 p-ISSN 2827-8585
e-ISSN 2827-8062

International Journal of Multidisciplinary Research and Literature
IJOMRAL
Vol. 4, No. 5, September 2025 pp. 896-908
Journal Page is available at http://ijomral.esc-id.org/index.php/home

IMPLEMENTATION OF TRANSPORT SECTOR DECARBONIZATION POLICY IN THE MAMMINASATA URBAN AREA

Sabery Said[1*], Muh.Ashary Anshar[2], Sujatmiko[3]
[1.2,3]Nitro Institute of Business and Finance, Indonesia
Corresponden Email: *sabrysaid.ss@gmail.com*[1]

Abstract

The transport sector contributes significantly to greenhouse gas (GHG) emissions in the Mamminasata metropolitan region. This study examines the implementation of transport sector decarbonization policy through strategic and operational perspectives by evaluating institutional roles, inter-agency coordination, and stakeholder engagement. The main objective is to develop a contextual roadmap that supports a transition to low-emission transportation. The study employs a qualitative approach with an exploratory case study design. Data were collected through in-depth interviews with local government agencies, transport operators, and community organizations, as well as analysis of policy documents (RPJMD, SUMP, NDC, and IGRK). The data were analyzed thematically and triangulated using perspectives from strategic management (Fred R. David), total quality management (W. Edwards Deming), and the theory of constraints (Eliyahu Goldratt).

The findings reveal the existence of normative frameworks, but their implementation lacks alignment. Institutional fragmentation, weak regulatory integration, and low community adoption of low-emission transport modes further hinder progress. These results highlight the need for institutional consolidation, measurable performance indicators, and a legally supported policy roadmap to operationalize a sustainable urban transport system. This research contributes to strategic transport management literature by providing an empirical basis for actor-based coordination and context-driven transformation. It also recommends developing performance indicators and policy measures to accelerate decarbonization in urban mobility systems. Keywords: Strategic management; operational management; transport decarbonization; institutions; policy roadmap; Mamminasata.

Keywords: Strategic Management; Operational Management; Transport Decarbonization; Institutions; Policy Roadmap; Mamminasata.

INTRODUCTION

Climate change is a pressing global issue with far-reaching environmental, health, social, and economic impacts. The transportation sector is a major contributor to greenhouse gas emissions, particularly CO_2, accounting for approximately 23% of total global emissions according to the IPCC. In Indonesia, rapid urbanization is driving an increase in motorized vehicles, worsening air pollution and congestion, particularly in large cities. The Mamminasata metropolitan area, encompassing Makassar, Maros, Gowa, and Takalar, faces similar challenges. Despite its strategic position as a center of economic growth and being designed to support sustainable development, limited public transportation continues to hamper its citizens' mobility.

This research reviews policies from a normative perspective and analyzes them from a strategic and operational management perspective. Eliyahu M. Goldratt's Theory of Constraints (TOC) and Fred R. David's Strategic Management Framework are the two main approaches used. TOC emphasizes that every system has key bottlenecks that limit the achievement of objectives. In the context of Mamminasata's

transportation decarbonization, these bottlenecks lie in weak institutional coordination and the absence of cross-regional implementing institutions. Meanwhile, a strategic management approach assesses how formulated policies can be systematically implemented, from implementation to evaluation. Thus, decarbonization is seen not merely as a technocratic step but rather as a strategic process involving institutional structures, actors, and public participation, allowing research findings to provide more measurable and contextual implementation strategies.

In response to the complexity of urban mobility and its impact on carbon emissions, the South Sulawesi Provincial Government, in collaboration with the Indonesia–Australia Partnership for Infrastructure (KIAT), developed the Mamminasata Sustainable Urban Mobility Plan (SUMP). This document contains a baseline of existing conditions, a sustainable mobility development strategy, and an implementable action plan, emphasizing the importance of corridor-based mass transit, electrification of public transportation, and metropolitan institutional reform. However, reality shows a gap between the planning on paper and its implementation in practice. Flagship programs such as the development of green corridors and modal integration often stall due to the absence of an authoritative, cross-regional implementing agency. This discrepancy demonstrates that institutional transformation has not been optimal despite the SUMP being a strategic reference. Therefore, understanding how this policy is translated within the social, spatial, and political context of Mamminasata is crucial.

