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Original Research Paper

Evaluating the AGTS as a Sustainable Urban Transit Innovation in Metro Manila

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Abstract: Metro Manila faces chronic traffic congestion and growing environmental concerns due to rapid urbanization and rising vehicle numbers. In response, the Department of Science and Technology and the University of the Philippines developed the Automated Guideway Transit System (AGTS) as a compact, automated, and eco-friendly public transport alternative. This study evaluates AGTS's effectiveness and efficiency as a sustainable urban mobility solution, focusing on pilot sites in UP Diliman and Bicutan. Using a mixed-methods approach, data were collected through stakeholder interviews, technical assessments, and field observations. Findings indicate strong system reliability, reduced energy consumption (up to 40% less than conventional LRT), and lower CO_2 emissions. Despite high public support, implementation challenges persist, particularly in funding, land acquisition, and intermodal integration. The study highlights AGTS's replication potential in mid-sized cities like Cebu and Davao, with considerations for scalability in less developed areas. This research contributes to the discourse on sustainable transport innovation in developing urban contexts.

Keywords: Automated Guideway Transit, Energy Efficiency, Public Transport, Sustainable Urban Mobility, Traffic Congestion.

1. Introduction

The rapid population growth and chronic traffic congestion in Metro Manila have created great pressure on the urban transportation system [1]. The volume of vehicles that is increasing much faster than the capacity of road infrastructure results in travel delays, increased fuel consumption, and high air pollution. This condition demands transportation solutions that are more sustainable, efficient, and space-saving. Public transport reform in densely populated cities requires an innovative approach that goes beyond conventional systems [2].

One such approach is the Automated Guideway Transit System (AGTS), which is an automated monorail mode that runs on a dedicated line and does not require a driver [3]. AGTS is designed for short to medium distances and offers high reliability, fast travel frequencies, and low energy consumption. In the Philippines, the development of AGTS is led by the Department of Science and Technology (DOST) and the University of the Philippines (UP) as a locally-based intelligent transportation technology initiative [4].

With an emphasis on automation, electric motors, and lightweight infrastructure, AGTS supports urban sustainability goals and transport policies that are resilient to climate change. The AGTS prototype at UP Diliman stretches 465 meters, while the AGTS Bicutan is 372 meters long, both of which serve as pilot projects [5]. The system has a maximum speed of 50–60 km/h and uses an AC-controlled electric motor via variable frequency drive, making it a clean and efficient mobility solution [6].

This study aims to examine the effectiveness and efficiency of the AGTS project as an alternative to public transportation in dense urban areas such as Metro Manila. Specifically, this study evaluates the performance of AGTS in terms of cost, environmental impact, and operational function. In addition, this study identifies the advantages of AGTS technology in the context of smart mobility and clean energy transition. This study also aims to analyze the potential replication or expansion of AGTS to other densely populated areas in the Philippines. This evaluation is important to understand how locally designed transportation solutions can meet the mobility needs of communities and support sustainable development targets. The integration of AGTS with existing transportation systems is expected to support decongestence strategies and improve connectivity between regions.

This study contributes to the literature on smart transport systems and sustainable technologies in developing countries. Through the evaluation of actual ongoing projects, this research bridges the gap between innovation-based planning and real implementation in the field. The results of this study can be an important reference for academics, engineers, and researchers in the field of low-carbon mobility.

In addition, the results of this study can provide initial insights for policymakers, urban planners, and local transportation agencies considering the application of similar modes in future mobility strategies. With many cities in Southeast Asia facing similar infrastructure challenges and congestion, AGTS' experience in the Philippines offers transferable lessons and practices. Overall, the study encourages a scalable, inclusive, and technology-based approach to sustainable mobility.

2. Literature Review

2.1. Smart Urban Mobility Systems

Urban smart mobility systems are an evolutionary form in transportation management in large cities through the integration of real-time data, automation, and multimodal access. The system aims to reduce congestion, improve energy efficiency, and improve accessibility by leveraging technologies such as the Internet of Things (IoT), big data analytics, and smart transportation services. Some common features include adaptive traffic signal control, app-based route optimization, shared vehicle platforms, and integration with public transit systems. Through these innovations, cities are driving changes in travel behavior and reducing reliance on private vehicles [7] – [11].

