UNLOCKING THE POTENTIAL OF MICROMOBILITY IN MALAYSIA

Exploring the Opportunities and Challenges

MINISTRY OF TRANSPORT
MALAYSIA

Unlocking The Potential of Micromobility in Malaysia

Exploring the Opportunities and Challenges

MIROS
MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
ASEAN ROAD SAFETY CENTRE

FUTURISE

Published by:
Malaysian Institute of Road Safety Research (MIROS)
Lot 125-135, Jalan TKS 1, Taman Kajang Sentral,
43000 Kajang, Selangor Darul Ehsan, Malaysia.

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Typeface: Arial
Size: 12 pt.

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PREFACE

DATO' JANA SANTHIRAN MUNIAYAN
Secretary General
Ministry of Transport
Putrajaya, MALAYSIA.

Congratulations to the Micromobility Management Research Cluster, MIROS in collaboration with Futurise Sdn. Bhd. for successfully completing the *Unlocking the Potential of Micromobility in Malaysia: Exploring the Opportunities and Challenges*. This report provides valuable information and covers the necessary components of the safety, social-economics, and sustainable impact on micromobility globally as well as in Malaysia.

Finally, I express my most profound appreciation to all parties involved in the publication of this report. It is my hope that with the combined efforts and cooperation from various parties, the implementation of the use of micromobility vehicles, especially shared e-scooters, can be done with appropriate legal control and support in order to guarantee the safety and sustainability of its operation.

Thank you!

FOREWORD MIROS

Ir. Ts. AZHAR BIN HAMZAH
Acting Director General
Malaysian Institute of Road Safety Research (MIROS)
Selangor, MALAYSIA

Micromobility vehicles use such as e-scooters are becoming the preferred choice, not only one of the first-mile transport modes of choice but also the main mode of transport for those who want to make short distances travel. In addition to the impact of the cost of living, it also supports the countrys mission and vision towards a low-carbon city in addition to addressing the issue of traffic congestion and the limited number of parking spaces.

This *Unlocking the Potential of Micromobility in Malaysia: Exploring the Opportunities and Challenges* report has been created to help stakeholders design a more sustainable and systematic implementation of micromobility in their cities as well as towards reducing 50% of the number of deaths due to road accidents by the end of 2030 in accordance with UN resolution. This is done to ensure that road safety aspects are always given attention in addition to creating a green city.

Thank you!

FOREWORD FUTURISE

ROSIHAN ZAIN BAHARUDI
Chief Executive Officer
Futurise Sdn. Bhd.
Cyberjaya, MALAYSIA

As the Chief Executive Officer of Futurise Sdn Bhd, I have come to believe that micromobility is the transportation of a near future. Since the emerging of shared escooters during mid-2019, the usage of these vehicles has only increased given the last-mile connectivity it provides. Furthermore, with the on-hit of Covid-19, these vehicles provided the perfect formula of social distancing and distance connectivity for those using public transportation. A publication by the World Bank back in 2015 stated only 17% of commuters in Kuala Lumpur use public transportation notwithstanding residents of greater Kuala Lumpur spend more than 250 million hours a year stuck in traffic. Given the push our government has made to increase public transport ridership and reducing the number of cars on Malaysian roads, this gives implication that micromobility will cover the gap that trains or buses cannot provide. Moreover, with the recent micromobility bans and ever-increasing need of micromobility in Malaysia, Futurise working with the Malaysian Institute of Road Safety Research and by extension, Ministry of Transportation, hope this study will shed light to users how to safely use micromobility and for relevant authorities to safely implement micromobility in Malaysia.

Thank you!

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ABBREVIATIONS

Km/h	Kilometer per hour
MM vehicle	Micromobility vehicle
SDG	Sustainable Development Goal

ACKNOWLEDGEMENT

The authors would like to express their sincerest appreciation to the Futurise Sdn. Bhd. for providing funding in producing this report. Our deepest gratitude goes to the Acting Director, Azhar bin Hamzah., who has support in this study. Finally, the authors would also like to express special thanks to the team members and research assistants for their contribution towards the completion of the project.

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EXECUTIVE SUMMARY

The global growth of micromobility, including electric scooters and bikes, is transforming cities economically, socially, and environmentally. It creates jobs, supports local businesses, reduces transportation costs, and fosters industry innovation. Micromobility also improves accessibility, promotes health, reduces congestion, and advances equitable transportation. Environmentally, it curbs emissions and pollution while promoting resource efficiency. However, challenges like safety, regulation, equity, and infrastructure development require careful management to maximize its benefits.

This study was initiated to investigate the current state of the micromobility industry in Malaysia and explore the impacts and opportunities arising from the increased use of micromobility vehicles, despite existing restrictions on public road access. The research focuses on several key areas: benchmarking and comparing market segment data with advanced micromobility regions, assessing the current micromobility landscape in Malaysia (including safety, public acceptance, industry outlook, trends, and opportunities), conducting an impact assessment encompassing social, economic, safety, regulatory, and sustainability aspects, and identifying the challenges and opportunities associated with implementing micromobility in Malaysia.

The study reveals that in the context of the global expansion of micromobility, Malaysia is still in its nascent stages, contending with a myriad of challenges. These include the establishment of a robust legal framework, the development of necessary infrastructure, and the adaptation of urban landscapes to accommodate micromobility solutions. In advanced markets like the USA and Europe, micromobility has seen widespread adoption, with robust infrastructure and well-established regulatory frameworks. The number of shared electric scooters and bicycles available for public use is significantly higher in these regions, resulting in greater market penetration.

Based on comprehensive surveys and data collected directly from service operators, the year 2022 witnessed an impressive 1.2 million rides covering a total distance of

approximately 2.1 million kilometers. Its noteworthy that despite survey results indicating that the majority of users, around 66%, employ micromobility for fun and recreational purposes, a significant portion, 37%, utilize micromobility vehicles at least 1-2 times per week. Additionally, 27% of users integrate micromobility into their commute by combining it with public transportation for their recent journeys. One particularly encouraging finding is that a substantial proportion of users expressed that, in the absence of micromobility options, they would resort to using a car for their recent journey. This recognition of micromobilitys importance highlights its potential positive environmental impact and underscores its role in promoting sustainable urban transportation alternatives.

In terms of economic impact, micromobility demonstrates substantial potential within the transportation sector, which currently contributes 3.8% to Malaysias GDP. In 2022, the existing shared micromobility ridership market displayed remarkable stability. This year, the micromobility industry has already contributed almost RM100 million to the GDP, encompassing both the micromobility sector itself and secondary sectors. This contribution is poised for further growth, with an anticipated 5% increase in the coming year, provided that the ban on micromobility vehicle use on roads is lifted. This underscores the significant economic role that micromobility can play in Malaysias evolving urban landscape.

In terms of safety, there have been relatively few reported crashes or incidents related to micromobility thus far. Several factors contribute to this lower incident rate. Firstly, the widespread usage of micromobility is still limited, reducing the frequency of potential accidents. Secondly, there is an issue with data classification, as micromobility is currently categorized as bicycles in police records, making it challenging to accurately document incidents. However, when we examine the data provided by micromobility service operators, its reassuring to note that the percentage of incidents remains relatively low. User surveys shed light on the characteristics of these crashes, revealing that they predominantly occur on roads and often involve collisions with other vehicles. Importantly, the majority of these incidents result in minor injuries only. While the data is still evolving and more comprehensive classification is needed, these findings offer valuable insights into the safety aspects of micromobility and can guide further measures to enhance its safety profile.

In Malaysia, the regulation and legislation surrounding micromobility vehicles, especially e-scooters, currently involve a ban on certain models to prioritize road safety. However, exceptions exist for specific areas under local councils, where operators can obtain permission to run their services, provided they adhere to guidelines set by the Ministry of Transport (MOT). Given that these vehicles are sold to the public and operated in private areas, experts emphasize the importance of establishing standards and mandating safety gear for users. According to a survey conducted, a majority of users express support for important legislation in this regard. This includes the implementation of age limits for users and the mandatory requirement of helmets. Such measures not only enhance safety but also contribute to the responsible and sustainable growth of the micromobility industry in Malaysia.

1. INTRODUCTION

Micromobility is the term that encompasses travel by a range of small, lightweight devices and can include bicycles, e-bikes, electric scooters, electric skateboards, shared bicycle fleets, and electric pedal assisted bicycles. Globally, the definition and categories of vehicles considered part of micromobility vary across countries and regions. In Malaysia, under the Road Transport Act 1987 (Act 333) Micromobility vehicles are defined as “any vehicle that is propelled by electrical means, an internal-combustion engine or human power or a combination of electrical means, an internal-combustion engine or human power, and having a maximum speed of 50 km/h”. Figure 1.1 shows the current categories of micromobility vehicles in Malaysia, classified according to their maximum speed capabilities.

Figure 1.1 Micromobility vehicles category in Malaysia

More detailed classifications for each category can be found in the Road Traffic (Prohibition of Use of Certain Micromobility Vehicles) Rules 2021. Under these rules, micromobility vehicles categorized as mopeds, personal mobility devices (PMDs), and personal mobility aids (PMAs) are not permitted to be used on public roads. Only bicycles and electric bicycles are allowed, subject to compliance with the regulations set out in the Road Transport Act 1987 and Road Traffic Rules 1959.

Micromobility has emerged as a rapidly growing new transport sector around the world, with over $5 billion invested globally in shared micromobility startups since 2015. Major players like Lime, Bird and Tier now have multi-billion-dollar valuations, and the total market is forecast to be worth $186 billion by 2030. It provides flexible employment opportunities through gig economy jobs.

Replacing trips in private cars with shared micromobility options like e-scooters can provide sustainability benefits for cities, including reduced congestion, emissions, noise, and need for parking. Global estimates suggest 25-50% of micromobility trips are replacing car trips, although there are concerns micromobility competes more with walking and cycling if not properly integrated into transport networks.

However, injuries and fatalities involving e-scooters and other micromobility devices have risen quickly as use has grown. Head injuries are common, along with fractures. Risk factors include unstable vehicle design, lack of riding experience, intoxication, lack of helmet use and ability of vehicles to reach higher speeds than anticipated. Pedestrians are also at risk from micromobility vehicles being ridden on sidewalks. Comprehensive data remains limited globally, but injury rates seem higher per trip or mile than bicycles, albeit lower than motorcycles.

Most countries now permit e-scooter use subject to some regulations, but the regulatory approach varies significantly. Speed limits typically range from 10-25 km/h, with some countries requiring helmets or permits. Rights to use bike lanes or sidewalks also differ. In Malaysia, the government has banned the use of certain micromobility vehicles on public roads, including e-scooters, due to safety concerns. Thus, this study was undertaken to investigate the current state of the micromobility industry in Malaysia and explore the impacts and opportunities since the widespread use of micromobility vehicles, despite restrictions on public road access. The findings can inform how Malaysia shapes policies and leverages micromobilitys benefits while addressing its challenges.

1.1. Objectives

The aim of this study is to understand the potential impacts of allowing micromobility to expand in Malaysia, particularly the social, economic, safety, regulatory, and sustainability implications. The specific objectives are:

a) To benchmark and compare data on market segment information regarding micromobility from countries that had advanced in the micromobility sector from regions such as Europe and USA.
b) To access the current micromobility situation in Malaysia in terms of safety, public acceptance and industry outlook including trends and opportunities.
c) To determine the impact of implementing micromobility in the city in terms of social and economic safety and regulatory, and sustainability.
d) To identify challenges and opportunities in implementing micromobility in Malaysia

1.2. Scope

This study focuses on micromobility vehicles that have motorized electric powertrains, specifically e-bikes and e-scooters. It covers both shared/rental micromobility as well as privately owned e-bikes and e-scooters. Normal human-powered bicycles without electric motors are excluded from the scope.

While there are other emerging micromobility devices such as mopeds, this study concentrates primarily on e-bikes and e-scooters as they currently have the highest rate of adoption and usage in Malaysia. However, the insights generated could help guide effective policies and planning for other forms of micromobility as they are introduced.

2. BRIEF OVERVIEW OF MICROMOBILITY

The micromobility landscape is diverse, with different regulations, technologies, and infrastructure around the world. This section provides an international benchmarking analysis, synthesizing definitions, regulations, and adoption trends related to micromobility globally. Furthermore, we present an overview of the growth of micromobility in Malaysia and delve into the profiling of local policies that align with the UN Sustainable Development Goals. These policies are specifically relevant to promoting sustainable mobility within the context of micromobility.

2.1. Definition

The definition of micromobility varies across the globe, reflecting the diverse needs and contexts of different regions. In essence, micromobility encompasses a range of compact, lightweight transportation options designed for short-distance travel within urban environments. However, the specifics of what constitutes micromobility can differ significantly. While some places define it narrowly to include shared electric scooters and bicycles, others take a broader view, incorporating electric skateboards, small electric vehicles, and pedal-assisted bicycles (Table 2.1)

Table 2.1 Definition of micromobility globally

SAE (Society of Automotive Engineers)	SAE defines micromobility as motorized, low-speed, and compact vehicles, typically operating at or below 20 mph (32 km/h), designed for short-distance urban travel.
ITF (International Transport Forum)	ITF describes micromobility as a set of lightweight, often electric, vehicles, typically used for short trips and well-suited for the first and last mile of a journey in urban areas. They are characterized by their small size and agility, making them ideal for congested urban environments.
United States	In the United States, micromobility often refers to shared electric scooters and bicycles, used for short urban trips. Each city may have its own specific regulations and definitions.

Germany	In Germany, micromobility includes e-scooters and e-bikes, often referred to as "Elektrokleinstfahrzeuge" or electric micro-vehicles. These are recognized as a distinct category of vehicles with specific regulations.
France	France defines micromobility as "engins de déplacement personnel électriques" (electric personal mobility devices) and includes e-scooters, e-bikes, and other similar electric vehicles.
Australia	In Australia, micromobility encompasses electric scooters, e-bikes, and other small electric vehicles designed for short urban journeys.
Singapore	Singapore defines micromobility as electric scooters, bicycles, and personal mobility devices (PMDs) used for short urban trips. The government has specific regulations governing the use of PMDs.
China	Chinas definition of micromobility includes electric bicycles (e-bikes) and various small electric scooters used for urban transportation.
Canada	In Canada, micromobility typically encompasses electric scooters, e-bikes, and other small electric vehicles used for urban commuting.
United Kingdom	The UK recognizes micromobility as electric scooters and e-bikes, with specific regulations for their use in different regions.

2.2. Regulations

Additionally, regulations and criteria such as speed limits, weight restrictions, and motorization requirements also differ from one location to another. This variance in definitions underscores the adaptable nature of micromobility, as cities tailor their interpretations to align with their unique urban landscapes and mobility objectives. In several countries, the regulatory framework concerning micromobility has undergone multiple changes in recent years, indicating an ongoing search for more effective policies.

Table 2.2 presents a comparative overview, highlighting key aspects of micromobility vehicle regulation in different countries. The table also includes brief descriptions of features that are most commonly observed among these countries.

Table 2.2 Micromobility vehicle regulation in different countries

Country	Vehicle design speed limit	Other limitations	Permitted area to ride	Is it allowed to move on the sidewalk?
France	25km/h	-	Cycling infrastructure, right side of the street (except for country roads).	No
Germany	20km/h	Capacity: maximum 500W (1400 for self-balancing devices), presence of the steering wheel.	Cycling infrastructure, roadway.	No
Great Britain	25km/h	Rental electric scooters only, weight: 55kg, capacity: 500W, need for a special certificate.	Cycling infrastructure, roadway, the right of local authorities to regulate.	No
Spain	25km/h	It is planned to introduce a special driver's license	Cycling infrastructure (with an additional speed limit of 15km/h in some cities), streets with a speed limit of 30km/h, parks (at a speed of not more than 10km/h).	No. Exceptions may be adopted by local authorities. E.g., in Barcelona it is allowed at a speed of 10km/h and its reduction to "pedestrian" speed when approaching pedestrians.
Austria	25km/h	Capacity: 600W	Cycling infrastructure, roadway.	No. Exceptions may be regulated by local authorities, but in that case the speed should not exceed the speed of a pedestrian.

Poland	-	Separate limits for scooters and other vehicles.	Cycling infrastructure, not faster than 20km/h, streets with a limit of 30km/h.	Separate limits for scooters and other vehicles.
Denmark	20km/h	Weight: 55kg. Scooters, segways, gyro boards were determined. Other MM vehicles are prohibited.	Cycling infrastructure.	No
Netherlands	25km/h	Only scooters are allowed, subject to the availability of driving license	Roadway.	No
Belgium	25km/h	-	Cycling infrastructure, roadway.	Yes, at pedestrian speed.
Sweden	20km/h	Capacity: 250W. Some more powerful vehicles are equated to mopeds, the rest are prohibited.	Cycling infrastructure, roadway.	Yes, at a speed of 5-7km/h.
Turkey	25km/h	Availability of identification number.	Cycling infrastructure, streets and roads with a speed limit not exceeding 50km/h.	No
Singapore	25km/h	-	Cycling infrastructure, roadway.	No
USA	16 – 24km/h	Different regulations in different states, mostly covering rental scooters	Cycling infrastructure, roadway	No, local authorities may establish exceptions. E.g., in Washington it's allowed outside the downtown
New Zealand	-	Capacity: 300W	Cycling infrastructure, roadway	Yes, the pedestrians are a priority in all cases
Colombia	20km/h	-	Cycling infrastructure, city streets (except for main roads)	No

2.3. Global trend

The current trend of micromobility is witnessing significant momentum, revolutionizing urban transportation across the globe. Bike-sharing and e-scooter services have rapidly gained popularity, providing commuters with convenient, eco-friendly, and cost-effective alternatives for short-distance travel. Figure 2.1 shows the comprehensive overview of the new mobility landscape in cities around the world in form of atlas, called The New Mobility Atlas[1]. Based on the Atlas it shows the micormobility has proliferated rapidly into more than 600 cities in 50 countries.

Figure 2.1 New Mobility Atlas from New Urban Mobility Alliance (NUMO)[2].

2.4. Growth in Malaysia

Micromobility has been a part of Malaysias transportation landscape for quite some time, starting with traditional bicycles. However, the introduction of motorized micromobility, particularly electric vehicles, gained significant attention when electric bicycle entered the Malaysian market in 2009. The issue of regulating electric bicycles sparked a heated debate during that time, with discussions around whether specific

[1] https://www.numo.global/new-mobility-atlas#2/22.9/19.5
[2] https://www.numo.global/

regulations were necessary. Ultimately, the government clearly defined electric bicycles in the rules and treated them on par with conventional bicycles, exempting them from license and helmet requirements. These vehicles were required to comply with the safety standards outlined in the Malaysia Standard - MS 2514:2015, ensuring their safe operation.

2.4.1. Shared service

Regarding shared micromobility, Malaysia experienced its first foray in 2017 with the launch of an electric bicycle. Two companies oBike and Ofo aimed to combat the rising traffic congestion and pollution in major cities by introducing a dockless bike-sharing system. Through a user-friendly mobile application, individuals could easily locate and rent bikes, enabling convenient pick-up and drop-off at designated public spots without the need for docking stations. Despite its initial popularity, oBike and Ofo encountered management and other challenges that ultimately led to its discontinuation in 2018.

Subsequently, with the advancement of technology, electric scooters, also known as e-scooters, began to gain popularity and became part of shared mobility programs. One of the first companies to venture into Malaysia was Neuron, a Singapore-based electric scooter sharing service. Neuron initiated its operations in Cyberjaya as a significant component of the Cyberview Living Lab Pilot Program, aimed at the development of Cyberjaya. Concurrently, Anywheels, another Singapore-based company, also entered the Malaysian market with its pilot program in Penang and Shah Alam. Anywheels distinguished itself by offering both e-scooters and electric bikes to users. However, despite their promising start, both Neuron and Anywheels faced challenges and, unfortunately, ceased their operations in Malaysia by 2020.

Currently, the shared micromobility industry in Malaysia has been dominated by three main operators - Beam, Anywheels, and Oogyaa. What started as a few small trials has rapidly expanded into large fleets operated by major international companies. Figure 2.2, as illustrated below, provides a comprehensive timeline detailing the evolution of shared micromobility in Malaysia, beginning with the introduction of electric bicycles and culminating in the entry of these major players. The timeline shows how quickly the shared micromobility industry has grown in Malaysia over the past few years.

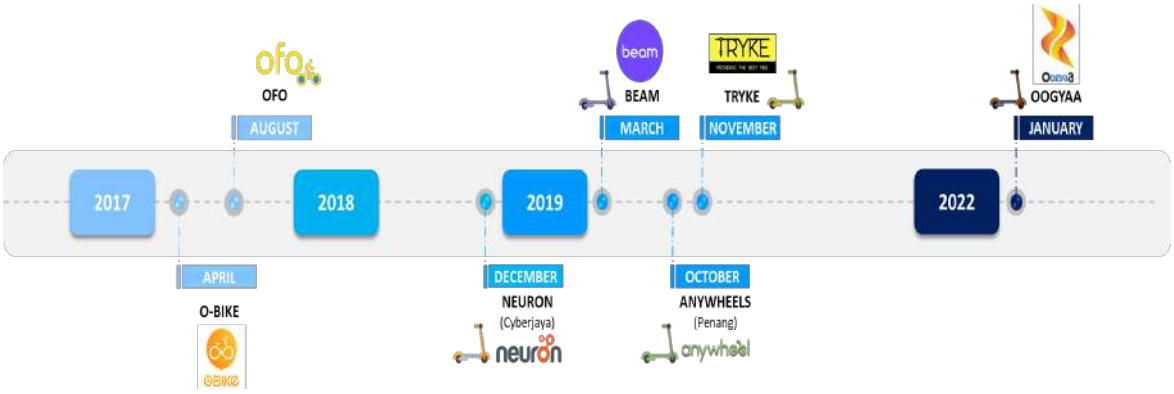


Figure 2.2 The evolution of shared micromobility in Malaysia.

2.4.2. Private e-scooters

According to MIROS market survey, micromobility vehicles for private use are typically sold through online e-commerce platforms like Lazada, Shopee, as well as physical stores including bicycle shops, specialty shops, and hobby shops. It is less common to find them in motorcycle shops.

An internet search reveals a wide range of prices for micromobility vehicles, with costs varying from as low as RM200 for an entry-level electric hoverboard to as high as RM14,000 per unit for a Ninebot Segway E+. The market offers a diverse selection, catering to a broad spectrum of customers, from those on a budget to high-end users. The majority of available micromobility vehicle models in the market are from lesser-known brands based in China and are powered by electric drives. Their popularity stems from their considerably lower price points compared to more well-established brands such as Ninebot Inc.

Table 2.3 provides an overview of the different types of micromobility devices (MMDs) available in the Malaysian market, categorized based on performance and specifications. Common categories include high-performance models, medium-performance models, Segways, e-scooters with seats, and monowheel e-scooters. Specifications typically include the maximum speed, product weight, maximum load capacity, maximum distance the MMD can travel, and wheel size.

Table 2.3 Micromobility Devices Available in Malaysia Market

Category / Market Price	Market Price	Specification
High Performance E-Scooter 	RM 5,000 – RM 12,000	Max Speed: 60 – 115 km/h Weight: 35 – 48 kg Max Load: 150 kg Max Distance: 50 – 90 km Wheel Size (Diameter): 10 – 11 in
Medium Performance E-Scooter 	RM 1,000 – RM 4,000	Max Speed: 15 – 45 km/h Weight: 7 – 20 kg Max Load: 100 - 120 kg Max Distance: 25– 35 km Wheel Size (Diameter): 5.5 – 9.5 in
E-scooter with Seat 	RM 2,000 – RM 6,000	Max Speed: 20 – 30 km/h Weight: 14 – 19 kg Max Load: 120 kg Max Distance: 25 – 40 km Wheel Size (Diameter): 12 in
Segway 	RM 1,200 – RM 14,000	Max Speed: 20 – 22 km/h Weight: 25 kg Max Load: 150 kg Max Distance: 25 km Wheel Size (Diameter): 14 – 16 in
3 Wheel Electric Scooter 	RM 1,500 – RM 6,000	Max Speed: 30 – 35 km/h Weight: 50 kg Max Load: 200 kg Max Distance: 30 – 35 km Wheel Size (Diameter): 9 in
Monowheel Electric Scooter / Motorcycle Hoverboard 	RM 1,200 – RM 14,000	Max Speed: 20 – 25 km/h Weight: 25 kg Max Load: 100 kg Max Distance: 30 – 60 km Wheel Size (Diameter): 17 – 18 in
Electric Unicycle 	RM 2,000 – RM 8,000	Max Speed: 50 km/h Weight: 16 kg Max Load: 150 kg Max Distance: 35 – 50 km Wheel Size (Diameter): 16 in
Electric Hoverboard 	RM 200 – RM 3,000	Max Speed: 20 km/h Weight: 15 kg Max Load: 120 kg Max Distance: 15 km Wheel Size (Diameter): 8 in
Electric Scooter with Child Seat 	RM 1,200 – RM 14,000	Max Speed: 30 – 60 km/h Weight: 30 kg Max Load: 200 kg Max Distance: 20 – 40 km Wheel Size (Diameter): 12 in

2.5. Sustainable Development Goals

The 2030 Agenda for Sustainable Development, unanimously embraced by every United Nations Member State in 2015, serves as a blueprint for coordinated worldwide endeavors. Central to this framework are the 17 Sustainable Development Goals (SDGs), which represent a pressing plea for collaboration among nations, whether developed or developing, in a unified global partnership (Figure 2.3).

Figure 2.3 Sustainable Development Goals (SDGs)

The SDGs encompass three key dimensions of sustainability: social, economic, and environmental. The implementation of SDGs serves as a framework for various stakeholders across industries to assess their roles in advancing sustainable development. Micromobility represents a promising avenue for making meaningful contributions to the attainment of the SDGs. Figure 2.4 offers a comprehensive perspective on how micromobility can positively impact the SDGs.

Figure 2.4 Potential micromobility contribution to the SDGs[3]

Aligned with the Sustainable Development Goals (SDGs), the Malaysian government and associated stakeholders have made dedicated commitments to address climate change and emphasize the adoption of eco-friendly technologies through policy measures. Consequently, a shift from individual car use to embracing micromobility and public transportation is considered a pivotal step toward fostering intelligent and ecologically responsible urban centers. Table 2.4 outlines the pertinent policies

[3] Micromobility: Progress, benefits, challenges, policy and regulations, energy sources and storage, and its role in achieving sustainable development goals.

endorsed by different stakeholders, all of which are in alignment with the SDGs and aim to promote sustainable mobility.

Table 2.4: Relevant policies from various stakeholders.

Kuala Lumpur Climate Action Plan 2050	▪ first/last mile 2022 – 2025: assessment; 2025 – 2030: enhance for 75% of stations in Central Business District (CBD). ▪ by 2050 active mobility >70% modal share. ▪ by 2050 300km dedicated bicycle lane.
Kuala Lumpur Low Carbon Society Blueprint 2030	▪ Promote walking and cycling on short to medium-sized trips. ▪ Carbon reduction from Green Mobility – 14.2%.
Smart City Framework	▪ Smart mobility: bike sharing with dedicated bicycle lanes.
National Transport Policy	▪ Thrust 3: enhance safety, integration, connectivity, and accessibility for seamless journey – strengthen infrastructure/facilities and intensify the use of digitalization to improve connectivity, accessibility, and acceptability.
Malaysian Road Safety Plan 2022 – 2030	▪ Sub-area 7.2, Strategy 1: Improving infrastructure, access and connectivity of public transport chains. ▪ Priority Area 9: Safer Micromobility.

3. STUDY APPROACH

Beyond the literature reviews presented in Section 2, our report harnessed locally acquired data from diverse sources to enrich our understanding. In this section, we outline the methodology employed to acquire the data.

3.1. Method

Our approach encompasses a blend of both quantitative and qualitative research methodologies to ensure a comprehensive dataset is obtained. Table 3.1 provides a concise overview of the research approach and the origins of the data collected in this study.

Table 3.1 Research Methodology

	Quantitative Research	Qualitative Research
Primary Data	▪ Public survey ▪ On site observations ▪ Road safety inspections	▪ Focus group discussion ▪ In-depth interview
Secondary Data	▪ Public database ▪ Government agencies' data ▪ Industry data ▪ Trade associations data	▪ Scientific journals ▪ Conference papers ▪ Public research reports

3.1.1. Quantitative Research

The primary objective of our quantitative research is to gather structured data from a wide range of participants, including the general public, stakeholders, and users. This method enables us to gather numerical data that can be statistically analyzed to derive meaningful insights.

Primary Data Collection

- **Public survey:** We conducted an extensive questionnaire that covered all facets of micromobility, targeting both users and non-users among the general public. This survey was distributed online and in-person to ensure a wide-reaching and diverse range of viewpoints.
- **Field observation:** We carried out observations at various sites within Kuala Lumpur and Selangor, focusing specifically on collecting behavioral data related to e-scooters, including factors like riding speed (Figure 3.1).

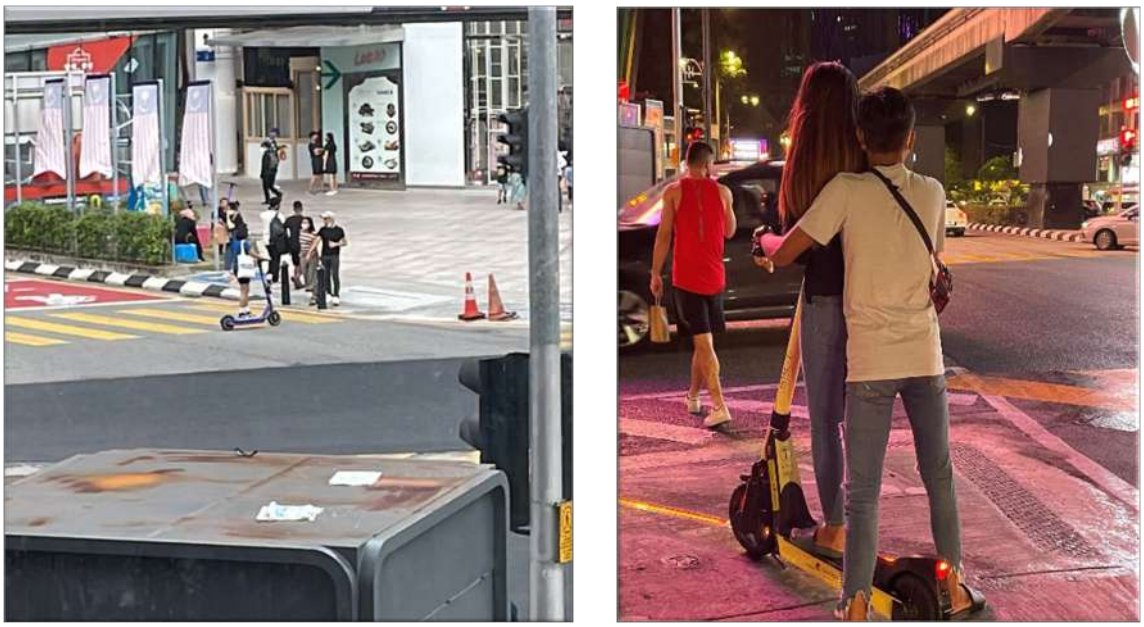


Figure 3.1 Field observation at selected locations.

Secondary Data Collection:

- **Government agency data:** We supplemented our primary data with relevant information obtained from government agencies. These authoritative sources provide valuable data and context related to the study.
- **Industry data**: We collected data directly from e-scooter vendors and shared e-scooter operators, encompassing various aspects such as sales volume, financial metrics, ridership statistics, employment figures, incident reports, and geographic locations. These datasets are of significant value for analyzing the socio-economic impact of e-scooters.
- **Reports from previous studies:** We utilised relevant reports related to our research topic was also utilised. This allowed us to benefit from existing knowledge and build upon prior research efforts.

3.1.2. Qualitative Research

Complementing our quantitative research, our second methodological approach involves qualitative research methods. This approach is designed to provide in-depth insights into the attitudes, perceptions, and experiences of the public, stakeholders, and users.