The dominance of private vehicles in the Mamminasata area shows a worrying trend. In 2024, the number of motorized vehicles was recorded at 2.72 million units, exceeding the population of only 3.01 million. In Makassar alone, the number of vehicles reached 2.09 million units, with the majority being motorcycles. Similar growth is seen in Maros, Gowa, and Takalar, where the number of vehicles continues to increase in line with increasing mobility needs. Data from 2020 to 2024 shows that the vehicle growth rate is much faster than population growth, posing significant challenges in controlling emissions, congestion, and providing sustainable transportation in the metropolitan area.

This phenomenon reflects the Mamminasata community's dependence on private vehicles due to the limited availability of affordable, comfortable, and integrated public transportation services. Vehicle growth far exceeds population growth, resulting in various consequences, ranging from traffic congestion and air pollution to a declining quality of life in urban areas. Suppose this trend continues without serious policy interventions, such as the development of corridor-based mass transit and vehicle electrification. In that case, efforts to decarbonize transportation in the Mamminasata metropolitan area will face significant obstacles and potentially exacerbate the environmental and socio-economic burdens on the community.

Congestion in Makassar has severe economic, social, health, and environmental impacts. According to Asrahmaulyana (2020), fuel costs increase significantly during congestion, causing losses of billions of rupiah annually. Public transportation drivers like Pete-Pete also lose significant income due to

reduced ridership. Furthermore, PM2.5 concentrations at congestion points exceed WHO recommendations, endangering public health, especially children and the elderly. From a climate perspective, the transportation sector contributes approximately 91% of the city's energy emissions, with a trend of increasing CO_2 reaching 34% in a decade. The lack of integrated public transportation exacerbates this situation and hinders transportation decarbonization.

Congestion and air pollution in Makassar have become strategic issues within the framework of transportation decarbonization. Over 65% of air pollution comes from motorized vehicles, exacerbated by low public transportation usage, minimal pedestrian infrastructure, and weak cross-sector coordination. A decarbonization strategy is needed through the development of electric-based public transportation, digitized mobility systems, bicycle lanes, and low-emission zones. Although various initiatives have been outlined in regional planning documents, implementation remains weak due to insufficient executive regulations, limited funding, community resistance, and strong institutions to oversee emission reduction targets.

This research is novel in its attempt to integrate strategic management analysis and the Theory of Constraints in studying transportation decarbonization in the Mamminasata region. This approach has not been widely used in similar studies, thus providing a new perspective on how institutional constraints, cross-regional coordination, and the involvement of local actors influence policy implementation. By simultaneously emphasizing the technical, social, economic, and institutional dimensions, this research offers a practical contribution in the form of a more contextual implementation strategy, while enriching the academic literature on low-carbon mobility transformation in metropolitan Indonesia.

LITERATURE REVIEW

Constraints (Theory of Constraints/TOC)

The Theory of Constraints (TOC) emphasizes that existing obstacles or bottlenecks significantly influence the performance of a system. In transportation, this theory is used to identify bottlenecks that hinder smooth traffic flow and cause high emissions. According to Kurniawan & Prasetyo (2021), applying TOC in transportation can improve efficiency by addressing critical points in vehicle flow. Meanwhile, Zhang et al. (2023) emphasized that TOC can be a strategic framework for reducing transportation emissions by optimizing road capacity. Thus, TOC is relevant for understanding transportation issues in the Mamminasata area.