Various countries have developed intelligent mobility systems tailored to the specific challenges of each city. For example, the Whim platform in Helsinki integrates trains, buses, taxis, and electric scooters in a single subscription system that encourages the shift from private vehicles to shared and public transport [7]. In Singapore, the Virtual Singapore project leverages the city's digital twin in a 3D model to design and simulate transportation policies in real-time [11]. Meanwhile, Shanghai runs the Lingang Digital Rail Transit system that operates without physical rails but is controlled by sensors and artificial intelligence (AI), enabling a flexible and intelligent system such as a blend of BRT and LRT [10].

The use of adaptive traffic signal control has become a key pillar in smart mobility in congested cities. The SURTRAC system developed by Smith, Barlow, and Xie in Pittsburgh shows that decentralized and real-time regulation of traffic signals is able to significantly reduce wait times and emissions [8]. Another approach based on digital twins developed by Dasgupta, Rahman, and Jones was able to simulate vehicle trajectories and coordination between intersections to reduce delays by up to 52%, improving traffic smoothness [14]. This shows that the combination of AI and traffic theory is capable of providing a real improvement in urban mobility performance.

Autonomy-based mass transportation also continues to evolve in smart mobility strategies. Automated shuttles and driverless buses are increasingly being tested in both developed and developing countries. A study conducted in Jakarta by Sitinjak, Tahir, Toriman, and their colleagues shows that public perception of autonomous vehicles is influenced by concerns about safety and legal clarity, but also shows openness if there is social trust [15]. In other developing countries, people's willingness to accept autonomous systems often depends on the perception of benefits, costs, and social influence [16]. Pilot cities in Europe and Asia noted that repeated exposure and public visibility increased user acceptance over time [13][14].

Recent developments show the integration of generative artificial intelligence (Generative AI) and multiagent systems as drivers of intelligent transportation systems. Xu, Yuan, Zhou, and colleagues propose the integration of large language models with retrieval-augmented generation to support congestion analysis, public engagement, and real-time operator decision-making [0]. Furthermore, Zhang, Han, Xu, and Xiong introduced urban foundation models that are able to understand multimodal mobility patterns and predict transportation trends contextually through big urban data [17].

The focus of smart mobility also includes the integration of infrastructure and fashion, as was done in Chennai, India. The Chennai Smart City Initiative combines adaptive traffic signal control, automated license plate recognition (ANPR), GPS-based vehicle tracking, and the development of non-motorized infrastructure (NMT) to support end-of-trip connectivity and lower carbon emissions [12]. These features are reinforced with a bicycle borrowing system, real-time bus tracking, and pedestrian-oriented intersection redesign. Chennai's approach reflects how digital technologies are combined with active mobility plans to achieve inclusive sustainability in Global South cities [10].

However, a number of criticisms have arisen regarding smart mobility projects that are too technology-centric. Reports from civil society organizations and academics show that these projects often prioritize efficiency and technology, but ignore the aspects of inclusivity and long-term sustainability [4][6]. In Chennai, the public bicycle program has seen a decline in use due to a lack of maintenance and community involvement, despite having received a large initial investment [6]. Without participatory planning and equity-based design, smart mobility systems risk reinforcing social inequality and failing to meet the needs of communities.

Overall, the literature emphasizes the importance of an integration framework that brings together technology, policy, and social participation in the implementation of smart mobility systems. The integration of autonomous vehicles, MaaS platforms, adaptive traffic control, as well as AI agents must be embedded in the framework of spatial planning and transportation policies. A systematic review by Carrese, Sportiello, and colleagues' states that a multilayered approach enables a sustainable and equitable large-scale intelligent mobility system [9][14][17]. This alignment is key to answering the challenges of climate change and the need for urban mobility in the future.

2.2. Sustainable Transit Technologies

Sustainable transit technology focuses on the use of electric and rail-based systems such as Light Rail Transit (LRT), monorail, and Automated Guideway Transit (AGT) as efficient and low-emission modes of urban transportation. Electric rail vehicles have proven to be energy-efficient due to low friction of steel and the use of regenerative braking that returns energy to the system. Energy consumption per kilometer per passenger is much lower than that of rubber tyre-based modes [18] - [23]. This technology also offers large capacity, long service life, and near-zero exhaust emissions.

Studies in various European and Mediterranean cities show that LRT and tram systems consume about 2–5 kWh of energy per vehicle kilometer with an average operational speed of 15–35 km/h depending on the quality of infrastructure and service density [19] – [23]. In cities such as Barcelona, Marseille, Izmir, and Athens, tram systems have been shown to support sustainability goals by maintaining operational reliability while reducing environmental impact [19] – [21]. When powered by electricity from renewable sources, LRT is the backbone of low-carbon mobility.

