MINISTRY OF TRANSPORT
MALAYSIA

SHARED MICROMOBILITY REFERENCE GUIDE

Approaches to enabling and managing shared micromobility services in Malaysia

"…a holistic framework for micromobility implementation in Malaysian cities that considers local context and global learnings…."

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PREFACE

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

Congratulations to the Micromobility Management Cluster, MIROS in collaboration with Micromobility Research Partnership (MRP), PLANMalaysia and Futurise Sdn. Bhd. for successfully completing the Malaysia Micromobility City Implementation Plan.

This book provides valuable information and covers the necessary components of the Sustainable Development Goals (SDGs), Benchmarking from global cities, Malaysia roadmap which includes infrastructure, social, economic and sustainability, as well as potential implementation plans in three main cities in Malaysia.

Finally, I express my most profound appreciation to all parties involved in the publication of this book. 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 I

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 country's 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 Malaysia Shared Micromobility Reference Guide has been created to help local authorities 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 II

TPr. Dr. ALIAS BIN RAMELI
Director General
PLANMalaysia
Putrajaya, MALAYSIA

The rising population due to rapid urbanisation around the world has created demand for more efficient solutions on urban transportation and mobility. Malaysia is not excluded from this global trend as micromobility such as bicycles, e-bikes, or e-scooters are getting more attention and have become a more popular mode of transportation particularly in big cities. The implementation of micromobility initiatives has become an integral part of policies for green mobility and energy efficiency at the national and international levels. The use of micromobility vehicles in the cities can play an important role in the success of 'first mile' and 'last mile' connectivity to replace short trips using vehicles.

Department of Town and Country Planning (PLANMalaysia) has prepared Planning Guidelines on Micromobility in response to the latest demand for micromobility implementation. We hope that this implementation guide will provide the basis framework for ensuring that micromobility vehicles can be used with proper infrastructure and safety features. These micromobility solutions will create positive impact on the reduction of carbon emissions and the way citizens move around the cities.

Thank you.

Foreword III

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!

Executive Summary

E-scooters (personal and shared) have been in operation in Malaysian cities since 2018. During this time, the uptake of this form of transport has been considerable and survey data from MIROS and operators confirms the majority acceptance of their adoption and high levels of the current and proposed use.

However, as a result of a number of safety incidents, the Malaysian Ministry of Transport had banned micromobility vehicles usage on the public roads. The ban was initiated to drive stakeholders especially local authorities to come up with comprehensive plan to enable micromobility operation in their areas safely and sustainable.

The Shared Micromobility Reference Guide has been developed as a guide to assist all levels of government in Malaysia in the successful adoption of micromobility. It should be read in conjunction with other guidance documentation including Plan Malaysia's Active Mobility Guideline and Ministry of Transport's Safety Guide.

Whilst the benefits of micromobility such as reduced congestion, transport equity and reduced carbon are understood the issues associated with an emerging form of transport such as safety, poor rider behaviour and public clutter must be overcome. This Guide seeks to provide guidance on how to approach these issues by reviewing the journey of other cities and providing a framework which will assist cities in the development and management of deployment strategies. This framework considers elements such as infrastructure, public transport, land use, population density, employment nodes, destinations, deployment density, sustainability, regulation and marketing & communications.

The development of this Guide has been focused on defining the best approach for Malaysia and more specifically the implications for Malaysia in terms of policy, regulation and operations.

1.0 Introduction

1.1 Context

E-scooters (personal and shared) have been in operation in Malaysian cities since 2018. During this time, the uptake of this form of transport has been considerable and survey data from MIROS and operators confirms majority acceptance of their adoption and high levels of current and proposed use.

As a result of a number of safety incidents, the Malaysian Ministry of Transport banned the usage of micromobility vehicles (except bicycle and e-bike) on public roads on 17 Dec 2021. However, the Minister may, after consultation with the appropriate authority, exempt the application of this rule on any road or any part of the road subject to any conditions as the Minister may determine.

The Malaysian government, at both the federal and state, as well as local council levels has a strong innovation agenda with a focus on reducing regulation and supporting sustainability measures. To deliver this agenda in a strategic and measurable way, new technologies delivered within the urban setting such as drones, autonomous vehicles and shared e-scooters are delivered in "regulatory testbeds" or "sandbox" opportunities. This thereby mitigates perceived risks in assessing sustainable technology opportunities by means of testing new ideas before scaling.

1.1.1 This Guide

The *Shared Micromobility Reference Guide* (the "Guide") has been developed to provide a framework for micromobility implementation in Malaysian cities that considers local context and global learnings. It has been developed to support considered implementation of micromobility into Malaysian cities, primarily through sandbox opportunities.

This Guide has been developed in consultation with the Ministry of Transport, MIROS, PLANMalaysia, Futurise and a number of local authorities. It also incorporates relevant inputs such as the PLANMalaysia *Active Mobility Guideline*.

It has been developed based on the *City Implementation Plan* model developed by Better Cities Group which seeks to consider a series of city parameters in the development of a deployment strategy. The City Implementation Plan model recognises that all cities are different, and this should be considered to drive successful delivery of programs. The City Implementation Plan considers elements such as infrastructure, public transport, land use, density, employment nodes, destinations, deployment operations, regulation and marketing & communications in an integrated manner.

Shared micromobility refers to the shared use of small, lightweight vehicles for short trips, such as bicycles, electric bicycles and e-scooters. These vehicles are typically dockless or station-based, meaning that they can be rented and returned to designated locations or parked at any convenient spot within a defined service area. Shared micromobility services are often accessed through smartphone apps, and users pay per use or through a subscription-based model.

1.2 Stakeholder Organisations

Micromobility adoption has many touch points for government. The following organisations have responsibilities in its implementation and have been involved in the development of this Guide.

Table 1 Stakeholder Organisations

ORGANISATION	DESCRIPTION & ROLE	RELEVANT PUBLICATIONS
Ministry of Transport (MOT)	Responsible for moving people and goods safely, efficiently and sustainably across Malaysia to improve quality of life and support a competitive economy. Includes aviation, land, maritime and logistics.	- Road Safety Plan 2022 – 2030 (Appendix A-1) - National Transport Policy (2019 – 2030) (Appendix A-2).
Malaysian Institute of Road Safety Research (MIROS)	MIROS is the Malaysian Institute of Road Safety Research. MIROS is governed by the MIROS Act 2012 (Act 748), designed to make Malaysian Institute of Road Safety Research ("MIROS") a corporate body. MIROS was set up to assist the Government in formulating policies and programs to address road safety and road safety issues	- Shared Micromobility Reference Guide. - Safe Cycling Guide (Appendix A-3).

	based on the results of studies and scientific research in addition to position Malaysia as a developed country in the field of road safety research.	
Futurise Sdn. Bhd.	Futurise is a company wholly owned by the Ministry of Finance Malaysia that focuses on innovation, regulation, and commercialisation. The company has been mandated by the Malaysian government through the National Development Council (NPC/MPN) to lead the National Regulatory Sandbox (NRS) initiative that aims to expedite regulatory intervention, deploy innovation and technology solutions, and establish new innovation ecosystems.	- Shared Micromobility Reference Guide. - Micromobility National Regulatory Sandbox Guidelines.
PLANMalaysia	Manages the use, development, and conservation of land, PLANMalaysia plays a role through its functions at three levels of the government: federal, state and local. PLANMalaysia has developed the Micromobility Guideline.	- Planning guidelines for micromobility lane.
Urbanice Malaysia	URBANICE Malaysia promotes the urban sustainability and resilience agenda with the aim of creating liveable cities and communities for Malaysia. Urbanice has been involved in the micromobility trial delivered in Shah Alam.	
Micromobility Research Partnership	The Micromobility Research Partnership (MRP™) is an independent research body, born out of a partnership between academics and researchers globally. The MRP™ conducts research on sustainable transport to identify and promote priority pathways to reduce global transport emissions.	- Shared Micromobility Reference Guide.