Strategic Transportation Management

Strategic transportation management is a long-term planning approach to managing urban mobility systems in an integrated manner. This theory emphasizes the importance of strategy formulation,

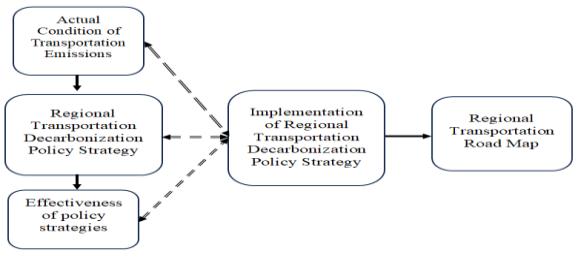
implementation, and continuous evaluation. Santoso and Wijaya (2024) explain that strategic management is crucial in formulating data-driven low-carbon transportation policies. Furthermore, Lee and Kim (2022) found that strategic transportation management can encourage a modal shift from private vehicles to public transportation by implementing incentives and fiscal policies. This demonstrates that a strategic approach can increase the effectiveness of decarbonization policies in Mamminasata.

Transport Decarbonization Policy Framework

The transport decarbonization policy framework emphasizes the importance of integrating environmentally friendly technologies, government regulations, and changes in public behavior. Briand et al. (2024) state that decarbonization policy design must encompass sustainable technical and institutional aspects. Meanwhile, Carvalho & Thomé (2023) emphasize that transport decarbonization is part of a socio-technical transition, linking technological innovation with social acceptance and regulatory support. Thus, this framework helps view Mamminasata's transport decarbonization not merely as a technical issue, but as a comprehensive transformation of the urban mobility system.

Conceptual Framework of the Research

This research's conceptual framework illustrates the relationship between the implementation variables of transportation decarbonization policies (X) and the goal of transforming a low-emission transportation system (Y) in the Mamminasata region. Variable X encompasses the actual condition of transportation emissions, formulated policies' substance, institutional support, and community participation. Meanwhile, variable Y emphasizes the creation of a sustainable and low-emission urban transportation system. This framework utilizes the approaches of policy implementation theory, the Theory of Constraints, and urban transportation system theory. These three theories explain the complexity of transportation issues in Mamminasata, which are influenced by policy, social, cultural, and infrastructure factors. This research emphasizes that the decarbonization roadmap must be adaptive, cross-sectoral, and based on continuous evaluation. Thus, this conceptual framework serves as an analytical and operational basis for formulating transformative policy strategies that can address local challenges realistically and contextually.



Picture1Conceptual Framework

This research's conceptual framework was designed to triangulate and address the complexities of transportation decarbonization policy in Mamminasata. By combining energy transition theory, the theory of planned behavior, and urban transportation systems theory, this framework examines the interrelationships between policies, actual conditions, and the roles of local actors. Data analysis was conducted using a thematic approach based on grounded theory, remaining open to field dynamics. This framework serves as a guide for interviews, observations, and data analysis. It develops exploratory propositions that provide a deeper understanding of low-carbon, participatory, and contextual transportation strategies for sustainable development.

METHOD

Research Design

This study uses a descriptive qualitative approach to explore the decarbonization policy of the transportation sector in the Mamminasata urban area. A qualitative approach was chosen because it is appropriate for understanding complex social phenomena, such as policy formulation and implementation dynamics from the perspective of local stakeholders. According to Creswell (2014), qualitative research focuses on an in-depth understanding of individual meanings and perspectives within a natural context. Descriptive research aims to provide a factual and interpretive picture of the problem under study. Therefore, this research design aims to uncover the state of transportation emissions and the effectiveness of decarbonization policies through mapping actors, resources, and policy coordination structures.

Location and Time of Research

The research was conducted in the Mamminasata area (Makassar, Maros, Sungguminasa, Takalar) of South Sulawesi Province. This area was chosen because it is the center of urban transportation activity and has been designated as a National Urban Strategic Area through Presidential Decree No. 55 of 2011. The research period covers 2024–2025, with primary data collection conducted from late 2024 to early 2025. The location determination refers to the Functional Urban Area (FUA) concept that views Mamminasata as a single metropolitan mobility unit. It allows for a more comprehensive analysis, as it includes transportation interactions between regions, per the logic of an integrated urban system.

Research Information Sources and Informants

Information sources consisted of primary and secondary data. Primary data was obtained from in-depth interviews and field observations, while secondary data came from official documents, agency reports, BPS statistical data, and relevant previous studies. The combination of the two was used to strengthen the analysis through triangulation.