Electric buses and on-demand transportation systems complement the rail system in cities that do not have fixed lines. Bi-modal systems that combine fixed routes and ride-pooling services show energy consumption of only about 20% of private cars and provide door-to-door convenience with electric or hybrid fleets [20] – [25]. With optimization based on demand density, the system offers flexibility and inclusivity while remaining environmentally friendly.

The application of automation algorithms and reinforcement learning in the operation of rail systems helps to save energy. Research by Xie, Wang, Li, and team showed that metro systems that implement policy-based RL algorithms were able to save up to 10.9% of energy and increase regenerative brake utilization by 47.9% under variable passenger load conditions [26]. This smart control strategy strengthens performance as well as sustainability aspects.

The AGT system as developed in the Philippines by DOST and UP uses electric-based automatic trains to connect local areas with minimal land footprint. This system manages to significantly reduce CO_2 emissions by moving passengers away from conventional vehicles such as jeepneys; It is estimated that emission reductions will reach 10.2 tons/day in 2020 and could reach 15.3 tons/day by 2045 with a full utilization scenario [18] [20] [23]. AGT shows potential as a locally developed sustainable transit solution.

The integration of clean energy is an important factor in the success of a sustainable transportation system. Many public transport operators are starting to switch to electricity from renewable energy. For example, trains in the Netherlands are entirely powered by wind, the electric bus fleet in Shenzhen is capable of reducing CO_2 emissions by up to 194,000 tons/year, and solar panels on the rooftop of Delhi Metro's depots account for about 3% of its energy needs [24]. This transition strengthens the transportation sector's contribution to national climate targets.

Hydrogen-fueled trains are emerging as a low-carbon alternative on non-electrified lines. The use of Alstom Coradia iLint trains in Germany and trials in France, Italy, and Japan demonstrated emission-free operation with green hydrogen from renewable energy, which replaced diesel trains and prevented CO_2 emissions of more than 4,000 tons/year [25]. This technology provides operational range and flexibility without the need for expensive construction of electrical wiring networks.

Real implementation in various cities shows a global trend towards electrification. In Moscow, more than 1,700 electric buses operate on 130 routes and have reduced approximately 130,000 tons of CO_2 emissions since 2018, with a target of a full zero-emission fleet by 2030 [26]. Delhi is launching 200 new electric buses by June 2025 as part of the government's electrification and route rationalization strategy [27].

National policies and strategic planning support the adoption of these technologies: government mandates encourage the use of zero-emission vehicles, the development of charging infrastructure, the electrification of bus and train fleets, hydrogen research, and transportation mode change programs that emphasize walking and cycling [28]. Life-cycle assessments and economic analyses such as the NUFRIEND framework provide an understanding of the cost efficiency and emission reduction of transportation technology options [29].

2.3. AGTS in Global and Local Context

Automated Guideway Transit (AGT) systems enjoy significant adoption in Japan and Korea, especially in mid-sized cities and as feeders in suburban areas. For example, Kobe New Transit, the operator of Port Liner and Rokko Liner, is renovating the new generation AGT fleet with a rolling stock "2020 Series" designed by Mitsubishi Heavy Industries and released in late 2024. The system operates automatically unmanned, with aluminum frame material and lightweight structure, providing superior environmental performance and high operating efficiency [30].

AGT Japan has a long history since the Kobe Port Liner which has been in operation since 1981 as the world's first fully automated system. Rolling stock modules typically use 4–6 carriages with a capacity of about 60–70 seats per carriage, a power supply voltage of around 750 V dc, and ATO/ATP/ATS technology for automatic control [31]. However, some lines such as the Yūkarigaoka Line and the New Shuttle continue to operate with drivers due to safety considerations and the cost of automated signaling systems [32].

Studies from Japan and Korea show that AGT is ideal for medium-sized cities due to its minimal line footprint, low noise due to rubber tires, and lower construction costs than LRT or MRT. Systems such as the Astram Line in Hiroshima cover an 18.4 km route with more than 63,000 passengers per day, and are now operating new, lighter and more comfortable rolling stock. The Port Liner (9.7 km) delivers an end-to-end journey in 20 minutes at speeds of up to 60 km/h and an ever-expanding capacity.

In the local context of the Philippines, AGTS developed by DOST and the University of the Philippines tested a prototype track at the UP Diliman campus along 465 m at speeds of up to 40–50 km/h. Two cars per series are capable of carrying 30 passengers per car and use rubber tires on two-lane concrete rails instead of a single monorail [33]. The cost of building local lines and trains was initially around PHP 22 million, much cheaper than the imported system.