1.3 Sustainable Development Goals

The 2030 Agenda for Sustainable Development which was adopted by all United Nations Member States in 2015, provides a framework for collective global effort. The framework includes 17 Sustainable Development Goals (SDGs) (Figure 1), which are an urgent call for action by all countries - developed and developing - in a global partnership. Shared micromobility is considered to contribute to the following SDGs.

- SDG 3 – Good Health and Wellbeing
- SGG 5 – Gender Equality
- SDG 7 – Affordable and Clean Energy
- SDG 8 – Decent Work and Economic Growth
- SDG 9 – Industry, Innovation and Infrastructure
- SDG 10 – Reduced Inequalities
- SDG 11 – Sustainable Cities and Communities
- SDG 12 – Responsible Consumption and Production
- SDG 13 – Climate Action
- SDG 15 – Life on Land

Figure 1 Sustainable Development Goals (SDGs)

2.0 Global Benchmarking

2.1 The Story So Far

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. For the purpose of this Guide, we are focused on e-scooters. When reviewing use of e-scooters it is critical to make the distinction between private e-scooters and shared e-scooters.

Private e-scooters are ridden by the rider wherever they want and whatever speed they which to travel. Whilst regulated by law, riding behaviour is at the rider's discretion. Private e-scooters are classified as being part of the legacy linear economy (Take, Make and Dispose).

Shared e-scooters are managed by operators and are representative of the share economy. This is part of the emerging circular economy globally, whereby there is a much greater focus on reducing waste, pollution, and higher utilization of capital assets through the shared economy model. Instead of users owning their own e-scooter which has its own Global Warming Potential (GWP) footprint, and which tends to be underutilized, riders access a shared e-scooter, thereby reducing their individual GWP footprint. A further sustainability and safety feature is that the operator regulates speed and where they can go through technology fitted into the e-scooters. As such, cities have far more control of the sustainable outcome through shared e-scooters than private e-scooters, and a much greater ability to measurably reduce emissions. An acceleration into the Shared Economy model also contributes towards achieving UN SDG 12, Sustainable Consumption. Nevertheless, private e-scooters should be considered while allowing the usage of micromobility in a city. It is still a viable choice to sustainable development if a private car owner chooses to use private e-scooter as his / her daily commuting transport vehicle, especially for resident area with low density.

In late 2017 shared e-scooter programs started being deployed in the United States. Since that time hundreds of cities around the globe have adopted shared e-scooter programs in their cities. This rapid global growth has been enabled by advances in GPS tracking, connectivity, mobile payments, battery cost and longevity, and the ubiquity of smartphones.

Advocates for shared e-scooters highlight the following benefits:

- Public transport patronage growth;
- Lower carbon emissions;
- Transport equity;
- Reduced congestion; and
- Increased tourism as well as general consumer expenditure.

However, as the sector has grown there have been growing pains, with cities introducing adopted shared e-scooter programs in 2018 and 2019 experiencing impacts such as:

- Safety issues;
- Poor rider behaviour;
- Public clutter; and
- Reduced footpath amenity.

These issues are receding as operators partner and contract with cities; employ centimetre perfect geofencing; adopt leading edge software technology which improves rider behaviour; invest in the ongoing evolution of improved vehicles aimed at improving safety and rider comfort, and all stakeholders work to agreed contractual Key Performance Indicators (KPI).

Only five years ago, micromobility was not considered a mode of transport. Today we see cities seeking to not only support the current level of micromobility mode share but actively grow it. The reason for this is that as cities battle congestion, social inequality and carbon emission reduction targets, shared micromobility presents a material part of the solution to these issues.

One key trend is that the cities seeking to grow the sector are those that actively partner with best practice operators for mutual benefit. It is in this type of collaboration that a system can be developed and amended in real time for the benefit of the local authority and its community.

To assist decision making, a review has been included in this Guide of a series of global cities to understand their micromobility journey, the current context and what learnings there are for Malaysian micromobility. The cities reviewed are:

- Birmingham (United Kingdom)
- Los Angeles (USA)
- Brisbane (Australia)
- Auckland (New Zealand)
- Paris (France)
- Bogor City (Indonesia)

2.2 Birmingham (United Kingdom)

In 2020, Birmingham conducted a 12-month pilot (sandbox) project with evaluation criteria for success. During the trial over 75,000 km were travelled and more than 38,000 trips were made with more than half of all users being repeat customers. Since that time the operating area has been increased twice, the second time to coincide with the delivery of the 2022 Commonwealth Games to support people moving around the city and going to different events.

Table 2 Birmingham Micromobility

Birmingham Micromobility[1][2]	
Year of adoption of Shared e-Scooters	• 2020
Number of Shared e-scooters in city	• Up to 10,000 in the region (has expanded following a successful trial period to include the city centre and expansion north and south west to provide access for around 150,000 residents).
Regulation	• Riders operating a bicycle or e-scooter must obey the instructions of official traffic control signals, signs and other control devices applicable to vehicles; • To unlock a scooter, a full driving licence is required; • No riding on footpaths; • Helmets are encouraged, but not required;

[1] https://www.birminghamal.gov/transportation/shared-micromobility/
[2] https://www.birminghamal.gov/wp-content/uploads/2020/02/COB-Shared-Micromobility_Ord.-No.-20-24.pdf

	• Bikes and e-scooters can be rented by adults 19 years of age or older. Those who are 18 years of age need permission from a parent or guardian. • No scooter riding between the hours of 11pm and 6am; and • No riding while under the influence.
Perceived Benefits	• Supporting transport for Birmingham 2022 Commonwealth Games. • Helping to reduce pollution levels and improve air quality. • Has supported delivery of active travel infrastructure.
Perceived Challenges	• Public clutter.
Innovation	• 50% discount to veterans or individuals who receive government assistance.
Implications for Malaysia	• Opportunity to deliver trial with evaluation process. • Expand if successful. • Support with active travel infrastructure investment. • Deployment to support event delivery.

2.3 Los Angeles (USA)

Los Angeles has been at the forefront of shared micromobility with operators deploying e-scooters throughout Los Angeles in late 2017. In many ways the experience of the different local government areas provide direction for other cities considering their approach to shared micromobility.

Whilst there are many areas in Los Angeles where operators seek to operate for commercial reasons, local governments have enabled operators to operate at no charge if they operate in areas with poor access to public transport or lower socio-economic areas. In this way, micromobility is being used to respond to transport inequity.

Table 3 Los Angeles Micromobility

Los Angeles Micromobility[3]	
Year of adoption of Shared e-Scooters	• 2017
Number of Shared e-scooters in city	• 20-30,000[4][5]
Regulation	• E-scooters may not be operated on footpaths; • E-scooters may not carry passengers; • E-scooters must be operated with the flow of traffic, on roads when possible; • E-scooters may not operate at a speed greater than 15 miles/hour (approximately 24 km/hour); and • E-scooter operators are encouraged to use dedicated bike lanes whenever possible.
Perceived Benefits	• Providing a transport mode for people without private vehicles or limited public transport areas. • Tourism • Commuting • Last mile
Perceived Challenges	• Public clutter • Too many operators • Service only offered in high density tourist locations
Innovation	• Reduced costs for operators to encourage deployment which may not be as popular but that have poor public transport infrastructure.
Implications for Malaysia	• Opportunity to engage with operators to provide broader transport coverage in areas of lower car ownership and public transport access.

[3] Catlin, Jarrett, Responding to Urban Innovation: The Case of E-Scooters in Los Angeles County. Santa Monica, CA: RAND Corporation, 2022. https://www.rand.org/pubs/rgs_dissertations/RGSDA2069-1.html.
[4] http://clkrep.lacity.org/onlinedocs/2017/17-1125_rpt_DOT_08-22-2019.pdf
[5] https://www.latimes.com/california/story/2019-08-22/electric-scooters-sidewalk-helmet-los-angeles-bird-lyft-lime-jump-tickets-lapd

Los Angeles, USA

2.4 Brisbane (Australia)

Brisbane has been a pioneer in the adoption of micromobility in APAC and was the first major city in Australia to introduce an e-scooter sharing scheme in 2018. It has continued to lead the way micromobility is used and has provided policy leadership in how micromobility can support lower income earners, increase access, generate local economic benefit[6] and reduce congestion. This has been well documented in the strategy document *Brisbane's e-mobility strategy 2021-2023*[7].

