



ANALYSIS OF THE IMPLEMENTATION OF GREEN TRANSPORTATION TO REALIZE A GREEN AND SUSTAINABLE CITY (STUDY ON THE RAPID TRANSIT BUS TRANSPORTATION MODE IN MEDAN CITY)

Annisa Aulia Lubis ¹, Muhammad Imanuddin Kandias Saraan ²

^{1,2} Department of Public Administration Faculty of Social and Political Sciences, Universitas Sumatera Utara, Medan, Indonesia

Corresponding author: lubisannisaaulia@gmail.com

Article Info

Article history:

Received : 17 February 2025

Acceptance : 27 February 2025

Published : 17 March 2025

How to cite:

Lubis, A. A., Saraan, K. I. M. (2025). ANALYSIS OF THE IMPLEMENTATION OF GREEN TRANSPORTATION TO REALIZE A GREEN AND SUSTAINABLE CITY (STUDY ON THE RAPID TRANSIT BUS TRANSPORTATION MODE IN MEDAN CITY). *OPINI: Journal of Communication and Social Science*, 2(1), 56-70.



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ABSTRACT

Rising motor vehicle ownership in Medan City has intensified traffic congestion and carbon emissions, worsening urban air pollution. Data from the Medan Environmental Agency show that transportation-sector carbon emissions increased from 1,575 tons in 2020 to 2,154 tons in 2022. Kumparan Tech (2019) also reported an Air Quality Index (AQI) score of 78 for Medan, placing it among Indonesia's five most polluted cities. In response, the Medan City Government introduced an electric-based Bus Rapid Transit (BRT) system as a green transportation initiative aligned with sustainable development goals. Nevertheless, its implementation remains suboptimal due to inadequate bus stop facilities, limited fleet availability, insufficient supporting infrastructure, declining ridership linked to the digital payment system, and weak stakeholder coordination. This descriptive qualitative study collected data through interviews, observation, and documentation, guided by Litman's (2015) green transportation indicators: safety, environmental impact, comfort, and land use. Findings highlight unmet standards, limited public outreach, and incomplete inter-stakeholder collaboration, prompting recommendations for stronger regulation, improved coordination, and better service quality.

Keywords: Green transportation, Bus rapid transit, Green city

1. INTRODUCTION

A Green City is a city development model integrated with a sustainable development perspective. Green and smart city development is a crucial approach to improving high-quality development and modern governance, with infrastructure development being a prerequisite (Engka et al., 2023). The implementation of the

Green City concept in Medan is reinforced in the official Green City Action Plan (GCAP) document, which identifies the transportation sector as key to achieving a clean city (Purba et al., 2025; Yusri, 2024). This refers to the Green Transportation concept, a sustainable development plan with a transportation model that prioritizes energy efficiency and reduced carbon emissions (Shah et al., 2021). This model encompasses various innovations, such as the use of renewable energy vehicles, improved public transportation, and the integration of environmentally friendly technologies (Hanafi et al., 2023). This can be achieved through the use of environmentally friendly transportation devices. This sustainable development plan, integrated into Presidential Regulation No. 59 of 2017, encompasses 17 key goals to be achieved by 2030. This program aims to end poverty, improve public welfare, and protect the planet through four main pillars: social, economic, environmental, and legal and governance development (Ekpenyong, 2024; Malhotra, 2023).

Based on the sustainable development plan in Medan City, where field conditions are increasingly problematic and pose significant challenges to the city's residents, the Medan City Government is improving its mass transportation system with the concept of implementing green transportation, which refers to the legal basis of Law No. 22 of 2009 concerning Road Traffic and Transportation, and Medan City Regional Regulation No. 9 of 2016 concerning the Implementation of Road Traffic and Transportation. This is a key effort to reduce dependence on private transportation and encourage people to switch to public transportation.

According to Portal.medan.go.id, in early January 2024, the Medan City Government launched free electric buses for Medan residents, conducting a trial run on one corridor: the J-City-Medan Plaza corridor. The purpose of the trial run on this route is because many people travel to the Medan Fair Plaza, and students also use this sustainable mode of transportation, as it passes through their daily activities.

According to Kompas.com, Iswar, Head of the Transportation Agency, stated that the first location for the electric bus route will be the J-City housing complex in Medan Johor District. The reason for this is because it is located in a densely populated area. The operation of this electric bus, the first of its kind in Medan, is one step towards realizing modern, road-based mass transportation.