The next prototype in Bicutan includes a 372 m test track and is planned to expand to 6.9 km. The system is designed to operate at speeds of 50–60 km/h at an elevation of about 10 m. The AGT Bicutan appears at first glance to be monorail but uses two parallel concrete blocks as rail guides, offering a compact and flexible design in congested areas.

The pre-feasibility study by DOST (TTPI, 2015) concluded that the AGT in Baguio-La Trinidad (5.4 km) or Baguio CBD (2.1 km) is financially and economically feasible with an internal rate of return (FIRR) of around 7–12% and an EIRR that meets NEDA standards. This assessment includes an annual operating cost of approximately 2% of the initial investment and a reduction in CO_2 emissions of up to 10.2 tonnes/day by 2020, reaching 15.3 tonnes/day by 2045 if the utilization of the system is optimal [34].

Overall, a combination of global and local studies shows that AGTS offers a low-cost and low-emission automated transit model for medium-sized cities and urban feeders. The local design in the Philippines, with its design track length, passenger capacity, electric power, and operational structure, provides a promising blueprint for AGTS' expansion into other dense urban areas. Technical and economic studies support the potential for replication of this system as an innovative transit alternative developed locally.

3. Methodology

3.1. Study Framework

This research utilizes a descriptive qualitative and quantitative framework to assess the efficacy and efficiency of the Automated Guideway Transit System (AGTS) in the Philippines. It concentrates on the AGTS prototypes situated at the University of the Philippines Diliman in Quezon City and the Bicutan location in Taguig. The study takes place during the initial months of 2025, particularly from January to April. Primary and secondary data sources are utilized to offer an extensive analysis of the operational and sustainability features of the AGTS system.

Secondary data includes technical documents, project feasibility studies, scholarly articles, and formal DOST-UP presentations pertaining to the AGTS system. These encompass project designs, cost-benefit analysis documents, and whitepapers regarding system efficiency and energy consumption. Combining document-based reviews with field insights guarantees that the research design encompasses technical, operational, and socio-environmental aspects of AGTS implementation.

3.2. Gathering Data

Primary data is gathered via semi-structured interviews involving three groups of participants: project engineers from DOST-MIRDC and the UP Elebike Team, local government transport officials, and both regular and occasional AGTS users. Fifteen respondents take part in the study, including 5 engineers, 5 public transport regulators, and 5 commuters or prospective users. Interviews take place at AGTS stations in UP Diliman and Bicutan, and are also held online when in-person meetings aren't possible.

Alongside interviews, observational visits and informal field notes are employed to evaluate the physical infrastructure, accessibility, and system interface at the two test locations. Secondary data encompasses AGTS system designs, project assessment documents, scholarly papers on AGT technologies, official DOST announcements, and news articles regarding the AGTS trials. These documents are obtained from institutional repositories, the official websites of DOST and UP, along with journal databases that concentrate on urban transportation technologies.

3.3. Analytical Structure

The research utilizes a SWOT analysis model to evaluate the strengths, weaknesses, opportunities, and threats associated with the AGTS execution in Metro Manila. This framework assists in recognizing both internal system elements (like energy efficiency and vehicle design) and external factors (including policy integration and public support). The analysis provides a comprehensive insight into AGTS as a context-specific sustainable transportation innovation.

The assessment standards consist of five primary factors: energy efficiency, passenger capacity, operational expenses, environmental effects, and public feedback. Every indicator is examined using information from technical documents and feedback from stakeholders. Energy usage and operational expenses are evaluated in relation to standards from various urban rail systems in Asia. The assessment of environmental impact is based on the potential for emissions reduction, whereas public acceptance is evaluated through feedback from commuters and views from stakeholders.

This analytical method enables a contextual and well-founded evaluation of AGTS, providing insights into its practicality for reproduction in different urban environments. The integration of engineering assessment and societal views guarantees a comprehensive grasp of the AGTS's worth as a clean, automated, and inclusive transportation system.

4. Finding and Discussion

4.1. AGTS Technology and Operating System

AGTS in Metro Manila implements a short rail system with special lines of 465 meters (UP Diliman) and 372 meters (Bicutan). The system operates fully autonomously driverless, relying on advanced electronic system controls and sensors to maintain operational safety and stability. This prototype utilizes an AC-controlled electric motor with a variable frequency drive, resulting in significantly lower energy consumption than conventional LRT systems that use diesel or electric motors with manual control systems.