Table 4 Brisbane Micromobility

Brisbane Micromobility	
Year of adoption of Shared e-Scooters	• 2018
Number of Shared e-scooters in city	• 2800 e-bikes and e-scooters
Regulation	Riders must: • be at least 16 years of age, or 12 with adult supervision; • wear an approved bicycle helmet, that is securely fitted, at all times (unless an exemption has been granted for medical or religious reasons); • not carry passengers; • not use a mobile device; • not drink and ride; and • have a working flashing or steady white light on the front, and a red light and reflector at the rear when travelling at night or in hazardous conditions. • When riding on a path, riders must: • Keep left and give way to pedestrians; • Travel at a speed that allows you to stop safely to avoid colliding with a pedestrian; • Travel at a safe distance from a pedestrian so you can avoid a collision;

[6] Citylink Cycleway Key Findings Report, Brisbane City Council, 2022
[7] Brisbane's e-mobility strategy 2021-2023, Brisbane City Council 2021

	• Keep left of oncoming bicycles and other personal mobility devices; and • Only use the bicycle side of a shared path.
Perceived Benefits	• Reduced congestion. • Improved tourism experience. • Increased active travel infrastructure investment.
Perceived Challenges	• Parking clutter. • Speeding.
Innovation	Safe Precincts Trial. Council has introduced new restrictions for shared e-scooters from operators in the: • Brisbane CBD Safe Night precinct • Fortitude Valley Safe Night precinct. • The Safe Precincts trial commenced in December 2021. It includes restrictions in the CBD and Fortitude Valley Safe Night precincts between midnight to 5am on Friday and Saturday nights including: • locking shared e-scooters from operators • 15km/hr speed limits for shared e-scooters in the CBD and Fortitude Valley • E-mobility parking hubs • As part of the e-mobility strategy, they are rolling out designated shared scheme parking areas across the city, to create a network of physical parking locations in areas of high demand. • E-mobility parking hubs provide a designated place to park and pick up shared e-scooters and e-bikes, to help ensure footpaths and roads are kept clear and safe for pedestrians and road users. • Council has established more than 25 e-mobility parking hubs at key locations across the CBD and inner suburbs and will continue to investigate and install new e-mobility parking hubs across Brisbane throughout 2022.
Implications for Malaysia	• Use geofencing in a city-responsive way to manage speed and parking clutter

	• Invest in active travel infrastructure to support shared micromobility success and reduce congestion and carbon emissions • Review the opportunity shared micromobility offers to support lower income earners by not requiring vehicle ownership and reducing commuting expenses

2.5 Auckland (New Zealand)

Auckland Council have adopted shared micromobility to provide alternate travel choices for Aucklanders to help reduce the need to travel by private motor vehicle. Shared micromobility schemes have been adopted to make active and micromobility modes more accessible and complement Auckland's cycling activity and existing public transport network[8].

The recently released Transport Emissions Reduction Plan (TERP)[9] has set a target of reducing transport emissions by 64 per cent by 2030, with much of that coming from halving cars share of transport mode of distance travelled from 94 per cent to 47 per cent. This would require reduction in cars for trips of less than 6km, which accounts for over half of all trips, and transitioning to walking, cycling or using public transport.

Brisbane, Australia

This would contribute to the goal of a five-fold increase in public transport trips from 100 million a year pre-Covid to 550million and "supercharging" the use of bikes, e-bikes and e-scooters from less than 1 per cent of the transport mode share to 13 per cent.

Table 5 Auckland Micromobility

Auckland Micromobility	
Year of adoption of Shared e-Scooters	• 2018
Number of Shared e-scooters in city	• 1,500
Regulation	• New Zealand Transport Authority has decided any e-scooter can be ridden on the footpath, shared paths, and on the road; • A helmet is not legally required but is recommended; and • The speed limit for e-scooters and e-bikes is the same as the road speed limit in a given area.
Perceived Benefits	• Increased usage of existing active travel infrastructure • Assisting in the reduction of carbon emissions and reducing car mode share
Perceived Challenges	• Safety (although it appears that claims are reducing as riders improve)[10]
Innovation	• Ambitious policy settings to increase micromobility mode share to reduce carbon emissions.
Implications for Malaysia	• New Zealand has identified micromobility as a key contributor to its efforts to reduce carbon emissions and this presents the same opportunity for Malaysia.

[10] https://www.acc.co.nz/newsroom/stories/three-years-of-e-scooters-the-true-cost-of-convenience/

2.6 Paris (France)

Since 2018, Paris has been one of the largest adopters of both private and shared micromobility[11]. In 2018 and 2019 there were thirteen operators in Paris with a fleet of over 20,000 shared e-scooters, making Paris the biggest world market at the time[12].

The approach by the government at the start was to provide little regulation and to not formalise engagement with operators. This led to significant issues associated with public clutter and poor rider behaviour. Since that time, Paris has contracted three companies with 5,000 e-scooters each and heavily regulated speed through geofencing and public clutter via the requirement to provide a photo of e-scooter parking.

Table 6 Paris Micromobility

Paris Micromobility	
Year of adoption of Shared e-Scooters	• 2018
Number of Shared e-scooters in city	• 15,000
Regulation	• Required to be at least 12; • Riding on the footpath is prohibited unless in designated areas, and then at walking speed only; • Only one rider is allowed per device, and no mobile phone use is allowed; • Users cannot go against the traffic flow and must use cycle paths where available; • Riders are not allowed to wear headphones while on their e-scooter; • Top speed is capped at 25km/hour; and • Users riding on permitted faster roads must wear a helmet and high-visibility clothing.
Benefits	• Ideal way to see city – tourism value add. • Reduces congestion.

[11] Zoi Christoforou, Anne de Bortoli, Christos Gioldasis, Regine Seidowsky, Who is using e-scooters and how? Evidence from Paris, Transportation Research Part D: Transport and Environment, Volume 92, 2021,

[12] A sound launch for micromobility services in the UK: the challenge of parking, momentum transport consultancy, 2020

	• Makes use of strong network of shared paths.
Challenges	• Poor rider behaviour. • Riding in incorrect locations. • Public clutter.
Innovation	• Significant use of geofencing in parks, gardens, streets near schools, squares in front of public buildings and of places of worship, pedestrianised streets and busy shopping areas to 10km/hour.
Implications for Malaysia	• Ensure appropriate use of geofencing for go slow or no-go zones.

Paris, France

2.7 Bogor City (Indonesia)

The Indonesian Government, led by President Joko Widodo has been highly supportive of the electric vehicle market, with legislation developed to support the sector's growth and accelerate local use. In 2020, the Ministry of Transportation confirmed the *Regulation of the Minister of Transportation Number PM 45 of 2020 concerning Certain Vehicles using Electric Motor Drives*[13].

This national legislation puts in place a framework for local Councils to define local requirements including where prescribed vehicles can be ridden. It sets high level requirements such as rider behaviour expectations, vehicle standards and safety expectations whilst providing the flexibility for local authorities to respond to their context including riding on-road where dedicated lanes or bike paths are not available.

The Bogor City Government has moved forward under the PM 45 national decree to provide over 600 e-mopeds at strategic locations aligned to transport routes and key centres.

E-bikes and e-mopeds have experienced significant growth in Indonesia generally, however e-scooters have not yet become mainstream. This will likely change as experienced operators provide shared e-scooter programs.

Table 7 Bogor City Micromobility

Bogor City Micromobility	
Year of adoption of Shared e-Scooters	• 2022
Number of Shared e-scooters in city	• 665 e-mopeds
Regulation	Required to be at least 12; • Safety requirements for vehicle (lights, brakes, speed, sound). • Safety requirements for users (single passenger ride only, accompaniment of children). • Operating area: In the event that there is no special lane specific vehicles may be operated on footpaths

[13] PM_45_TAHUN_2020.pdf (dephub.go.id)

	with adequate capacity and by paying attention to the safety of pedestrians.
Benefits	• Growing local electric vehicle market. • Responding to first and last mile challenge. • Supporting public transport investment.
Innovation	• National legislative framework (safety, vehicle standards) provides strategic direction and enables local decision making. • Local authorities encouraged to deliver micromobility solution with existing road and footpath infrastructure.
Implications for Malaysia	• National legislative framework provides guidance for local authorities to adopt micromobility – provides certainty to local government. • Policy can support the use of micromobility using existing infrastructure.