Primary Data Collection:

- **In-depth interviews:** We performed semi-structured, one-on-one interviews with selected participants representing relevant stakeholder groups (Figure 3.2). These included government agencies, industry representatives, users and non-users.
- **Focus groups:** Similarly, we organize focus group discussions with selected participants from relevant stakeholders to facilitate group interactions and generate rich qualitative data.
- **Survey Content Analysis**: Given that the survey questionnaires included open-ended responses, we conducted an analysis to extract qualitative insights and discern emerging themes and trends.

Figure 3.2 In-Depth-Interview with selected participants

Secondary Data Collection:

- **Scientific journals and reports:** We complement our primary data by conducting an extensive review of relevant scientific journals, academic publications, and authoritative reports., These sources offered useful pre-existing data and context relevant to our research aims.

- **Other documents and digital data:** We also performed textual analysis on relevant documentation, including government policies, news articles, ministerial speeches, press releases, and other public records.

3.2. Study limitations

There are several limitations in this study, particularly concerning the data. Our data collection strategy was carefully planned to include participants from all regions of Malaysia, not limited to urban areas, and aimed to cover both e-scooter users and non-users. However, due to the banning of e-scooters, the response rate among users was somewhat lower compared to non-users.

The impact of the ban on micromobility also disrupted trend analysis in specific areas. In certain local councils, the operations of e-scooters were entirely halted, thereby prohibiting further examination of e-scooter acceptance and growth development trends.

Furthermore, due to privacy and confidentiality concerns, access to financial data from shared e-scooter operators and sellers was restricted. This limitation significantly curtailed the extent of our analysis in this regard.

Given the novelty of micromobility and the evolving nature of its definitions and legal frameworks, there is currently a lack of available collision data recorded by law enforcement agencies. This includes data related to the frequency of collisions, the types of collisions that occur, casualty rates, as well as information on injuries and fatalities.

4. PUBLIC USAGE AND PERCEPTION

Before implementing any new regulations or policies, authorities should understand the public's comments and usage pattern on micromobility to integrate public perception and understanding as part of the policy. For this purpose, we have conducted public surveys to understand the public's feedback on micromobility usage, public acceptance, demographic of micromobility users, and travel characteristics. Furthermore, we use ridership data from shared micromobility operators to analyze the travelling pattern and preferred locations.

4.1. Public perception

Our result shows that only 2% of the respondents don't know anything about micromobility vehicles. However, 53% respondents have never used micromobility despite their knowledge about micromobility vehicles. The result of the finding is illustrated in Figure 4.1. This finding indicates that the public did know about the existence of micromobility vehicles, however, only less than half of them have tried this new mode of transport.

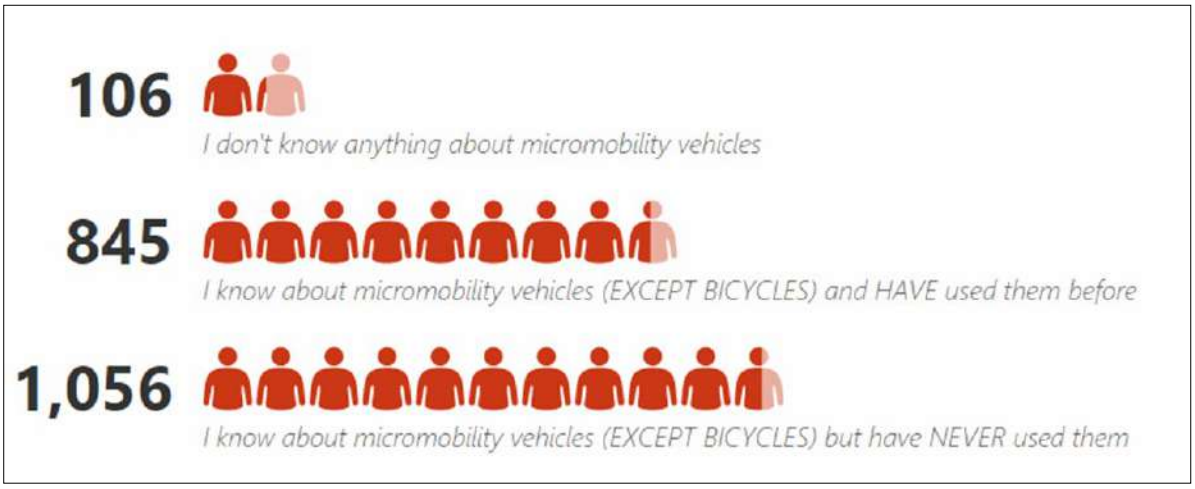


Figure 4.1 Public awareness of micromobility vehicles

When the public was questioned about their first perception about micromobility, the three (3) most frequently mentioned ideas were its environmental friendliness, its affordability as an alternative mode of transportation for short distances, and its convenience and speed. On the other hand, responses with negative connotations, such as concerns about safety, user irresponsibility, and excessive speed, were among the least chosen by the respondents. The public's comment towards micromobility vehicles is as shown in Figure 4.2.

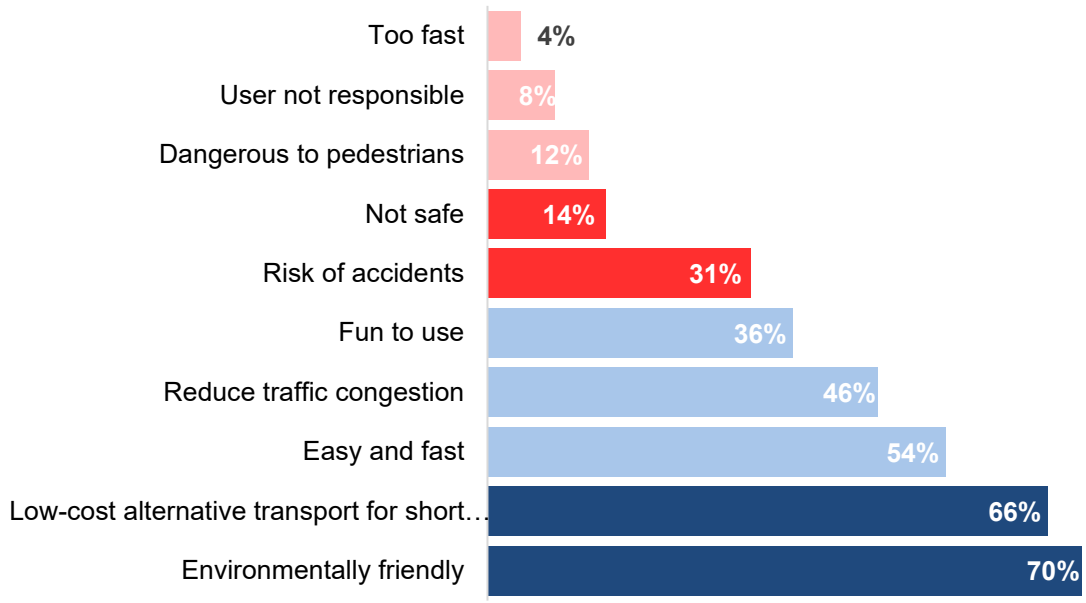


Figure 4.2 Public common ideas when ask to think about micromobility

Figure 4.3 displays the percentage of public perception or awareness regarding laws and regulations pertaining to micromobility. A significant majority of respondents were aware that micromobility vehicles are prohibited on the road, indicating that the governments message or announcement regarding this matter has successfully reached the masses.

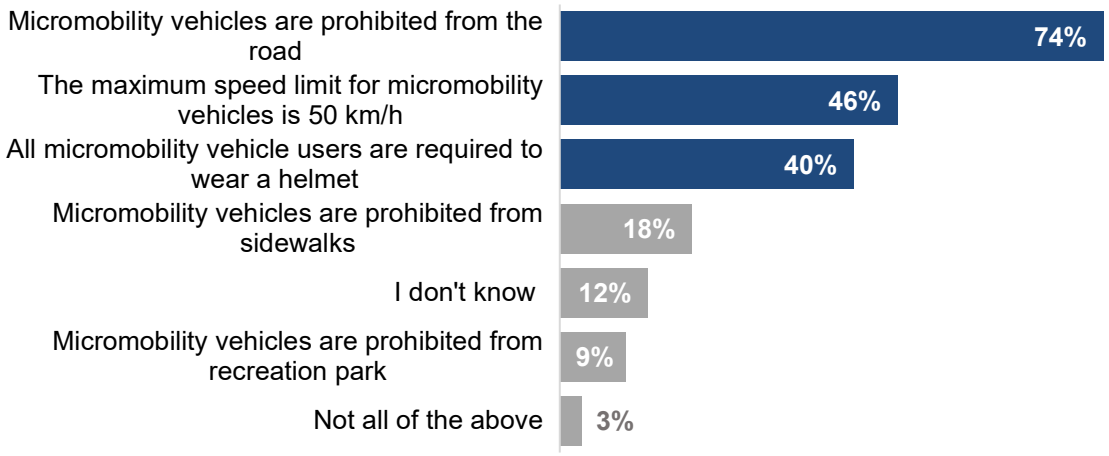


Figure 4.3 Public awareness on laws and regulations for micromobility

In our public survey, some sections of the questionnaire focus on respondents that have never used micromobility vehicle. One of the questions was about the willingness to use micromobility vehicle if the banning order is lifted. Our result shows that more than 60% of them are interested to rent or buy micromobility vehicles. This signifies that the banning order did affect the willingness of the public on the usage of micromobility users. The distribution of this question is as shown in Figure 4.4.

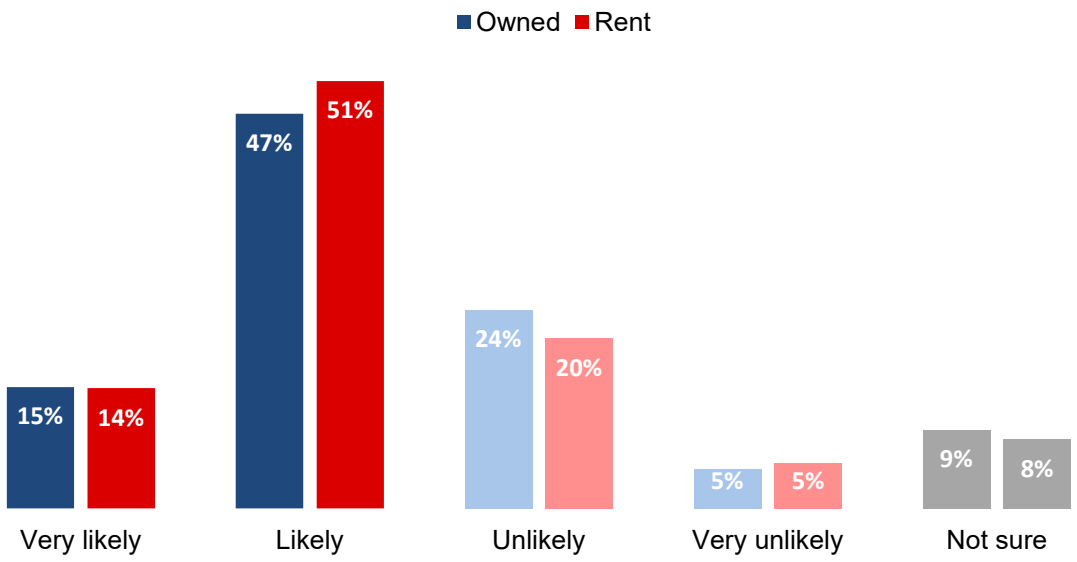


Figure 4.4 If there is no ban on its usage on the road, would you rent or buy a micromobility vehicle?

Nonetheless, about one third of the same respondents would use micromobility vehicles for the purpose of recreational as illustrated in Figure 4.5. About 26% of this group of respondents would use it for social activities or going to religious places and travelling to shops or restaurants. Only 8% and 7% of the respondents would use for the purpose of daily commuting to work and public transport stations respectively.

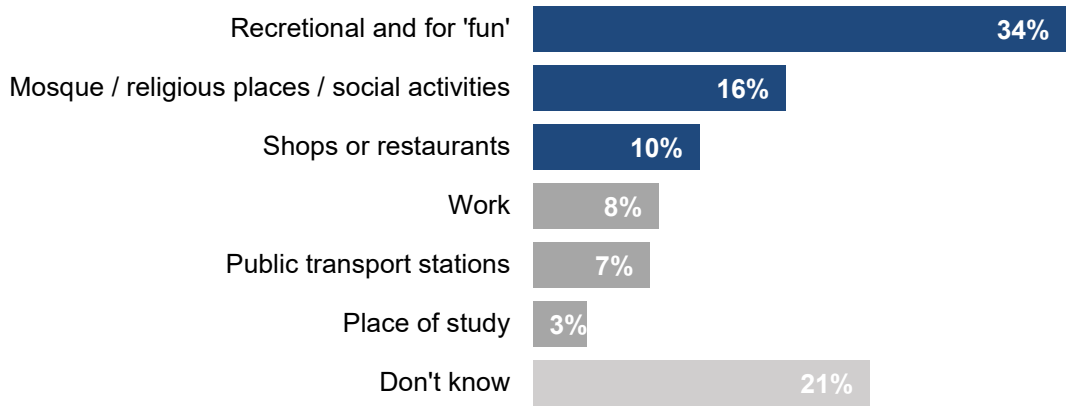


Figure 4.5 If there is no ban, what is the main purpose of using a micromobility vehicle

When asked about the frequency of usage, 70% of this group of respondents claimed that they will use micromobility frequently, in which 23% would use for every day, 21% would use for 3 – 6 times per week and 26% would use for 1 – 2 times per week, as shown in Figure 4.6.

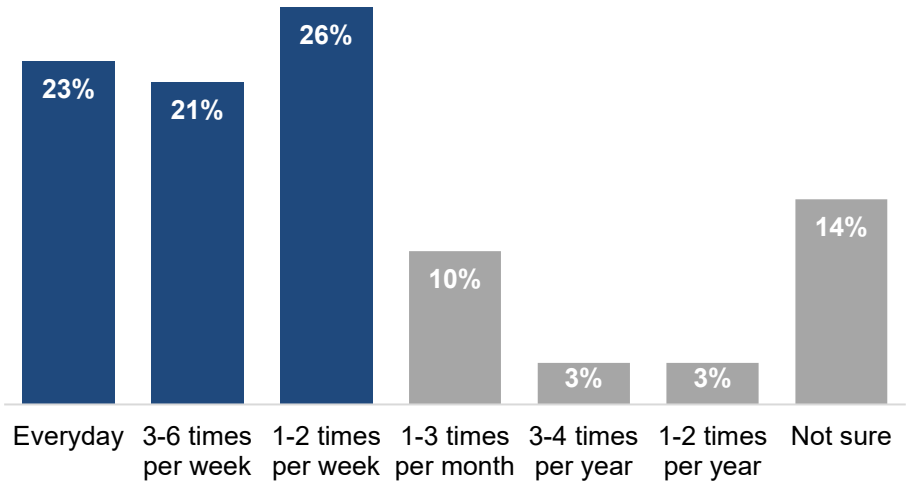


Figure 4.6 If there is no ban, how frequent would you use micromobility vehicle

4.2. Public Usage

The growth of micromobility in the western countries particularly the United States and Europe is driven by ease of mode switching to micromobility due to a large proportion of trips by private vehicles are short distance. The characteristic of commuting in Malaysia, however, on average is at a longer distance with the average distance of travel in Malaysia is 66km (MIROS) and in Kuala Lumpur is 17km (Hamsa et al, 2016)[4].

At the same time, the main purpose of using micromobility in Malaysia is still dominated by recreation as compared to other countries such as Australia where the main purpose is commuting. Similar observation was made by Beam in their surveys across different countries, which indicated that the main purpose of micromobility usage in Malaysia is recreational, while the main purpose in Australian cities is to commute to work.

Micromobility vehicles encompass a diverse array of types and categories. According to the survey findings, the most prevalent micromobility vehicle used in Malaysia is the electric scooter or e-scooter. Figure 4.7 indicates that 62% of the public respondents reported using e-scooters, while 15% respondents used mopeds, and only 11% respondents utilized electric bicycles. This trend is likely attributed to the greater market availability and the proliferation of shared services offering e-scooters, making them a more accessible and popular choice compared to other types of micromobility vehicles.

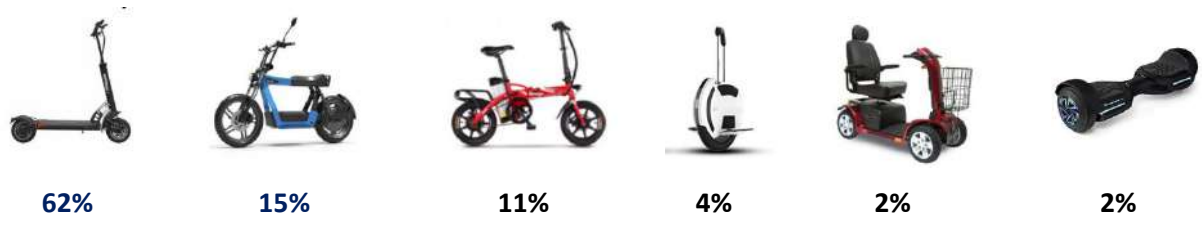


Figure 4.7 Common micromobility vehicles used by the public

[4] Hamsa, AAK, Jaff, MM, Ibrahim, M, Mohamed, MZ, Zahari, RK (2016). Exploring the effects of factors on the willingness of female employees to telecommute in Kuala Lumpur, Malaysia. Transportation Research Procedia, 17, 408-417.

4.2.1. General characteristics of micromobility vehicles users

The common user groups of micromobility are private user who owned the vehicle or shared vehicle users who rented the vehicle from the operators. Based on our public survey, more than half of the micromobility users are within the age of 31 – 40 years old, regardless of owned or rented users. The age distribution of owned users is slightly higher, in which 25.1% in between 41 – 50 years old and 4.5% in between 51 – 60 years old. On the other hands, the overall users of rent users are slightly younger, in which 25.8% in between 21 – 30 years old and 2.3% less than 21 years old. The overall age distribution is as shown in Figure 4.8. Regardless of private or shared vehicle users, male is the more dominant user group with proportion of 77% and 67% respectively. The gender distribution is as shown in Figure 4.9.

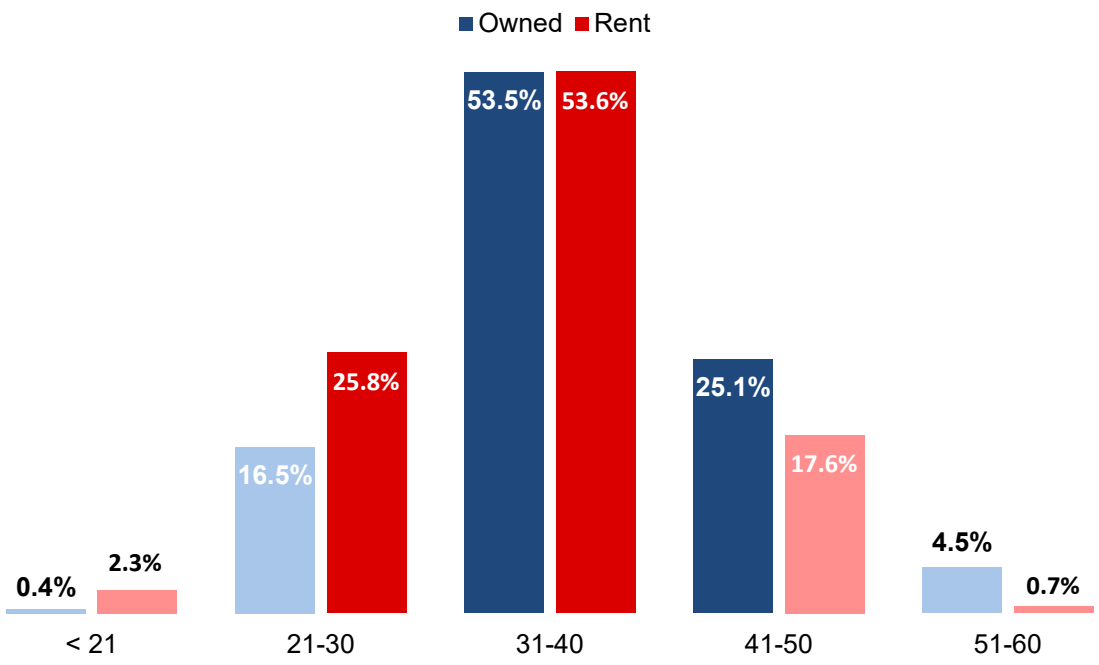


Figure 4.8 Age distribution of micromobility users for owned and rent users

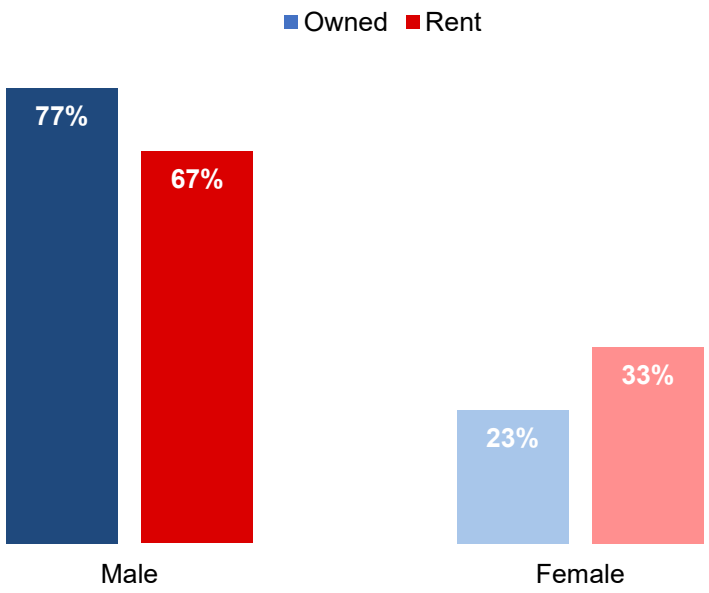


Figure 4.9 Gender distribution of micromobility users according to owned and rent users

According to Figure 4.10, one-third of micromobility users rely on this mode of transportation for their daily activities. However, most users still utilize micromobility for recreational purposes. This could be attributed to the early phase of exposure, limited availability of micromobility options, lack of a comprehensive legal framework, and public apprehension stemming from recent ban orders. Nevertheless, there is reason for optimism as 5% of respondents use micromobility for first and last-mile travel, which showcases its potential as a convenient solution for short-distance trips. Further improvement of existing infrastructure and assess to public transport could possibly increase the number of users using micromobility vehicle for daily commuting and achieve reasonable modal shift. Additionally, 7% of users employ micromobility for their daily work commute, indicating its growing relevance as a viable commuting option.

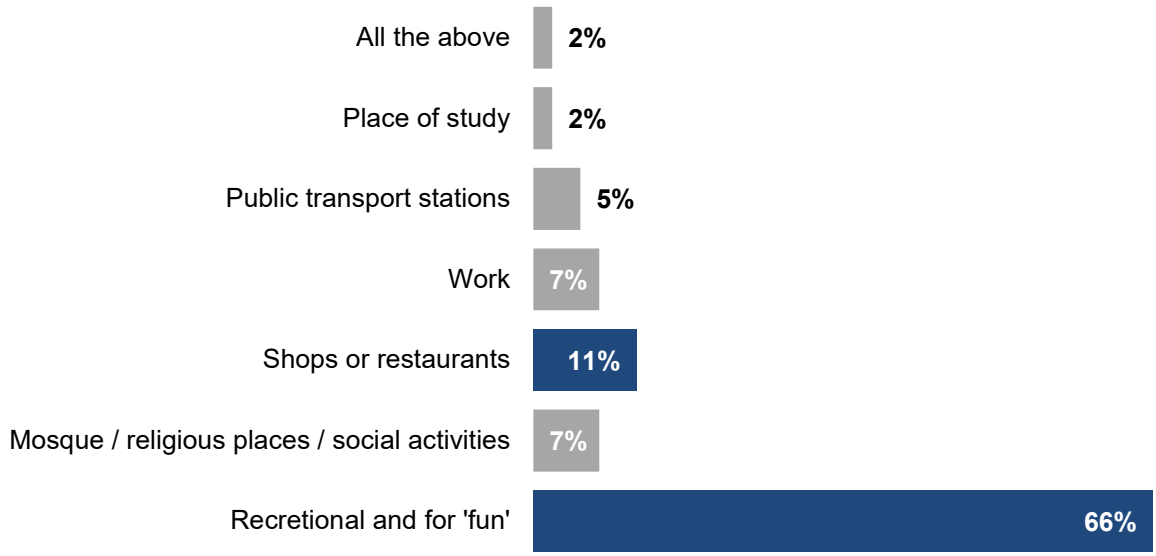


Figure 4.10Travelling purpose of micromobility user

4.2.2. Existing micromobility users – Owned

Based on our survey (Figure 4.11), we can estimate the distribution of micromobility private users in Malaysia. Selangor and Kuala Lumpur have the highest proportion of users, with a total of 62.6%. Interestingly, we found that both Johor and Sarawak were the third highest states with a percentage of 6.2%. It reflects that demands of micromobility vehicles were not only concentrated in Klang Valley but also attracted interest from other states. Even with a small population compared with other states, Putrajaya scores the fifth highest micromobility private users (5.3%).

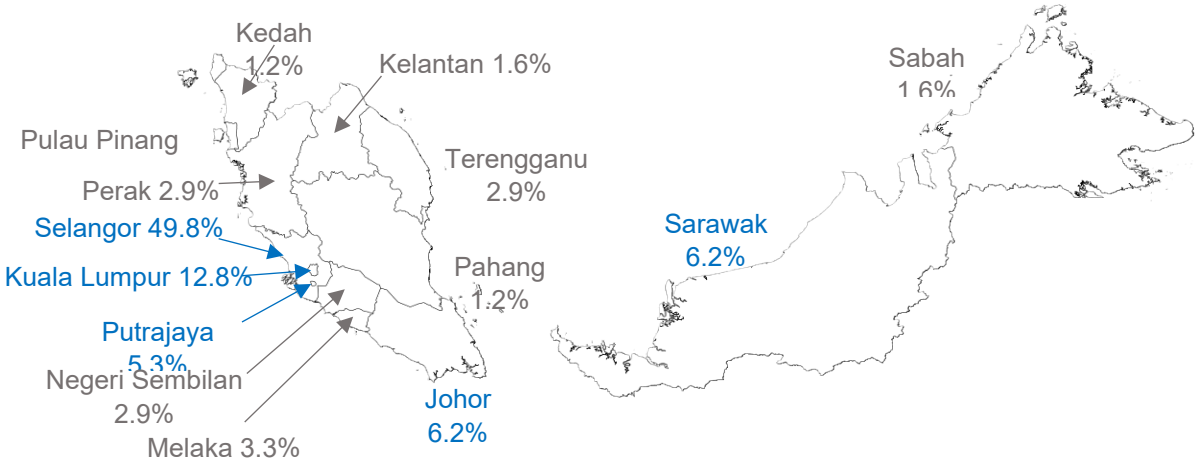


Figure 4.11 Distribution of Private Micromobility User

Figure 4.12 presents survey data depicting the distribution of private user frequencies when utilizing micromobility vehicles. Notably, approximately one-third of the respondents (38%) are already frequent micromobility users. Among these, 10% use them every day and 28% use weekly.

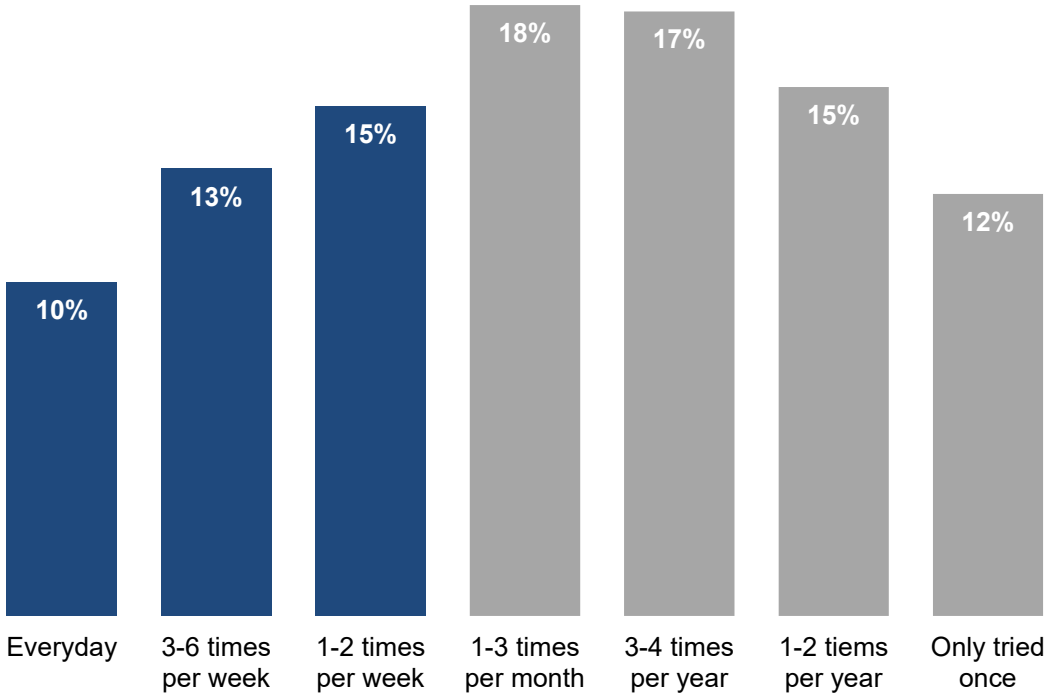


Figure 4.12 Frequency of micromobility usage for private user

4.2.3. Existing micromobility users – Shared or Rent

In this section, we will present the ridership details of shared micromobility in Malaysia (Figure 4.13). Some of the common questions on micromobility ridership are “which cities have the highest ridership?”, “where is the usage distribution?”, “what is the average riding duration and distance?”, “what is the growth pattern of ridership?” and many more similar questions about existing micromobility users. This section will provide an overall picture and summarize information to answer these common questions.

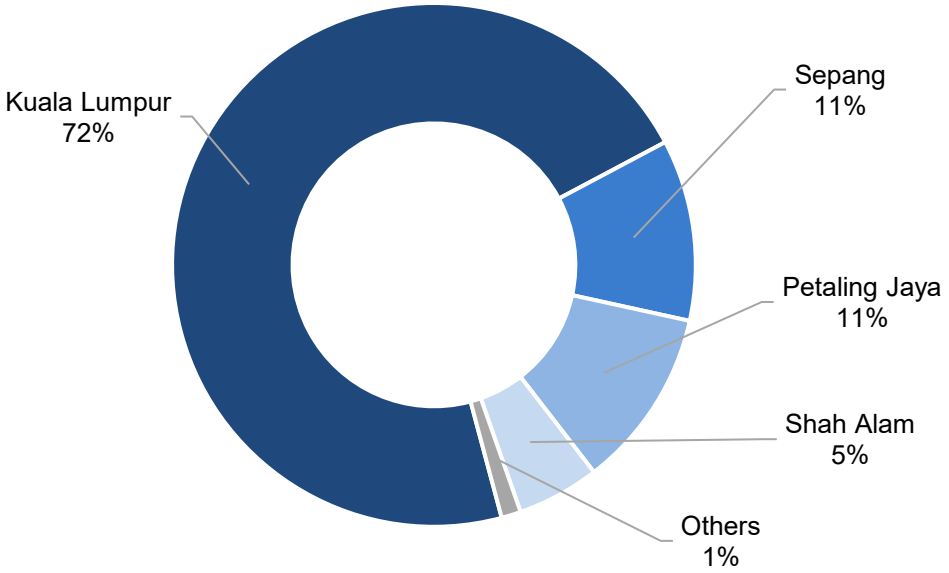


Figure 4.13 The most popular cities for shared micromobility operation

In 2022, the total number of rides is about 1.14 million in Malaysia. From this figure, Kuala Lumpur is the city with the highest numbers of ridership, scoring more than 71% of total ridership. Next is Sepang, with 11.2% of ridership, which is operated in Cyberjaya. Nevertheless, the market share in Sepang could be higher if the shared operators did not cease operation after April 2022 after the government announced the banning usage of micromobility on the public road. The Sepang city council ordered the operators to remove their shared vehicles from the roads and only allowed the shared operators to operate around the lakeside. This mandatory order to cease operation caused drastic reduction in the amount of ridership after April. The third highest city ridership is Petaling Jaya, with a market share of 11.1%. In contrast, Petaling Jaya's ridership started to increase since April 2022 and reached peal in July 2022.