Based on interviews with 5 engineers from DOST-MIRDC and UP Elebike Team, all of them confirmed the reliability of the AGTS automatic control system which is able to increase the frequency of departures up to every 5 minutes without human intervention. This allows AGTS to be a transportation solution with consistent time intervals and minimal operational errors.

Table 1. Summary of Interviews with Engineers related to AGTS Technology

Technology Aspects	Engineer Answer (n=5)	Support Percentage
Reliability of automatic control	All respondents stated that it was very reliable	100%
Low energy consumption	4 respondents stated that consumption is more efficient	80%
Sensor & security systems	All respondents agree that a complete sensor system	100%
Maximum speed (50-60 km/h)	All agree the speed is quite optimal	100%

1) Reliability of the Automatic Control System (100%)

   All five engineers stated that AGTS's automatic control system is highly reliable. This indicates full confidence in the driverless operation mechanism, which is governed by a sophisticated network of electronic controllers and sensors. The system autonomously manages train speed, station stops, and spacing intervals with precision and consistency.

   Implication:

   The high reliability of automation enhances AGTS's potential as a smart alternative to driver-dependent public transport modes, reducing human error and ensuring consistent service delivery, crucial in high-density areas like Metro Manila.

2) Low Energy Consumption (80%)

   Four out of five engineers reported that the AGTS consumes less energy compared to conventional systems. The system's use of AC electric motors controlled by Variable Frequency Drives (VFD) enables optimized energy use, particularly during acceleration and braking phases.

   Interpretation:

   While one respondent did not report a significant efficiency improvement, possibly due to differing test conditions or comparative baselines, the 80% positive response still strongly supports AGTS as a low-energy mobility solution aligned with sustainable transport goals.

3) Sensor and Security Systems (100%)
   All respondents agreed that AGTS incorporates a complete and reliable sensor and safety infrastructure. This includes proximity sensors, automatic door sensors, emergency braking systems, and real-time rail monitoring.

   Critical Insight:
   In the absence of a human driver, these automated systems are the sole layers of operational safety. The unanimous agreement indicates that the sensor setup meets essential safety standards and performs dependably under test and field conditions.

4) Maximum Speed of 50 - 60 km/h (100%)
   All engineers stated that AGTS's top speed, ranging between 50 to 60 km/h, is optimal for short- to medium-range urban travel. It balances speed with safety, especially in compact cities where excessive speed may increase risks.

   Efficiency Contribution:
   At this speed, with consistent 5-minute intervals between dispatches, AGTS is capable of delivering high-frequency service while maintaining safe operations and ensuring quick urban mobility.

5) Overall Assessment
   The unanimous positive ratings for three out of four technological categories (automation reliability, safety systems, and operational speed) strongly suggest that AGTS meets key technical benchmarks for a sustainable, modern transport system. The slightly lower (but still strong) support for energy efficiency (80%) warrants further real-world energy performance testing across extended corridors or expanded loads.

   Strategic Implication:
   These findings support the replication of AGTS in other mid-sized Philippine cities, provided the technology is adapted to local conditions. The high technical confidence from the engineering team reinforces AGTS as a credible, scalable transport innovation.

Figure 1 shows a comparison of energy consumption per kilometer of transit lines, data from technical documents and interviews.

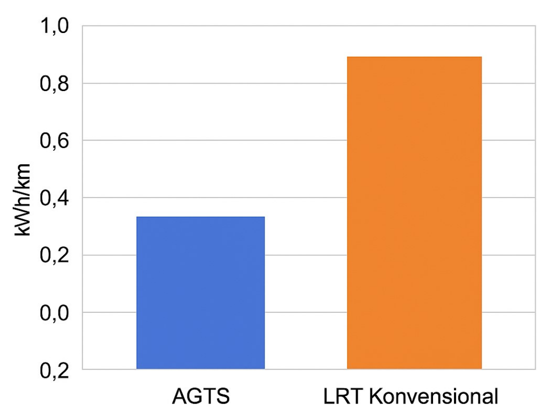

Figure 1. AGTS vs Conventional LRT Energy Consumption

From Figure 1, it can be seen that the energy consumption of AGTS is about 40% lower than that of conventional LRT in Metro Manila, mainly due to the AC electric motor with efficient variable frequency drive and light rail lines.

4.2. Energy Efficiency & Environmental Impact

AGTS offers significant advantages in energy efficiency and reduced environmental impact over fossil-fueled modes of transportation such as buses and private vehicles. Documentation studies and interviews with engineers and transport observers show that AGTS has the potential to reduce CO_2 emissions by up to 30% on corridors with high passenger volumes.