Informants were selected using purposive sampling, using individuals with the best understanding of transportation decarbonization policies. Creswell (2014) emphasized that qualitative informants should be selected based on the research objectives. Merriam (2009) added that informants are individuals or groups with in-depth experience in the studied context. Palinkas et al. (2015) stated that this technique allows researchers to obtain rich, relevant information. Research informants included officials from the Transportation Agency, planners at the Regional Development Planning Agency (Bappelitbangda), and academics/members of the Indonesian Transportation Society.

Data Types and Sources

The collected data consisted of narrative qualitative data, including interview transcripts, observation notes, policy documents, and official reports. The analysis focused on key meanings and themes such as implementation constraints, public participation, and emission reduction strategies.

The data sources consist of: (1) primary data in the form of interview results and field observations, and (2) secondary data in the form of regulations, official reports, statistical data, academic publications, and media information. Both sources are combined using the principle of triangulation to maintain the validity and reliability of the data.

Method of collecting data

Three main techniques were used, namely: (1) semi-structured in-depth interviews with key informants, (2) field observations related to infrastructure and transportation conditions, and (3) documentation studies of regulations, reports, and statistical data. Each method was used in an integrated manner to enrich information and strengthen research findings.

Research Instruments

In qualitative research, the primary instrument is the researcher themselves. Sugiyono (2017) states that the researcher is the primary instrument, interacting directly with the subjects, gathering information, and interpreting data. Additionally, supporting instruments such as interview guides, observation sheets, and documentation checklists help systematize data collection.

RESEARCH RESULTS AND DISCUSSION

1. Research Location

The Mamminasata urban area is the primary focus of this research. As the largest metropolitan area in South Sulawesi, it is crucial in driving economic and social activity in Eastern Indonesia. With an area of approximately 2,689 km² and a population of over 3.5 million, Mamminasata faces high

mobility dynamics. Data from the Sustainable Urban Mobility Plan (SUMP) shows that the transportation sector's greenhouse gas (GHG) emissions increased by 161% between 2020 and 2030. This increase is primarily driven by the growth of motorized vehicles, which reached over 2.1 million units by 2022.

Increasingly congested road conditions have pushed the volume-to-capacity ratio to the saturation point. As a result, congestion has become a chronic problem, worsening air quality, increasing noise, and reducing public comfort. In an interview with Prof. Lambang Basri, Chairman of the Advisory Board of the Indonesian Transportation Society (MTI) South Sulawesi, he emphasized that the failure of public transportation programs such as Teman Bus reflects weaknesses in institutional design and unintegrated routes. He argued that the lack of a hierarchical public transportation system has led to continued reliance on private vehicles and increased carbon emissions.

In addition to operational challenges, institutional aspects are also a fundamental issue. As the development planning institution, the South Sulawesi Provincial Development Planning Agency (Bappelitbangda) has included low-carbon transportation issues in the RAD-GRK and RPJMD documents. However, interviews with Anna Buana and Fidaan Azuz indicate that policy implementation remains hampered by budget constraints, weak political commitment, and poor coordination between administrative regions. With four regencies/cities as part of Mamminasata, aligning policies and programs is complex, as each region has different priorities and characteristics.

The above reality demonstrates that transportation decarbonization policies in Mamminasata have not been effectively implemented. Spatial, social, economic, and institutional complexities reinforce the urgency of this research to understand how managerial and operational strategies can be designed to be more contextual, inclusive, and able to address the challenges of low-emission transportation in metropolitan areas.

2. Informant Description

This study involved four key informants representing the planning, technical, and scientific dimensions to obtain in-depth data.

First, Anna Buana, S.Hut., M.Si**,** is an Associate Expert Planner at the South Sulawesi Regional Development Planning Agency (Bappelitbangda). With a background in regional and environmental planning, Anna views decarbonization issues from the perspective of policy integration into regional development documents. She emphasizes the importance of cross-sector and cross-regional synchronization, as without it, low-emission transportation strategies struggle to achieve consistent implementation.