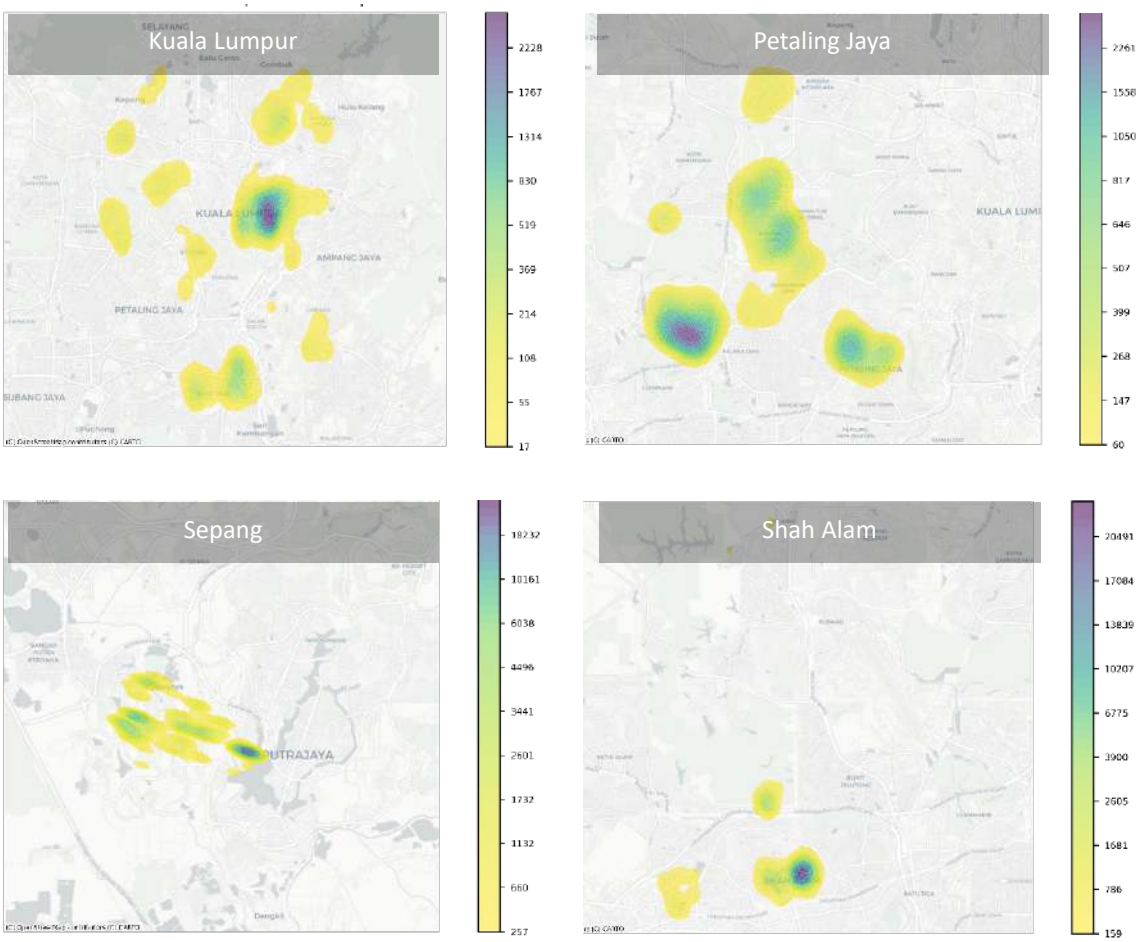


Figure 4.14 What is the distribution of Ridership in the most popular cities?

The city centre of Kuala Lumpur (Figure 4.14) records the highest usage of shared micromobility especially in Bukit Bintang, KLCC, Kampung Baru and Masjid Jamek. However, the usage of micromobility in Kuala Lumpur does not limit in the city centre only, Sri Petaling, Bukit Jalil, Kuchai Lama, Setapak and Bandar Menjalara are some of the famous places for the micromobility users. In Petaling Jaya, the hotspots of shared micromobility activities are Ara Damansara, areas around Asia Jaya, Bandar Utama and Taman Tun Dr Ismail. Unlike Kuala Lumpur and Petaling Jaya, the shared micromobility activities in Sepang and Shah Alam mostly concentrated in recreational parks or space. In Sepang, we found that the highest number of usages was next to the lakeside in Cyberjaya. Nonetheless, we did identify shared micromobility activities in residential and commercial areas, which includes Mutiara Ville, Tamarind Square and Persiaran Bestari. On the other hand, the hot spot areas in Shah Alam are Dataran Kemerdekaan Shah Alam, Taman Botani Negara Shah Alam, I-city.

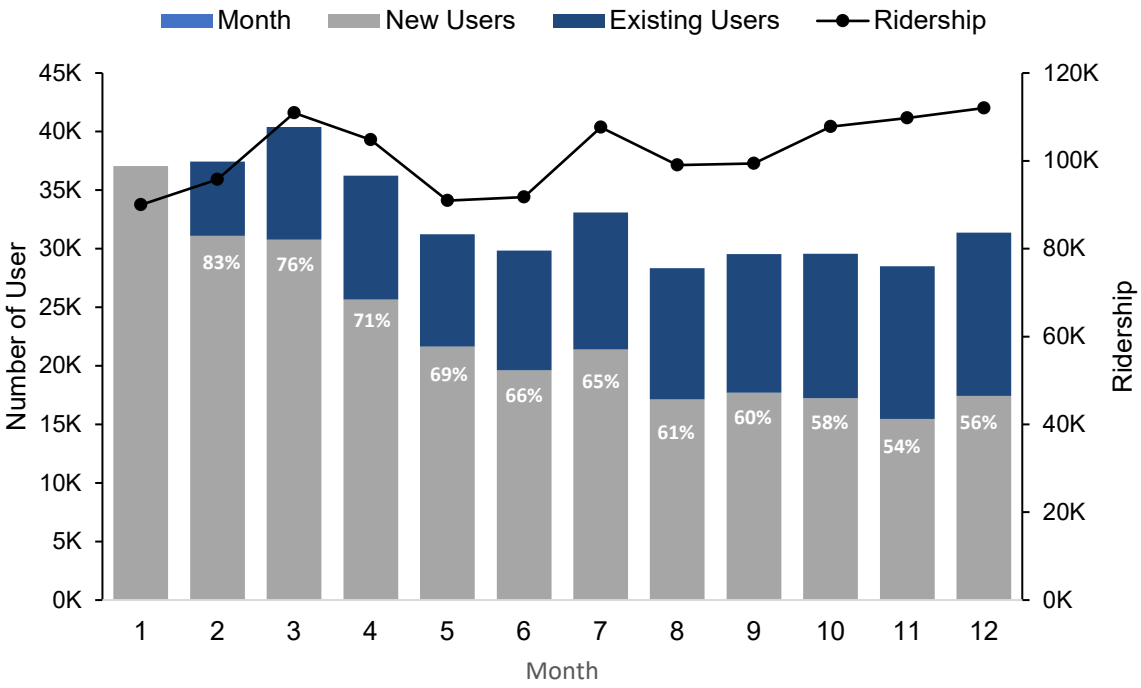


Figure 4.15 Number of new users, total users and total ridership by months in 2022

From the Figure 4.15 above, we can find that the total number of users steadily increased from January to March 2022. However, starting April 2022, the number of users started a reducing trend for three months before rebounding back in July 2022. The sudden dropped on number of users and ridership was very likely due to the change of policy by the Ministry of Transport in banning the usage of micromobility in April. This directly caused the cease of shared micromobility services in Cyberjaya since April 2022. Nonetheless, the shared micromobility services still can attract new users and expand their overall user population. In addition, we find that the shared micromobility operators can convert new user to long term users who are willing to continue using their services with continuous growing trend. Although facing challenging legal environment, the shared micromobility operators still can maintain the number of active users and sustain their increasing trend of ridership.

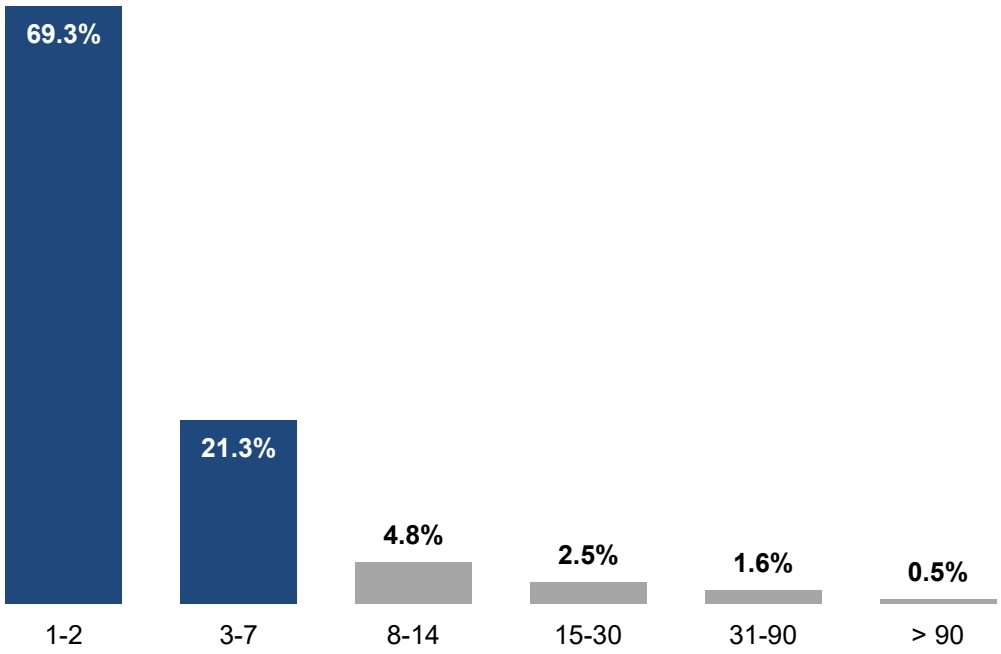


Figure 4.16 Frequency of a user ride a shared micromobility vehicle

Our data (Figure 4.16) reveals that 69.3% of shared micromobility users only ride the vehicle for 1 to 2 times. Less than 10% of the users have used the service for more than 7 times throughout 2022. It signifies that most of the users are still in the trial stage and yet to use shared micromobility as their daily transportation tools. However, 0.5% or 1,483 users, started to ride shared micromobility frequently, more than 90 times or equivalently 1.7 times per week in 2022. The number of high frequent user will likely increase if the government provides a more friendly legal environment and convenient infrastructure to the users.

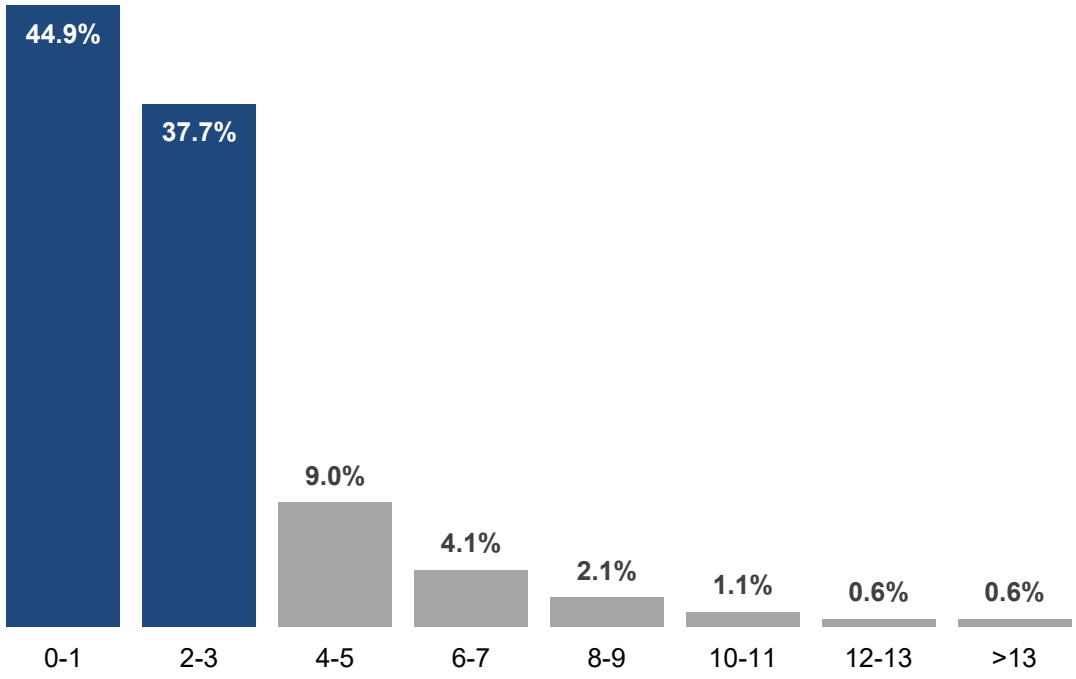


Figure 4.17 Distribution of distance travelled in kilometres

The usage pattern shows (Figure 4.17) that shared micromobility was mostly used for short distance travelling. In a city, the most commonly agreed walkable distance is 400 meters. Our study shows that 44.9% trips are within 1 km, which is very likely for the purpose of replacing walking to a destination. Overall, 82.6% of the trips were within the radius of 5 km. Only 2.3% of the trips are further than 10 km. The travelling distance pattern reveals that shared micromobility is more likely to replace transportation within the travelling distance of 5 km. Therefore, it can be a good option for connectivity for public transport and short distance travel.

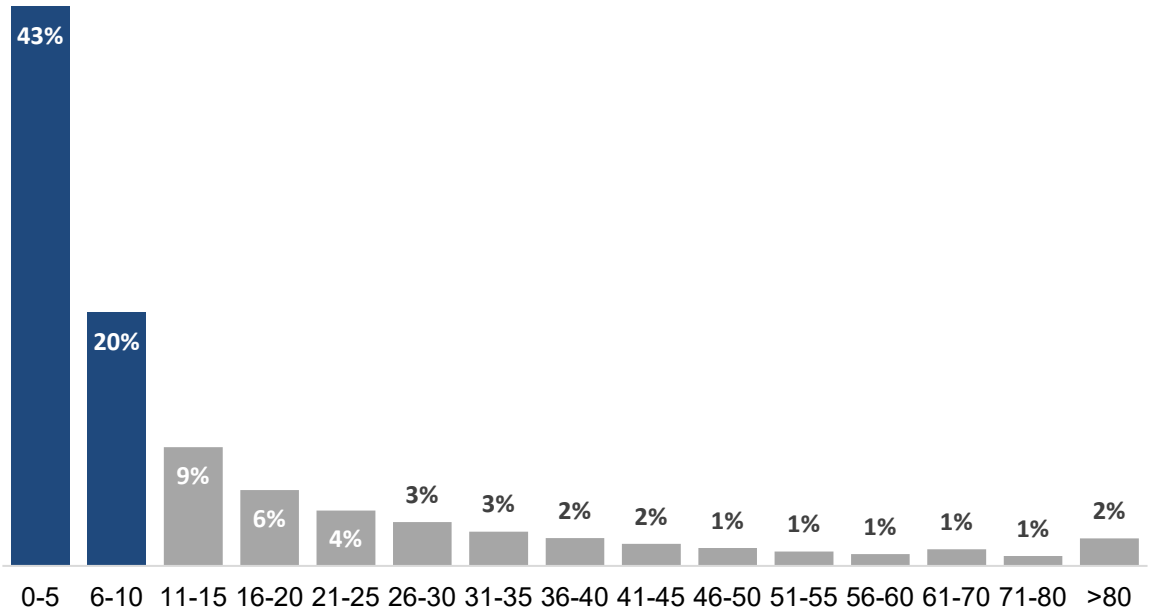


Figure 4.18 Distribution of riding duration in minutes

The top speed of shared micromobility is usually capped at 25 km/h, which means the vehicle can travel approximately 0.4 km in a minute. Since most of the trips were short distance trips within the radius of 5km, we can deduce that most of the riding duration should be within 15 minutes. Our data (Figure 4.18) shows that 72.2% of the trips were done within 15 minutes, which is slightly lower than the percentage of trips that travelled within 5km. This signifies that the users may not be riding at the top speed all the time.

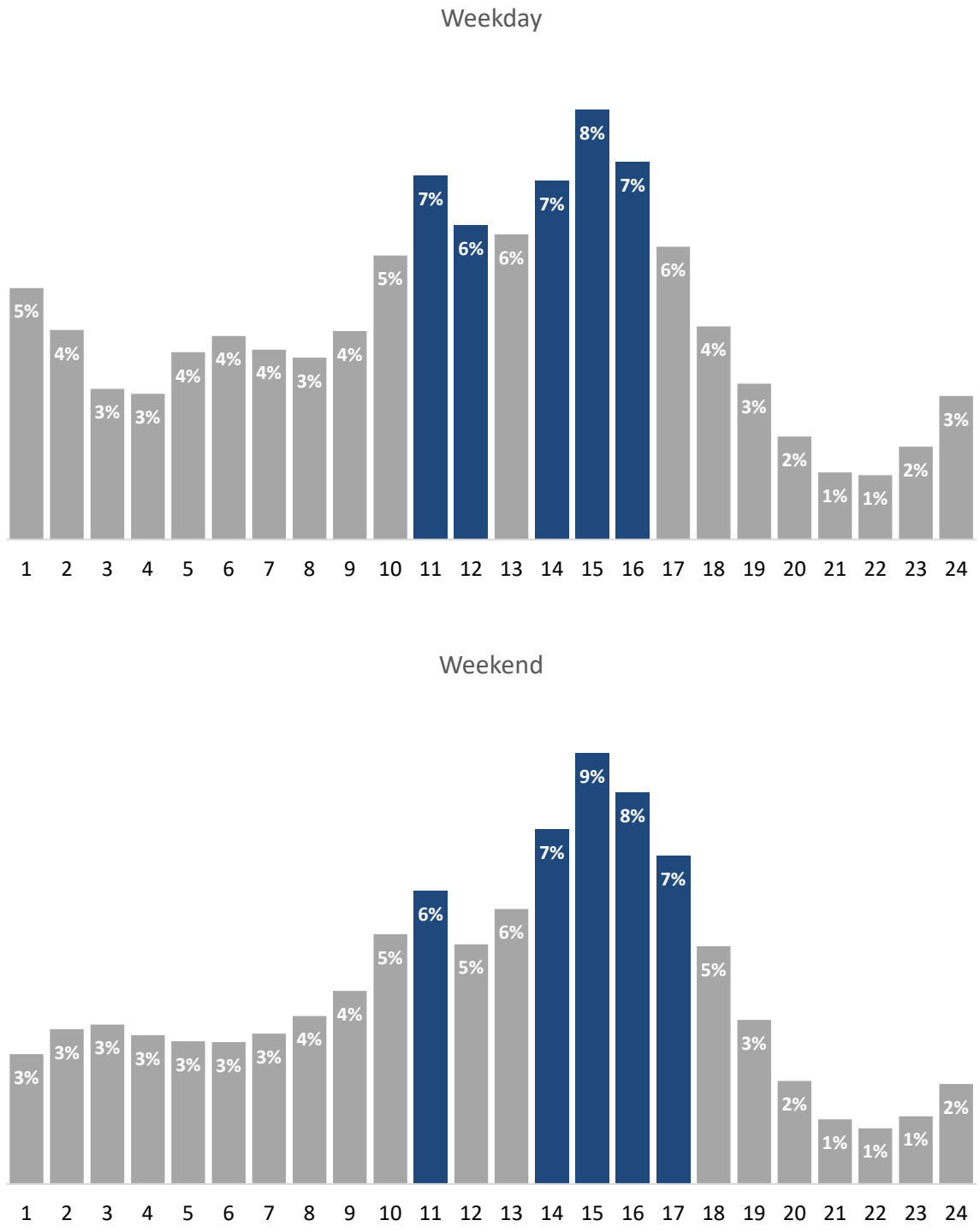


Figure 4.19 Peak hours for shared micromobility riding activities

Figure 4.19 above shows the top 5 ridership number by hour for both weekday and weekend. Overall, both weekday and weekend shares common distribution and peaks. Surprisingly, the peak hours occur between 1300 and 1559 for both weekday and weekend, which means during lunch hours. Another peak hour happens at 1000

which was supposed to be off peak hour for normal traffic. The riding activities start to decrease at 1700 and reach to minimum level at 2100 before starting to rebound in the next hour. The usage of shared micromobility were relatively low during normal traffic peak hours.

5. SOCIAL & ECONOMIC IMPACT

Transportation ecosystem is changing rapidly across cities worldwide. There is an increase hype over the utilization of micromobility devices, particularly shared micromobility. Some of the experience from other cities suggests promising socioeconomic impact from the introduction of micromobility into the larger urban transportation ecosystem in terms of modal shift away from private transportation, income generation and economic inclusivity. For instance, there was a shift of 23% from private vehicles in Chicago and 36% in London. The success of micromobility sector requires its full integration into the urban transportation system, supported by flexible regulatory framework.

The inception of micromobility in Malaysia requires careful study where lessons can be learned from the success and failure of its implementation in other countries. Thorough feasibility studies should be conducted to examine not only the market readiness and possible economic contribution, but emphasis should also be placed on the social and welfare implications. Transportation took up 11.3% of household expenditure in 2025, with the largest proportion went to purchase of fuel. A larger proportion of expenditure is devoted for transportation among lower income households, signifying the importance of an inclusivity agenda in the overall city's transport framework.

5.1. Industry Outlook

As Malaysia continues to look forward to better economic progress, mobility as part of the human quality indicator should also take a progressive turn to be supported by and supporting the national agenda for growth. Many anticipations are placed on the role of micromobility in transitioning the transportation landscape. Despite its current well

[5] https://www.dosm.gov.my/portal-main/release-content/household-expenditure-survey-report--malaysia--states-

acceptance and positive outlook, some concrete actions are required to ensure that the overwhelmed reception is not transient.

Globally, the electric scooter market by itself is predicted to reach almost RM200 billion by 2030. There is an expanse of potential and ample room for appropriate regulation and policy actions given the inception of micromobility in Malaysia is considered still at infancy.

5.2. Technological advancement

Technological progression is the key to exponential growth in micromobility sector. Micromobility services are based on mobile applications, where the micromobility providers and users connect each other for the purpose of booking rides and making payments. In other words, shared mobility is a wholly technology-dependent platform that offers micromobility services round the clock, at the time of need. Innovations in technologies have led to the introduction of several platforms that have allowed for simplified access to services. One such innovation is cloud sharing that delivers computing services related to network, software, storage, database, and analytics to the users at a minimal cost. Additionally, the internet of things (IoT) in the fleet management system has proved highly beneficial in running mobility services. IoT helps optimize the process by enabling efficient methods of tracking and monitoring vehicles, handling routes, and analyzing potential problems from a remote location. Technological convergence allows a consumer to be better served as the transportation services could be better integrated into different networks. On the other hand, the ability to utilize big data from real time micromobility usage will assist policymakers to make better transportation planning. The fact that Malaysians are among most connected citizens in terms of smartphone ownership, social media usage, and high acceptance of cashless payment facilitate quick adoption of micromobility.

5.3. Market Trends

Despite regulatory uncertainties, use of micromobility remains promising. Based on data provided by operators in Figure 5.1, monthly ridership in the Klang Valley area in

2022 shows an increasing trend with some short-term fluctuations. The sudden drop in the number of ridership between March and May 2022 could be attributed to the hype in micromobility banning, although the banning has already been imposed since December 2021. April was also the fasting month which could also affect the utilization of micromobility vehicles. The number of ridership then rebound in two consecutive months in June and July 2022 before it took a shallow dip in August and regained its increasing momentum after September 2022. The overall stable trend implies that the demand of micromobility use is still high and even become a necessity as a main vehicle for a certain group of users as their daily commuting mode.

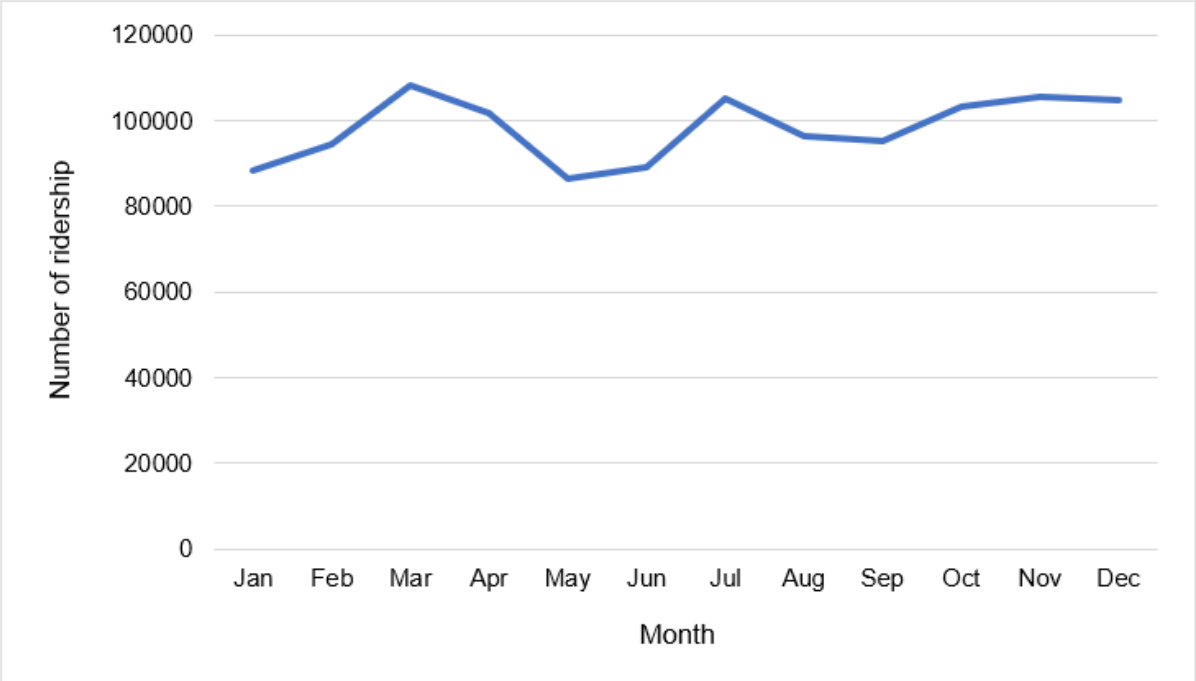


Figure 5.1 Monthly ridership of shared micromobility in Malaysia, 2022

5.3.1. Market size: Shared micromobility

The micromobility market captures different groups of users including local residents taking utilitarian trips, visitors and local residents taking recreational trips, and non-local employees commuting or taking utilitarian trips[6]. The market for shared micromobility in Malaysia made a huge leap in 2019 when revenue jumped more than 30-fold compared to 2018. The market is served by several operators with Beam as the largest market player, dominating 79% of the market share in 2022. Other

[6] San Mateo County Shared Micromobility Feasibility Study and Implementation Plan, Dec 2022.

operators are Oogyaa, Scoot, Bolt, and Trike sharing the remaining 21% of the micromobility rental market. In 2022, the revenue from the electronic scooter submarket was approximately RM23 million.

5.3.2. Market size: Privately Owned Micromobility

The micromobility sellers are mostly small in terms of market share and size. Market share ranges between 0.7% and 14%, with an average of 4.5%, suggesting a competitive market for personal micromobility vehicle and low barrier to entry into this submarket for micromobility. Firms' size in terms of number of workers ranges between 4 to 40 employees. The average size of firms is 11 employees with the majority of them having 15 or less workers.

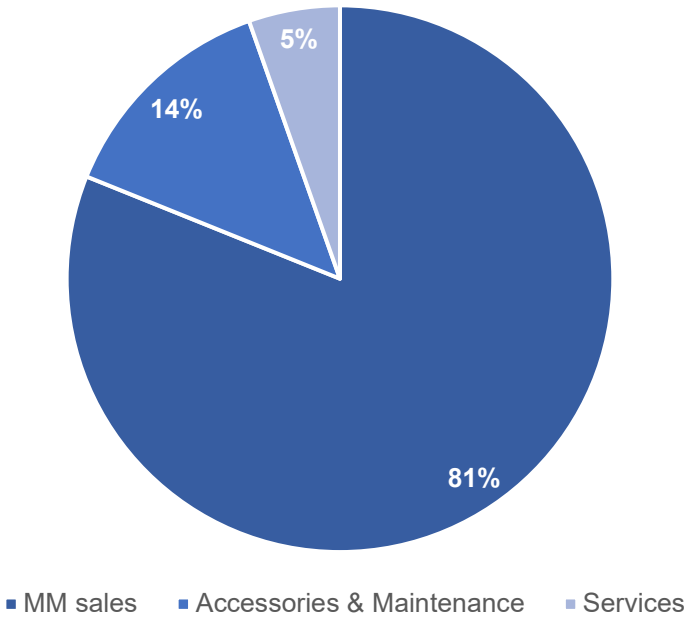


Figure 5.2 Composition of sellers' revenue

Figure 5.2 presents the composition of revenue for personal micromobility vehicle sellers. Sales of micromobility vehicles represent 81% of the total revenue generated by sellers. A smaller share comes from sales of accessories, maintenance and services. Based on data provided by the sellers, the price of e-scooters ranges between RM1,799 and RM7,999. This generates an average monthly revenue of RM119,979 from sales of solely micromobility devices. Accessories sales and

maintenance contributed on average RM18,818 monthly, while service of devices lent on average RM7,527 monthly to sellers' revenue.

5.4. Market potential

Based on our survey of 1,283 respondents for both users and non-users, 71.3% of non-users expressed their interest to own the micromobilty vehicle, while 65.9% of non-users stated that they are likely to rent the micromobility vehicle. The details of probability of likely to buy and rent the micromobility vehicle is shown in Figure 5.3 and Figure 5.4, respectively. Almost two-third of non-users are more likely to buy compared to renting the micromobility vehicle as a potential user implies that the use of micromobility is in strong demand in current and future markets.