Bogor City, Indonesia

3.0 City Roadmap

3.1 Infrastructure

The provision of supportive infrastructure is an important consideration for a city when considering a shared micromobility program. In this instance infrastructure includes:

- Bike lanes;
- Active travel lanes;
- Footpaths; and
- Bridges (green and traditional).

Since 2017, hundreds of cities around the world have had shared micromobility programs deployed without reviewing infrastructure to support this. In many ways, the strength of micromobility is that it fits in within the current city context. However, that is not to say that there is not an opportunity to consider how the success of micromobility could be supported by improvements to existing or delivery of new infrastructure.

There are many examples around the world where the success of micromobility has led to increased investment in active travel infrastructure of micromobility specific infrastructure[14]. The rationale for this is that in many cases it represents the ambitions of citizens, supports micromobility success and generates a real alternative to private vehicle travel, while city governments increasingly recognize the contribution to potential emission reductions.

It is also important to consider that micromobility IoT technology generates unprecedented trip data which should be used to guide future infrastructure investment. This ensures that investment considers what riders are doing, not what designers think they might do. The same data flows create the dynamics for academic research and insights such as conducted by the MRP globally, to foster debate and educate on more sustainable transport options.

Review of existing infrastructure also presents opportunity to consider the allocation of different transport modes. The COVID-19 pandemic catalysed the reallocation of car parking and vehicle lanes into active travel lanes. For many cities the reallocation of existing road reserve presents the best value for money approach to maximising existing

[14] https://www.brisbane.qld.gov.au/sites/default/files/documents/2021-06/20210623-Brisbanes-emobility-strategy_web-tagged.pdf

infrastructure, supporting micromobility and mitigating private vehicle use in cities, which will assist cities meet their obligations under UN SDG 13, Carbon Emission reductions.

Implications for Malaysia	1. Consider the delivery of a pilot which will inform future infrastructure investment. 2. Use IoT trip data to understand rider preferences and deliver supportive infrastructure. 3. Consider the reallocation of existing infrastructure.

3.2 Public Transport

Micromobility (personal and shared) has long been considered a first and last mile form of transportation. The 'first and last mile' refers to movement from a transportation hub to a final destination (home, workplace, shopping centre, institution, etc.) and vice versa. This is an important consideration for urban movement as public transport takes people to a set location (not necessarily the final destination) nor are there parking spaces exactly where people wish to travel. This is why micromobility is considered an essential addition to the current transit mix for the last mile with university surveys indicating that up to 12 percent of e-scooter users employed micromobility transit to complement their trips[15].

In addition, the adoption of shared micromobility in cities increases the catchment of users that can consider using public transport which leverages more value from the investment in public transport infrastructure and operations.

Walk up catchment is a critical element in the success of public transport infrastructure. This refers to the quality and distance of the walking environment around a station or node which will effectively increase the number of patrons who consider it a reasonable walking distance. A 400-metre radius is considered to be a comfortable 5-minute walk and 800 metre radius is considered to be a comfortable 10 minute walk. The 800-metre radius is commonly used to define the walk-up catchment for a station although this can be impacted by actual walking distance, quality, intersections etc. Regardless, the intention for all parties with an interest in the success of public transport is to increase patronage. With

[15] Zuniga-Garcia, Natalia & Tec, Mauricio & Scott, James & Machemehl, Randy. (2022). Evaluation of e-scooters as transit last-mile solution. Transportation Research Part C: Emerging Technologies. 139. 103660. 10.1016/j.trc.2022.103660.

regards to the catchment, government or operators can either improve infrastructure, prioritise pedestrian movements or improve direct access.

E-scooters provide another opportunity to increase the catchment and make using public transport and staying out of vehicles more probable. What this means is that far more people can consider using public transport than before - either on the journey of entry or return. Operators are also able to monitor how many e- scooter trips are departing from and arriving to a public transport node.

The adoption of a shared micromobility scheme has to be done within the context of the broader benefits it provides individuals in their total journey. Commonly referred to as Mobility as a Service (MaaS), MaaS is a total mobility solution focused on the individual's need to get from A to B. Micromobility, with its ability to link first and last mile destinations and its rich data sources is set to be a fundamental pillar of the ongoing maturity of MaaS. MaaS combines multiple transport modes such as car and ride share, with public transport and now micromobility options and seeks to deliver a seamless user experience with dynamic journey planning and streamlined payment processes.

Implications for Malaysia	4. Consider the value of shared micromobility for increased public transport use and develop a deployment plan and geofencing that supports increased catchment.

3.3 Socio-Economic

The evidence base regarding the socio-economic benefits of micromobility are becoming better understood as studies from around the world become published. Whilst the potential benefit to traders has been anecdotally recognised, research from Townsville in Australia confirms that e-scooter riders spend further and more[16].

Benefit to local trade is also supported by recent research conducted in Brisbane, Australia highlighting that the majority of local expenditure (75%) was attributed to people catching

[16] Micromobility and tourist dispersal in Townsville Do e-scooters help tourists spread out, visit more sites and spend more? Research Summary June 2021 Dr Abraham Leung, A/Prof Matthew Burke, Benjamin Kaufman, Xuna Zhu, Dr Elaine Yang Cities Research Institute

public transport, walking or using bikes or e-scooters as opposed to the smaller amount for drivers of private vehicles[17].

The addition of micromobility as a contributing mode share to city transport systems has led to the economic benefit associated with the development of this new industry. There are two shared micromobility operators in Brisbane who both deliver similar scale operations. Research by one of the operator highlighted that in the 2020/2021 financial year their operations contributed $116.6 million in direct, indirect and enabled economic activity towards Brisbane's economy and is estimated to have created and supported 681 Brisbane based jobs[18].

The socio-economic costs of congestion associated with lost productivity, loss of income and environmental impacts are well documented and understood. Recent research from the United States confirms that when scooters are banned, drivers experience statistically significant increases in traffic congestion as many riders revert back to passenger vehicles for last-mile transit[19].

The authors also concluded that the impact on commute times would likely be higher in other cities across the US, stating that "based on the estimated US average commute time of 27.6 minutes in 2019, the results from our natural experiment imply a 17.4% increase in travel time nationally".

Implications for Malaysia	5. Consider the research from other cities that confirms the economic benefit of supporting the emerging micromobility sector and the flow on benefits to local traders. 6. Determine the value that micromobility could play as a demonstrated tool in reducing congestion.

[17] Citylink Cycleway Key Findings Report, Brisbane City Council, 2022
[18] The economic contribution of neuron to the Brisbane economy, QEAS, 2022
[19] Impacts of micromobility on car displacement with evidence from a natural experiment and geofencing policy

3.4 Land Use

Analysis of land use and urban form is a key consideration when reviewing a deployment strategy for shared micromobility as every city is different. Differences can be driven by contextual elements that include:

- Origin of the city;
- Age of the city;
- Land uses and integration;
- Economic drivers for the city;
- Culture of residents;
- Integration of public and private land;
- Quality of public realm;
- Safety and perception of safety; and
- Hierarchy of movement.

Geofencing and deployment needs to be cognisant of where it is expected that shared e-scooters will be prioritised and where it is appropriate for them either not be allowed or slowed down. This is a relevant discussion for cities to have with operators and presents the opportunity to blend local and technical knowledge with shared micromobility expertise.

The ability to connect residential, employment, retail and other uses via micromobility is an important lever in reducing congestion and carbon emissions. This should be considered in both operational and infrastructure decision making.

Implications for Malaysia	7. Ensure that review of the city includes consideration of land use and urban form with geofencing and deployment to reflect the values of a city whilst optimising the success of the program.