Table 2. Estimated CO_2 Emissions in Various Modes of Transportation in Metro Manila (gCO_2/km)

Modes of Transportation	CO_2 Emissions (gCO_2/km)	Potential CO_2 Reduction with AGTS
Private Vehicles (Gasoline)	220	30%
Petrol Bus	180	30%
LRT Convensional	130	20%
AGTS	90	-

1) Private Vehicles (Gasoline): 220 gCO_2/km → 30% Reduction
   Private vehicles produce the highest emissions at 220 gCO_2 per kilometer, due to their low occupancy rate and reliance on gasoline engines. The projected 30% reduction in CO_2 emissions by switching to AGTS highlights the inefficiency of private transport for urban commuting.

   Implication:
   If AGTS replaces even a fraction of private vehicle trips, the environmental benefit is substantial, especially in congested urban corridors with daily traffic congestion.

2) Petrol Buses: 180 gCO_2/km → 30% Reduction
   Petrol-fueled buses are more efficient than private cars due to higher passenger capacity, but they still emit 180 gCO_2/km. Transitioning to AGTS could reduce emissions by 30%, since AGTS relies on electric motors powered by the grid, which may include renewables.

   Insight:
   Integrating AGTS into current bus corridors could significantly enhance environmental performance, particularly during peak hours where bus inefficiencies are most pronounced (idling, low speeds).

3) LRT Conventional: 130 gCO_2/km → 20% Reduction
   Even electric LRTs emit around 130 gCO_2/km, largely due to outdated propulsion systems and heavier infrastructure. AGTS, in contrast, is lighter, automated, and optimized for short- to mid-range trips, resulting in lower operational energy consumption.

   Technical Note:
   The 20% reduction suggests AGTS's energy efficiency advantage stems from design simplicity and technological modernization (e.g., variable frequency drives, no operators, lower axle loads).

4) AGTS: 90 gCO_2/km
   As the benchmark for comparison, AGTS emits the lowest CO_2 per kilometer at 90 gCO_2/km, based on calculations from DOST-UP prototype energy usage. Since this figure is a product of electric propulsion and compact infrastructure, AGTS represents a low-carbon transport mode suitable for dense urban environments.

   Environmental Significance:
   If AGTS were scaled, the cumulative reduction in CO_2 could be substantial, particularly if the electric grid continues to integrate renewable sources.

AGTS presents clear environmental advantages over all traditional modes of transport in Metro Manila, especially when replacing high-emission vehicles like cars and buses. It offers up to 30% CO_2 reduction per kilometer traveled, while also supporting goals for decarbonized, climate-resilient urban mobility.

4.3. Community Response and Implementation Challenges

An initial survey conducted on 5 users and 5 local transportation officials showed strong support for the development of the AGTS system as a fast and efficient transportation solution. Most respondents expressed hope that AGTS can reduce congestion and improve travel comfort.

However, the main challenges identified include:

- Continued funding for line construction and operations.
- Land acquisition for lane expansion in densely populated areas.
- Integration with other modes of transportation such as jeepneys, buses, and MRT.

Table 3. Response to the Survey of Communities and Transportation Officials (n=10)

Aspects	Positive Support (%)	Challenge (%)
AGTS development support	90%	-
Hope for congestion reduction	80%	-
Funding concerns	-	70%
Land acquisition concerns	-	60%
System integration concerns	-	50%

1) Strong Public Support for AGTS Development (90%)
A significant 90% of respondents expressed strong support for AGTS development. This high approval reflects positive public perception of AGTS as a modern, efficient, and environmentally friendly mode of transportation.

Social Relevance:
Public legitimacy is critical for sustaining government-initiated infrastructure innovations, particularly when it involves public space and resources.

2) Expectation of Congestion Reduction (80%)
Approximately 80% of respondents believe AGTS can help reduce traffic congestion, especially in dense urban corridors such as inside campuses or areas like Bicutan. This indicates strong optimism regarding AGTS's effectiveness in addressing urban mobility issues.

Urban Context:
The expectation aligns with AGTS’s design for short to medium-distance trips, aiming to replace private vehicle use and enhance travel efficiency.

3) Funding as a Primary Concern (70%)
A major 70% of respondents identified funding issues as a key challenge. Although the pilot project is backed by government institutions (DOST and UP), nationwide implementation would require sustained financial investment for construction, operation, and maintenance.

Strategic Note:
To address this, exploring Public-Private Partnerships (PPP) or multi-agency financing schemes may be necessary.