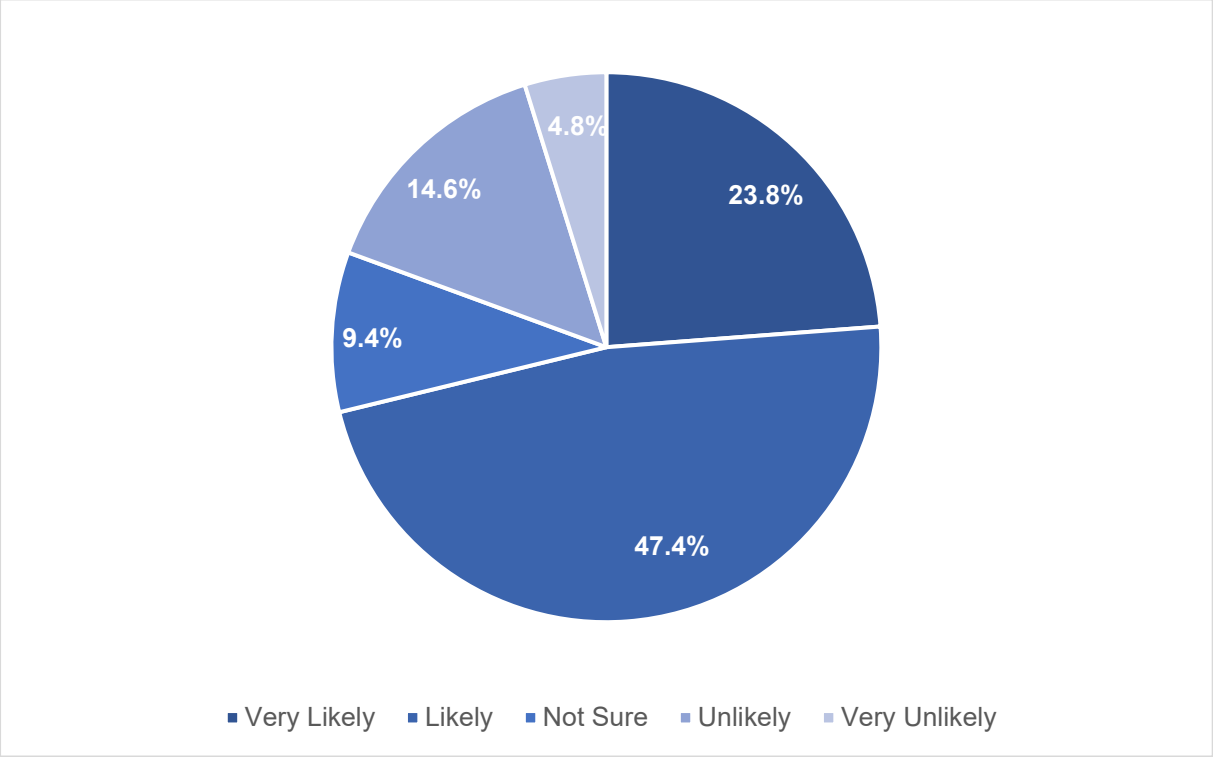


Figure 5.3 Intended to buy the micromobility vehicle among non-user

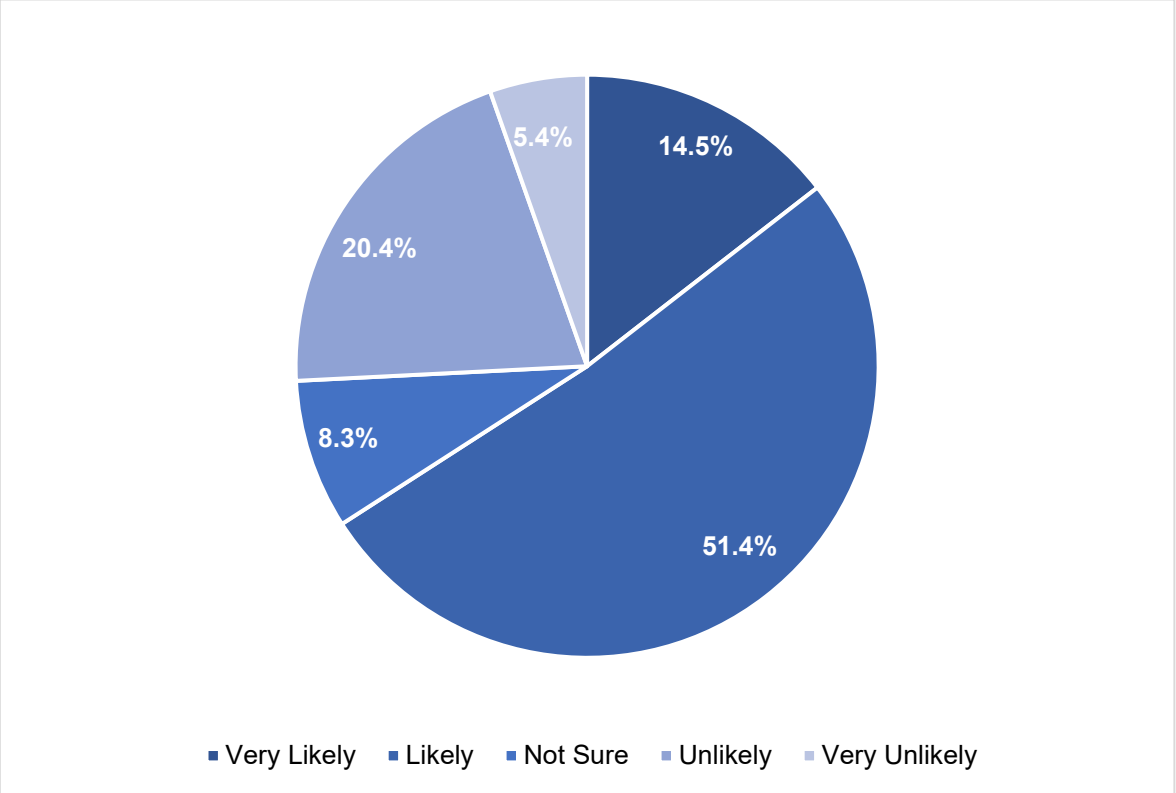


Figure 5.4 Intended to rent the micromobility vehicle among non-user

The micromobility users are also willing to pay for the certain price to own the micromobility vehicle as a private use, which shown the commitment and high preference to use the micromobility vehicle. The price of micromobility vehicle that they owned indicating their willingness-to-pay. The willingness-to-pay for the micromobility vehicle type in different price levels is portrayed in Figure 5.5 below.

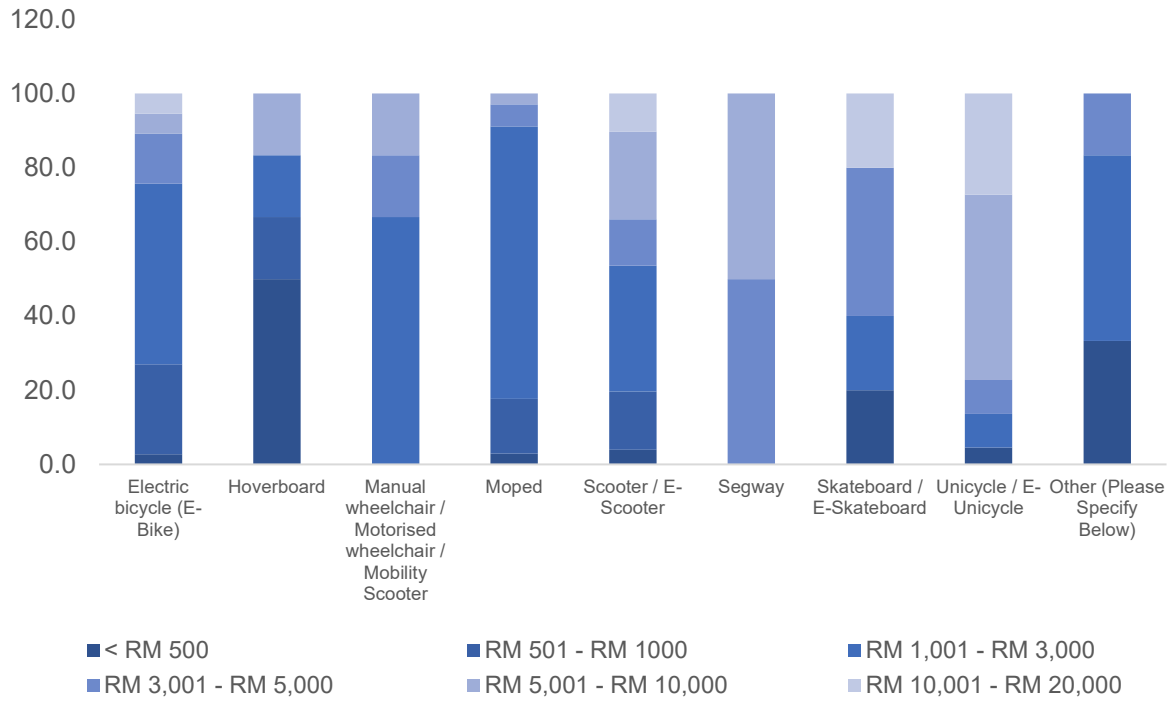


Figure 5.5 Price paid by type of micromobility vehicle

The breakdown of price of the micromobility vehicle owned by the users based on different level of income is shown in Figure 5.6 below. This shows the willingness-to-pay for the different level of price of micromobility vehicle based on income level. Surprisingly, users from lower income groups are also committed to owning the micromobiliy vehicle at a price beyond RM10,000. This implies that the micromobility vehicle becomes a necessity item to own even by the vulnerable group, especially to commute from one destination to another.

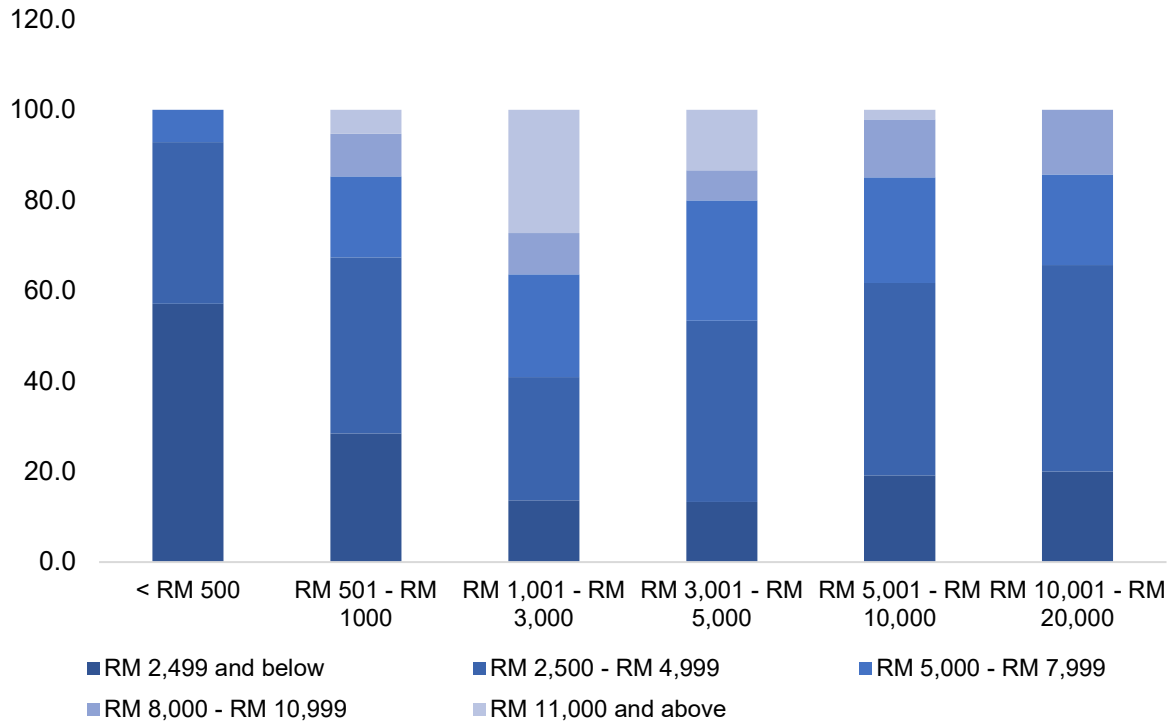


Figure 5.6 Willingness-to-pay for the price of micromobility vehicle by different income level

5.4.1. Connectivity

The growth of the micromobility market is mainly ascribed to the rapidly rising demand for first- and last-mile connectivity within the local area of the country. Micromobility services play a pivotal role in covering this gap, by offering mobility options for shorter distances, which is a key driving factor for the market growth. Shared micromobility services are usually used for short distance trips of less than 3km in average as shown in Figure 5.7 below. Other studies have also recorded a short average distance of between 1km and 2.5km[7]. Although the ridership is quite stable for the whole year in 2022, the average distance has however reduced from month to month. Hence, shared micromobility users integrating other vehicles to complete their journey. Moreover, these services are mostly offered via the dockless or station-less model, which allows users to drop off the vehicles at any place as per their convenience, which is further assisting in first- and last-mile traveling. Consequently, micromobility sharing has emerged in urban areas as a low-cost and more convenient transportation mode for short distances.

[7]Sengul & Mustofi (2021). Impacts of e-micromobility on the sustainability of urban transportation: a systematic review. Applied Sciences 2021,11, 5851. https://doi.org/10.3390/app111358551

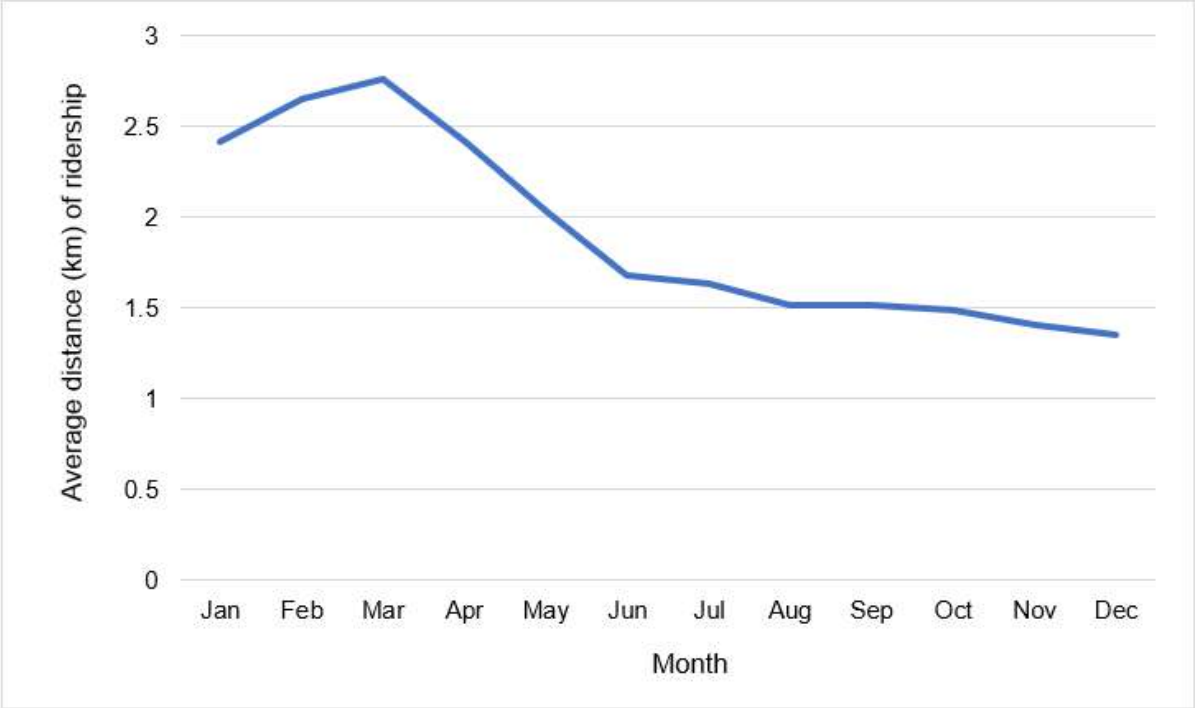


Figure 5.7 Monthly average distance (km) of ridership in 2022

5.4.2. Affordable and convenient mobility option

The daily use of micromobility vehicle can reduce the daily cost of fuel which is needed by the motor vehicle to ride to the destination. It has also become a convenient mobility option especially for the short distance.

5.4.3. Growing need for urban mobility solutions

In the past decade, Malaysia has experienced a persistent increase in its rate of urbanization. In 2021, 77.7% of Malaysians lived in urban areas, among the highest in ASEAN region, the third after Singapore and Brunei Darussalam. The high rate of urbanization coupled with ever increasing personal vehicle ownership and inadequate public transportation have been the main challenge for most cities in this country. Malaysian cities are struggling with appropriate measures to reduce the over-dependency on private transportation, while at the same time improving the efficiency of public transportation. Micromobility offers a way for urban mobility transitions. To avoid the traffic congestion on the road that causes time delayed especially during peak hour, the use of micromobility vehicle is a convenient option to mobilize from one place to another in short distance.

5.4.4. Economic Condition

Based on Malaysia economic growth in the first half in 2023 shown 5.7% increase which is higher than targeted within 4.0% to 5.0%, the consumer behaviour in micromobility industry anticipated to be grown in stable demand in the entire year.

5.4.5. Impact of Banning

The announcement of banning the use of micromobility vehicle on the road by the Malaysian government has dampened the revenue of players in the micromobility industry. The trend of shared micromobility user was increasing and peak in March 2022, but started to be decreased in April 2022 due to the announcement of banning and its enforcement in May 2022 as shown in Figure 5.8 below.

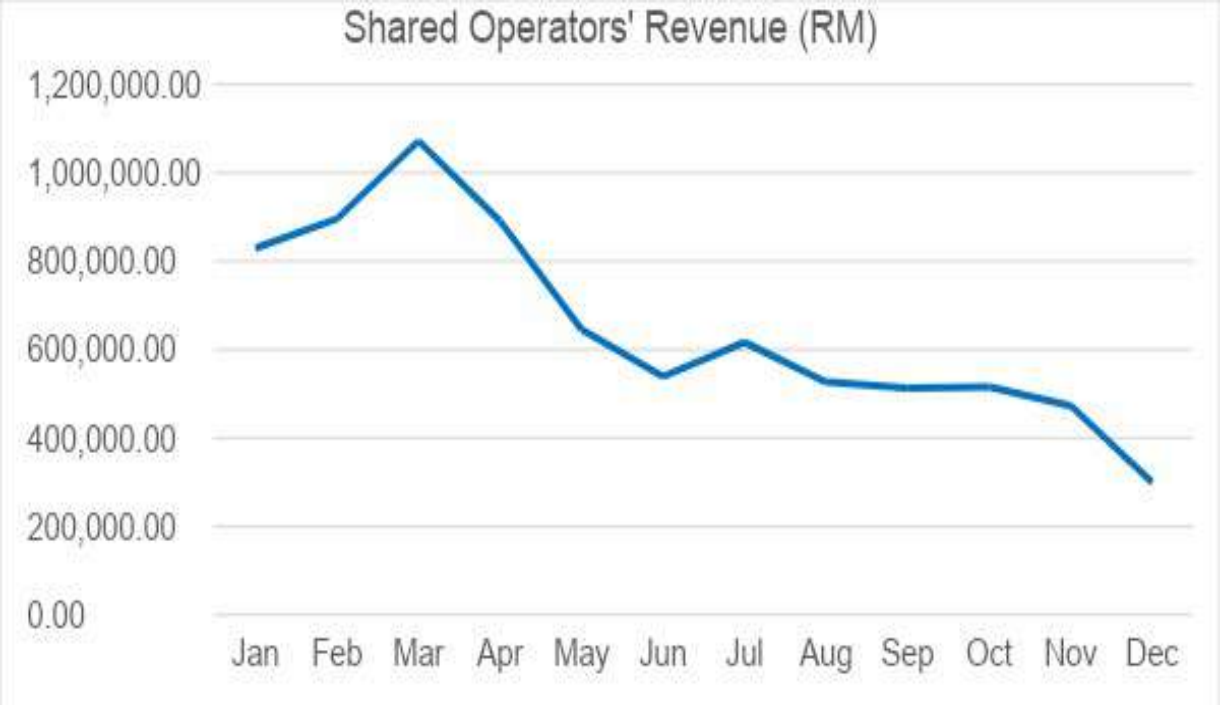


Figure 5.8 Monthly revenue of shared operator's revenue in 2022

The banning also impacting the micromobility vehicle's sellers. After banning, the sales were dropped 85% to 90% compared to before banning. The decreasing trend in sales will be inherit another micromobility sales and services such as micromobility vehicle's repair and maintenance parts and services, as well as micromobility vehicle's accessories. Based on our interview with them, the micromobility vehicle's seller only

can survive until June 2023 based on current capacity and resources, if the banning is not being lifted.

5.5. Opportunities

To move forward and promote the use of micromobility, it is necessary to assess the strength, weaknesses, opportunities and threats of its adoption in Malaysian context (Table 5.1). Many of the discussions on benefits of micromobility stem from its environmental advantage by offering users a greener transportation option. It is also widely recognized as an important component in urban connectivity which fills the first and last mile gap, allowing for better accessibility to public transportation services. Government's commitment towards more sustainable transportation to support the national agendas are the opportunities that could be leveraged by the industry to accelerate growth. A larger benefit from adoption of micromobility in terms of revenue that could be generated and spillovers in terms of job creation would increase the acceptance of the government to adopt micromobility. Malaysia also has tremendous opportunities to be the leading device producer with local production capacity.

Table 5.1 Are we ready?

Strength	**Weaknesses**
Convenience	Safety
Affordability	Environmental burden
Emission free	Visual pollution
Connectivity	Weather and terrain
Opportunity	**Threat**
Sustainable agendas	Restrictions
Source of revenue	Infrastructure
Job opportunities	Inexperienced users
Local production capacity	Market structure and regulation

However, lack of monitoring could lead to other environmental problems particularly visual pollution if the devices are not properly managed. Overuse of micromobility such as e-scooter and e-bike could pose an environmental burden when devices reach their

end life. Much of the discussion on the use of lithium batteries highlights a larger potential environmental harm throughout the life cycle from the mining of lithium to production, and to disposal of the batteries. On the other hand, the success cases of European and North American cities can also be attributed to weather and terrain factors. Tropical weather together with inadequate infrastructure could limit the use of micromobility devices in Malaysia.

Uncertainty in terms of restrictions also poses a threat to the industry. A prolonged uncertainty affects consumer's or user's confidence while inadequate infrastructure affects users' experience, thus the demand for micromoblity devices. On the other hand, players in the industry could be hurt by unfair competition within the industry especially if there is market domination that is prone to monopolization. All in all, given the tech-driven nature of micromobility, the government, regulator and market players will need to be open to changes in the market and thus be flexible enough to ensure the investment made today will be well paid off.

Box 4.1: Code of Good Conduct in Paris

The city of Paris launched Code of Good Conduct while waiting for national legal framework. The Code was signed by all provider in May 2019, mainly for rental of e-scooters in public spaces and for data sharing. It provides guiding principles for operators and paved ways for good public-private collaboration. The main aspects are parking and riding rules, operators' commitment to safety and security, respect for others particularly PWD, relationship with the city authorities, and use of e-scooters in line with sustainability priorities and the city. The success of the Code was supported by strong political will, massive support from operators. It provides power to the city to change certain business practices in mobility which regulated the behavior of operators. The operators accepted the code because they realized the essential of working cooperatively with the local authorities for the success of business.

5.6. Economic Impact

5.6.1. Direct Impact

Automotive Industry

The sales of the automotive industry are expected to decrease due to the substitution effect in modal shift. Based on our survey, 74.9% of micromobility trip does not involve driving own car but use another alternative of public transport such as bus, Keretapi Tanah Melayu (KTM) Komuter, Express Rail Link Sdn. Bhd. (ERL), Light Rapid Transit (LRT), Mass Rapid Transit (MRT), and taking the e-hailing services, to complete their journey to the destination. The alternative mode of transport may lead to shift from own car to the micromobility vehicle and public transport in the long term. This implies that the demand for automotive industry may be dampened due to the substitution effect of modal shift to the alternative mode of transport. Reduction in use of private vehicles especially in the urban areas could be translated into lower use of fuel and thus smaller amount of fuel subsidy, and lesser wear and tear to public roads and thus smaller proportion of budgets to road maintenance.

Micromobility Operators

In 2021, the main player of shared micromobility operators achieved approximately RM13.9 million[8] revenue from the e-scooter rental business. Profits are reinvested back into the business to upgrade technology in their vehicles, upgrade hardware features in their vehicles, increase manufacturing output, hiring new talent, increase operational and maintenance capacity, and increase marketing and communication efforts.

Micromobility Sellers

Based on the seller's data from the top-5 sellers in our survey, the number of micromobility sold before being banned is around 100 to 200 units per month. Meanwhile, the monthly revenue from selling micromobility device for e-scooters is around RM100,000 to RM300,000, the sales of e-bicycle can generate between RM20,000 and RM40,000 per month. The top-5 e-scooter brands owned by Malaysian

[8] Statista, current currency conversion.

users based on our survey are Xiaomi, Kaabo, Startron, Zero, and Starwheel (Figure 5.9).

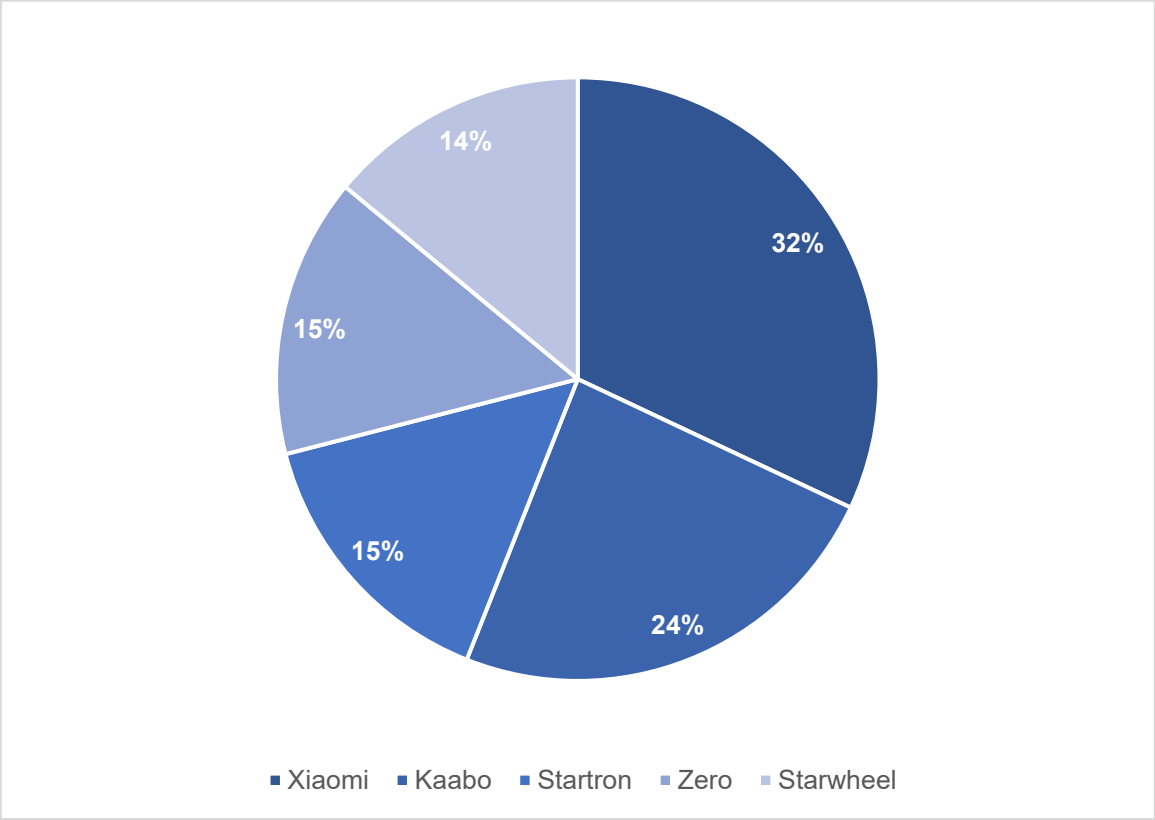


Figure 5.9 Top-5 e-scooters owned by the users

Micromobility Repair and Maintenance Services

Monthly revenue from repair and maintenance services from among high market share in micromobility sellers reported that their monthly revenue from these services approximately between RM5,000 to RM20,000, lead to their profit based on repair and maintenance services in range RM2,630 to RM7,890 per month. These services contributed to the national income up to RM240,000 per year.

In addition, our survey shows that the frequency and cost of repair and maintenance activities among micromobility users are different based on micromobility vehicle they owned. Most users maintain their e-scooter once a month with the average cost less than RM100 per service visit. Meanwhile, the user of an e-skateboard maintains it once in every 6 months with the cost range between RM201 to RM500.

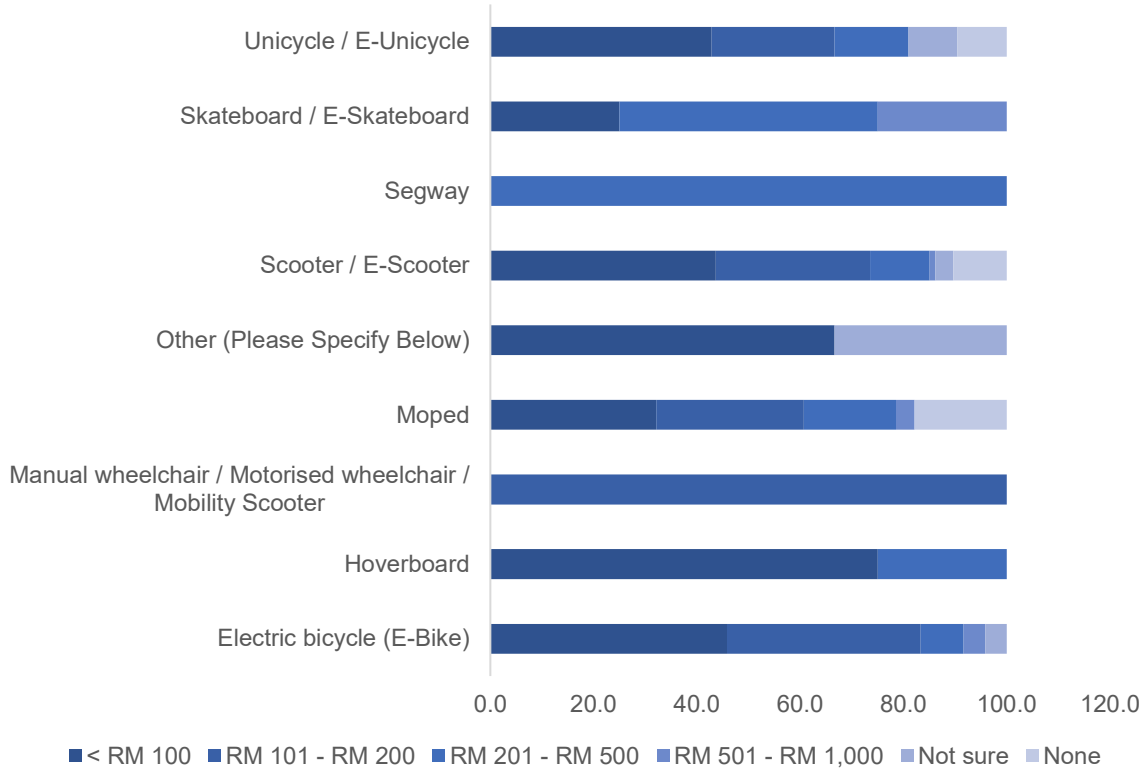
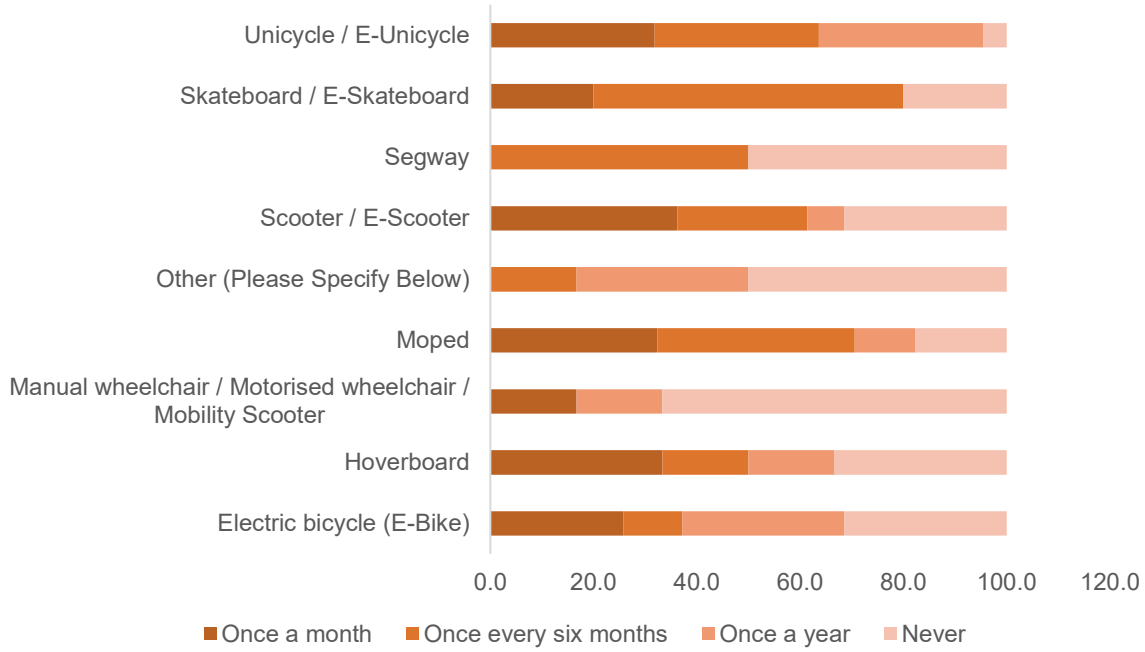


Figure 5.10 below shows the frequency and the range of cost of repair and maintenance by different types of micromobility vehicle, which reflects the potential market for micromobility repair and maintenance services industry.