3.5 Population Density

Population density is the concentration of people in a specific geographic locale. Population density is a very useful tool to guide understanding of urban form as it provides reference to urban activation and the subsequent requirement for housing, infrastructure, commerce etc. It also provides insight into how people move, and the space afforded to that movement.

As density increases the ability to use private vehicles reduces, making other forms of transport such as public transport, active transport and micromobility more feasible. This is considered further in section 3.8 focused on deployment density.

It is for this reason that review of population density is a critical input into a deployment plan as it highlights concentration of potential riders within an environment that is likely to promote micromobility and also add value to other modes such as public transport.

Implications for Malaysia	8. Consider population density and the impact that will have on deployment. As a rule, higher density development provides more opportunity for shared micromobility.

3.6 Employment

The opportunity for shared micromobility to assist in the daily commute in either providing a first and last mile or enabling the full commute to be completed through e-scooter is being realised in many shared e-scooter programs around the world. The increased use of e-scooters for commuting use has been a growing phenomenon over the last few years with cities that have had shared e-scooter programs for the longest recognising and receiving the greatest benefits.

This presents the obvious benefit of reducing vehicle trips and subsequent congestion. Any review of shared micromobility deployment should consider the opportunity to deploy e-scooters in locations which will enable a full commute to occur or support the last mile connection between either public transport or potentially park and ride outside the city centre.

The ability for people to be able to use micromobility for commuting has flow on impacts to planning requirements for car parks and resident decision making regarding where they live. The ability to access on-demand shared e-scooters enables people to make lifestyle choices predicated on not requiring a private vehicle for commuting. It also supports achieving targets set under UN SDG 8, focussing on Sustainable Employment creation.

Implications for Malaysia	9. Ensure that review of the city includes consideration of land use and urban form with geofencing and deployment to reflect the values of a city whilst optimising the success of the program.

3.7 Destinations

Shared micromobility is a game changer in people's ability to move around a city to different destinations without the need for vehicles. Destinations include:

- Civic centres;
- Government offices;
- Tourist attractions;
- Places of prayer and worship;
- Commercial centres;
- Business districts; and
- Innovation precincts.

Assessment of key destinations in a city provides a framework for deployment for residents and visitors. This process supports the development of a strategy which will support tourist movements which has been demonstrated to encourage people to travel further and spend more when using shared e-scooters[20].

Consideration could be given to defining a "City Destinations Trail" and defining a support framework potentially delivered by a commercial operator or a volunteering organisation with no recurrent cost to government.

Implications for Malaysia	10. Review of the City's destinations will inform the deployment strategy and generate increased tourism expenditure.

3.8 Deployment Density

As noted in the Sustainability section in 3.10, there is significant academic evidence that e-scooters can reduce transport emissions in any city or country of deployment. A recent study in Germany found that, due to the relatively high level of e-scooters deployed in that country compared to other EU countries, e-scooters could switch as much as 2% of all internal combustion engine (ICE) trips nationally. The authors find that this switch could result in as much as 1.3% contribution to reduce transport emissions nationally. (Germany, 2022)[21]. Their estimate was based on an estimated 120,000 shared e-scooters operating in Germany (2021). That number has now increased to 150,000, spread across 86 German cities. Berlin has the highest number of shared e-scooters (30,000)[22] followed by Frankfurt (20,000). In comparison, Stockholm (Sweden) recorded 21,000 deployed vehicles (DV), which has been reduced to 12,000 DV after more stringent regulation was introduced in 2022[23].

Logically, the emissions reduction potential of e-scooters to contribute to emission reduction targets is directly tied to the availability of e-scooters and other micromobility vehicles. In turn, this is also related to the parameters under which e-scooters are deployed, including licensing caps in cities, and policy settings.

There are no international models to calculate optima for e-scooter deployment, based on the MRP research. The MRP has developed and is certifying an advanced model to calculate Deployment Density ranges for cities. One reason for the paucity of developments in this space is the complexity of calculating such optima, and the limited availability of data and variables to drive modelling.

[2121] Can shared E-scooters reduce CO2 emissions by substituting car trips in Germany?, Transportation Research Part D: Transport and Environment, Volume 109, Laura Gebhardt, Simone Ehrenberger, Christian Wolf, Rita Cyganski, 2022

[22] https://zagdaily.com/places/tier-exceeds-50000-shared-e-scooters-on-german-streets

[23] https://www.bloomberg.com/news/articles/2022-08-20/stockholm-targets-electric-scooters-with-more-restrictions

Internationally, practical deployment numbers of e-scooters vary. Estimation and definition of deployment ranges can be on the basis of populations, area or an alternative approach, which is to calculate deployment density on the basis of emissions reduction targets.

3.8.1 Population basis estimation

MRP research has found that the numbers of shared e-scooters deployed can range from around 2 DV in cities with fixed limits to e-scooter deployment, and up to 40 DV per 1,000 capita (adult, over 18 years of age) in cities where there are no limitations on e-scooter deployment, and where the market determines optimal deployment. For example, in Seoul we find that DV reached a peak of 72,000 DV which reduced to 55,449 DV deployed after the introduction of stricter regulations (Seoul City Hall, 2022)[24]. This works out to a rate of 7 DV per 1,000 adult population in Seoul currently, from a peak of around 10 DV/ 1,000 capita in 2021. In Germany the equivalent rate is around 10 DV/ 1,000 adult population currently[25]. In Stockholm City, the rate was around 29 DV/ 1,000 adult capita and has been adjusted down to around 16 DV (2022) with greater regulation.

3.8.2 Area based estimates

An alternative approach to calculating optimal deployments is to work out the density of shared e-scooters in a city. Momentum Transport Consultancy (2020) took this approach, based on surveys defining satisfaction of users with availability, and calculated that with 15,000 DV deployed in Paris at the time of the satisfaction surveys, this worked out to around 142 DV/ sq km. The range of DV/ sq km in France was found to be between 14 – 142. The MRP has found that city deployments in New Zealand range between 1.5 - 3 DV/ sq km. In the case of Stockholm City, the current rate is 64 DV/ sq km, dropping from around 112 DV (2021)[26][27]. Area based estimates therefore echo a similar trend, whereby relatively relaxed, lower regulation and uncapped cities of deployment tend to record significantly higher numbers of DV deployed compared to cities where regulatory caps are maintained.

[24] MRP Research in Seoul has found that e Scooters have been deployed and are available across the majority of Seoul districts, accounting for about 7.6 M population in the greater metropolitan area

[25] https://www.businesslocationcenter.de/en/business-location/berlin-at-a-glance/demographic-data

[26] https://momentum-transport.com/wp-content/uploads/2020/12/smart-parking-by-the-Dott-x-Momentum.pdf

[27] MRP Proprietary research and calculations (2022)

It must further be noted that neither the Population nor the Area based DV Density assessments factor in the availability and accessibility to privately owned e-scooters, which are by and large not monitored, reported on nor quality controlled to any great degree.

Table 8 DV Density calculated by city area and population

City	Total Shared e Scooters (DV)	Surface Area CBD (Sq km)	Per sq km (Central City operations)	Adult Metro Population (2021) (1,000)	Per 1,000 Adult capita (adjusted for area of ops)	Year
Auckland	1,500	607	2.5	1,300	1.5	2021
Berlin	30,000	891	34	3,769	8.0	2021[28]
Frankfurt	20,000	248	80	941	21	2021
Paris	40,000	105	381	1,729	23.1	2022[29]
Seoul	72,000	605	119	7,622	9.4	2021
Seoul	55,449	605	92	7,622	7.3	2022
Stockholm	21,000	188	112	780	26.9	2021
Stockholm	12,000	188	64	780	15.4	2022

Source: MRP calculations and modelling

3.8.3 Emissions Reduction Target Based Calculations

Due to the challenges of determining accurate private and shared e-scooter vehicle deployment numbers, a current approach the MRP has developed tackles the challenge from a different perspective. The modelling MRP has developed takes the end sustainability goal as a basis on which to calculate the total DV that would need to be deployed in order to achieve the required switch from more emitting baseline transport options, using an established average annual distance achieved by e-scooter travel as evidenced in academic and operator evidence.