Second, Fidaan Husein Azuz, S.Hut., MT, MA, also serves as an Associate Expert Planner at the South Sulawesi Regional Development Planning Agency (Bappelitbangda). Armed with technical and

environmental management expertise, he highlights the need for clear performance indicators and measurable data in policy development. In an interview, Fidaan emphasized that decarbonization policies cannot simply be declarative but must be translated into monitorable targets supported by fiscal instruments.

Third, Agustina Widyati, S.Sos., M.Tr.APAgustina, Head of the Road Safety and Infrastructure Section at the Mamminasata Transportation Technical Implementation Unit (UPT) of the South Sulawesi Provincial Transportation Agency, provided a comprehensive overview of the situation on the ground, particularly regarding the challenges of inter-regional coordination and limited public transportation facilities. According to her, people tend to be reluctant to switch to public transportation due to inconsistent service quality, limited routes, and a lack of supporting infrastructure such as bus stops, sidewalks, and bicycle lanes.

Fourth, Prof. Ir. H. Lambang Basri Said, MT, Ph.D., IPM, ATU**,** is an academic and public figure in transportation. He offers a critical perspective. He emphasizes the importance of institutional reform, hierarchical route design, and changes in transportation user behavior. His insights provide a theoretical framework and comparisons with practices in other cities, enriching policy analysis in Mamminasata.

The combination of these four informants provides a comprehensive picture: from strategic planning dimensions, policy technocratization, operational conditions on the ground, to academic reflections. Thus, the data obtained reflects a single perspective and depicts the dynamics of low-emission transportation policy more comprehensively.

3. Initial Field Findings

Based on interviews and initial observations, several key findings were identified. First, there is a gap between planning documents and implementation. Although the RAD-GRK and RPJMD include targets for sustainable transportation development, operational steps on the ground are still minimal. Second, fiscal aspects are a significant obstacle, as public transportation budgets are often prioritized less than other infrastructure development. Third, public resistance to public transportation exacerbates the situation. The high preference for private vehicles is closely related to social status, comfort, and time flexibility.

Another finding is weak institutional integration. Transportation programs in Mamminasata are often implemented partially by region, without coordination between districts/cities. It leads to service inefficiencies, overlapping routes, and a lack of minimum service standards. Prof. Lambang emphasized that it will be challenging to develop and decarbonize public transportation without a hierarchical route system that regulates the roles of mainline buses, feeder buses, and supporting modes.

4. Research Relevance

The findings demonstrate that the challenges of decarbonizing transportation in Mamminasata are not merely technical but also institutional, social, and behavioral. Given this complexity, this research is relevant for providing policy input that is both normative and applicable. The research's focus on managerial and operational strategies at the regional level is expected to provide a roadmap toward a low-emission, inclusive, and sustainable metropolitan transportation system.

DISCUSSION

1. Transportation Emission Conditions in the Mamminasata Area

The Mamminasata Metropolitan Area (Makassar, Maros, Sungguminasa, and Takalar) faces serious challenges related to transportation emissions. Based on the Mamminasata SUMP baseline, without significant intervention, emissions are projected to increase 161% from 2020 to 2030 (business-as-usual scenario). Population growth, urban sprawl, and the dominance of private vehicles, exceeding 2 million units by 2024, with motorcycles accounting for 60% of the total, are driving increases in fossil fuel consumption and CO_2.

The transportation sector contributed 26% to Makassar City's GHG emissions (2019), ranking second only to households. Field observations by the Mamminasata Transportation Technical Implementation Unit (UPT Transportasi Mamminasata) show that air quality in densely populated areas like Jalan AP Pettarani frequently exceeds WHO safety limits. This impact is twofold: it exacerbates the global climate crisis and threatens the health of urban communities.

Institutional constraints exacerbate the situation. The Teman Bus (BTS) program only covers a few corridors, facing challenges of post-subsidy sustainability. The electrification of public transportation in the South Sulawesi RAD-GRK has not yet taken off due to a lack of fiscal incentives and electric charging infrastructure. Prof. Lambang (MTI South Sulawesi) emphasized, "If the system is not well designed, congestion will increase emissions." The experiences of other cities offer important lessons. Bogotá has reduced emissions by 40% through the TransMilenio system, while Curitiba has reduced private car use by integrating BRT into the city's spatial planning. It demonstrates that structural reforms and reliable public transportation can reverse emissions trends.