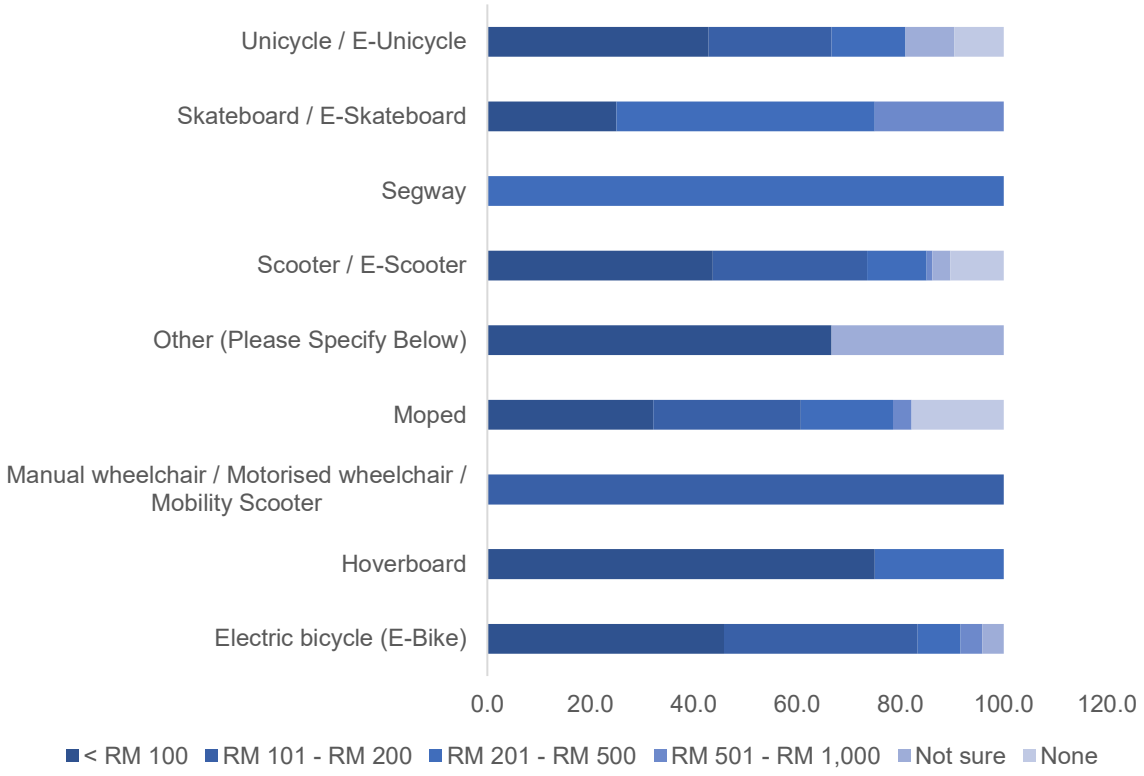


Figure 5.10 Frequency and the range of cost of repair and maintenance

Micromobility Spare Part Manufacturers

Monthly revenue from spare part manufacturers from among high market share in micromobility sellers reported that their monthly revenue from approximately between RM10,000 to RM40,000, lead to their profit in range RM5,250 to RM15,750 per month. This contributed to the national income up to RM480,000 per year.

Internet of Things (IoT) Industry

All micromobility vehicle for rent purposed is require the computerised programming to systemized customer information, the details of ridership, and information for payment calculation. Thus, this requirement needs the Internet of Things (IoT) device for each unit of micromobility vehicle. The information from the micromobility seller reported that the number of micromobility vehicle sold approximately from 100 to 200 units per month which projected the number of IoT device needed to be produced. However, most all the IoT devices are imported from other country. However, the completely knocked down (CKD) unit of micromobility vehicles are assembled in the

domestic manufacturing plant. Hence, the assembling activities include the IoT device which requires manpower service charge.

5.6.2. Indirect Impact

The advantage of the use of micromobility vehicle can benefited to many businesses during the trip of ridership. This includes the benefit from the stop activities in the business of food and beverages and restaurants, groceries shops, and tourism attraction locations. Nevertheless, the micromobility users use the micromobility vehicle for first- and last-miles to complete the journey of using public transport and also e-hailing service businesses. The trip using micromobility vehicle encourage the interaction people-to-people as a fun ride.

Food & Beverages Sector

The micromobility trip is stop at certain places other than their destination as a part of trip, such as recreational place, grocery store, restaurant, tourist attraction, supermarket, and micromobility vehicle maintenance or accessory shop. These places also become as their destination as the whole trip of using micromobility vehicle as shown in Figure 5.11. In addition, the micromobility vehicle has been used to deliver the food ordered by the customer by the service provider and also the gig economy workers in p-hailing services.

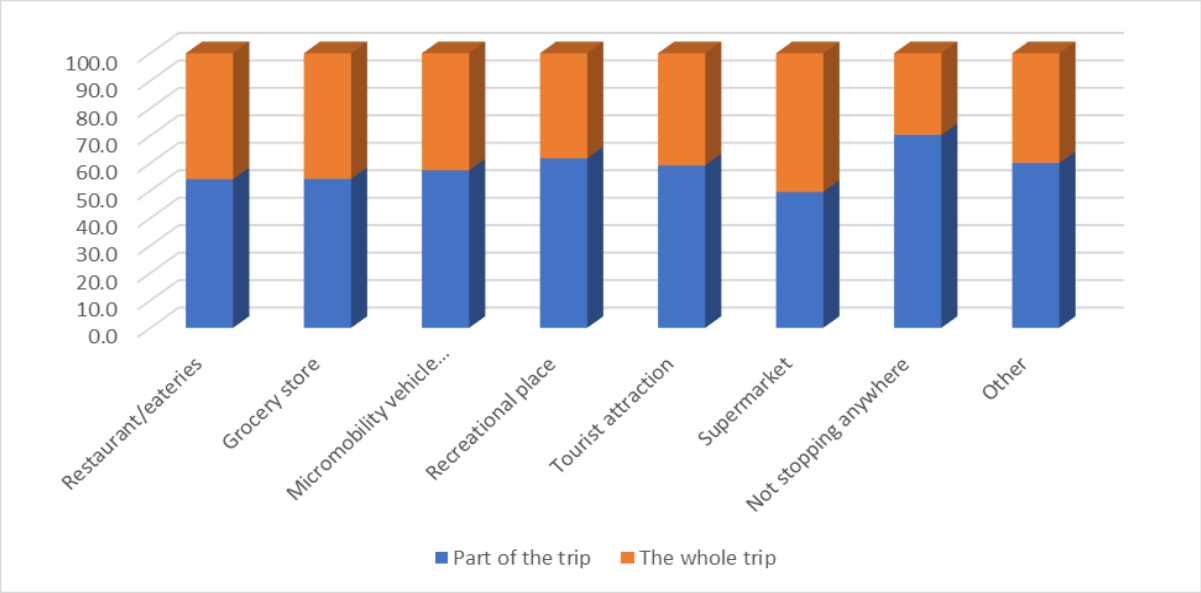


Figure 5.11 How the journey was accomplished

Tourism and Urban Renewal

Recreation serves as the highest purpose of using micromobility in Malaysia. Recreational places and tourist attractions are among the main stops for micromobility users involved in our survey. On one hand, the use of micromobility boost tourism as it assists tourists in terms of their mobility around the city. On the other hand, use of micromobility will increase the demand for local attractions as more spots can be visited as they can accomplish their visits in a shorter time period. The positive spillover effect to the local economies due to the stop activity during the trip is shown in Figure 5.12 below.

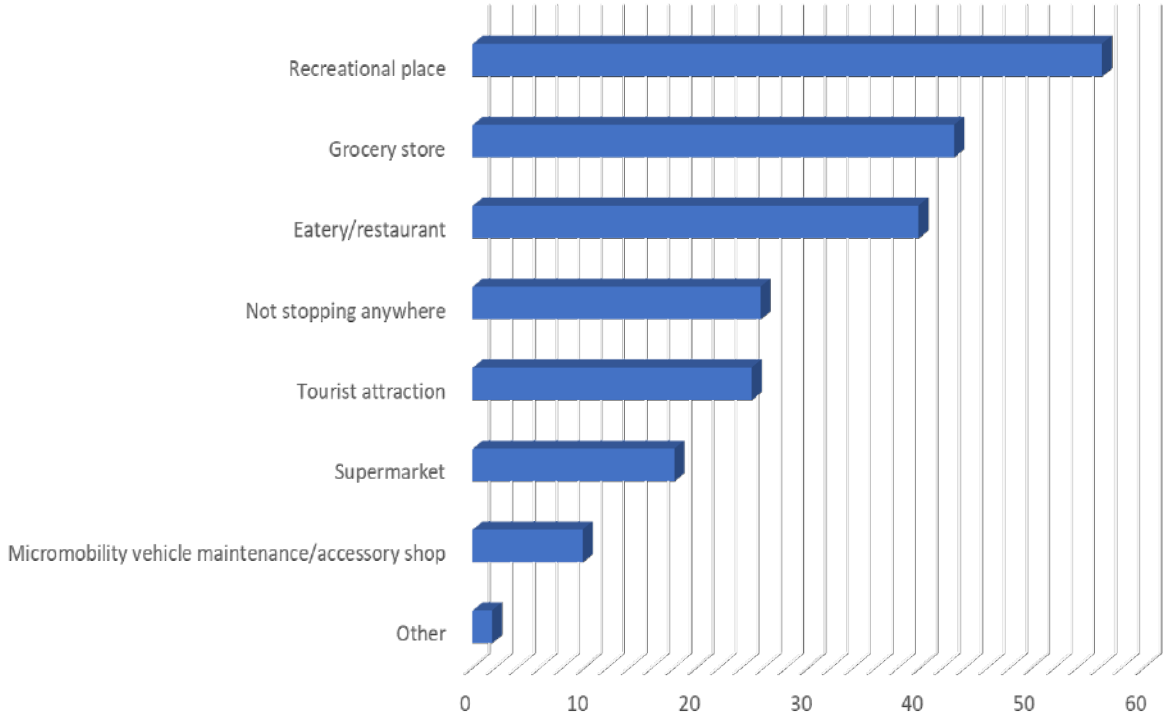


Figure 5.12 Activities undertaken during a trip using micromobility

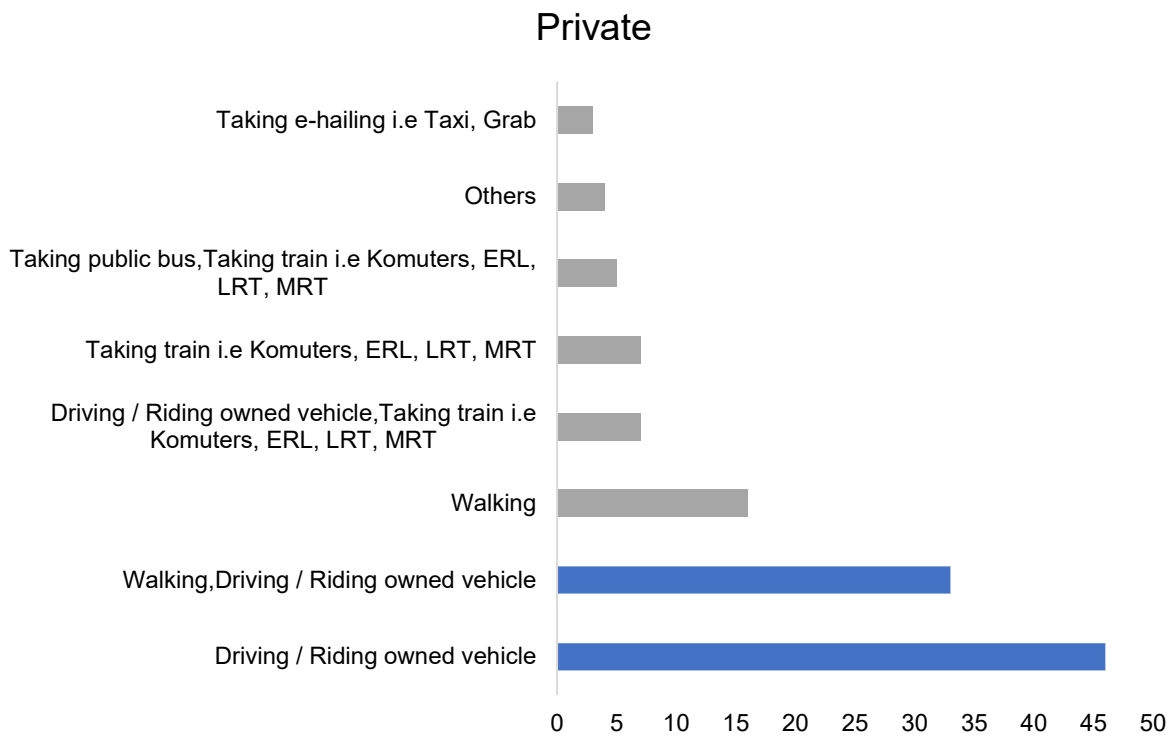
Public transport operators

Based on our survey, the purpose of use of micromobility vehicle to travel to reach the destination is 32.6% for the first- and last-mile use. The complementary role of micromobility utilization encourages more people to use public transport, because the option of using micromobility for connecting to or from the bus stop or train station makes it easier and more interesting. Since micromobility is often used together with other modes of transportation, collaboration between micromobility operators and

other public transport providers will facilitate the multimodal use of micromobility. Such a collaboration will allow the operators to offer seamless services which will be the pull factor for road users to switch to public transportation.

E-hailing industry

Besides the public transport, the micromobility users also use the e-hailing service to complete their journey. The substitution activity will be beneficial to the e-hailing operator business. Based on our survey, the micromobility users use another vehicle to complete the trip as shown in Figure 5.13 below.



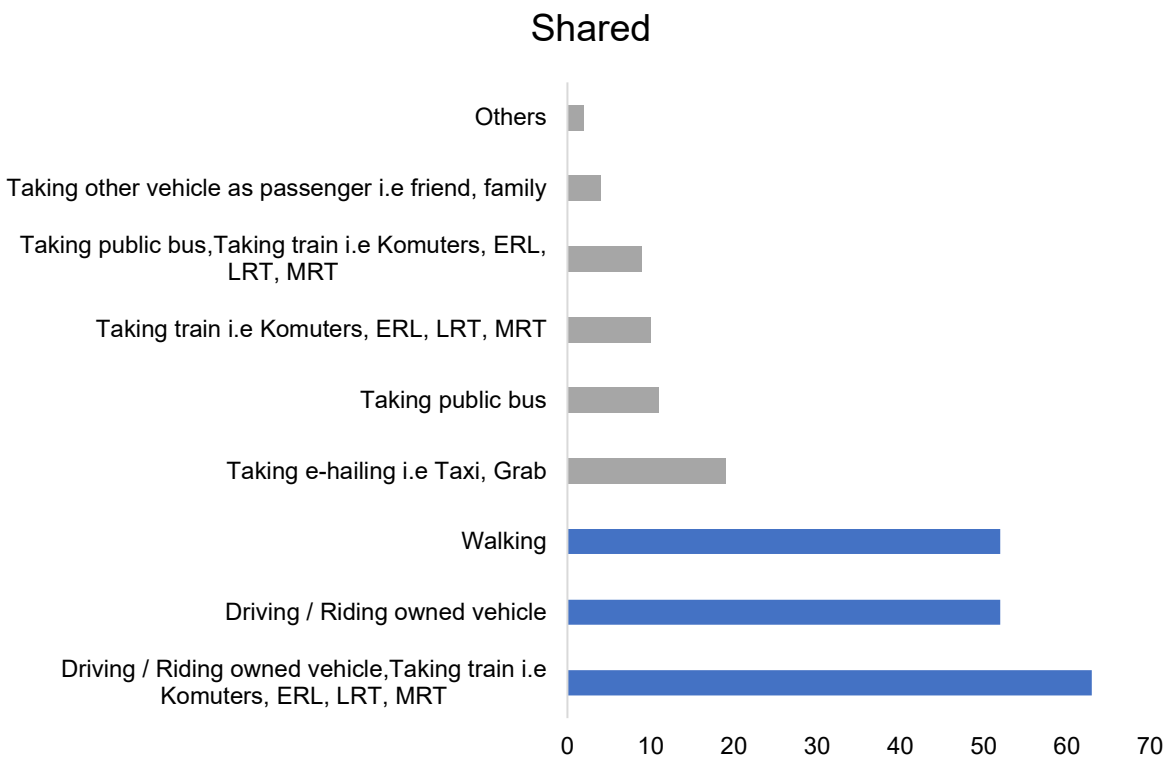


Figure 5.13 Other vehicles used to complete the trip both private and shared users

Insurance industry

Based on our survey, 48.9% of private users and 43.4% of shared users are not being covered by insurance if collision as shown in Figure 5.14 below. The awareness of the micromobility vehicle users to take insurance is still low. Thus, this implies that there is a big space which is almost half of market share for insurance businesses to penetrate the market. On the other hand, insurance industry could largely benefit from the requirement for shared micromobility operators to provide insurance coverage for its users and employees. Table 5.2 presents some examples of insurance requirements for micromobility operators in major cities in the US.

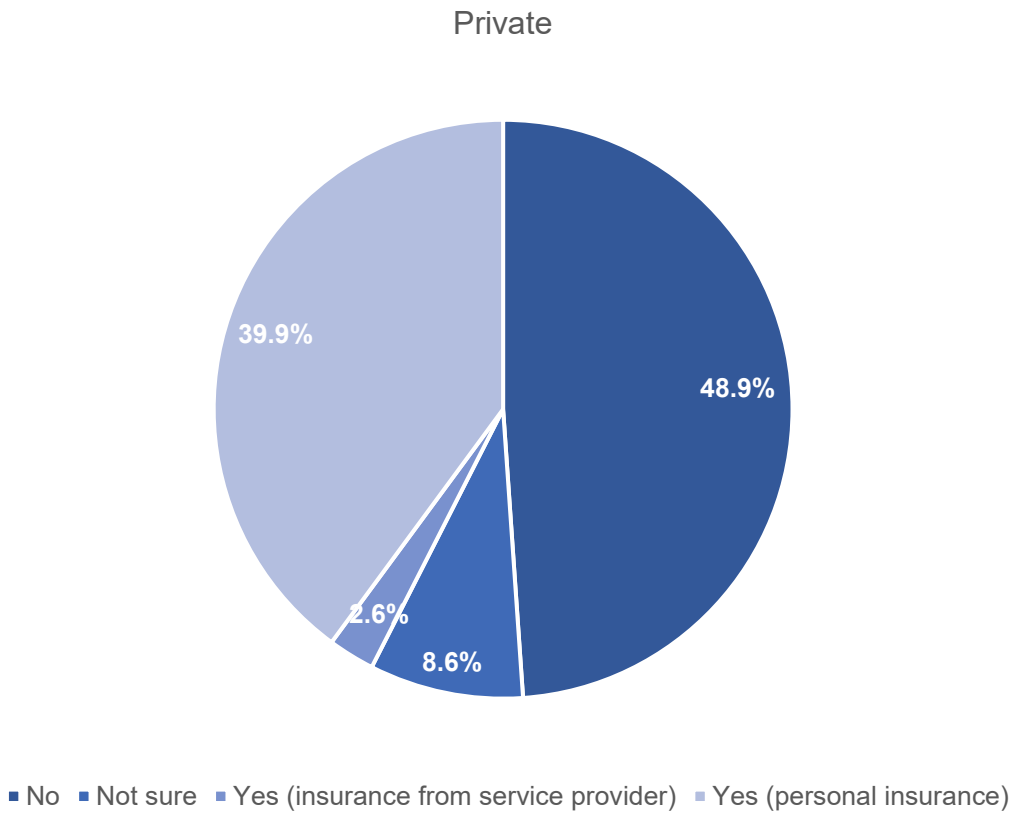


Figure 5.14 Insurance coverage status by the private and shared micromobility vehicle users

Table 5.2 Insurance requirements by municipalities: cities example

City	Types of coverage
Los Angeles[9]	General liability: $5 million limit per occurrence for property damage, bodily injury, and personal injury. General aggregate: $5 million. Hired or Non-Owned Auto or Commercial Auto Liability: $1 million. Employee Benefit: $1 million. Umbrella Policy: $5 million. Cyber Coverage/Errors and Omissions: $2 million
Los Angeles[10] Denver Austin Miami, Portland, Indianapolis, Seattle, Dallas, Chicago	General Liability: At least $1 million per occurrence General aggregate: $2 million Excess general liability: $3 – 10 million Worker's compensation Property insurance HNOA

Time of travel

The traffic congestion created by the use of various motor vehicles on roads such as cars, buses and lorries will delay the time of journey. The time delay of delivery will increase the cost of operation. Based on the study by TomTom.com (Table 5.3), the usual time to drive in 10km length is 8 mins 56 seconds. If the traffic is congested especially during peak hours, it will take about 21 minutes for a 10km drive.

Table 5.3 The time delay, emission and cost of driving in rush hour in Kuala Lumpur (yearly)[11]

Dimension	Description	Effect
Travel time	Time spent driving	159h
	Additional time due to congestion	75h
Emissions	CO2 emitted	833kg
	Additional CO2 emitted due to congestion	180kg
Fuel price	Money spent	RM1,023
	Additional money spent due to congestion	RM221

[9] https://www.electronomous.com/the-role-of-insurance-in-micromobility-growth/

[10] https://foundershield.com/industry/micro-mobility/

[11] Source: https://www.tomtom.com

In a year, additional time delayed due to congestion is 75 hours which is equivalent to reading 31 books. Traffic congestion causes an additional 180kg CO2 emission in a year that needs 83 trees to absorb the air pollution. In terms of accounting cost, the additional money spent for fuel is RM221 per year which is equivalent to 7 average-sized tanks of petrol. Hence, by using the micromobility, it can avoid these effects of the traffic congested of using the motor vehicle on the road especially during peak hour.

City Economic Growth

The use of micromobility vehicle depends on the local authority support by providing certain infrastructure to accommodate the micromobility user's activities. Better infrastructures and facilities provided by the local authority will encourage more micromobility utilization. Hence, the ridership volume is different from one region to another region. The higher volume of ridership will generate income to the shared operators directly and contribute to the income spillover to the local economic activities indirectly.

The frequency of ridership data provided from the shared operators based on selected regional local authority in 2022 in Selangor and Federal Territory of Kuala Lumpur and Putrajaya. The selected cities and districts are based on top seven highest ranking of ridership based on share micromobility operator's data. Based on our survey, 74% of micromobility trip is stop at certain places other than their destination as a part of trip. By assuming that each micromobility user in average spent at least RM20 for their stop activities, the local income generation due to the spillover effect are shown in Table 5.4 below.

Table 5.4 The number of ridership and the approximate income generation from spillover effect by selected city and district

City/District	Frequency	Percentage %	Income RM*
Kuala Lumpur	839,904	75.7	12,430,579
Petaling Jaya	130,875	11.8	1,936,950
Sepang	68,754	6.2	1,017,559
Shah Alam	60,304	5.4	892,499
Ampang Jaya	7,486	0.7	110.793
Selayang	1,011	0.1	14,963
Putrajaya	696	0.1	10,301
	1,109,030	100.0	

*Note: * is refer to the approximate spillover effect from economic activities to local income generation from the stop activities during trip*

5.7. Economic

In terms of social economic impact overall, the micromobility industry contributes to the national income which benefited the industrial players, as well as creating a job for the high-skilled workers in terms of managing the service operation, as well as semi-skilled and low-skilled workers for the routine jobs.

5.7.1. Contribution to National Income

Micromobility industry has a potential to contribute to national income. The industry addresses the necessity of use the micromobility vehicle in micro level among different level of income, mostly for leisure and commute. The income generation by the shared micromobility operators and sellers can contribute to the national income. It also contributed to the government revenue in terms of sales and services taxes. In 2022, the contribution of micromobility industry to the national income from shared operator is over RM7.8 million and RM68 million from shared operator and sellers, respectively.

5.7.2. Job Creation in Micromobility Industry

The industry of micromobility can create full-time and part-time jobs, especially among youngsters. The job creation generated by the existing shared operators in Malaysia are over 50 full-time workers and over 60 gig economy workers in 2022. Meanwhile, full-time employees are over 300 staff hired by the micromobility sellers. The jobs created by shared micromobility operators and sellers are open to the high-skilled, semi-skilled and low-skilled workers in various types of position levels. If the banning of micromobility vehicle use on the road is officially lifted, the number of micromobility players will be growing, hence the size of micromobility firms will expand and there will be more jobs created simultaneously.

5.8. Government Expenditure and Revenue

5.8.1. Expenditure

The governance of micromobility falls under the jurisdiction of local authorities. Commonly, two types of expenditure incurred for a full integration of micromobility into the urban transportation ecosystem are operational and infrastructure. Depending on the actual implementation, the government could evaluate its human resource and funding capacity to determine the financing model. For instance, the provisions of infrastructure for micromobility could be achieved via strategic partnership with operators or through sponsorships from multinational corporations.

Table 5.5 Types of expenditure

Types of expenditure	
Operational	Administrative and enforcement Inclusivity initiatives
Infrastructure	Bike lane Traffic signs/Road signs and markings Parking spaces Traffic management Crossing and intersections End-of-trip facilities

Table 5.6 Cost of infrastructure: country comparison

Country	Examples of infrastructure	Cost
Australia	• Cycle lane	$2,500/km
	• Bike symbol	$100/unit
	• Off road shared pedestrian and cycle path (concrete)	$130/sq meter
	• Minor works and line marking	$650 / meter

Europe	• High-quality protected bike lane • Simple track in easy terrain outside built-up area, no significant challenges • Mixed localisations and solutions, some challenges to overcome. • Urban area, difficult terrain or cycle highway standard in easy terrain • Cycle highway standard in urban area • Elevated track, cycle bridge	0.21 million Euro 50,000 Euro/km 200,000 Euro/km 500,000 Euro/km 1.5 mil Euro/km 10 mil Euro/km
Portland, OR	• Bike lanes • Bike lane stencil • Buffered bike lanes • Stop sign • Wayfinding signs • Speed hump • Bike box • HAWK signal • Bike racks	$0.83-$6.35 / ft $250-$270/stencil $2-$9.33/ft $150/sign $200-$440/sign $2,500-$2,800/hump $5,000/box $150,000/intersection $200/rack
Kuala Lumpur	• Bike lane	Approx. RM337,268/km
Shah Alam	• Bike lane	Approx. RM190,476/km – RM695,652/km[12]
Petaling Jaya	• Bike lane	Approx. RM69,090/km – RM118,181/km[13]
Klang	• Bike lane	Approx. RM244,000/km – RM260,000/km[14]

[12] Mesyuarat Ketiga Penggal Pertama Dewan Negeri Selangor 2013.

[13] Mesyuarat Ketiga Penggal Pertama Dewan Negeri Selangor 2013.

[14] Mesyuarat Kedua Penggal Kedua Dewan Negeri Selangor 2014.

Table 5.7 Estimation of cost

Description	Value per unit	Amount / year
Enforcement assistant officer (2 officers)	RM48,732 / year / staff	RM97,464
Admin assistant (operation)	RM43,152 / year / staff	RM43,152
Infrastructure costs – bike lane	RM350,000 / km	RM7,000,000
Maintenance	RM35,000 / km	RM700,000
Inclusivity program		RM2,500,000
Awareness program		RM200,000

Basis for cost estimates

- Administrative staff: the annual salary was based on the Selangor state budget for grade 29 (administrative assistant) and 41 (assistant officer). Local authorities involved in our stakeholder engagements believed that there will be no significant increase in manpower needed. Other countries' experience suggests dedicated staff to oversee micromobility implementation. The number of additional staff needed also depends on the different implementation model chosen.
- Bike lane: based on approximate cost of the first 11.86km bike lane in Kuala Lumpur which cost around RM337,268/km. By 2030, Kuala Lumpur aims to have 250km dedicated bike lanes in the city areas, which means approximately 20km per year if the cost is distributed over the period of 2023-2030, ignoring the inflation.
- Maintenance: 10 percent annually of cumulative construction costs, based on industry estimation rules.
- Inclusivity program: calculation is based on use of shared micromobility usage to provide subsidies for lower income households to increase participation in micromobility options. Based on our survey, 30% of those who rent the micromobility belong to the lowest income group (income below RM2,500). However, only a small portion of the lower income users utilize micromobility for work, to access public transportation services, and to educational institutions (around 5%). Practically, it is difficult to differentiate users based on purpose of use, even this can be done by looking at day and time of use. The subsidy could be given in the form of a monthly pass which could be integrated with other public

transport services, or reduction in operators per unit fee for serving underprivileged users. Such an inclusivity program could be achieved via either direct government transfer or cross-subsidization by micromobility and other public transportation operators.

5.8.2. Potential revenue

Operator's fee

A new source of revenue for local authorities comes from fees charged on micromobility operators. However, local authorities should consider an operating model that ensures greatest financial and business sustainability. The choice of operating model also depends on the citys aspiration and aims in introducing micromobility. For instance, other than as a smart and sustainable city, the introduction of micromobility could also ensure greater inclusivity by allowing access to cheaper mode of transportation to the poor. Other considerations include city size and administrative capacity, vendor availability, funding capacity. In general, there are three types of micromobility operating models implemented in different cities, namely contract-based, permit-based and hybrid (See Figure Box 4.2[15]).

Box 4.2: Micromobility Operating Models

- **Contract-based**: Publicly owned and administered system with single contracted private company. Example: Pittsburgh (not-for-profit), Toronto (for-profit)
- **Permit-based**: Multiple companies operating their own devices subject to terms defined in the permit. Examples: Kelowna, Calgary, Edmonton
- **Hybrid**: A combination of contract- and permit-based operating systems. Examples: Minneapolis, Portland, Washington DC, Memphis.

[15] IBI Group (2020)

Table 5.8 General tasks for launching and managing a shared micromobility program for a contracted and permitted system[16]

Tasks for launching and managing a program	Contracted system	Permitted system
Obtaining political, public and other support	x	x
Securing funding for initial capital and operating costs	x	
Procuring an equipment vendor and system operator	x	
Administering the contract with the operator	x	
Managing operations of the system	x	
Evaluating and expanding the system		
Negotiating and overseeing system sponsorships or an advertising vendor	x	
Developing program regulations		x
Reviewing and approving vendor permit applications		x
Collecting and utilizing permit fees		x
Overseeing and evaluating vendor compliance with permit regulations		x

Table 5.9 presents some examples of how operators are charged in different cities. Most of the cities used two-part fee pricing that is to charge a fixed annual fee plus charge imposed on device or ride.