The inauguration was held on November 24, 2024, by Mayor Bobby Nasution. The

inauguration also included the distribution of 15,000 free e-money cards to the public. The cards were distributed in two phases: the first with 3,000 cards, and the final with 12,000. The distribution of e-money cards indirectly informs the public about the digital payment system. According to the 2023 Institute for Transportation and Development Policy (ITDP) report, BRT operations in Medan currently cover six corridors: Pinang Baris Terminal -Amplas Terminal, J.City Housing Complex -Medan Fair Plaza, Belawan -Merdeka Square, Tuntungan -Merdeka Square, and Tembung -Merdeka Square. However, another corridor, Adam Malik Regional Hospital -Merdeka Square, is not yet operational due to technical difficulties. The following table shows BRT routes in Medan.

From an economic perspective, Bus Rapid Transit (BRT) is managed efficiently and affordably, with operating fares remaining the same for both short and long distances (Kurniawan, 2023). Affordability refers to the economic context, as it reduces travel expenses, thus increasing public interest. From a social perspective, this bus mode offers comfort and priority seating for those with disabilities, such as the elderly, pregnant women, and the disabled. The bus has a capacity of 52 passengers, consisting of 24 seats, 24 standing, and 4 seats for priority groups. This environmentally friendly transportation operates from 06.00 WIB –20.00 WIB.

From an economic perspective, Bus Rapid Transit (BRT) is managed efficiently and affordably, with operational fares remaining the same for both short and long distances (Dwiputri et al., 2021). Affordability refers to the economic context, as it reduces travel expenses, thus increasing public interest. From a social perspective, this bus mode offers comfort and facilitates priority seating for those with disabilities, such as the elderly, pregnant women, and the elderly. The bus can accommodate 52 passengers, consisting of 24 seating options, 24 standing, and 4 seats for priority groups. This environmentally friendly transportation operates from 6:00 a.m. to 8:00 p.m. Western Indonesian Time.

To support the sustainability and equity of services, the Mayor enacted a fare policy through Medan Mayoral Decree No. 550/16K on January 1, 2025. Under this Mayoral Decree, the general public is charged Rp 5,000, while special groups such as students, the elderly, and people with disabilities are charged Rp 3,000 per person. They must first register at designated locations: Amplas Terminal,

Pinang Baris Terminal, J-City, Bandar Kalifah Station, Lau Cih Terminal, Tuntungan, and Medan Fair Plaza. Toddlers under five years of age travel is free.

This sustainable transportation mode features an app to track bus routes and schedules, reducing long waits at bus stops. Furthermore, the BRT fleet features a modern infrastructure design, further enhancing public interest. However, after the Bus Rapid Transit was implemented, various problems emerged indicating its ineffectiveness in the field, such as natural disasters and technical issues, such as flooding and a BRT breakdown in front of Siti Hajar Hospital. Concerns arose regarding the Bus Rapid Transit (BRT) breakdown in Medan City, which led to concerns about its operation. Public concerns were expressed on social media. According to Antara.News.com, Iswar confirmed that the dozens of electric buses were properly configured and safe to operate even in flooded conditions. A river overflowed next to the electric bus pool, but this did not affect the bus engines; they were simply dirty from the standing water (Septiaty et al., 2024).

Despite this incident, the electric buses continued to operate because the batteries were positioned above the bus terminal, ensuring their safety. Furthermore, the government also provided alternative routes from Corridors 1 to 5 to maintain service. The public is still unaware of these alternative routes due to a lack of public awareness regarding Bus Rapid Transit operations (Afrianti et al., 2022; Hanafi et al., 2023).

In early 2025, Mayoral Decree No. 550/16K was issued concerning fares via e-money. The introduction of fare policies has impacted passenger numbers. According to data from the Transportation Agency, the number of passengers in 2025 was 310,182. In 2024, the number of Bus Rapid Transit passengers was 473,730. This decrease of 163,548 was due to the public's lack of readiness for digital payment systems. Based on field data, many people still do not use e-money cards and prefer Qriss. However, the BRT paymentsystem still lacks transparency in payment information. This situation has resulted in a decline in passenger numbers. The following data shows passenger numbers for 2024-2025.

Although the number of bus stops on each corridor is quite large, in terms of quality, many still do not meet green transportation standards. Of all the existing bus stops, only one is close to meeting the green transportation standard: the bus stop in

front of the Post Bloc. The bus stop in front of the Post Bloc is called Bus Stop, or BS13. During the operation of the Bus Rapid Transit, the bus stop used was the Trans Metro Deli (TMD) bus stop. The construction of this bus stop caused traffic congestion due to its location in the middle of a major city highway. Many residents were unaware of the purpose of the construction, leading to several comments on social media regarding the bus stop. Bus Stop 13 was inaugurated on February 19, 2025. The inauguration also caused conflict among the public because its location in the middle of the road was inefficient, requiring people to cross the road, which hampered traffic flow.