2. Mamminasata Low-Carbon Transportation Transition Roadmap Strategy

This sub-chapter answers the third research question by formulating a phased strategy as a roadmap to accelerate the transition to a low-carbon transportation system in Mamminasata. The roadmap is based on previous empirical findings (emission conditions and implementation constraints) and a theoretical framework for strategic and operational management. The roadmap is structured to cover aspects from policy formulation to implementation and ongoing evaluation. Fred R. David

recommended that the strategic management process involve continuous formulation, implementation, and evaluation. Decarbonization efforts can be systematic, measurable, and adaptive to change with this roadmap.

a. Three-Phase Roadmap Framework

The transportation transition to carbon neutrality is a long-term process that must be divided into realistic phases. This study proposes a roadmap with three phases: short-term (2026–2030), medium-term (2031–2045), and long-term (2046–2060). This division aligns with the 2060 Net Zero Emission (NZE) target and national development stages. Each phase has a distinct focus: the initial phase focuses on formulation and institutionalization, the intermediate phase on implementation and expansion, and the final phase on consolidation and evaluation. Each phase does not stand alone but is interconnected with a continuous feedback mechanism (continuous improvement), as Deming emphasizes.

b. Evidence-Based and Indicator Basis

The roadmap was developed based on evidence, considering emission projections and actual implementation capacity. Baseline data indicate that Mamminasata's transportation emissions can increase by 161% within a decade if no intervention is implemented. Therefore, the initial phase is directed at fundamental steps to reverse this trend. Each phase is equipped with key performance indicators (KPIs), such as reducing annual CO_2 emission growth, increasing the share of public transportation, and reducing emission intensity per kilometer. Total Quality Management (TQM) principles are implemented through a multi-stakeholder monitoring and evaluation mechanism to create continuous improvement. Furthermore, this roadmap integrates the Transit-Oriented Development (TOD) concept into transportation infrastructure development. Thus, emission reductions go hand in hand with improvements in urban spatial planning that are more oriented towards public mobility and environmentally friendly.

c. Constraint-Based Approach

Each roadmap phase is designed to address the main constraints encountered, based on the Theory of Constraints (TOC) approach. In the initial phase, the most significant obstacles are institutional and regulatory, so the focus is on establishing supporting institutions and regulations. In the intermediate phase, funding and program reach are primary constraints, making financing innovation key. Meanwhile, in the final phase, challenges lie in adopting advanced technology and changing community behavior. Therefore, the roadmap ensures that bottlenecks in each phase are resolved before moving on to the next.

d. Three Phase Details

Phase I (2026–2030)The development of institutional foundations, regulations, and basic infrastructure includes the establishment of the Mamminasata Transportation Authority, policy harmonization between regions, electrification pilot projects, and the digitalization of the integrated ticketing system. Phase II (2031–2045) focuses on operational transformation by developing mass public transportation infrastructure, implementing AI- and IoT-based intelligent technologies, and expanding low-emission areas. In this phase, the share of public transportation is expected to increase significantly, and transportation emissions begin to decline in absolute terms. Phase III (2046–2060) is a consolidation effort towards achieving net-zero emissions. All public transportation is expected to have switched to clean energy (electricity or hydrogen), the transportation system is entirely digitally integrated, and a culture of low-carbon mobility is rooted in society.

e. Roadmap as a Strategic Instrument

It is important to note that this roadmap is not simply a list of plans, but a strategic management tool. It provides a clear timeline for all stakeholders' government, private sector, and community to identify their respective roles. By dividing the project into three phases, the complex transition can be mapped into concrete steps that are easier to manage, monitor, and evaluate.

With this strategy, the Mamminasata roadmap is expected to guide the transition to an integrated, technology-based, socially just, low-carbon transportation system consistent with the NZE 2060 target.