Table 5.9 Fee structure for micromobility operators: cities experience

City	Permit / license fee
Chicago	$1-per-divice-per day, upfront for two years Property lease tax 9% of trip revenue[17]
Chula Vista	Annual permit fee $146 Review and inspection fee $1,680 Administrative fee $70/device (first 500 devices, $50 next 500 devices, $25 remaining devices)[18]
La Mesa	$1/device/day on quarterly basis Costs of addressing or abating any violation, repair and maintenance of public property[19]

[16] San Mateo County Shared Micromobility Feasibility Study and Implementation Plan, December 2022.
[17] https://www.chicago.gov/city/en/depts/cdot/supp_info/escooter-share-pilot-project.html?utm_source=
[18] https://www.chulavistaca.gov/home/showpublisheddocument/18787/637036338039770000
[19] https://www.cityoflamesa.us/AgendaCenter/ViewFile/Item/3720?fileID=6918

	Operator should reimburse the city council for any cost of addressing and abating violations; and city staff time for relocating, removing and storing micromobility vehicles from any prohibited locations.
Tallahassee	Annual permit fee $2,500 Per-ride fee $0.20/ride Operations fee $0.60 non-refundable fee per MMD deployed per day or $0.50 per MMD with an electric bike per day[20]
Austin	Annual license fee $1,500/year Annual device fee $80/device Public right of way $0.15 – 0.40/trip Performance bond $100/unit[21]
Santa Monica	Annual operator fee $20,000 (must be paid in advanced each year) Annual device fee $104/device (prorated and pay monthly) Business license minimum tax $75 cASP state mandated fee $4 Public Right of Way $0.20 / trip[22]
Miami Lakes	Annual license fee $275/year Annual device fee $85/unit[23]
San Jose	Application fee $1,953 Annual device fee $97/device Property repair and maintenance deposit $10,000/section[24]
Redwood	Application fee $2000 Operations fee $0.15/ ride pay quarterly Repair and maintenance $5000/year Impoundment fee $99 / hour/staff [25]
Owatonna	Annual fee $500 Operations fee $25/scooter[26]
Long Beach	Annual fee $25,000/year Annual device fee $100/unit/year (first batch limited to 500 vehicles, payment $12,500 every 90 days x 4)[27]

[20] https://www.talgov.com/Uploads/Public/Documents/place/spin-permit.pdf

[21] https://www.austintexas.gov/sites/default/files/files/Transportation/Dockless_Final_Accepted_Searchable.pdf

[22] https://www.smgov.net/uploadedFiles/Departments/PCD/Transportation/SM-AdminGuidelines_04072021.pdf

[23] https://www.miamilakes-fl.gov/index.php?option=com_docman&view=download&alias=5408-ord-21-278&category_slug=2021-3&Itemid=287

[24] https://www.sanjoseca.gov/your-government/departments-offices/transportation/micro-mobility/micro-mobility-vendor-page#:~:text=Device%20Fee%20and%20Deposit&text=Applicant%20must%20pay%20the%20%22Shared%20Micro%2DMobility%20Annual%20Permit%20and,the%20right%2Dof%2Dway.

[25] https://www.redwoodcity.org/home/showpublisheddocument/24564/637792362798970000

[26] https://www.owatonna.gov/DocumentCenter/View/6570/1632---Fees---Micromobility-Sharing-Operations---Electric-Scooters-PDF?bidId=

[27] https://www.longbeach.gov/globalassets/go-active-lb/media-library/documents/programs/micro-mobility-program-e-scooterse-bikes/shared-micromobility-regulations-update-feb_24_2022-final

Calgary	Application fee $600 Annual operations fee $50/device Education and encouragement $10/device[28]
Los Angeles	Administration fee $20,000/permit renewal (yearly) Public right of way $0.06 – 0.40 / device[29]

Each city has its own limitation in terms of the number of fleets. For example, Chicago put a total fleet cap at 12,500 devices across all licensees. Los Angeles Dept of Transportation allows a minimum of 500 and maximum 6000 vehicles per operator. Local authorities, with the guidance and consultation from relevant agencies could be allowed to set their own fee system. This should take into considerations factors such as demand, cost of administration and enforcement, infrastructure maintenance, population density and so on. Some of alternatives are as follows:

Public right of way only	Rate: RM0.10 – 0.20/ride For 1 million rides, total fee received: RM100,000 – 200,000 per year.
Fixed fee and device fee	Fixed fee: RM40,000 – 50,000 RM10/device x 2000 fleet Total fee received: RM60,000 – 70,000
Device fee only	RM50 - 60/device For 2000 fleet, total fee received: RM100,000 – 120,000

Import duty.

Most of micromobility vehicles by the mobility shared operators and micromobility sellers are imported from abroad in the form of completely built up (CBU). Figure *5.15* shows a consistent increase in the demand for imported micromobility between 2019 and 2021 from 1.5 million to more than 2.7 million units. The demand for imported micromobility vehicle however decreased in 2022 due to the effect of banning. Micromobility import activities can generate income to the government in terms of import duty which approximately generated over RM2.9 billion from 2018 to 2022.

[28] https://www.calgary.ca/content/dam/www/transportation/tp/documents/cycling/cycling-strategy/electric-scooter-permit-application.pdf

[29] https://ladot.lacity.org/sites/default/files/documents/on-demand-mobility-rules-and-guidelines-2021.pdf

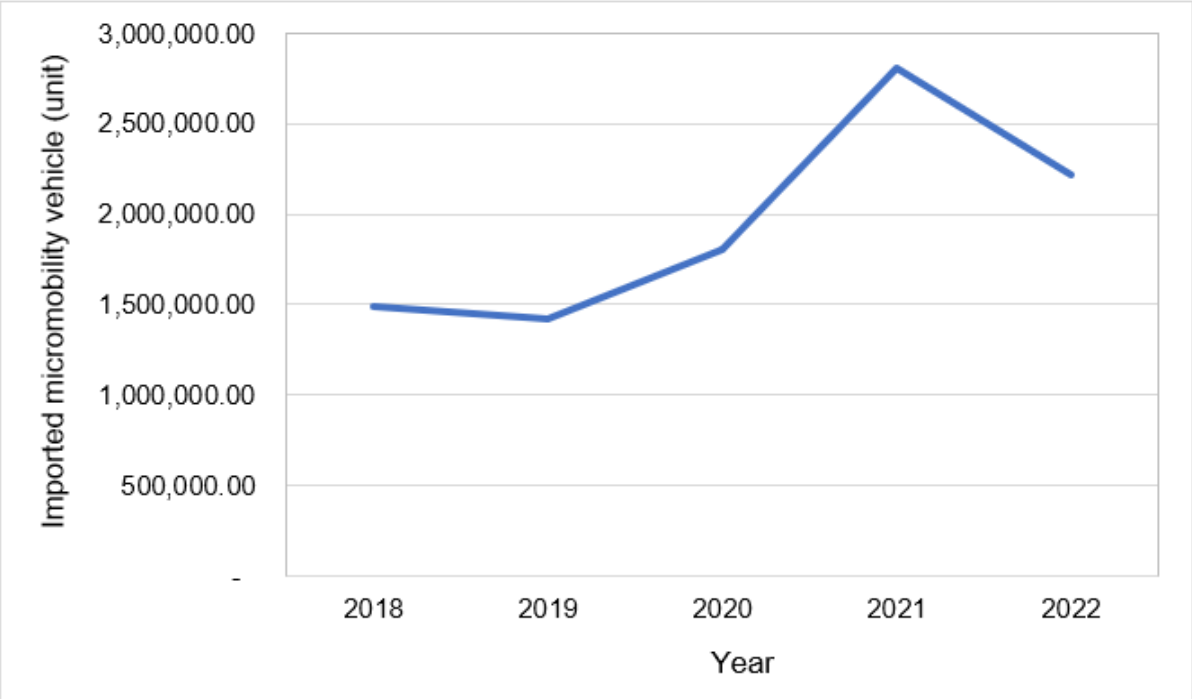


Figure 5.15 Import volume of micromobility vehicle[30]

5.9. Cost Benefit Analysis

The cost burden and the benefit of micromobility vehicle use is different to individual, sellers and operators, as well as to the local authority and the Malaysian government. The report focuses on social cost and benefit, that is wide-range societal cost and benefits.

Components of benefits

Reduction in daily cost of fuel when using a motor **Vehicle transportation cost saving:** vehicle. In terms of accounting cost, the additional money spent due to congestion is RM221 per year per individual. In our ridership data, the number of users who use the micromobility vehicle for the first mile- and last-mile to go to work approximately 19,000 or 2% of total riders in 2022. Hence, fuel cost saving in aggregate is RM4.2 million per year.

Reduction in traffic which perceived travel time benefits: Based on the World Bank Malaysia Economic Monitor, Malaysians wasted around 1 million hours of their time on the road in 2015. And when experts translate the hours to currency, it shows

[30] Source: Malaysian Royal Custom Department.

that Malaysians waste around RM10-20 billion each year just being stuck in the terrible traffic. Based on the Road Transport Department (JPJ), the estimation of active vehicles in Malaysia until September 2021 is 21,709,492. This number is anticipated to be on the road in 2022 21.7million. Meaning to say, each vehicle on the road will lose RM921 per year due to traffic congestion. Based on our micromobility shared operators' data, approximately 19,000 micromobility ridership use the vehicle for the first- and last-mile to commute to work. Hence, by using the micromobility vehicle, the cost of total loss due to traffic congestion can be saved approximately to RM17.5 million.

Health benefit from recreational activities and physical inactivity: Health care costs can be saved since the micromobility can be used for recreational activities. According to the study by the American Heart Association and National Cancer Institute, regularly exercising at moderate levels can add up to savings of $2,500 and $1,874 per person per year in healthcare costs, respectively. By averaging these costs, the healthcare costs can be saved up to $2,187, equivalent to RM10,060 a year. According to our micromobility shared operators' data, there are 110,903 persons rides using micromobility vehicle in 2022. Hence, the healthcare costs can be saved up to RM1.12 billion per year.

Environmental cost (carbon and air pollution): Climate change and health related to air pollution. According to National Transport Policy 2019-2030, the carbon emitted from vehicles on the road was a major source of air pollution, contributing 90 per cent of CO2 emissions per capita in Malaysia. According to the World Health Organization (WHO), the economic cost for Malaysians would be reduced by a third annually, saving RM212 billion in air pollution related costs per year. Hence, the economic cost for air pollution reduced from the vehicle source is RM190.8 billion. By having 21,709,492 cars on the road in 2021 as reported by the JPJ, it means one car reduced can save air pollution cost of RM8,788. Based on our micromobility shared operators' data, approximately 110,903 riders using the micromobility vehicle for modal shift from vehicle car to the micromobility vehicle. Hence, the environmental cost reduced if using the micromobility vehicle can save cost RM974.7 million a year.

Spillover effect to the local economy: They are seven cities chosen based on top seven highest ranking of ridership based on shared micromobility operator's data. Based on our survey, 74% of micromobility trip stop at certain places other than their destination as a part of trip. By assuming that each micromobility user in average spent

at least RM20 for their stop activities, the local income generation due to positive spillover effect. With total ridership for selected 7 cities 1,109,030 in 2022, thus, total income generation from the spillover activities to the local economies approximately RM16.4 million.

Micromobility sellers' revenue: According to Malaysia Electric Micromobility Industry Association, there are 22 main sellers in the country. However, not all sellers have a big scale of business. We select top 5 sellers with a big scale of business and assume the big scale companies have the same trend in terms of sales and revenue. Big scale companies' monthly revenue is approximately RM300,000 from e-scooter sales and RM40,000 for e-bicycle. Hence, total revenue generated among 5 big players of micromobility sellers in 2022 is RM20.4 million.

Shared operators' revenue: Income generation for the industrial players specifically to the total shared operators' revenue is RM7.9 million which is obtained from the total duration of ridership 15.8 million minutes in 2022, times RM0.50 per minute on average. Statista reported a total revenue of RM23 million.

Micromobility repair and maintenance services revenue: By assuming 5 main sellers with repair and maintenance services, their monthly revenue from the services is approximately RM20,000 per company. Hence, total revenue generated among 5 big players of micromobility repair and maintenance services in 2022 is RM1.2million.

Micromobility spare part manufacturers revenue: Monthly revenue from spare part manufacturers from among high market share in micromobility sellers reported that their monthly revenue from approximately between RM10,000 to RM40,000, which contributed to the national income up to RM480,000 per annum.

Summary of Benefit Analysis in total per year

No.	Description	Benefit (RM)
1.	Fuel cost saving	4,199,000.00
2.	Cost saving of time loss due to traffic jam	17,499,000.00
3.	Healthcare costs saving	1,115,684,180.00
4.	Environmental cost reduced	974,702,328.36
5.	Income generation from spillover activities to local economies	16,413,644.00

6.	Total revenue generated from micromobility shared operators (before service tax)	7,908,478.55
7.	Total revenue generated from micromobility sellers (before sales tax)	20,400,000.00
8.	Total revenue generated from micromobility sellers (before service tax)	1,200,000.00
9.	Total revenue generated from micromobility spare part manufacturers (before sales tax)	480,000.00
	Total Benefits (RM):	**2,158,486,630.91**

Note: The data is based on 2022 from various sources. The approximate benefit and cost estimated are referred to the above explanation. In summary, the total benefit is RM2.158 billion.

Costs

Imported micromobility vehicle cost: The calculation is based on the number of imported micromobility vehicle from the Custom Division multiply with the average price of the most popular of the type of micromobility vehicle.

Repair and maintenance cost for micromobility vehicle: The calculation is based on the data from the big scale of seller which provides repair and maintenance services for the whole year. We assume that there are 5 big businesses scale players in the micromobility industry.

Infrastructure cost: Based on Federal Highway Administration, United States Department of Transportation, the estimated cost of installing a bike lane is approximately $5,000 to $50,000 per mile (which equivalent to RM23,000 to RM230,000), depending on the condition of the pavement, the extent of removing and repainting of lane lines, the need to adjust signalization, and other factors. Based on the discussion in section 5.8.1, the approximate cost of the first 11.86km bike lane in Kuala Lumpur which cost around RM337,268/km.

Infrastructure maintenance cost: The estimation is based on the length of the bike lane. We refer to the examples from the selected countries to estimate the infrastructure maintenance cost.

Enforcement cost: The enforcement cost is referring to the number of enforcement staff required based on the size of ridership for each selected 7 local governments.

Operation cost: The operation cost is referring to the number of operating staff required based on the size of ridership for each selected 7 local governments. Their tasks such as to ensure that the micromobility industry players comply to the rules and regulations.

Inclusivity program: The inclusivity program to promote the importance of the micromobility to all levels of income groups, vulnerable groups, and various types of categories of society.

Awareness program: The awareness program such as the advantage and benefits of micromobility activities, safety and security.

Summary of Cost Analysis in total per year

No.	Description	Benefit (RM)
1.	Imported micromobility vehicle cost	5,539,386,000.00
2.	Repair and maintenance cost for micromobility vehicle	221,575,400.00
3.	Infrastructure cost	75,413,124.80
4.	Infrastructure maintenance cost	1,508,262.50
5.	Enforcement cost	877,176.00
6.	Operation cost	345,216.00
7.	Inclusivity program	2,500,000
8.	Awareness program	200,000.00
	Total Benefits (RM):	**5,841,804,179.30**

5.10. Forecast

5.10.1. GDP

Transportation sector contributes 3.8% to GDP. The existing market of ridership of shared micromobility is quite stable in 2022. Micromobility industry contributed to the GDP in 2022 almost RM100 million in total from micromobility sector itself and other secondary sectors. The contribution is anticipated to grow by 5% in the coming year if the banning of micromobility vehicle use on the road is lifted (Figure 5.16).

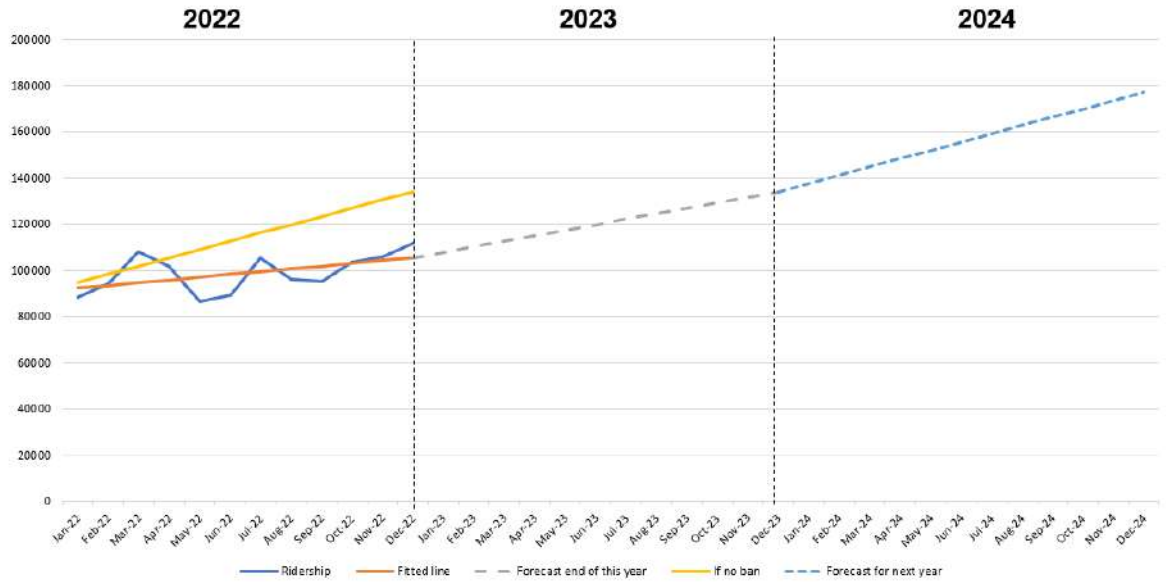


Figure 5.16 Forecasting for ridership

5.10.2. Market Size

For shared micromobility, the market segment is expected to grow on average 13.4% between 2023 and 2030. This means by 2030 the revenue generated by this market is estimated to be USD13.8 million (approximately RM60 million) in the assumption that the current ban is lifted. On the other hand, the average annual growth of users between 2023 and 2030 is 11.4%, where it is expected that the number of users is 1,325,782 by 2030. This means each user generates an average of USD10.28 (approximately RM47) for the same time period. With the expected exponential growth in the shared micromobility market, it is necessary for the local authorities and relevant ministries to expedite the regulatory framework governing micromobility usage.

With the government's continued aspiration for greener transportation, proper education of personal micromobility users, and adequate and safe infrastructure, the personal micromobility segment is expected to continue growing. Between 2023 and 2030, the revenue is expected to increase by 12.6% on average.

5.10.3. Job Creation

In general, transportation sector in Malaysia employed more than 500,000 workers. The application of technology device in micromobility vehicle needs technical experts and procurement staffs to handle the sales of services and payment needs such a

high-skilled workers, as well as semi-skilled and low-skilled workers for handling and managing the operations and routine jobs. The number of industrial players in micromobility sub-sector will be grown if the banning is uplifted in future. Hence, micromobility industry can create more jobs which requires more people to fulfill the vacancies.

6. SAFETY IMPACT

The requirement for age limit, riding license, license plates, and insurance could also be the case for a wide range of powered micromobility such as e-scooters, e-bikes, and e-boards. Similar to a helmet, the necessity of providing a riding license, license plates, and insurance is unclear for other types of micromobility, such as e-scooters.

The case of license plates might not be necessary for shared e-scooters as operator companies track riders for registration and cost estimation. Similarly, insurance could also be provided by e-scooter companies as part of the rental costs. The quick acceleration feature characteristics of e-scooter riding imply the requirement of the users experience and knowledge about the device.

From the discussion with the authority, providing some mandatory safety course prior to the use of an e-scooter might increase the safety of riders as they would understand potential risks both in theory and practice. Others, it allows the owner to understand and comply with the road laws and safety of using the vehicle. Ensure all users read any supplied safety instructions (application or on their website), practice basic movement, starting and stopping, accelerating, and decelerating, and maneuvering around obstacles for familiarization.

6.1. How well are you covered?

It is critical to make sure riders are covered with insurance when riding. If youre driving on the road, youre covered by insurance. Similarly, while riding an e -scooter, you need to be covered with insurance too as it is highly risky riding on the road, and it will provide protection for riders if any accidents occur. Interestingly, some of the service providers did provide insurance for their riders free of charge during registration. As shown in the Figure 6.1, around 14% service providers covered their riders with insurance and 19% users do have their own personal insurance during riding micromobility.

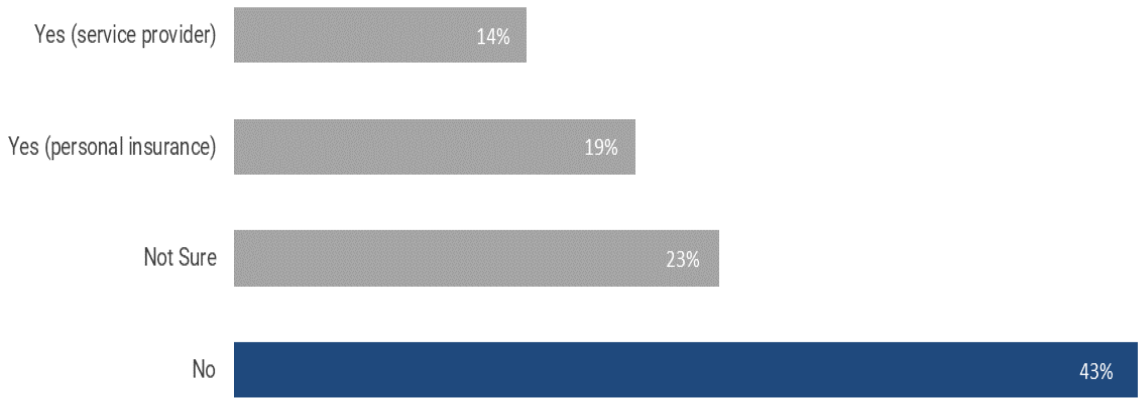


Figure 6.1 Are you covered by insurance while using the micromobility vehicle?

6.1.1. Personal Protective Equipment (PPE)

PPE (Personal Protective Equipment) are safety gears for micromobility users to safeguard themselves during the use of micro vehicles during transportation. Among the essential PPE items for micromobility users include the use of safety helmets, elbow and knee pads, gloves, reflective materials, and closed-toed shoes. Specific PPE requirements may vary depending on local laws and regulations. Some areas may have specific rules regarding helmet usage, for example, while other safety gear may be left to the riders discretion.

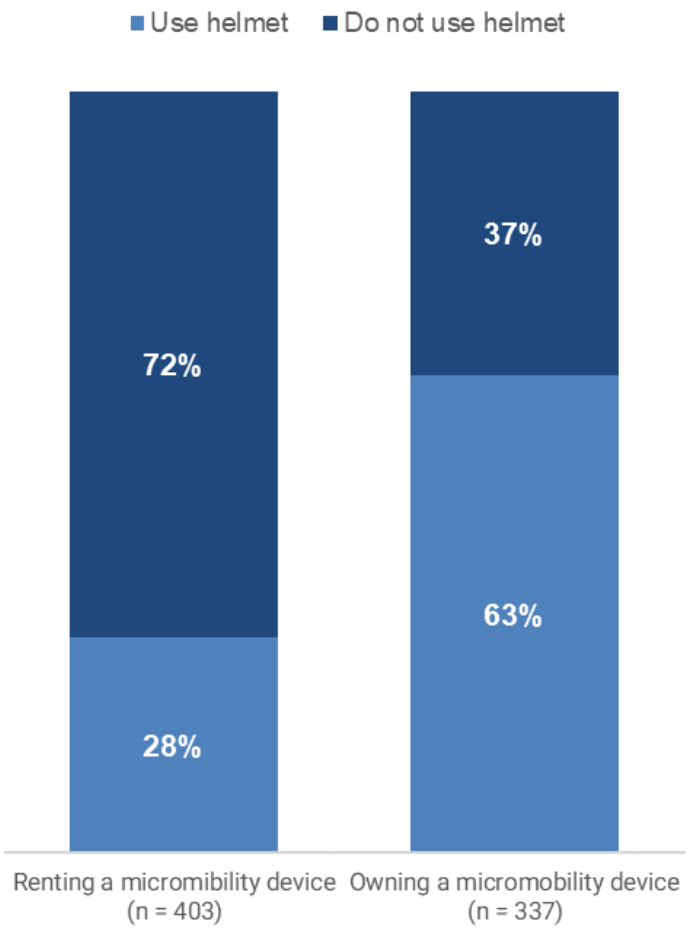


Figure 6.2 Percentage of users wearing a helmet based on device ownership status

Users' trend in using PPE may differ depending on whether their transportation device is rented or owned. This is exemplified in the public survey which indicated that users owning a micromobility device tend to gear towards using a helmet while riding, while less than 30% of users who are renting use a helmet (Figure 6.2). While everyone is responsible for their own safety when it comes to being well-equipped, shared micromobility service providers also bear significant responsibilities in ensuring the safe operation of their services. Clear and comprehensive user education is vital for promoting responsible riding and preventing accidents. It involves providing instructions on proper vehicle operation, road rules, safety guidelines, and highlighting best practices and potential risks.

The public survey showed that a total of 740 users indicated experience in using a micromobility device for commuting or leisure. However, less than half reported using

at least one form of safety gear when riding (Figure 6.3). The type of safety gears reported by users include safety helmet, safety vest, elbow guard, knee guard, and gloves. Users reported of using one or more safety gears while riding a device. Those using at least one safety gear state the use of safety helmet being the main safety device (95%), followed by use of gloves (152 users), elbow (122 users) and knee (128 users) guards, and safety vest (85 users). Some users indicated the use of shoes and a lighting device while riding. One user mentions the use of activated speakers to provide audio-enabled notifications to pedestrians and other road users.

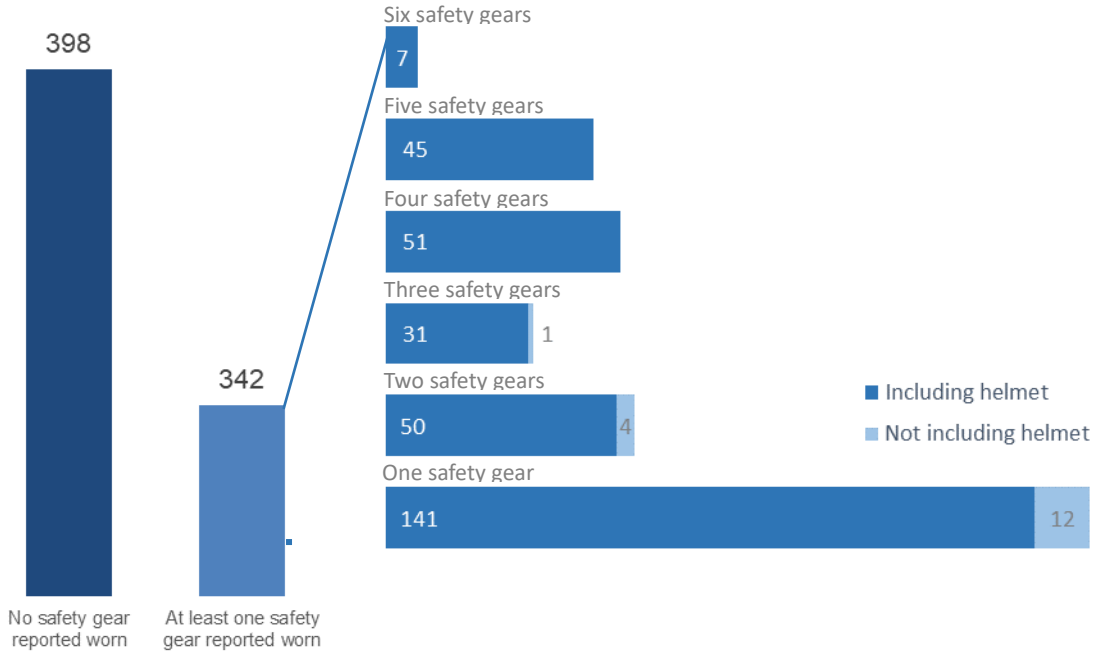


Figure 6.3 Number of users by number of safety gears reported worn (n=740)

Helmets stand as the most vital component of PPE for micromobility users. They provide essential protection to the head and brain in case of accidents or collisions. It is imperative to consistently wear a well-fitted helmet that adheres to safety standards and suits the particular type of micromobility vehicle in use. However, it is always recommended to prioritize safety and wear as much protective gear as possible to reduce the risk of injuries while using micromobility vehicles.

6.1.2. Route Options Selected

Safety should be the top priority when riding micromobility vehicles in which riders are responsible to make choices based on the type of roadway and traffic conditions. Ideally, the use of a dedicated or designated pathways intended for such use is preferred. In a 2019 study conducted in Austin, Texas, researchers examined e-scooter rider behaviour and safety preferences. While the study was not solely focused on roadway preferences, it revealed that a significant number of riders preferred using bike lanes or roads with designated cycling infrastructure rather than sidewalks or busy streets. However, where such dedicated facilities are not provided, riders may opt for lower risk roadways. Figure 6.4 below illustrates the micromobility user preferable area to ride.

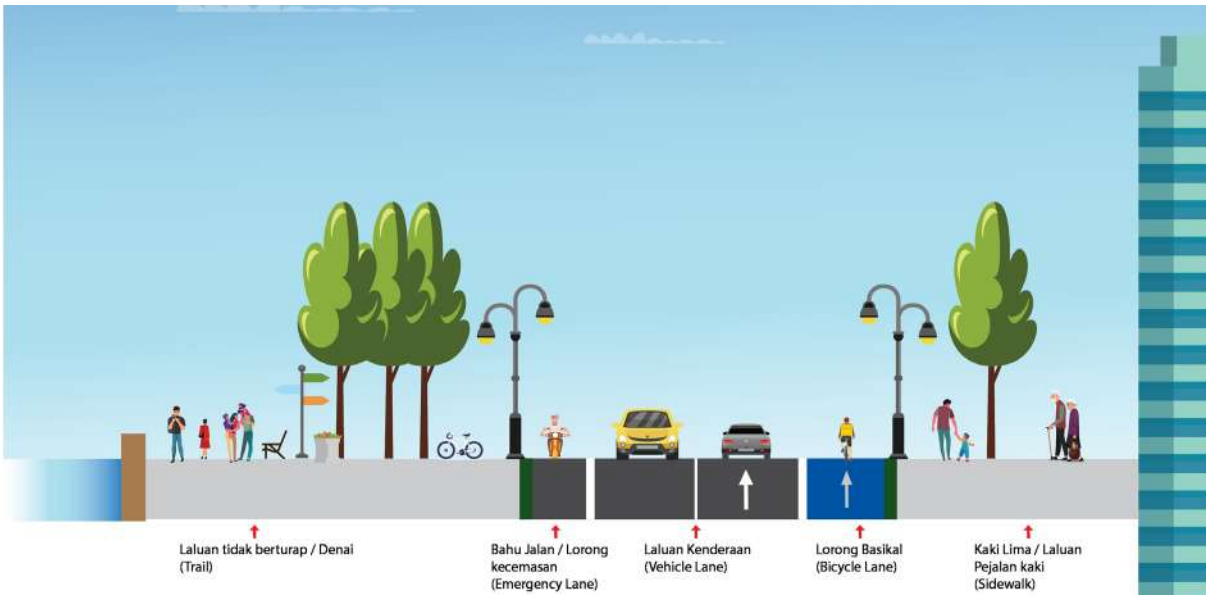


Figure 6.4 Illustration of micromobility user ride preferable

The findings of the public survey indicated that e-scooter riders do not exclusively prefer one type of roadway for their journeys. In areas lacking dedicated routes for micromobility vehicles, a significant majority of riders showed a higher preference for using sidewalks or shoulders (274 riders) rather than riding on roadways shared with other vehicles (113 riders) (Figure 6.5). Riders naturally lean towards facilities perceived as safer, avoiding high-traffic roadways like shared roads. Therefore, creating suitable facilities that prioritize rider safety becomes crucial in promoting micromobility vehicle usage and encouraging higher ridership.

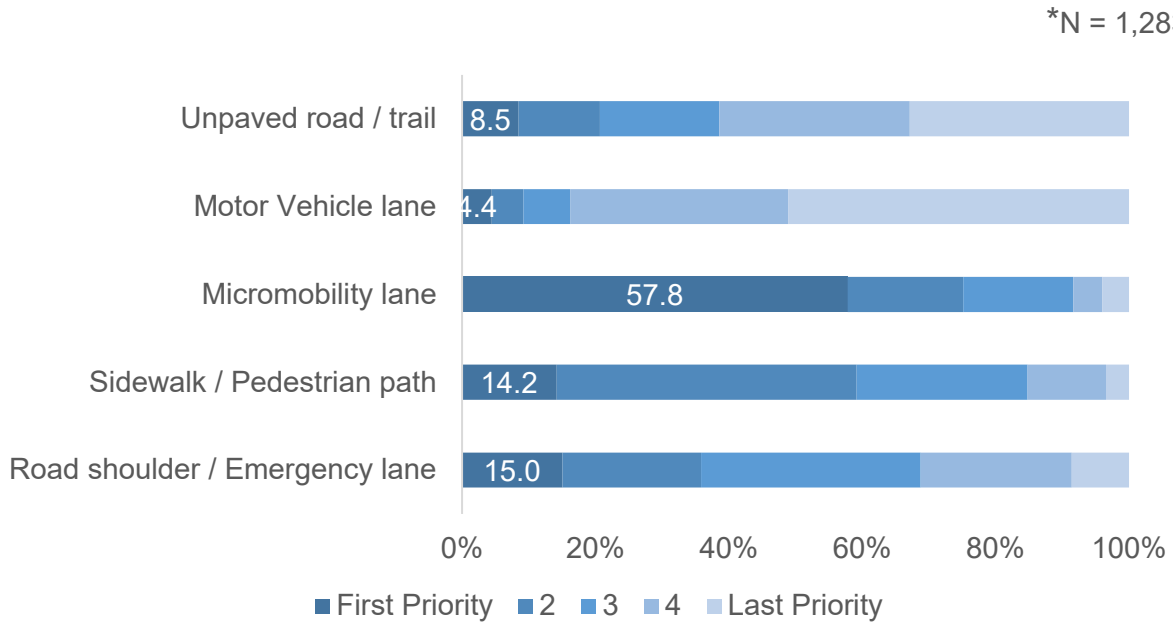


Figure 6.5 Preferred location to ride a micromobility vehicle according to PRIORITY.

