive.

For more significant mitigation impacts, the most replicable instrument is the renewal and electrification of public transport fleets (buses, BRT systems), accompanied by investment in charging infrastructure and tariff or social policies that maintain affordability. Both the Ministerial Declaration and the Issues Note (BRICS, 2025a, 2025b) emphasize fleet electrification as a core BRICS priority, recommending that national programs consider local industrial capacity and innovative financing mechanisms to reduce barriers to adoption. Countries with established industrial bases, China, India, and Brazil, are well positioned to lead regional supply chains for electric vehicles and batteries, while countries with more limited capacity can initially focus on priority corridors and retrofitting terminals and depots.

Innovation-oriented initiatives, such as corporate mobility management

platforms, sensor-based diagnostics for cycling infrastructure, and sustainable certification for transport stations, are recommended as complementary actions that strengthen governance, monitoring, and private-sector engagement. Successful adoption of these technologies requires interoperable data standards and public-private partnerships. The proposed BRICS Institute for Sustainable Transport, Mobility and Logistics (BISTML) could serve as a platform for technical knowledge exchange and the harmonization of key metrics, such as methodologies for estimating emissions reductions and evaluating resilience.

The main obstacles to broader adoption concern financial constraints (high upfront costs for electrification and infrastructure), institutional fragmentation (limited coordination across levels of government), and social barriers (public acceptance and land-use patterns that privilege car dependence). Overcoming these challenges requires a three-pronged strategy: (1) prioritizing quick-win interventions (sidewalks, cycling lanes, bus corridors), (2) strengthening institutional and financial readiness for larger-scale projects (electric fleets, charging infrastructure, public-private partnerships, green financing, and regional loan mechanisms), and (3) implementing capacity-building and public engagement programs that integrate gender equity, accessibility, and community participation, elements emphasized across the BRICS documents.

Finally, it is recommended that intra-BRICS cooperation leverage proposed joint instruments (BISTML, BRICS Logistics Alliance) (BRICS, 2025a, 2025b) to exchange experience

on cost-benefit evaluation, develop compendiums of best practices (particularly for port decarbonization, sustainable aviation fuels, and green logistics), and promote transnational pilot projects that test financing models and technical standards. In this way, the combination of local infrastructure measures with regional programs for technical and financial support would allow countries with different development levels to adapt and scale sustainable mobility solutions pragmatically and in alignment with the bloc's climate and social development objectives.

### **Conclusion**

This study set out to map and analyze how Brazilian municipalities are operationalizing climate action within the transport sector, specifically examining 26 initiatives from the Ministry of Cities' "Urban Climate Initiative Mapping". By evaluating these measures against the pillars of the National Climate Plan (Plano Clima) and the Sustainable Development Goals (SDGs), several key conclusions emerge regarding the current state and future trajectory of urban mobility in Brazil.

First, the findings demonstrate a significant, albeit burgeoning, commitment to active mobility and public transport modernization. The majority of initiatives analyzed—ranging from the expansion of bicycle networks in Vitória da Conquista to the electrification of bus fleets in Curitiba and Camaçari—show a high degree of synergy with SDG 11 (Sustainable Cities) and SDG 13 (Climate Action). However, a critical synthesis of these findings reveals a "maturity gap": while 26 diverse measures were identified, most remain in the early or "ongoing"

stages of implementation, often hindered by the exhaustion of traditional tariff-based financing models and a lack of institutional capacity for long-term maintenance.

Second, the study highlights a persistent technical and data barrier that undermines local-national policy alignment. Although initiatives like the "Ecomilhas" platform and the LEED-certified Anália Franco Station provide rare examples of quantifiable mitigation—avoiding over 244,000 and 214 tons of CO<sub>2</sub> respectively—most municipal actions lack standardized methodologies for GHG accounting. This absence of robust data prevents cities from accurately measuring their contribution to Brazil's 2024 NDCs and limits their ability to access international green financing. Strengthening the integration between technical monitoring systems, such as SIRENE, and municipal planning is therefore essential to transform isolated "good ideas" into a coherent national carbon budget.

Third, the research confirms that Brazil's experiences offer a high potential for upscaling and replication within the BRICS framework. The evidence for this potential is rooted in shared structural challenges—such as high urban density and transport capacity gaps—identified in countries like India, South Africa, and Indonesia.

As emphasized in the 2025 BRICS Ministerial Declaration, the transition to low-carbon systems is a collective priority. Brazil's low-cost active mobility models (e.g., bike lanes and "walking routes") and its pioneering BRT heritage serve as viable benchmarks for emerging economies that require rapidly deployable, high-impact solutions.

Finally, the study concludes that for these initiatives to be truly transformative, they must move beyond technology transfer toward Climate Justice. Measures that incorporate gender and race perspectives, such as the "Walking Together" project in São Paulo, demonstrate that sustainable mobility is inseparable from social equity. Brazil stands at a crossroads: while structural barriers like car dependence persist, the robust body of technical knowledge and the convergence of local actions with global agendas provide a clear roadmap. Advancing this agenda will require a renewed federative pact, innovative financing through mechanisms like the Green Climate Fund (Fundo Clima), and a steadfast commitment to building cities that are not only low-carbon but fundamentally just and resilient.

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