2. RESEARCH METHODE

This research uses a qualitative approach. According to Creswell (2021), qualitative research is based on the philosophy of postpositivity, used to examine natural object conditions (as opposed to experiments), where the researcher serves as the key instrument, data collection techniques are triangulated (combined), data analysis is inductive/qualitative, and qualitative research results emphasize meaning over generalization (Creswell, 2021). This research orients toward a descriptive research method. Descriptive research describes or depicts a phenomenon. Qualitative research is defined as research that uses scientific methods to uncover a phenomenon by comprehensively describing data and facts in words related to the research subject. The informants selected by the researcher were the Head of Land Transportation at the Medan City Transportation Agency, the Head of Bus Rapid Transit Management, Bus Rapid Transit users, and private vehicle users. The researcher selected research subjects using purposive sampling. Purposive sampling is a technique for selecting informants based on specific considerations. This particular consideration, for example, is that the person is considered to know best about what we expect, or perhaps he is the ruler so that it will be easier for the researcher to explore the object/social situation being studied (Supriyono & Susmonowati, 2022).

3. RESULT AND DISCUSSION

The short operating hours create a culture of discipline that fosters positive habits in the community. This serves as a guideline for service implementation, with the goal of being more focused and aligned with a sustainable transportation system. The implementation of this environmentally friendly transportation system provides services to six of the five operational corridors: the first is Amplas-Pinang Baris; Corridor 2 is J.City-Plaza Medan Fair; Corridor 3 is Belawan-Merdeka Square; Corridor 4 is Tuntungan-Merdeka Square; Corridor 5 is Tembung-Merdeka Square; and the final corridor is Adam Malik Regional General Hospital-Merdeka Square. However, it is currently not operational due to the pending extension process for additional routes.

In the context of green transportation, it is not primarily about environmentally friendly transportation but also emphasizes public service, operational stability, and community participation in supporting public transportation. The implementation of Bus Rapid Transit is part of a national policy derived from the Draft Regional Regulation (Rupiah Perda) that aims to encourage the public to switch to mass transportation by reducing vehicle volume and carbon emissions (Bangun & Suwandi, 2024; Sinaga et al., 2020). However, this government program has not been fully implemented, and several infrastructure challenges remain, such as inadequate public service infrastructure and resistance to online payment systems due to the public's lack of information about using e-money cards.

Based on the interviews above, Bus Rapid Transit in Medan City has operational standards in collaboration with third parties to oversee its operations. The Transportation Agency acts as the regulator, PT Blue Bird as the operational operator, and Survior Indonesia oversees field conditions. The payment system technology and supporting facilities are regulated through contracts and regulators. Travel safety indicators for passengers and drivers are not fully met for Bus Rapid Transit. Although administratively, operational guidelines exist, including job training, vehicle inspections, and a third-party monitoring system, challenges remain in the field, such as public vehicles crossing Bus Rapid Transit lanes, parking issues, and traffic accidents. While these obstacles have been addressed responsively, and the monitoring system by third parties and regulators has not yet been fully

addressed, the results have not been met because the challenges in the field have not been fully addressed. Regarding supporting facilities, such as bus stops, which are not yet operationally feasible due to the lack of safe facilities, there are plans to revitalize this, but it has not been fully implemented due to the ongoing data collection process (Yanis et al., 2024).

Linked to the 2015 Litman concept, safety and security are fundamental social aspects. In implementing green transportation, Litman emphasized that a green transportation system must reduce accidents and ensure user safety, both physically and operationally (Jelti et al., 2023). Therefore, it is a relevant indicator for an environmentally friendly transportation program (Sun et al., 2022). Therefore, the implementation of green transportation, based on travel safety indicators for passengers and drivers, is not yet optimal because the social aspects have not been fully met. This program still requires inclusive improvements in facilities, operational management, and policy dissemination to the public to achieve a safe, comfortable, and sustainable national program (Ritonga et al., 2025).

The impact of transportation on the surrounding environment is one indicator of a sustainable transportation system, which leads to urban and social impacts. Ecological/environmental sustainability, by creating a dynamic environment and suppressing unfavorable externalities, and social sustainability, by reducing poverty, achieving prosperity, and equality (Rohmah et al., 2024). This sustainable transportation system program, often referred to as environmentally friendly transportation, is excellent for implementation in cities with high mobility volumes. Essentially, this program is an effort to reduce congestion and carbon emissions (Purba et al., 2025).