6.1.3. Rider Speeds and Exposure

The public survey revealed that the majority of users rode at speeds between 11km/h to 20 km/h (Figure 6.6). However, it was also reported that 5% of users rode at speeds greater than 40km/h. When comparing between male and female riders, similar to previous studies conducted, male users were found to ride at higher speeds compared to female riders (Figure 6.7).

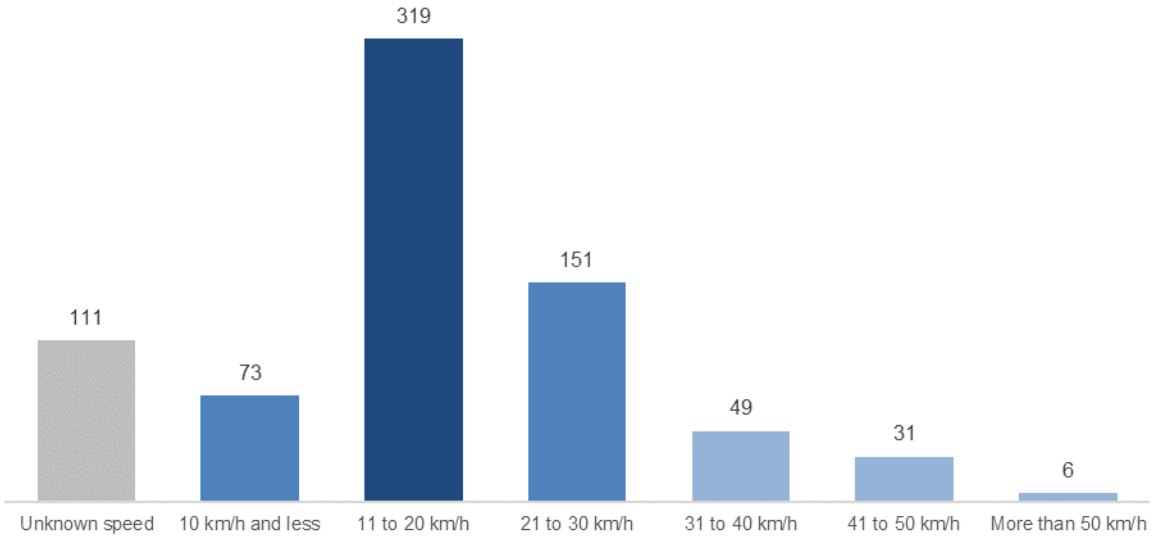


Figure 6.6 Riding speed of users in km/h (n=740)

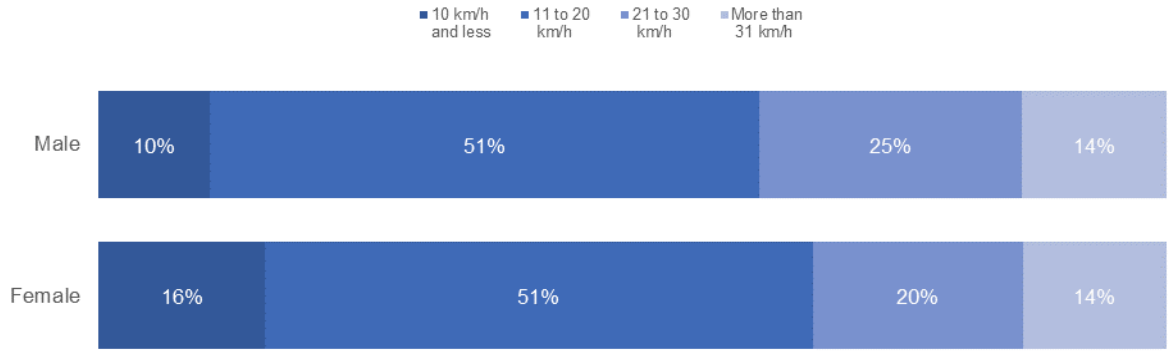


Figure 6.7 Comparison between riding speed of male and female riders

Figure 6.8 shows the percentage of users by frequency of rides and the average speed of users for each ride frequency category. The trend indicates some relation between frequency of rides and speed of rides. Riding speeds were found to significantly decrease as frequency of ridership decrease beyond one ride per month ($p<0.05$). This indicate that familiarity with riding a micromobility device may influence users towards higher riding speed. As such, it is a necessity for service providers and authorities to continually inform users on the best practices and potential risks can help prevent accidents and promote responsible riding.

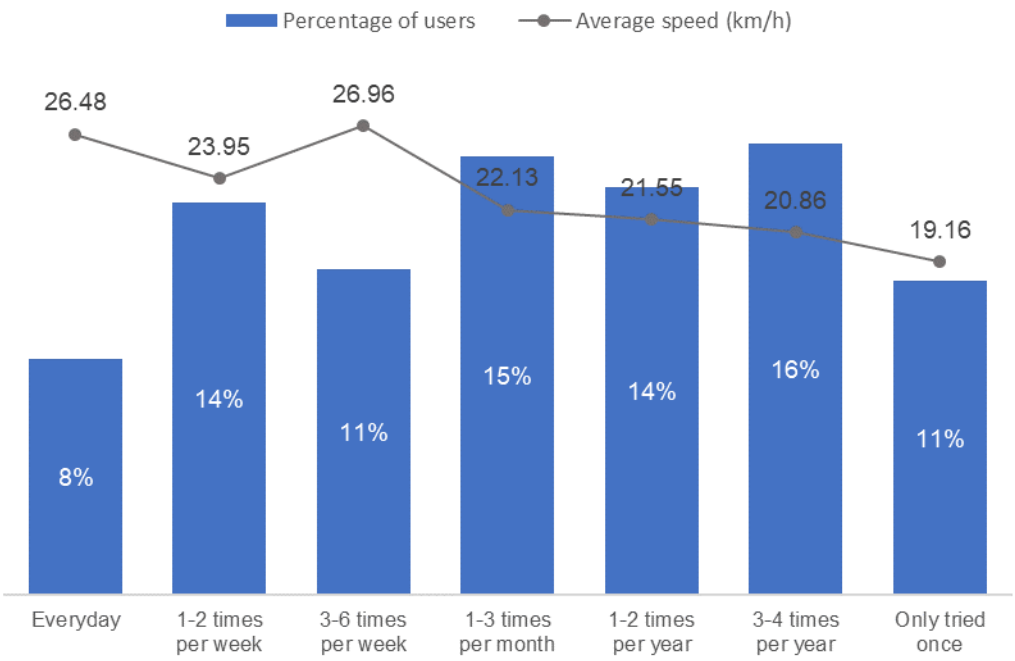


Figure 6.8 Frequency of use and average speed

In conclusion, user safety is a critical aspect of micromobility. By implementing a combination of regulatory measures, infrastructure improvements, user education, and responsible behaviour, we can create a safer environment for all road users and pedestrians while enjoying the benefits of micromobility solutions. All user perceptions also must be taken into account in order to regulate the suitability of micromobility solutions (Figure 6.9).

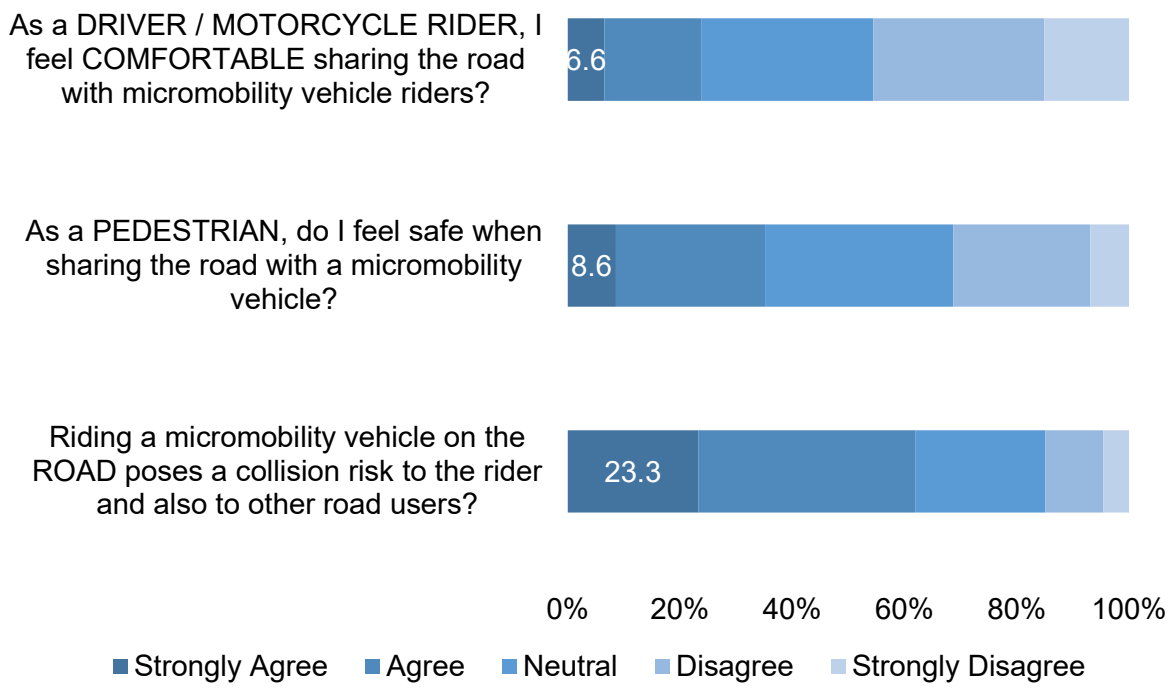


Figure 6.9 Public perception on micromobility users'

6.2. Road User Risk

Micromobility are one of transportation mode that can offers several advantages, such as convenience, eco-friendliness, and cost-effectiveness, making it an attractive transportation option, especially for short distances and typically within urban areas. However, its essential to acknowledge that with any form of transportation, theres always a potential for risk and the possibility of associated injuries. Same goes with micromobility where it comes with its share of challenges in terms of safety and

occurrence of incidents related to micromobility usage. For this study, the information of micromobility incident were collected from survey data and in-depth interview.

6.2.1. Type of Incident

Incidents can be broadly categorized as near misses and collisions which may occur among micromobility riders or involve other members of the public. Near miss is defined as an incident almost occurs but is avoided at the last moment. Collision definition is involving direct contact between micromobility riders or between micromobility users and other road users such as a pedestrian, cyclist, or motorist.

From the survey data (Figure 6.10), there are 17.9% of the respondents did experienced incident while using micromobility with most of them involved near miss incident 84.3% compared to collision incident with 15.7%.

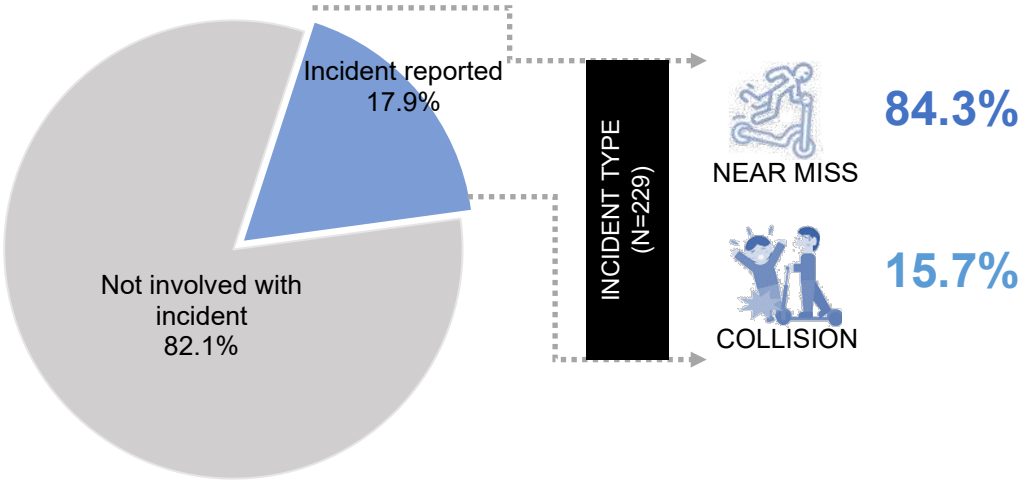


Figure 6.10 Type of incident reported from survey

6.2.2. Micromobility incident pattern

Distribution of incident pattern on involvement of crash partner, associated injury and location of injury were illustrated in Figure 6.11 below. Majority of the collision and near miss incident in the survey study involved other vehicle as crash partner which near miss with other vehicle contribute the most with 51.4% while collision with another vehicle contribute 9.9%. The injury reported were derived from injury related to

collision incident only as no injury were reported for near miss in the survey data with most of the victims involved minor injury. The incident mostly occurred at shared road.

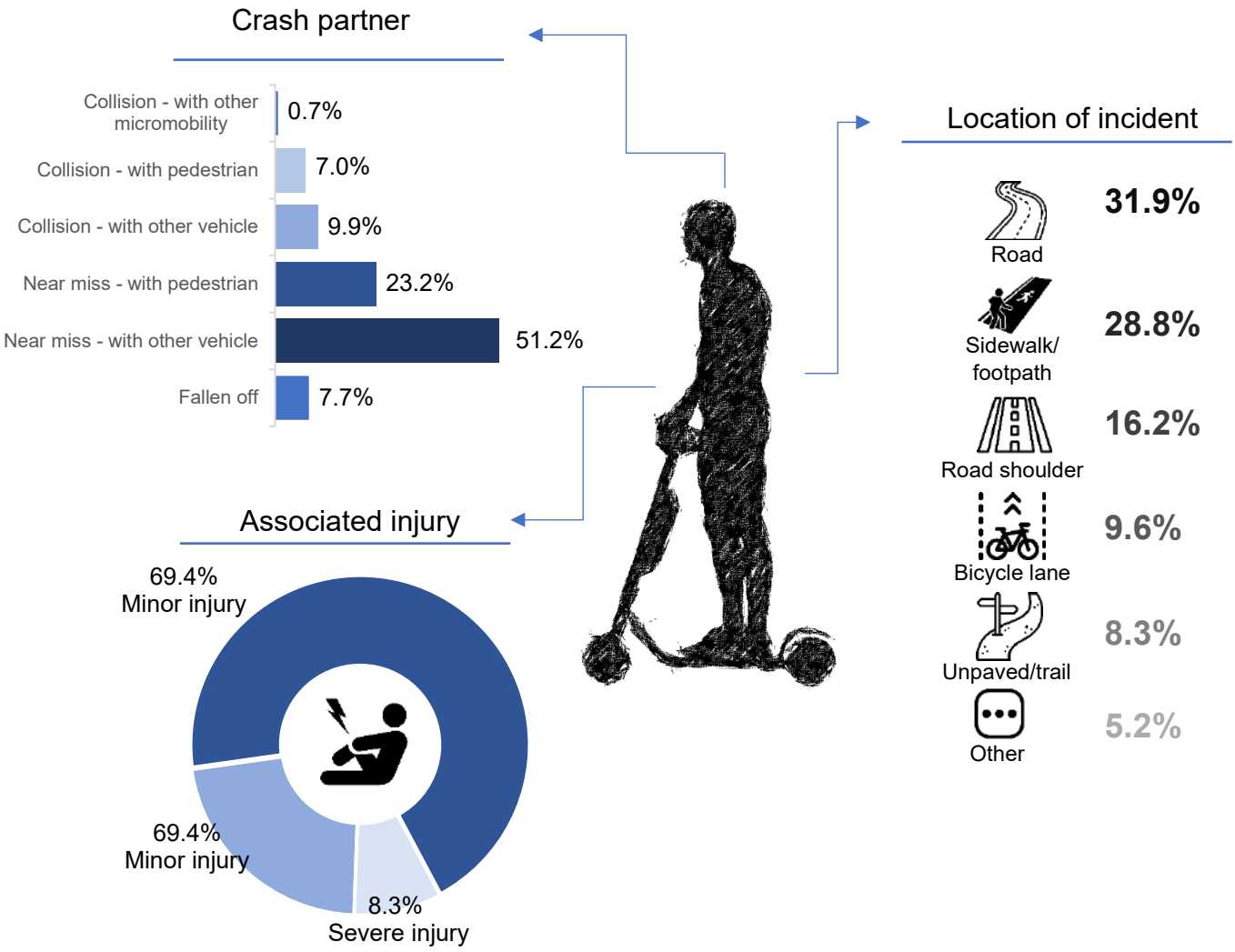


Figure 6.11: Parameter related to incident derived from survey

6.2.3. Incident cases

The key findings of incident cases mentioned from In-depth Interview were mainly gathered from local authority, shared operator and trusted seller are summarised below. The participants brought about valuable information and recommendation regarding micromobility growth in Malaysia strategically especially to prevent unnecessary incident happen pertaining to micromobility.

Accident occurrence

There were cases happened among the user, yet the numbers were very small. As shared by one of the micromobility operator that involved in the IDI session informed that the occurrence of their users involved in accident was 0.0007% per e-scooter trips.

Injury type

Most of the accidents that did occur resulted in minor injuries. However, it is crucial not to dismiss or ignore these incidents. Even though the numbers may be low, the impact of accidents on individuals involved can be significant, leading to injuries, medical expenses, and potential long-term consequences.

Cause of accident

The primary cause of these accidents is attributed to human error. This could include factors like riders losing control of the device, not being familiar with its operation, or making mistakes while riding due to inexperienced of handling the device. These type of causes implying fall to seem to be a common type of accident. Meanwhile incidents involving pedestrians are not as frequent as fall.

Insurance

The fact that insurance coverage is included in the rental fee is beneficial for riders. Including insurance in the rental cost provides an added layer of protection for users in case of accidents or injuries. Its positive to hear that the operator takes responsibility for the incidents related to micromobility devices. Having the operator undertake responsibility helps ensure that they are incentivized to maintain the safety and quality of their services.

Incident Reporting

A potential issue highlighted during the interview was majority of the accident occurred were underreporting. It means that not all accidents are being officially documented or reported to police, which could impact the accuracy of accident data involving micromobility in Malaysia. However, people now a days are keen to report in media social rather than reporting through proper channel.

Nevertheless, rental operators did receive accident reports, which suggests that at least some of the accidents have been reported to the companies responsible for renting out the micromobility devices. To encourage proper reporting, its crucial for

Recommendation from local authorities

Local authorities have suggested few recommendations to operators to prevent accident such as:

- Self-declaration on the experiences in handling micromobility devices in the rental application.
- Only experienced riders are allowed to ride the device;
- First timer riders are allowed to ride but in the control compound such as small park or housing area.

Micromobility offers a promising solution for urban transportation, but it comes with its share of challenges in terms of safety. By fostering a culture of responsible riding, enhancing infrastructure, and promoting awareness, we can create a safer environment for both micromobility riders and the public, ensuring that the benefits of micromobility are maximized while minimizing the risks.

6.3. Safe Infrastructure

The main challenge is inadequate infrastructure such as bike or pedestrian lane. Many of Malaysian cities are still lack of walkability features, with less emphasis given to

micromobility or pedestrian and much more emphasis is given to facilitate automobile. At the same time, providing such infrastructure will be costly for older cities which are already overcrowded.

Micromobility infrastructure, such as bicycle lane infrastructure (Figure 6.12), has grown significantly in many cities. On the other hand, the design concepts for bicycle lanes mainly rely on standard road design for bicycles and lack consistency in integrating newly powered micromobility devices like e-scooters. A safer, more comfortable and more conducive micromobility infrastructure is necessary in guaranteeing the safety and comfort of users which can indirectly build the confidence of new users; other motor vehicle users or pedestrians to switch to the use of micromobility vehicles.

However, there are several issues that are factors and obstacles in the provision of good micromobility infrastructure in one city, namely cost or allocation which led to a lack number of micromobility infrastructure developed, maintenance which led to the level of user satisfaction to use the infrastructure, guideline which led to guiding the local councils to developed and prepare the safe and suitable infrastructure, and last but not least the enforcement which led to behaviour issues such as misuse and under-utilize.

Figure 6.12 Example of micromobility (bicycle) lane in Malaysia

6.3.1. The availability of micromobility infrastructure in Malaysia

Allocation, space and demand are the main reasons why there is still a lack of provision for micromobility lanes in Malaysia even though the Selangor State Transport Standing Committee set a target of 1,000km of bicycle paths for a period of five years from 2017. Thus, contribute to the usage of other paths such as motor vehicle lanes, just to ensure the user can complete their journey. Figure 6.13 below also revealed the findings from the survey on availability of the micromobility infrastructure. This not only brings discomfort to e-scooters users but also to other road users and will eventually expose them to a high risk of road accidents. Therefore, cooperation and engagement with various parties such as developers in new development areas is required in building and providing micromobility lanes as one of the conditions in the approval of Planning Permission which in turn can ensure that infrastructure is available in the development area without involving costs that must be borne by the local council itself.

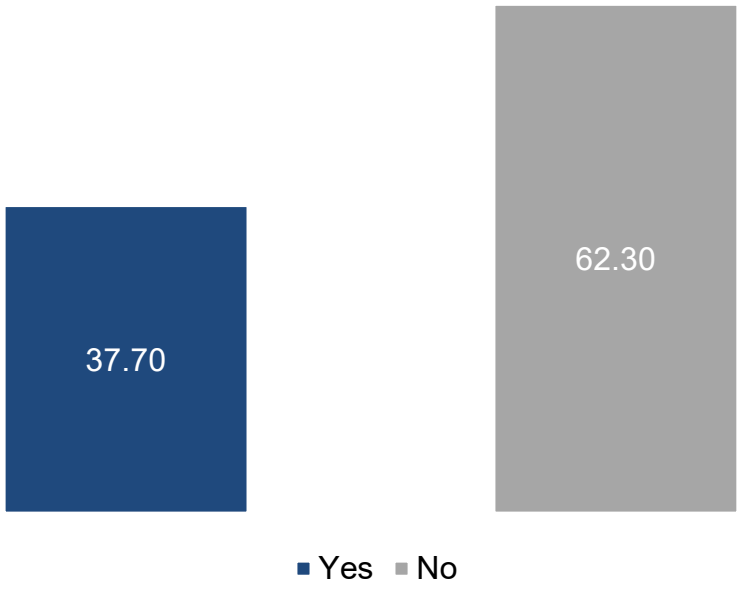


Figure 6.13 The availability of micromobility infrastructure in Malaysia

6.3.2. The level of user satisfaction with existing micromobility infrastructure

In addition, the maintenance of existing infrastructure is also a crucial thing to pay attention to. Survey shows that the level of satisfaction of micromobility users towards

micromobility infrastructure is also at a moderate level (Figure 6.14). The installation of signage still needs to be paid attention to by all stakeholders. Apart from that, connectivity and micromobility lanes surface conditions have also been highlighted.

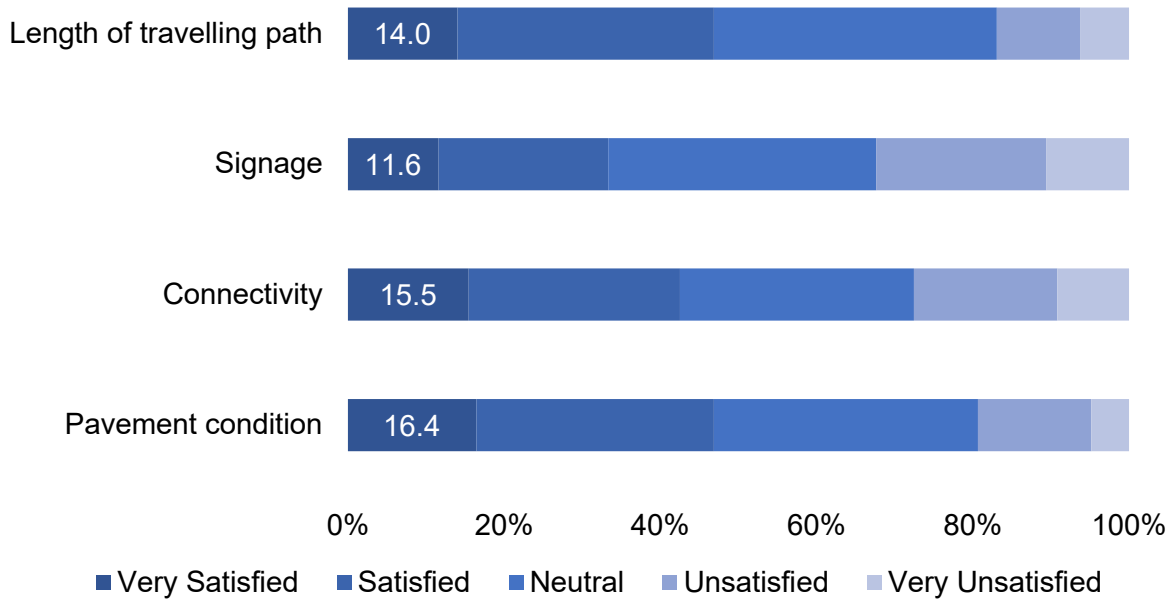


Figure 6.14 level of micromobility users' satisfaction with the travelling path for micromobility in Malaysia

6.3.3. Varying degrees of micromobility infrastructure

To encourage the utilisation of the infrastructure, its development or installation must meet the wishes and needs of users (Figure 6.15). However, the safety factor cannot be ignored. The interaction of micromobility users with other vehicles, the interaction of micromobility users with pedestrians and the interaction of micromobility users need to be looked at more deeply before the location of a micromobility lane is determined.

To encourage the utilisation of the infrastructure, its development or installation must meet the objectives and needs. The literature also emphasizes that the development of dedicated lanes helps to create safer conditions for road users, whether they are pedestrians, motorists or micromobility users.

Attribute	N	%
Paved lane / path, Wider bicycle lane, Special parking for micromobility vehicles (e-scooter), Dedicated bike lanes and separated from traffic with physical dividers	363	**28.29**
Dedicated bike lanes and separated from traffic with physical dividers	197	15.35
Wider bicycle lane	83	6.47

Figure 6.15 Public demand on micromobility infrastructures

Different kinds of micromobility infrastructure and lanes make travelling on the road much simpler and safer. Despite not being a riding lane, a "sharrow" is a frequently seen road marking that features a picture of a bicycle or two arrows next to it. A "sharrow," which is a mashup of the word's "share" and "arrow," serves as a visual reminder to drivers that the road is shared. These are used when motorised vehicles must share the road with users of micromobility and there are no available bike or ride lanes.

A segment of the road that has been set aside just for micromobility is known as a dedicated micromobility lane. Due to the wider than normal road and defined areas for both cars and micromobility, the use of micromobility lanes means that motorised vehicles and micromobility vehicles are no longer sharing the same space. Traditional micromobility lanes are found on the right side of the road and are frequently divided from the road by a striped, white line. Buffer space separates the micromobility lane from the travel lane for motor vehicles in buffered micromobility lanes, which are comparable to conventional micromobility or bicycle lanes. Two horizontal white lines with diagonal crosshatching or chevron lines in between are typical visual representations of buffer space. Also known as non-exclusive lane. Usually, this route does not provide any physical median and was not fully painted - just provided with lane marking. Experts also *voice their opinion on the advantages and disadvantages* of providing shared or non-exclusive infrastructure.

Advantages:

- Easy to prepare and cheap solution.
- Fully painted or lane marking.
- More convenience. Most micromobility users prefer this type of route.

Disadvantages:

- Users are exposed to traffic hazards. Exposed to higher road risk especially when involving heavy vehicles such as lorries and buses.
- Not easy for to recognize by other motorize rider/driver.
- Micromobility users tend to be speeding.
- Misuse by other road users, especially motorcyclists.
- Be a route/parking to unload goods.

Protected micromobility lanes take things a step further by putting up physical barriers to separate the micromobility lane from the travel lane for motor vehicles. These barriers, which separate micromobility vehicles from cars, may appear as metal, plastic, or concrete posts, planters, or parking lanes. Drivers can feel safer knowing that micromobility users have their own protected lane in addition to micromobility users being safer.

Also known as an exclusive lane due to the presence of the physical median to separate micromobility users from other road users. Experts also *voice their opinion on the advantages and disadvantages* of providing exclusive infrastructure.

Advantages:

- Normally shared with pedestrians.
- Have physical median or guard rail.
- More convenience. Most of the other motorized user prefer this type of route.
- Highly visible - Easy to recognize.
- Usually available in areas with a high number of pedestrians

Disadvantages:

- City Councils need to provide more spaces.
- Pedestrians are exposed to e-scooters speeding (if shared with pedestrians).
- Higher cost on provided and maintain.

6.3.4. For riders safety, segregated micromobility lanes are best.

Dedicated or exclusive micromobility lanes are well worth the investment as they reduce accidents between vehicles and micromobility users and also between micromobility users and pedestrians. Businesses have reported growth on these streets as a result of the increased riding micromobility traffic in cities that build dedicated micromobility lanes. And experts voice out "*expanding riding micromobility*

options, people can decrease the number of cars on the road and enjoy all the advantages that comes with it, such as shorter commutes and traffic jams, fewer accidents and delays, lower carbon emissions, and better air quality!".

6.3.5. Other infrastructures

Crossing

Crossing for micromobility vehicles is also divided into two types (Figure 6.16). Signalize and unsignalized. However, awareness and enforcement programs need to be held to ensure that micromobility users cross at the safer and appropriate areas to ensure their safety. Most of the locations provide crossing shared with pedestrians.

Figure 6.16 Signalize and unsignalized crossing

Parking

Similar to type of micromobility lanes, experts also *voice their opinion on the advantages and disadvantages* of providing docked and dockless parking. Dock-less e-scooter parking (Figure 6.17) is a virtual parking which can ONLY be identified through the e-scooter operators' apps.

Advantages:

- Easy to prepare and cheap solution.
- Do not require a docking station.

- There is no limit to the number of e-scooters.
- Easy to maintain.
- More convenience. Users no longer need to worry about empty parking at the end of the trip or full stations upon arrival.

Disadvantages:

- Users tend to park scattered.
- Not easy for to recognize.
- Misplacement of dockless e-scooters.

Figure 6.17 Dockless parking

Docked parking (Figure 6.18) is a parking which equipped with a structure or signage that makes it easier for users to recognize. Installing a docked parking station at a location provides users with a safe and convenient means to store and lock their e-scooters.

Advantages:

- There is a limit to the number of e-scooters.
- Easy to manage the e-scooters.
- Highly visible - Easy to recognize.
- Encourage people to use e-scooters as a means of transport.

Disadvantages:

- City Councils need to provide parking spaces.
- Higher cost.
- Misuse by motorcyclist.

Figure 6.18 Docked parking

6.4. Device Safety

Globally, the powered micro-mobility market has grown quickly. The serious safety issues surrounding the use of new means of transportation, like e-scooters, provide a significant barrier to their widespread acceptance.