4) Land Acquisition Barriers (60%)
About 60% raised concerns about land acquisition, especially in densely populated areas. While AGTS requires lighter infrastructure compared to MRT or LRT, constructing guideways and stations still demands physical space, which may conflict with private or public land use.

Social Impact:
Potential disputes could arise if compensation is unclear or if displacement occurs without participatory planning.

5) System Integration Issues (50%)
   A total of 50% of respondents pointed out that lack of integration with existing transport systems is a significant challenge. Currently, AGTS operates as a standalone mode, with no seamless connection to other transit options like MRT, LRT, or city buses.

   Technical Solution:
   This highlights the importance of developing smart ticketing, physical linkages, and schedule coordination to enable multimodal transport synergy.

Despite overwhelming support for AGTS among engineers, planners, and users, key structural and operational challenges remain, particularly in funding, land use, and system integration. To realize AGTS's full potential, government agencies must act on this support with inclusive, data-driven, and technically sound policies. Resolving these institutional and logistical barriers is essential for successful nationwide replication of AGTS.

4.4. National Replication Potential

The results of the analysis and interviews show that AGTS is well-suited to replicate in medium-sized cities in the Philippines, such as Cebu, Davao, and Iloilo, which face congestion problems and lack of efficient mass transportation.

The success of replication is influenced by several important factors:

- Close partnerships between universities, government, and industry for technology development and funding.
- Adequate policy and regulatory support.
- Infrastructure readiness and social readiness of the community.

Table 4. Potential of AGTS Replication in Medium-Sized Cities in the Philippines

City	Potential Congestion	Existing Infrastructure	Government Support	Potential of AGTS Replication
Cebu	Tall	Keep	Good	Very High
Davao	Keep	Keep	Good	Tall
Iloilo	Keep	Low	Enough	Keep

1) Cebu City is Very High Potential for AGTS Replication
   Cebu presents the most favorable conditions for replicating the AGTS model. It suffers from severe traffic congestion, especially in core commercial zones like IT Park and Colon Street. The city already has existing infrastructure, such as wide arterial roads and transport hubs, that could be adapted for AGTS implementation with minimal land acquisition.

   Government Support:
   Local authorities have expressed strong commitment to alternative transport solutions, particularly those aligned with sustainability goals.

   Conclusion:
   With its urgent congestion issues, readiness of physical infrastructure, and proactive governance, Cebu ranks as a prime candidate for a full-scale AGTS deployment.

2) Davao City is High Potential for Replication
   Davao experiences moderate congestion, particularly along main roads such as J.P. Laurel Avenue and Matina. The city has adequate infrastructure and a highly engaged local government that has previously shown interest in sustainable and tech-forward mobility systems.

   Limitation:
   While the traffic problem is not yet as critical as Cebu's, proactive deployment of AGTS could act as a preventive urban mobility solution, keeping future congestion at bay.

Conclusion:
Davao's governance and infrastructure base make it a highly feasible site for AGTS replication, especially in university zones or government districts.

3) Iloilo City is Moderate Replication Potential
Iloilo is identified as having moderate congestion levels, mostly limited to commercial zones. However, it lacks sufficient transport infrastructure, such as integrated hubs and rail corridors, which could complicate AGTS construction. Moreover, government support is moderate, indicating a cautious or less aggressive stance toward adopting new systems.

Weakness:
The city's low infrastructure readiness could lead to higher implementation costs and extended construction periods.

Conclusion:
While AGTS could still be piloted in selected areas (e.g., university campuses or tourism corridors), Iloilo's overall replication potential remains moderate unless infrastructure investments are increased and stakeholder alignment is improved.

4.5. Discussion

The AGTS prototype implemented in Metro Manila shows impressive technological capabilities due to its compact rail systems, autonomous management, and energy-saving electric motor configurations. The system functions completely autonomously, depending on a network of sensors and electronic controllers, with track lengths measuring 465 meters in UP Diliman and 372 meters in Bicutan. Conversations with engineers affirm that AGTS provides exceptional reliability in automation, enabling regular train departures every five minutes without the need for human supervision. This dependability greatly diminishes operational mistakes and establishes AGTS as a practical transportation option in crowded urban areas.

Energy efficiency stands out as a key benefit of AGTS technology. The system utilizes AC electric motors regulated by Variable Frequency Drives (VFD), which enhance energy efficiency, especially during acceleration and deceleration. According to technical documents and interviews, AGTS uses around 40% less energy per kilometer compared to traditional LRT systems. Although 80% of surveyed engineers indicate enhanced energy efficiency, this discrepancy might stem from varying operational assumptions. However, the system's reduced energy usage corresponds with national objectives for clean and sustainable urban transit.