CONCLUSION

This study concludes that the transportation sector in the Mamminasata Urban Area is in critical condition, with CO_2 emissions continuing to rise due to the dominance of private vehicles powered by fossil fuels and the low availability of adequate public transportation. Business-as-usual projections indicate a threat of a 161% increase in emissions by 2030, which will impact global climate change and worsen local air quality and public health. This situation emphasizes the urgent need for policy interventions to decarbonize transportation.

Policy formulation analysis shows that Mamminasata has relatively comprehensive strategic documents, such as the SUMP and RAD-GRK. However, key weaknesses lie in weak cross-regional coordination, the absence of a metropolitan transportation institution, and the lack of binding legal instruments and incentives. The implementation of flagship programs, such as Teman Bus (Bus Friend) and the electrification pilot project, remains limited in scale and fails to address the root causes of

structural problems or user behavior. This gap between strategy and execution highlights the need for institutional design and governance improvements.

To address these challenges, this study formulates a three-phase roadmap for a low-carbon transportation transition toward 2060, encompassing institutional and regulatory foundations (2026–2030), infrastructure expansion and innovative financing (2031–2045), and system consolidation toward carbon neutrality (2046–2060). This roadmap emphasizes strategic management principles, the Theory of Constraints, and Total Quality Management to ensure a systematic, measurable, and adaptive process. The novelty of this research lies in its emphasis on the importance of cross-regional institutional design as a key prerequisite for successful urban transportation decarbonization, not solely on technological or infrastructure aspects. These findings provide practical implications for local governments to establish metropolitan transportation authorities, strengthen regulations, and encourage multi-stakeholder participation in accelerating the transition toward an inclusive and sustainable low-carbon mobility system.

REFERENCES

Asrahmaulyana, A., Qarina, Q., & Edison, L. E. (2020). Kerugian ekonomi akibat kemacetan lalu lintas terhadap masyarakat Muslim yang bermukim di Kota Makassar. *Iqtisaduna: Jurnal Ilmiah Ekonomi Kita*, 6(2), 157–166. https://doi.org/10.24252/iqtisaduna.v6i2.19016

Briand, Y., Gupta, D., D'Agosto, M. de A., Goes, G. V., Gonçalves, D. N. S., Garg, A., & Koning, M. (2024). A pathway design framework for national freight transport decarbonization strategies. *Climate Policy*. https://doi.org/10.1080/14693062.2024.2412709

Briand, P., Laurent, G., & Dupont, A. (2024). *Designing Sustainable Transport Decarbonization Policies: Technical and Institutional Perspectives.* Paris: Green Mobility Institute.

Carvalho Ferrer, A. L., & Thomé, A. M. T. (2023). Carbon emissions in transportation: A synthesis framework. *Sustainability, 11*(8475). https://doi.org/10.3390/su15118475

Carvalho, L., & Thomé, A. (2023). *Socio-Technical Transitions in Urban Transport Decarbonization: Linking Technology, Regulation, and Social Acceptance.* London: Routledge.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approach* (4th ed.). Thousand Oaks, CA: Sage Publications.

Kurniawan, B., & Prasetyo, H. (2021). Application of the Theory of Constraints in transport system optimization. *Transport Policy, 108*, 45–54. https://doi.org/10.1016/j.tranpol.2021.02.004

Lee, J., & Kim, S. (2022). Strategic transport management and modal shift: Evidence from fiscal policy scenarios. *Journal of Transport Geography, 102*, 103399. https://doi.org/10.1016/j.jtrangeo.2022.103399

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation.* San Francisco, CA: Jossey-Bass.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research, 42*(5), 533–544. https://doi.org/10.1007/s10488-013-0528-y

Santoso, A., & Wijaya, D. (2024). Strategic transport planning for low-carbon urban mobility: Evidence from Indonesian cities. *International Journal of Technology, 15*(6), 1862–1872. https://doi.org/10.14716/ijtech.v15i6.5723

Zhang, H., Liu, Y., & Wang, J. (2023). Reducing emissions through Theory of Constraints: A transport sector perspective. *Energy Policy, 178*, 113620. https://doi.org/10.1016/j.enpol.2023.113620