For example, a New Zealand study published by the NZ Transport Agency (NZTA, 2020)[30] found that e-scooters could potentially switch between 1.6 – 5.7 % of all car trips, depending on a number of variables and specific to New Zealand, and specifically in CBD areas of New

[28] https://zagdaily.com/places/tier-exceeds-50000-shared-e-scooters-on-german-streets
[29] https://francetravelplanner.com/go/paris/trans/bike/electric-scooters-in-paris-france.html
[30] https://www.nzta.govt.nz/assets/resources/research/reports/674/674-Mode-shift-to-micromobility.pdf

Zealand cities. This correlates to the German study on shared e-scooters[31], although care must be taken to compare an actual emission reduction assessment, based on deployed DV numbers, with a hypothetical range proposed by NZTA. The NZTA study was based on big data analysis of transport modes and trips available from a New Zealand database and is shared e-scooter centred due to the absence of private e-scooter data and insights noted by the authors.

An alternative approach is to take the emissions reduction goals and desirable switch percentage from available public plans. The aforementioned TERP 2022, published by Auckland Council[32] targets a 16% switch of all car trips to micro and active mobility by 2030 to support a significant emissions reduction commitment by 2030. This includes walking trips targeted to reach 3 %, and a targeted 8 % of switched household trips by e-scooters and e-bikes. TERP 2022 does not itemize the percentage switch for e-scooters. It is safe to assume that the mix will include a 4 – 6 % of e-scooter trips.

To calculate the equivalent contribution to emissions reductions, it is necessary to obtain household travel statistics by transport mode and distance, then reduce the population to a replaceable target market for trips and distances. An estimated total DV can then be calculated, although this number is a grand total for any location without factoring in transport flows and variability in such transport demand and flows.

Using this approach MRP has calculated Auckland City could support up to 33,333 shared DV[33] to allow for a maximum and efficient switch of ICE trips to shared e-scooters. This calculates at around 29 DV/ 1,000 population as at 2030 (TERP population forecast). On an area basis, this calculates at around 31 shared e-scooters/ sq. km. Note that both results are in range of population and area-based ranges, using a different approach working back from target emission reductions and transport mode switches desired.

If this level of e-scooters is deployed by 2030, shared e-scooters in Auckland could achieve an estimated reduction of emission of 133,332 Tonnes CO2-eq against 2030 targets[34],

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[31] Can shared E-scooters reduce CO2 emissions by substituting car trips in Germany?, Transportation Research Part D: Transport and Environment, Volume 109, Laura Gebhardt, Simone Ehrenberger, Christian Wolf, Rita Cyganski, 2022

[32] https://www.greaterauckland.org.nz/wp-content/uploads/2022/08/220815-Transport-Emissions-Reduction-Plan-Final-for-Adoption.pdf

[33] MRP Proprietary DV Optimization Modelling (2022)

[34] Based on 2016 Auckland emissions, net, of 10.1 Million T. 2030 targets are to reduce by 50% i.e. 5 M T GHG (TERP 2022)

equivalent to around 2.7% of emission reductions targeted. Note this is well in range of international comparisons and findings.

MRP has developed aggregate models to calculate city specific totals without and specificity on locations of hubs and deployments at a micro level. A next MRP collaborative research project will develop the granular micro level insights to determine what an optimal gross DV deployment for a city like Kuala Lumpur would look like.

3.8.4 The Impact of Private e Scooters

The three calculation approaches do not factor in the impact from private e-scooter ownership, which is notoriously challenging to define in any markets. According to public information from the main global producer of micromobility vehicles, Segway (producing 75% of all shared e Scooters globally), to date they have produced around 1.5 Million shared e-scooters, compared to 8.5 Million e-scooters for private usage. This works out to a ratio of about 5 – 6 times. In Seoul, it appears the ratio appears to be 1:4 (MRP research), which works out to a ratio of 32 DV/ 1,000 capita in Seoul (Estimated). It is also notable that since regulations for micromobility were introduced in 2022, the total Seoul deployment of DV dropped by 17,000 vehicles[35]. In France there are currently around 2.5 M private e Scooters, with 900,000 sold in 2021 alone[36].

3.8.5 Status of calculation methodologies and models

Future MRP research will aim universal mathematical formulae to calculate optimal DV deployment for any city, based on relevant and pertinent variables. This formula will be tested for adequacy of fit against current proposed MRP research projects globally, to determine optimal deployments of DV at granular levels in city locations, using big data analysis and machine learning.

3.8.6 Implications for Malaysia

At this stage, using a macro approach to modelling, MRP proposes a range of 10,000 DV - 53,000 DV[37] would be feasible to be deployed in Kuala Lumpur in total, based on international ratios. Additional modelling would be possible on a city-by-city basis within

[35] MRP proprietary Research (2022)
[36] https://www.lemonde.fr/en/france/article/2022/11/10/france-s-electric-scooter-market-continues-to-explode_6003788_7.html?utm_source=substack&utm_medium=email
[37] MRP proprietary modelling and calculations (2022)

Kuala Lumpur boundaries, to define the same for any sandbox developments that will be initiated.

On a more granular level, using the case study of Shah Alam and a similar transport mode switch target as used in Auckland, (4 – 6% of household trips), a range of up to 17,000 – 18,000 DV is feasible by 2030, translating to 29 DV/ 1,000 adult capita as at 2030 (on a 2.5% population growth rate). On a per sq. km. basis, this calculates out at 57 DV/sq.km.

Implications for Malaysia	11. In order to accurately determine the optimal range of shared e Scooter deployment, a level of regulation and monitoring of private e Scooters will be critical. 12. Emission reduction targets can significantly benefit from setting target transport mode switches in a reasonable and achievable manner. 13. At this stage, optimal deployment levels for any city are best determined using a mix of calculation approaches, based on international benchmarking on a per capita, per area and as against emission reduction targets. Additional trends will likely be informative using an active/ micro mobility infrastructure-based approach. 14. MRP research will continue to investigate optimization approaches based on international collaborative research across a number of cities to determine optimal deployment density based on actual operator data analysis. 15. This research will also identify significant factors impacting on the deployment of shared e Scooters, as well as a potential mathematical modelling arising from globally comparative research the MRP is currently conducting with a number of collaborative universities.

3.9 Regulation & Safety

There are a number of levers that can be pulled in the regulation of shared e-scooters, and these include:

- Policing;
- Local law regulation;
- Rider education;
- Geofencing; and
- Technological advancements.

Whilst the first two are sometimes necessary it is the last three: education, geofencing and technology that provide the most opportunity for cities in the successful adoption of shared e-scooter programs. This is why it is critical to partner with operators that offer leading edge hardware, software and operations.

Geofencing ensures that shared e-scooters only travel, park and move at the speed that the geofence allows them. A geofence is a virtual geographic boundary, defined by GPS or RFID technology, that enables software to trigger a response when a mobile device or e-scooter enters or leaves a particular area. In the case of shared e-scooters this means that a city or precinct can be broken into an operating area, slow zone, no parking zone or no ride zone as shown in Figure 3. For advanced operators they can control the geofence to within centimetres, providing unparalleled precision of operations within the public realm.