The implementation of environmentally friendly transportation through Bus Rapid Transit in Medan City, based on indicators of transportation impacts on the surrounding environment, is still not optimal. This is due to the lack of infrastructure, such as a limited number of corridors, fleets, dedicated lanes, inefficient infrastructure spatial planning, which causes congestion at certain points and irregular spatial planning based on the user and non-user community. This indicates that environmentally friendly transportation has not been aligned with the impact of transportation on the surrounding environment. This results in

congestion persisting at several strategic points and the continued use of private vehicles.

Although this program is presented to achieve net-zero emissions and reduce congestion, in fact, the implementation of green transportation has not been fully realized. While the 2015 Litman approach aimed to realize this program, it focused on economic, social, and environmental aspects, this indicator refers to social and environmental aspects. If the community is not willing to implement green transportation, then the environmental aspects will not be optimally achieved and sustainable environmental impacts will not be achieved. Based on the long-term plan to improve public comfort by adding automatic corridors and increasing the fleet to 527 by 2027. And there is an extension of the route with the term MeBiDang. There has been a revitalization of bus stops, but this will initially focus on five units. However, plans to improve this service have not yet been implemented, meaning the public has not yet experienced this improved public comfort. This should be implemented quickly so that those who have not yet used it will participate in this program (Abdurrahman, 2022).

Based on the indicators of enjoyment and comfort, the implementation of green transportation through Bus Rapid Transit has not been fully achieved. According to Litman's 2015 green transportation concept, it should encompass three main aspects: economic, social, and environmental. However, when compared to the facts on the ground, the economic and social aspects still face challenges. From an economic perspective, the payment system still faces obstacles, both due to a lack of public understanding and technical issues, such as illegible systems. Meanwhile, from a social perspective, public services are not optimal because the infrastructure does not fully meet public needs. Regulators will improve facilities with a target implementation date of 2027. Therefore, improvements in comfort and comfort must be implemented immediately, along with a better revitalization of the payment system and transparent information dissemination to motivate the public to use this service, which is part of the green transportation implementation.

In the context of land use planning, decisions cannot be made automatically. Because this development is permanent, prior studies have been conducted, as previously stated. Despite widespread public criticism of the development,

he commended the ethical criticism. Regarding the land use change at the J-City site, it was an alternative solution because it was the only area capable of accommodating bus loads and would permanently support Bus Rapid Transit. However, in reality, the community was disappointed with the development plan. Although the program's concept oriented toward the capital, the social impacts in Medan are certainly not the same, and local participation is key to its success. A sustainable transportation system encompasses three pillars: economic, social, and environmental. Therefore, a transparent study involving the community is essential.

Therefore, it can be concluded that land use indicators, such as parking, have not met the needs on the ground (Jiménez-Espada et al., 2023). Although the government has assessed strategic locations, passenger volumes, and coordinated with agencies such as the Transportation Agency, Regional Development Planning Agency (Bappeda), and Public Works Agency, implementation still faces several obstacles. Technically, there are no dedicated BRT lanes, so buses still share the same route as other vehicles, impacting operational efficiency. The placement of bus stops is not in line with green transportation principles, and the lack of supporting facilities, such as zebra crossings and sidewalks, makes access to the stops uneconomical.

According Mavlutova et al (2023), the green transportation concept has not fully addressed the issue in the field (Mavlutova et al., 2023). This is evident in social aspects, such as community participation and the lack of adequate access. The inaccessibility of bus stops addresses the suboptimal economic aspects, while the environmental aspects are not yet in line with the implementation of a green transportation system, as bus lanes still share the same route with other vehicles.

The construction of bus stop 13, modeled after the development in Jakarta, presents environmental challenges in Medan. The location of the bus stop on a narrow road median, coupled with the vastly different social context of Medan's residents, necessitates adaptation. This requires adapting to local conditions and land conditions. Therefore, the success of green transportation implementation is not solely determined by technical and planning aspects but also requires adaptation

to social conditions, transparency of information, and active and sustainable community participation (Kibthiah et al., 2023).

As stated by the public, the transition period is far from being comparable to operations in other cities. Bandung, which still uses conventional buses, has already provided adequate facilities, but Medan is far behind in its readiness for this sustainable transportation program; its facilities are not yet fully met. This is because not all bus routes have been identified for this program, let alone other facilities. Therefore, this policy is considered too hasty or instant, without understanding the community's needs. The success of this program is assessed by the level of physical readiness, management, and participation.