6.4.1. Keep your device in good condition

The safety of battery packs and battery management systems need to be assessed to the requirements of safety standards to minimize the potential risk of fire, explosion, and electric shock during real use. There have been multiple reports of micromobility malfunctioning, with some complaints resulting in lawsuits overseas. Therefore, before stepping on board, do a visual inspection by walking around the scooter and looking for any signs of damage or unusual wear. The wheels should be true and lights and batteries sufficiently powered. At the start of your ride, test the brakes and throttle. If you detect any issues, immediately contact the service centre or switch your rented device. There is quite a lot of vibration going through when riding an e-scooter so loosening of screws is not uncommon. So, keep your screw tighten if needed to avoid any damage that can cause an incident.

From the observation, as shown in Figure 6.19 below, among 243 owners of micromobility, 72% of them well maintained their vehicle at least once a year. While the rest had never or yet maintained their micromobility. It is advisable to do regular

maintenance at least once in 3-4 months for minor. For maintenance, about 59% were comfortable to do it on their own compared to bringing it to the workshop. This may be that the damage is minor and not significant.

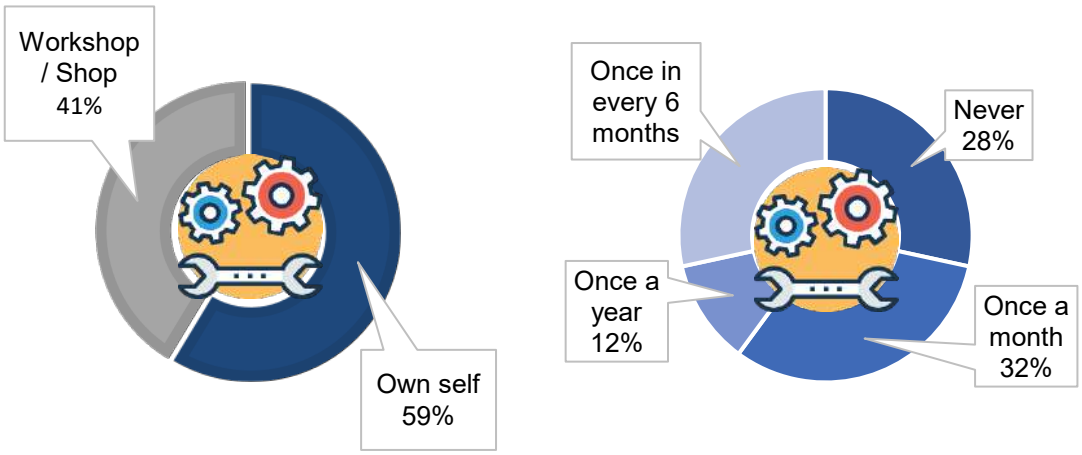


Figure 6.19 The location and frequency of vehicle being maintained (owned)

6.4.2. What are safety features to look out for?

From the study discovered that there is no safety standard and enforcement that have been implement in Malaysia related to micromobility vehicle. To ensure this type of vehicle is safe to use, establishing safety standards for these vehicles is crucial. Here are some important safety features, requirements, and standards that should be considered to enhance safety of micromobility vehicles.

Safety Standards

Comply with EN 15194:2017 or EN 17128:2020

- EN 15194:2017 – standard for electric assisted bicycle
- EN 17128:2020 – new standard applies to personal light electric vehicles with or without self-balancing system totally or partially electrically powered from self-contained power sources having battery voltages up to 100 VDC, with or without an integrated battery charger with up to a 240 VAC input.

Battery Requirement

The battery use in a micromobility vehicle should comply with UL2271 standard. UL2271 is a standard that released in 2013 for batteries in light electric vehicle or LEV applications including electric bicycles, scooters, motorcycles, and wheelchairs. Use high quality battery for safer usage.

Brakes

Brakes are the most crucial safety features. Good-quality brakes will avoid accidents should you need to stop abruptly due to any emergency. The brakes will also determine the devices safety in harsh weather conditions. Most e -scooter have two main brake categories: electronic and mechanical. It is recommended to have multiple brakes; in case one fails.

Tires and Traction

The tires are also part of the safety features as it improves the device stability when braking. Non-pneumatic tires are more resilient than ordinary solid tires. Wide wheel size also provides high shock absorption, which provides more safety when riding through terrains. Traction control enables wheels not to spin while traveling through slippery roads or other dangerous road conditions. This makes traveling and driving in bad weather safer.

Horn and Bell

Horns or bells can be used to warn other drivers or pedestrians nearby and help you avoid collisions. These can also be used to signal to the driver in front that you intend to overtake.

Lights

Having bright lights is considered essential for avoiding accidents on the road. During nighttime in low light, it can be difficult for drivers to see the vehicles around them.

Indicators

Type of indicators embedded in some e-scooter model for the purpose of enhancing the safety features of the vehicle are:

- indicators to show other drivers on the road of your intended change of direction, whether turning left, right, or weaving through traffic.
- battery indicators that indicate the charge level of an electric scooter.
- tail light indicators that turn on when braking which provides clear signage for vehicles behind.

7. SUSTAINABLE

As discussed in Section 2, micromobility has the potential to make significant contributions to achieving the Sustainable Development Goals (SDGs), encompassing crucial aspects related to social, economic, and environmental dimensions. While Sections 5 and 6 delve into the social and economic impacts of micromobility, this section focuses on its environmental implications within the context of sustainable mobility.

Although this section highlights the environmental potential of micromobility based on current usage patterns among the public, it is essential to recognize that a comprehensive evaluation of its environmental impact requires sophisticated tools like Life-cycle Assessments (LCAs). LCAs are quantitative methods for assessing the environmental impacts of a product or service across all phases of its life cycle, from resource extraction and raw material processing to product assembly, transportation, packaging, usage, maintenance, waste treatment, and disposal[31,32] . However, its important to note that conducting a full-scale LCA is beyond the scope of this study.

7.1. Modal Shift

The most significant potential offered by micromobility lies in its capacity to drastically reduce our transportation-related carbon footprint. This reduction is achievable through a transition from carbon-emitting vehicles to eco-friendly transportation alternatives, including electric vehicles and well-developed public transportation systems. In essence, achieving this transformation hinges on what we term a "modal

[31] Finnveden, G., Hauschild, M. Z., Ekvall, T., Guinée, J., Heijungs, R., Hellweg, S., Koehler, A., Pennington, D., & Suh, S. (2009). Recent developments in Life Cycle Assessment. Journal of Environmental Management, 91(1), 1–21. https://doi.org/10.1016/j.jenvman.2009.06.018

[32] Rebitzer, G., Ekvall, T., Frischknecht, R., Hunkeler, D., Norris, G., Rydberg, T., Suh, S., Weidema, B. P., & Pennington, D. W. (2004). Life cycle assessment Part 1: Framework, goal and scope definition, inventory analysis, and applications. Environment International, 30(5), 701–720.

shift." Modal shift entails a change in the transportation methods individuals employ when traveling from one location to another. In the context of this discussion, our focus centers on examining the shift from conventional vehicles to micromobility options, specifically e-scooters.

Drawing insights from our earlier survey, as outlined in Section 4, it becomes apparent that roughly one-third of the respondents already demonstrate significant engagement with micromobility. Within this group, 15% incorporate e-scooters into their routines at least twice a week, while an additional 9% rely on them daily. Figure 7.1 reinforces the significance of micromobility by revealing that one-third of these users have seamlessly integrated it into their daily activities. However, it is worth noting that a majority of micromobility users predominantly employ these options for recreational purposes. This preference can be attributed to several factors, including the nascent stage of micromobility exposure, limited accessibility of micromobility services, the absence of a comprehensive regulatory framework, and lingering public apprehensions arising from recent bans on these transportation modes.

Nonetheless, there exists cause for optimism within these findings. Notably, 5% of respondents already utilize micromobility for first and last-mile travel, underscoring its potential as a convenient solution for short-distance trips. Furthermore, an encouraging 7% of users have incorporated micromobility into their daily work commutes, signifying its increasing relevance as a practical and sustainable commuting option. These trends underscore the growing role of micromobility in our collective journey towards more sustainable and environmentally responsible transportation systems.

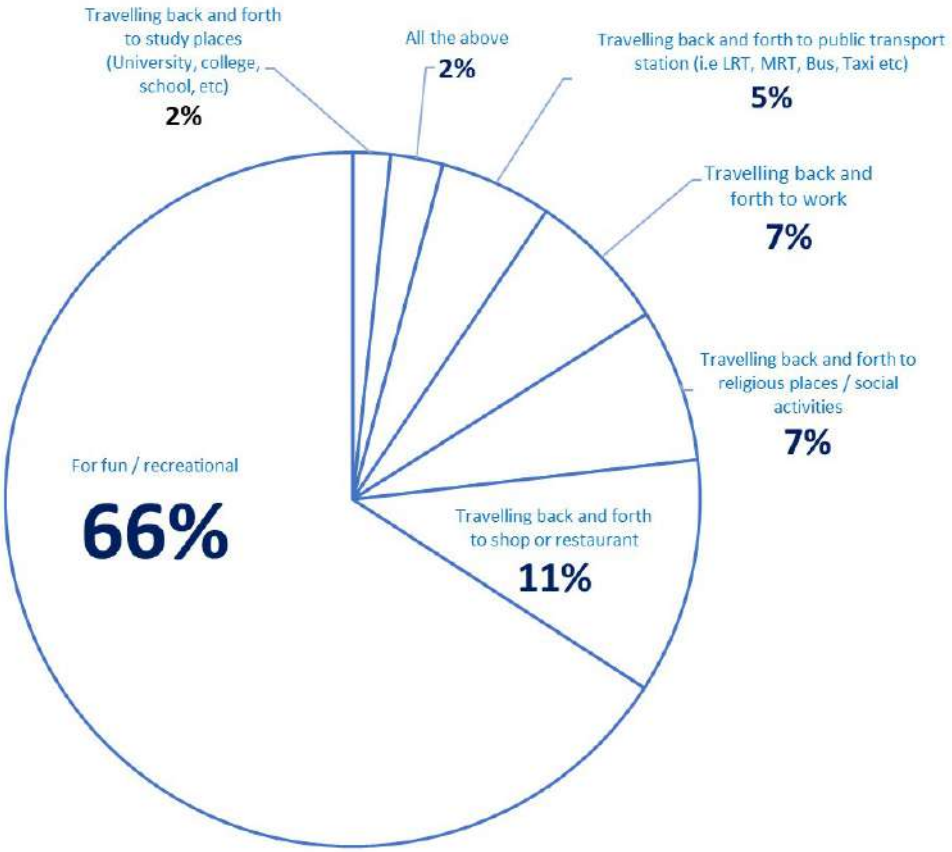


Figure 7.1 Micromobility usage purpose

Specifically, when examining modal shift among the public who recently used shared micromobility for a trip, a significant portion of them expressed that in the absence of micromobility vehicles, they would choose to walk. Furthermore, it is noteworthy that many of these individuals shifted away from using private vehicles, such as driving their own cars, using e-hailing services, or accepting rides from others. Figure 7.2 illustrates this distribution, demonstrating a positive trend towards reducing reliance on conventional personal transportation methods in favor of more environmentally friendly and community-oriented options like micromobility and walking.

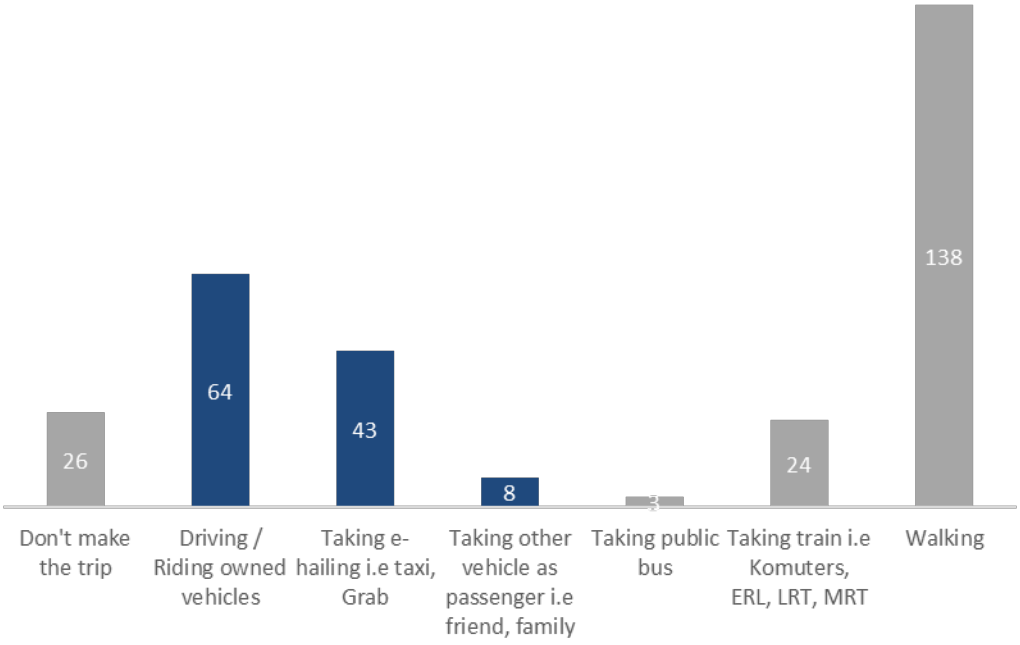


Figure 7.2 Modal shift among public who used shared micromobility vehicles recently.

The results for private micromobility users are particularly fascinating since a majority of them are making a notable shift from private vehicles to micromobility. This stands in stark contrast to shared micromobility users, where a larger number are opting for micromobility over walking, as demonstrated in Figure 7.3. The primary reason behind this compelling trend is likely the convenience of private micromobility, allowing users to travel directly from their homes to their desired destinations. This door-to-door transport option provides unparalleled ease and flexibility, making micromobility an attractive and practical alternative to conventional private vehicles.

This encouraging development signifies a significant step towards more sustainable transportation practices. By reducing their dependence on private vehicles and embracing micromobility, individuals are actively contributing to a greener future and an eco-friendlier urban mobility landscape. As this shift gains momentum, it holds the potential to generate positive environmental impacts and foster a more sustainable and resilient transportation system.

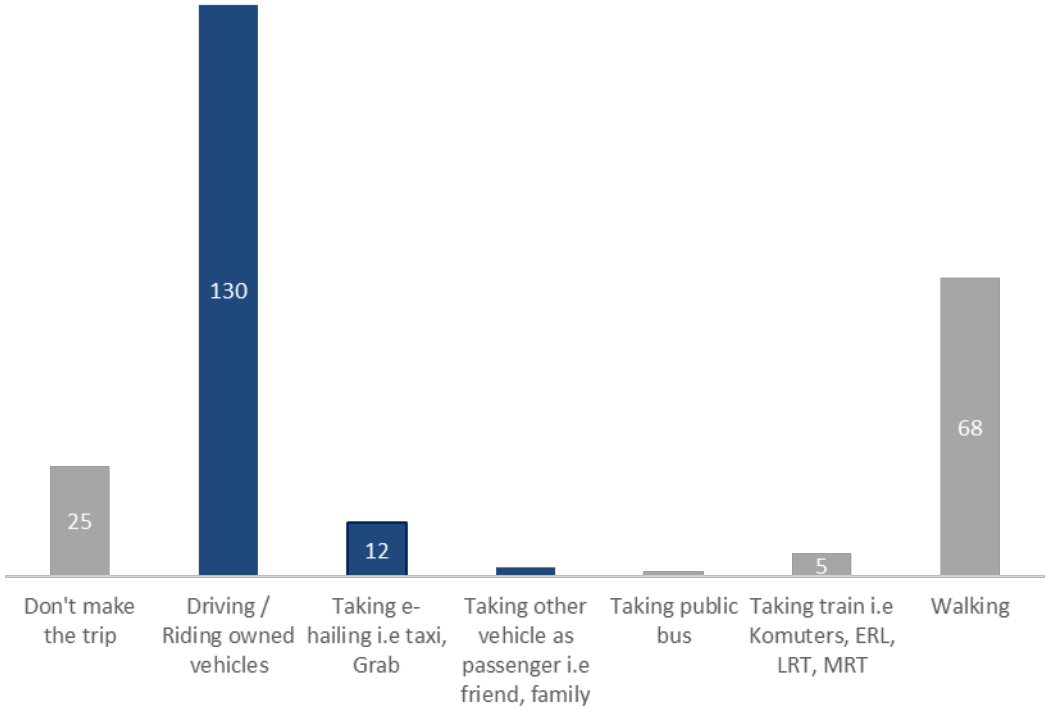


Figure 7.3 Modal shift among public who used private micromobility vehicles recently.

7.2. Public Transport Integration

When considering the utilization of micromobility vehicles for completing trips, there are notable differences between shared and private micromobility users. For shared micromobility users, the majority only used the micromobility vehicles for a portion of their trip. However, for private micromobility users, half of them utilized the micromobility vehicle for the entire duration of their trip, as depicted in Figure 7.4. This data once again emphasizes the convenience enjoyed by private users who can initiate their journey directly from their homes.

On the other hand, the majority of shared users who employed micromobility to complete their trips indicated its usefulness in multimodal transportation. Micromobility serves as an effective first and last-mile solution, facilitating seamless connections for users from one place to another. This highlights the value of micromobility in enhancing the accessibility and connectivity of transportation networks for shared users, offering a practical solution to complement other modes of transportation for their journeys.

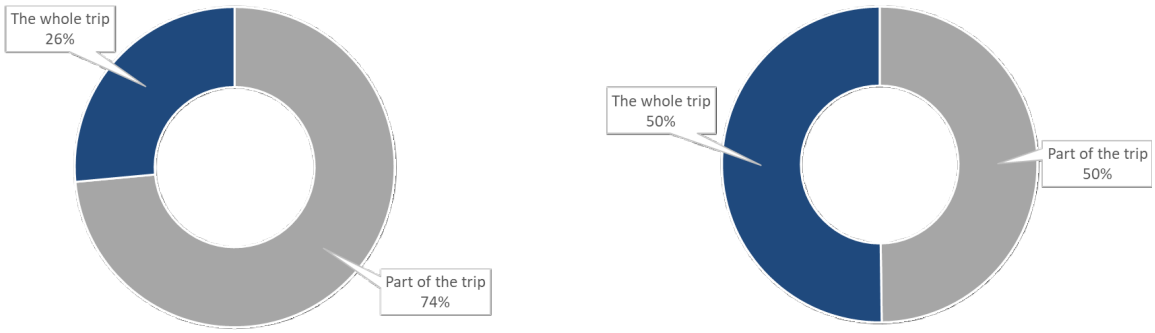


Figure 7.4 Utilization of micromobility vehicles for completing trips.

8. REGULATORY FRAMEWORK

The following rules were enacted in the vast majority of the nations under study between 2018 and 2020; however, in some of the countries, the legislation is still in the development stage or specific transitional periods are currently in effect. The quick growth and accessibility of both micromobility cars and businesses that offer pertinent rental services are to blame for this urgency. At the same time, attempts to apply current regulatory practises to micromobility are hampered by their inability to anticipate the particular of their use or to avoid ambiguous interpretations. As the usage of micromobility vehicles becomes more common, several issues, including road safety, urban infrastructure and development, the location of such vehicles, rental agreements in the urban transportation system, and environmental effects, will need to be addressed.

8.1. Malaysia current regulation

Selected micromobility vehicles such as mopeds, personal mobility devices (PMD) and personal mobility aids (PMA) are not allowed to be used on public roads since December 2021. PROHIBITION on the basis of:

i. Ensuring the safety of all road users by avoiding unsafe mixing traffic with the flow of motor vehicle traffic which carries a high risk of road accidents.
ii. The use of micromobility vehicles that do not comply with road rules and there is no control over the level of competence of the user is dangerous for all road users.
iii. Avoid traffic jams.
iv. Avoid using vehicles that do not comply with road rules.
v. Avoiding high financial implications following damage to property/road infrastructure and health care costs.

vi. Avoiding the occurrence of illegal modifications and racing.

8.2. Malaysian awareness and perception

Unfortunately, there are still people who do not know the law for micromobility vehicles (Figure 8.1). Nevertheless, Malaysians know about the ban on the use of certain micromobility vehicles on the road and the speed limit for each micromobility vehicle. In fact, there are also those who think that the use of helmets is enforced for users of micromobility vehicles.

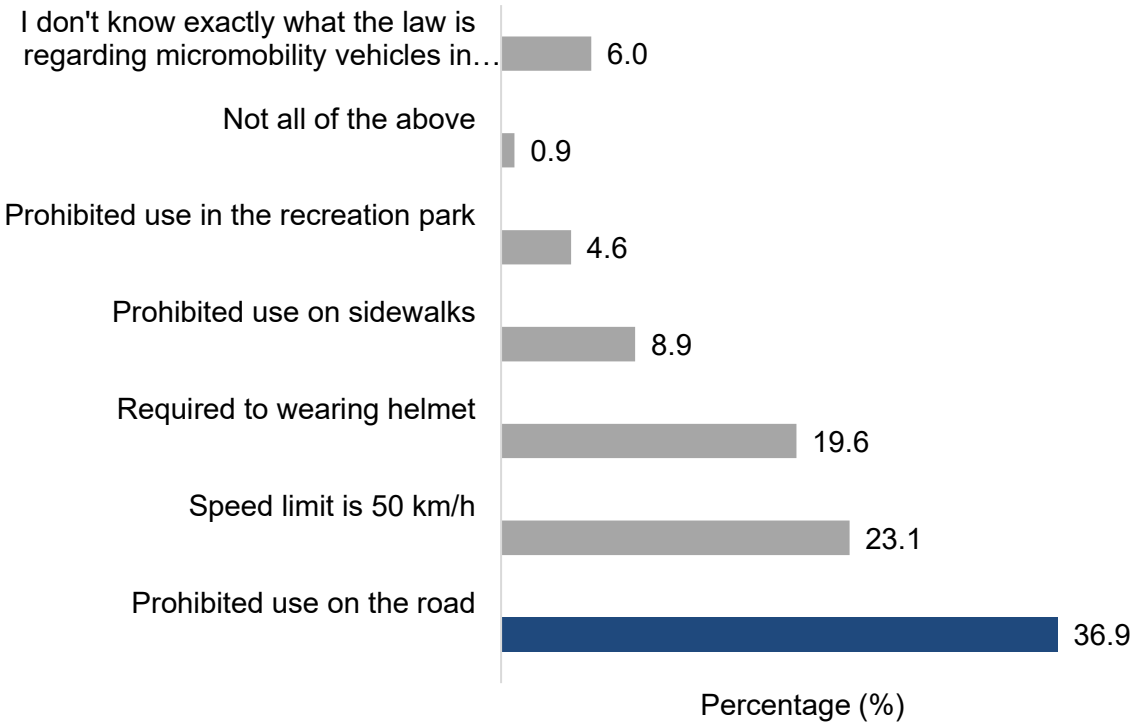


Figure 8.1 Public perception on micromobility rules and regulations

8.2.1. A Guideline for Regulating Micromobility

The current safety standards and the rules for using the new mobility services differ not only from country to country, but often even from city to city, which is why the regulations play a decisive role in ensuring the safety of these services. Establishment of guidelines for operators and users on the specification and safety caution of devices

that are needed urgently. For example, minimal requirements need to be taken into consideration for micromobility vehicles such as lamps and bells for safety purposes and provide Personal Protective Equipment (PPE) especially helmets when renting or riding on own. of thes is because, among the scooter injuries analyzed by the CDC, one-third occurred during the users first ride. In order to improve the safety of the use of micromobility vehicles, the survey asks for counter measures that respondents think need to be implemented (Figure 8.2).

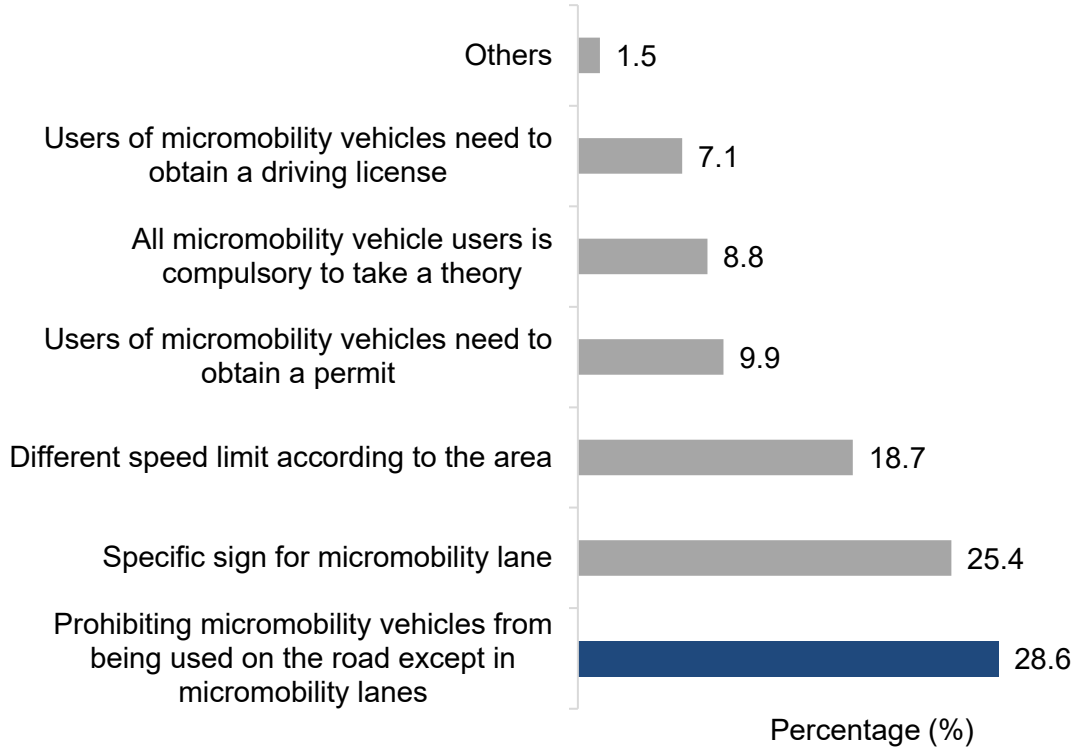


Figure 8.2 Public demand for micromobility regulation

Helmet requirement

Micromobility users do not have protective bodies like other vehicles, so a helmet is the important and primary safety gear to protect us from head injuries. The usage of helmets for cycling and e-cycling still faces several challenges, even though it has been mandatory. Yet, to implement micromobility safety gear is another challenge. The adoption of helmet use for e-scooters, especially shared, could be expected to be even more cumbersome. However, through a survey done, almost 63% of road users agree to mandatory of helmet wearing when using a micromobility devices (Figure 8.3).

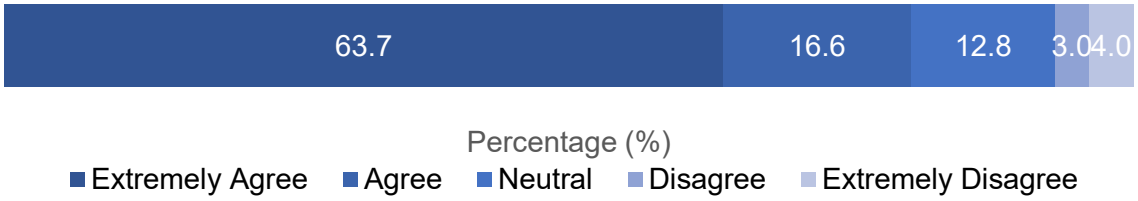


Figure 8.3 Public perception on helmet regulation

Experts also agreed "*they should wear helmets while riding on the road like other power-two-wheeled vehicle users*" in order to reduce the risk of injury from road accidents. In addition, "*their disobedience to the road traffic rules deserves the same legal action as other users*".

Age limit and license requirement

However, through a survey done, almost 62% of road users agree to mandatory of age limit when using a micromobility devices (Figure 8.4) While expert suggest "*micromobility vehicles can only be used in designated areas and are suitable for those aged 16 and above.*

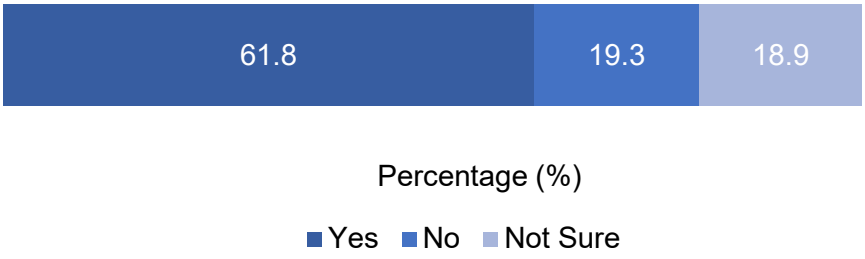


Figure 8.4 Public perception on age limit regulations

They also need to have at least an L driving license or attend a basic traffic course. This is to ensure that those using micromobility vehicles understand basic traffic rules and signposts. In addition, they also need to be healthy and free from the influence of alcohol. They also have to obey all other road rules that have been imposed on other

road users". The survey conducted found that 33.5% of users agree to the requirement of license/permit for owned/rent (Figure 8.5).

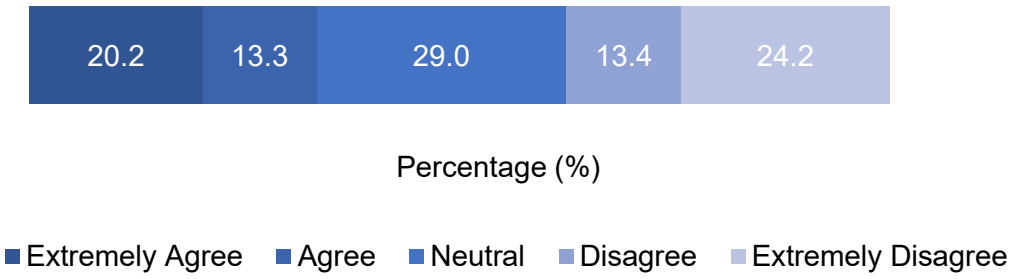


Figure 8.5 Public perception on license regulations for micromobility

9. CONCLUSION

In the context of Malaysia, this study sheds light on the nascent state of the micromobility industry, exploring its potential impacts and opportunities despite existing restrictions on public road access. The study encompasses benchmarking against advanced micromobility markets, assessing local conditions, conducting a comprehensive impact analysis, and identifying both the challenges and opportunities associated with micromobilitys integration into Malaysias transportation landscape.

Malaysias micromobility sector, while still emerging, exhibits promising signs of growth. In 2022, the industry witnessed significant ridership, with users primarily engaging in micromobility for leisure but also integrating it into their weekly routines. The economic potential is substantial, contributing to the countrys GDP, with the prospect of further growth provided that road access bans are lifted.

Safety remains a paramount concern, with relatively few reported incidents recorded to date. However, challenges persist in data classification, hindering comprehensive analysis. Nevertheless, user surveys indicate strong support for safety gear mandates and regulations, underlining the importance of responsible and sustainable growth within the micromobility sector.

In the regulatory realm, Malaysias approach involves bans on certain micromobility models, albeit with exceptions in specific areas. The study underscores the need for standardized regulations and safety mandates, including age limits and helmet requirements, to ensure not only the safety of users but also the responsible and sustainable growth of the micromobility industry in Malaysia. As this sector continues to evolve, careful management and thoughtful policy considerations will be crucial to maximize its benefits while addressing its unique challenges.

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List of Stakeholders

Ministry of Transport, Malaysia

Malaysian Institute of Road Safety Research (MIROS)

Road Transport Department (RTD)

Ministry of Investment, Trade and Industry (MITI)

Royal Malaysian Customs Department (KASTAM)

Malaysia Automotive, Robotics & IoT Institute (MARii)

Dewan Bandaraya Kuala Lumpur (DBKL)

Perbadanan Putrajaya (PPj)

Majlis Bandaraya Shah Alam (MBSA)

Majlis Perbandaran Sepang (MPS)

Majlis Perbandaran Ampang Jaya (MPAJ)

Majlis Bandaraya Petaling Jaya (MBPJ)

URBANICE Malaysia

Sepang International Circuit (SIC)

Persatuan Pengguna Mikromobiliti Malaysia (PPMM)

Malaysia Electric Micromobility Industry Association (MEMI)

Bike Commute Malaysia

Beam Mobility

TRYKE Malaysia

Star Wheels Electronic

OoGyaa Mobility

EFORGE Bikes

Jerung Wheels