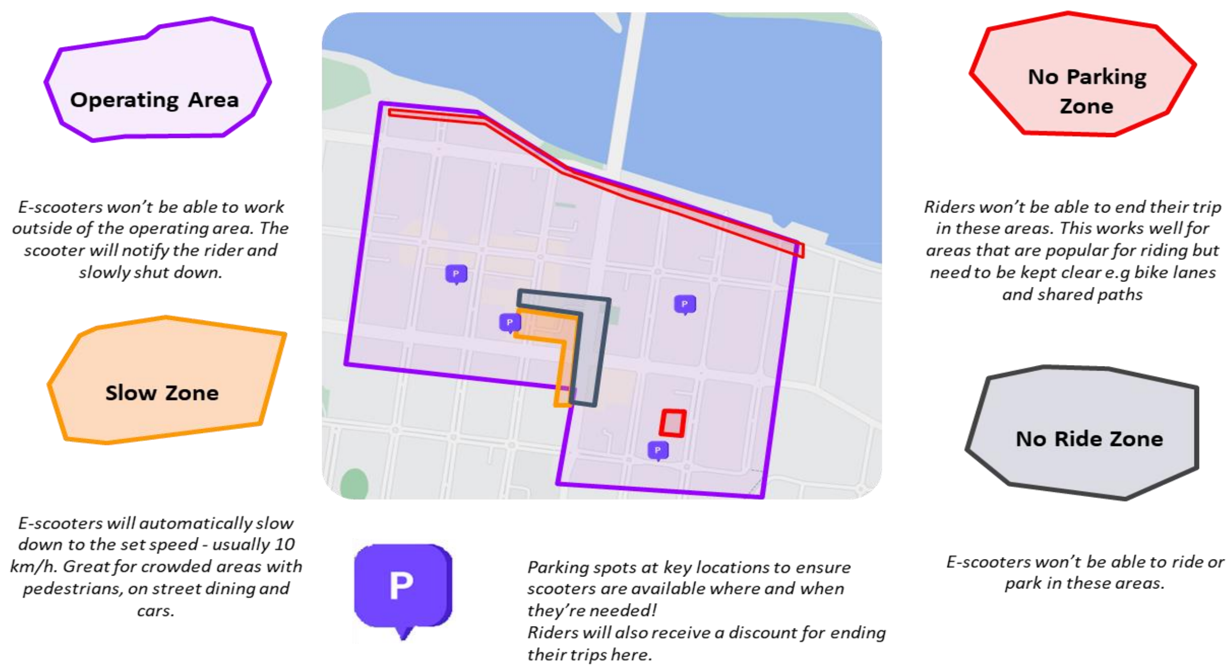

Figure 2 Geofencing

Rider education is a critical element in influencing behaviour and at a minimum, operators should be expected to:

- Ensure that a basic safety briefing be held before a new rider can move forward;
- Reduce power for the first couple of rides to assist in orientation; and
- Use of gamifications such as quizzes to raise rider awareness.

Best practice operators will provide rider courses and safety days for new riders to come and learn the rules and engage in safety briefings whilst learning how to ride e-scooters in a low-risk environment. It would be logical for authorities to seek out operators who provide these additional activities focused on education and rider behaviour when adopting shared micromobility.

Further safety initiatives include

- Safer riding behaviour through technology, training and communication; and
- Raise awareness to broader audience (Riders and Non- Riders).

Further information is available in the MIROS Safety Guideline.

Implications for Malaysia	16. Develop a geofence strategy that suits your city or precinct and continue to refine it through ongoing evaluation. 17. Engage an operator who provides best practice rider education and safety features.

3.10 Sustainability

3.10.1 Transport Mode Switch Potential

A significant number of kilometres are travelled annually in Malaysian cities and across the country. The volume of private car trips is rising in parallel with a growing population and increasing personal light vehicle ownership. Malaysia recorded the highest rate of private car ownership and motorisation among all ASEAN countries (2018). By 2030, the Energy sector is expected to be the biggest contributor to emissions in Malaysia, based on Malaysian academic studies[38]. Transportation emissions will be the single biggest source of the increase in this sector's emissions.

Malaysian cities are increasingly auto centric, where public transport participation is generally low. This is academically found to be a reversal from half a century ago when reliance on public transport was significantly higher than personal car usage. A significant percentage (generally over 50%, depending on country concerned) of household trips globally are by petrol fuelled personal vehicle, generally carrying up to 1.5 passengers on average, and travelling up to 5 kilometre per trip[39].

The MRP proposes that a significant portion of short length trips in Malaysian cities could therefore be switched to e-scooter. This is confirmed by academic research and independent, as well as, in house micromobility operator travel user surveys, and in line with other cities globally, for example Auckland (Transport Emission Reduction Plan 2022)[40].

Accordingly, based on independently prepared and verified LCA comparisons, the MRP is confident that the resulting switch of travel from emitting private vehicles will result in material and meaningful carbon emission reductions in Malaysian cities of operation, as compared to a baseline emissions footprint of alternative modes of transport. Baseline modes of transport are reported individually in official Malaysian Household Travel Surveys. For the purpose of its research and calculations MRP has included the following comparative baseline transport modes:

- Internal Combustion Engines (ICE) – Light Personal Vehicles;
- Public Transport (PT);
- Electric Passenger Vehicles (EV); and
- Ride hail services (Taxis and E-hailing service providers).

In addition to the opportunity to switch short trips from existing modes of transport, e-scooters have a further impact in two aspects.

3.10.2 Increased Public Transport participation

As noted in section 3.3, a measurable and significant increase in Public Transport (PT) participation has been noted academically and from micromobility user surveys, once e-scooters are available in any city[41]. Individuals living within a PT network service area, defined as the area within the "willingness to walk" threshold distance, can theoretically be considered to have access to PT. However, the "Willingness to Walk" threshold distance varies by country and between cities. Historic urban planning has often not factored in this threshold in PT infrastructure planning. A resulting lack of connectivity within the transportation system, where potential users are outside the Willingness to Walk distance, has been shown to lead to increased private car use and reduced use of other

[40] https://www.greaterauckland.org.nz/wp-content/uploads/2022/08/220815-Transport-Emissions-Reduction-Plan-Final-for-Adoption.pdf

[41] Explaining shared micromobility usage, competition and mode choice by modelling empirical data from Zurich, Switzerland, Transportation Research Part C: Emerging Technologies, Volume 124, Daniel J. Reck, He Haitao, Sergio Guidon, Kay W. Axhausen,2021

transportation modes, including PT. This can occur both at the point of departure in a trip, but also in between multi modal nodes of a multimodal trip.

Car (ICE) trips to and from PT hubs are among the highest polluting vehicle trips. Often, these ICE trips are short distances (under 5km), starting and ending with a cold engine. These factors lead to a significantly higher rate of pollutant and GHG emissions than officially tested and reported under national automotive testing protocols[42]. Short ICE trips under 5km[43] can effectively be replaced with an e-scooter trip. The availability of e-scooters will significantly reduce local pollutants and carbon emissions and enhance connectivity with PT by solving what is known as the First/ Last Mile challenge. (FM/LM).

The MRP models calculate the impact from the switching of household and other trips away from more emitting transport modes to micromobility vehicles. The model also calculates an increase in PT usage factors in both the replacement of emissions caused by short cold start ICE trips for FM/LM purposes, and the distance an ICE will travel as a substitute for the PT travel that would have otherwise been undertaken if there had been accessible PT connectivity.

For example, in cities across Australia and New Zealand, ICE dependence is also very high, with over 90% of all household trips made by ICE. In addition, a very high percentage of over 70% of these trips are under 5 km. In Malaysia, a significant number of trip kilometres are made by ICE as well, nearly 50% (2014)[44]. This high level of car reliance represents a very significant opportunity to switch a significant population of ICE trips to PT, whereby a passenger travelling on PT causes significantly lower emissions compared to ICE, especially over short trips of under 5 km. This is also in line with Malaysian PT planning. For example, in Kuala Lumpur, official plans indicate that the target is to nearly double the level of PT travel to 40% of all trips from 21 % (2014). The resulting PT FM/LM Project Impact can be calculated based on academic and survey results of the number of trips that are switched from ICE to PT in any city, at a conservative trip distance multiplied by the significant GHG emissions difference between PT and ICE, expressed in grammes $CO_{2\text{-eq}}$ / passenger

[42] Effect of cold start emissions from gasoline-fueled engines of light-duty vehicles at low and high ambient temperatures: Recent trends, Case Studies in Thermal Engineering, Volume 14, Abdulfatah Abdu Yusuf, Freddie L. Inambao, 2019

[43] https://www.transport.govt.nz/area-of-interest/public-transport/new-zealand-household-travel-survey/,NZ Statistics, Household Travel Surveys, 2022.

[44] https://www.planningmalaysia.org/index.php/pmj/article/view/793/594

kilometre (g/pkm). The resulting total estimated emission reductions are a direct assistance to any city and Malaysia's national emission targets.