The limited public interest in switching is due to challenges in the field. This is relevant when linked to Law No. 22 of 2009 concerning Road Traffic and Transportation, which stipulates that Article 138 paragraph (1) states that public transportation is provided to meet the need for safe, secure, comfortable, and affordable transportation. Article 139 paragraph (1) states that the government is obliged to ensure the availability of public transportation for intercity, interprovincial, and cross-border passenger and/or freight transportation. These two articles demonstrate that the Transportation Agency, as an intermediary, obliges the regional government to provide safe and comfortable transportation. Therefore, the existing infrastructure in Medan City does not comply with Law No. 22 of 2009.

Ministerial Regulation No. 29 of 2015 concerning Minimum Service Standards for Public Motorized Vehicles on Routes stipulates the obligation of public transportation companies to meet minimum service standards, including security, safety, comfort, affordability, equality, and orderliness. However, when comparing the actual conditions in the field with Ministerial Regulation No. 29 of 2015, there is a discrepancy between the regulations and their implementation. Inadequate bus stop facilities, such as the lack of protective roofs, seating, real-time information, and ramps, indicate that standards for comfort and equality are not yet optimal. Furthermore, the practice of public transportation stopping at road markings and parking demonstrates that city safety and order remain serious obstacles. This situation demonstrates weak oversight by the Transportation Agency, hampering the implementation of environmentally friendly transportation (Suyono et al., 2021).

Thus, the conclusion regarding the inhibiting factors for physical and operational safety is unruly operations, as other vehicles stop suddenly and park haphazardly in bus rapid transit areas, which can lead to congestion and other unforeseen events. However, there are more obstacles than just inadequate infrastructure that doesn't comply with laws and ministerial regulations. These obstacles stem from a lack of management, oversight, and coordination with stakeholders. These obstacles, in the field, hinder the creation of environmentally friendly transportation. Field findings indicate that the Bus Rapid Transit program is highly beneficial, but its implementation has not been optimal. The construction of the Bus Rapid Transit program has had a significant impact on social and urban planning. The bus stop was inspired by Jakarta. However, its implementation has not been optimal for the local community.

The bus stop was built on a narrow road without a pedestrian bridge (JPO), ramp, accessibility, or proper waiting area. When buses stop at the bus stop, traffic congestion and congestion immediately occur. Furthermore, there has been no public awareness of the reasons for the bus stop construction and the operational route, leading to immediate rejection. Based on the New Public Management (NPM) aspect, this program has not demonstrated efficiency, effectiveness, or ideal public service. The construction of the bus stop, which causes traffic congestion and endangers users, is not aligned with the principles of NPM, which encourage innovation and maximize results. From a sustainable development perspective, the lack of balance between physical development and the community's social needs, and the lack of alignment between urban planning and social needs, poses a specific challenge. Therefore, the government needs to review the infrastructure, establish service standards, and involve the community, as this program is intended for the community.

4. CONCLUSION

Based on the research findings presented, it can be concluded that the implementation of green transportation through the Bus Rapid Transit (BRT) system as a municipal government effort to address traffic congestion and promote modern transportation in Medan City has not been effective. Although there is strong internal

coordination such as driver training, CCTV-based monitoring, a zero-complaint principle, and routine supervision by accompanying management its on-the-ground implementation has not aligned with the concept of green transportation, which encompasses economic, social, and environmental dimensions. When examined through four main indicators namely safety and travel conditions for drivers and passengers, the environmental impact of transportation on surrounding areas, enjoyment and comfort, and land use such as parking facilities the implementation still faces numerous obstacles. These include bus stop infrastructure that is not yet operationally feasible, an inefficient payment system, the absence of dedicated lanes, and limited supporting facilities such as zebra crossings and sidewalks. Furthermore, the lack of comprehensive routes has resulted in underserved communities and unmet mobility needs.

The factors hindering the implementation of green transportation in Medan include limited infrastructure, weak supervision of BRT routes that leads to disruptions from other vehicles, a payment system that is not yet fully understood by the public, and urban spatial planning that has not adapted to Medan's social and cultural context. In addition, bus stops are not strategically located, BRT routes overlap with other transportation options, and public participation in the planning process remains limited. Therefore, this program is perceived as top-down, with decisions made by higher authorities and oriented toward the capital city. Ultimately, the success of green transportation implementation depends not only on technical aspects but also on the integration of economic, socio-cultural, and environmental considerations, collaborative planning, and alignment with sustainable transportation policies.

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