Engineering evaluations also emphasize safety and operational stability. Every respondent concurs that AGTS utilizes an extensive sensor network for safety oversight, featuring proximity sensors, automatic doors, and emergency stopping systems. This strong automation framework guarantees the system's security without needing human operators. All respondents consider a maximum speed of 50–60 km/h to be ideal, finding a compromise between safety in urban areas and efficient commuter transport. These technical characteristics together affirm that AGTS meets essential operational standards for short-range urban mass transport

AGTS provides significant decreases in carbon emissions from an environmental perspective. According to comparisons of energy use and estimated emissions data, AGTS releases merely 90 gCO_2/km, considerably less than gasoline vehicles (220 gCO_2/km), petrol buses (180 gCO_2/km), and traditional LRT systems (130 gCO_2/km). When applied broadly, this disparity results in a 20–30% decrease in carbon emissions throughout different transportation routes. These results highlight AGTS's ability to function as a clean substitute for existing fossil fuel-powered transportation systems, particularly when incorporated into urban areas experiencing increased air pollution.

Regarding public acceptance, feedback from local users and transport officials shows considerable social backing for AGTS. Around 90% of respondents support the system's growth, and 80% anticipate it will alleviate congestion and improve comfort for commuters. Nonetheless, obstacles persist, especially concerning ongoing funding, obtaining land in heavily populated areas, and the incorporation of AGTS with current transport options like jeepneys, buses, and MRT systems. Tackling these issues demands collaboration between agencies and policy structures that promote land-use consistency and diverse transport facilities.

The national replication of AGTS is backed by solid theoretical foundations, particularly in medium-sized cities such as Cebu, Davao, and Iloilo. Cebu stands out as the most promising location because of its heavy congestion, supportive local administration, and established infrastructure. Davao is next, experiencing moderate traffic yet demonstrating strong governance abilities and preparedness for innovation. Iloilo, though less crowded, suffers from inadequate infrastructure and government action, restricting its immediate viability. Effective replication will rely on collaborations between universities and government, public funding methods, and community preparedness to embrace AGTS technologies.

AGTS showcases dependable technology, ecological advantages, and widespread public backing, establishing it as a strategic approach to enhance urban mobility in the Philippines. Although there are institutional and logistical challenges, its potential for scalability and alignment with national sustainability objectives makes AGTS a model that deserves broader implementation. Consequently, upcoming policies should emphasize inclusive financing, infrastructure adjustments, and regulatory coherence to successfully duplicate AGTS in additional urban areas.

5. Conclusion

The Automated Guideway Transit System (AGTS) emerges as a locally developed transportation innovation that effectively addresses the pressing urban mobility challenges in Metro Manila. By utilizing driverless automation, AC electric motors with variable frequency drives, and lightweight infrastructure, AGTS demonstrates strong performance in operational reliability, energy efficiency, and environmental impact, key metrics identified in this study. The system operates consistently at optimal speeds with minimal human intervention, and its energy consumption is significantly lower than traditional transport modes, making it a promising clean mobility solution for dense urban areas.

Through a descriptive mixed-methods approach, this research evaluates AGTS based on technical assessments, stakeholder interviews, and observational data. The study confirms that AGTS meets critical benchmarks of efficiency, safety, and sustainability, with strong support from engineers, users, and transport officials. However, implementation challenges persist, including funding continuity, land acquisition in high-density zones, and integration with existing transport networks. These factors must be strategically addressed for AGTS to achieve broader national impact.

In line with its original objectives, the study demonstrates that AGTS holds substantial potential for replication in other congested Philippine cities, such as Cebu and Davao. It provides scalable solutions for short- to medium-range travel while aligning with national goals for sustainable development and clean energy transition. The system's compact footprint and low-emission profile make it particularly suitable for cities lacking heavy rail infrastructure.

This study contributes to the literature on smart urban mobility and localized transport innovation by evaluating a real-world AGTS prototype. It bridges the gap between policy planning and practical implementation in a developing country context. Nonetheless, future research is needed to assess long-term system performance across varied geographic and socio-economic settings. Specifically, studies should investigate AGTS integration into multimodal transport ecosystems, life-cycle environmental costs, and user experience at larger operational scales.

These findings support the formulation of a national policy framework to institutionalize clean, automated transit systems like AGTS. Such policies should encourage public-private partnerships, infrastructure investments, and inclusive governance to ensure the system's sustainability and adaptability across the Philippine archipelago.

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