3.10.3 Car Ownership Reduction

A second direct and significant contributor to reduced GHG emissions is a notable reduction in car ownership, once e-scooters are accessible to select as an alternative transport mode, on a consistent and reliable basis[45].

A measurable and significant decrease in reliance on ICE for household trips has been noted academically and from regular micromobility user surveys undertaken, once e-scooters are deployed in any city[46]. Once increased deployment creates a more consistent and permanent usage and reliance on e-scooters to solve FM/LM challenges, and thereby increases PT usage in favour of using ICE, transport usage related behavioural changes take on greater permanence. Reliance on personal ICE therefore shifts significantly lower.

Car ownership reduction is in evidence from academic studies globally, where greater accessibility to PT causes significant changes in household travel dynamics as well as ICE ownership. A comparison of household travel statistics between different cities in Australia and New Zealand compared to European cities is clear evidence of this dynamic, in addition to the user surveys and academic studies referenced. As a result of transport users either opting to divest their ICE or to delay and/or avoid purchasing an ICE, the net number of ICE in any city thereby reduces significantly, depending on the speed of deployment of e-scooters to create confidence in accessibility for transport users.

The mathematical model the MRP has developed calculates the difference in lifetime emissions between an e-scooter and an ICE, and then calculates the total based on ICE avoided, adjusted for by the current level of e-scooters deployed in any city compared to the optimal number of e-scooters that could be deployed in ideal market and operational conditions. For example, current e-scooter deployment numbers are generally set arbitrarily by city governments in Australia and New Zealand as well as other countries globally, resulting in suboptimal deployments and a limited impact on emission reductions potential.

[45] https://www.portland.gov/sites/default/files/2020-04/pbot_e-scooter_01152019.pdf

[46] https://www.portland.gov/sites/default/files/2020-04/pbot_e-scooter_01152019.pdf

This section analysis does not factor in a range of other positive contributions towards UN SDG goals. For example, a significant increase in employee productivity is noted when more efficient transport options are available. The level of lost time and impacts on mental health from poor transport infrastructure, inefficient and congested traffic conditions, and thereby on productivity, are noted to be significant internationally[47]. The economic impacts of these UN SDG contributions can also be calculated, as a total return on sustainability.

3.10.4 Measurable Economically Sustainable Emission Reductions

To calculate emission reductions potential from e-scooters, modelling needs to factor in what national and city by city emissions targets and interventions are based on, which is known as tailpipe emission calculations. Tailpipe emission calculations are based on direct fuel emissions from the energy used to propel any vehicle. An emerging factor is known as indirect fuels emissions[48], which calculate the emissions related to the production of fuels and the subsequent distribution to point of usage, also known as Well to Wheel calculations. These comparatives exclude the other phases of what is scientifically known as a Life Cycle Assessment based approach (LCA). The difference in baseline calculations using tailpipe or LCA based results potentially significantly impact on transport emission reduction strategies in a national or urban context. Tailpipe emission comparisons do not accurately present the full lifetime emissions footprint for any transport mode.

Bearing this limitation in mind, as an indicative example of a tailpipe emissions-based modelling exercise, the MRP estimates that e-scooters in Australia and New Zealand (ANZ) contribute significantly to reducing city transportation emissions, based on a comparative analysis of a number of ANZ metropolitan areas. Overall, the current e-scooter emission reductions impact is estimated at around 12,000 T $CO_{2\text{-eq}}$ emissions of total city and national transport emissions, within a relatively tight regulatory limit on e-scooters deployed in ANZ[49][50]. This limited level of impact is corroborated by an Auckland City Council analysis (Transport Emission Reduction Plan, 2022) which notes that less than 1 % of household trips are currently classified as active or micro mobility trips. Increased PT

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[47] https://www.ehinz.ac.nz/assets/Factsheets/Released_2020/Commuting-Time-by-Mode-of-Transport.pdf
[48] A probabilistic life cycle assessment comparing greenhouse gas emissions from electric and fossilfuelled vehicles in Australia. Air Quality and Climate Change, 55(1), 36–37, Smit, R. 2021
[49] MRP Proprietary Modelling and Calculations
[50] https://www.greaterauckland.org.nz/wp-content/uploads/2022/08/220815-Transport-Emissions-Reduction-Plan-Final-for-Adoption.pdf

participation is also a significant segment of this achieved reduction, and the same plan envisages a significant increase in PT trips taken by 2030.

In Kuala Lumpur terms, if a similar impact was achieved under current similar deployment limitations and parameters, a similar deployment of e-scooters could achieve up to 42,000 T $CO_{2\text{-eq}}$ emission reductions per annum. However, if higher numbers of e-scooters are deployed per capita, international academic studies propose that up to 1.3 % of transport emissions could be reduced (Germany, 2022)[51], which is in the range of 180,000 Tonnes $CO_{2\text{-eq}}$. These are indicative figures as they are contingent on location and transport as well as micromobility variables that need to be adjusted for in any bespoke modelling and calculations. They also depend on city specific targets. For example, Auckland, New Zealand, has set an ambitious target to switch existing high emitting household trips to 16% of all trips, including e-bike and e-scooter trips (8%).

An additional factor to consider is the level and speed of infrastructure improvements to promote safe active and micro mobility transport usage. In a recent article concerning Paris[52], the authors note that since 2016, when strategies were implemented to reduce car journeys and replace these with active mobility modes, the share of journeys made by car in the city has fallen by nearly half, and that trend is now accelerating. As the article further notes, "…. over recent years, Paris has implemented an array of measures to prioritize pedestrians, cyclists and transit while bringing car use screeching to a halt." Similar trends are noted in reviews of other global cities with high levels of active and micromobility participation, including Amsterdam (2022)[53].

3.10.5 Return on Sustainability

A recent report by the Office for Cycle Superhighways in Denmark[54] aims to calculate the economic returns from bicycle infrastructure investments compared to other transport mode infrastructure.

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[51] Can shared E-scooters reduce CO2 emissions by substituting car trips in Germany?, Transportation Research Part D: Transport and Environment, Volume 109, Laura Gebhardt, Simone Ehrenberger, Christian Wolf, Rita Cyganski, 2022

[52] https://reasonstobecheerful.world/cars-are-vanishing-fromparis/?utm_source=substack&utm_medium=email

[53] https://www.bloomberg.com/news/articles/2022-10-14/how-the-bicycle-conquered-amsterdam?utm_source=substack&utm_medium=email

[54] https://cyclingsolutions.info/cost-benefit-of-cycling-infrastructure/

Similar calculations can be completed for any city in Malaysia equally, for both active and micromobility transport modes and vehicles. Based on the Danish rationale, MRP has calculated active mobility, specifically bicycle usage, could save Malaysian society up to MYR 6 per kilometre, subject to localized calculations being completed. Similarly, considering the Danish example and subject to further adaptations, the Internal Rate of Return (IRR) for active transport infrastructure, including bicycle lanes, could be significantly higher as well. The IRR for cycling in Denmark is 11% versus 4 – 7.5% (car infrastructure investments).

The MRP has developed a broader more inclusive metric that factors in the impact from UN SDG contributions. Rather than defining returns on capital investments in ROI/IRR, MRP proposes to calculate the Return on Sustainability™ (RoS™) for any sustainability and UN SDG oriented capital investments, including active and micromobility infrastructure. Based on that adjustment, a full RoS result, using Denmark results that would need to be adjusted for Malaysia could achieve an RoS of MYR 6.72 / km travelled by bicycle.

Implications for Malaysia	18. Micromobility, including shared e-cooters, can make a significant contribution to support city and national transport emission reduction targets through mode switching and other impacts. 19. Transport planning, including emission reduction strategies, should factor in target mode switch percentages by key dates (2030 and beyond), to project the desired switch over to support defined emissions reductions against targets. 20. A full calculation of social savings from more sustainable transport modes and investments should also be calculated as Return on Sustainability, to compare different capital investment alternatives and options in a rigorous fully inclusive manner. 21. Any such targets (emissions reductions and RoS) should be based on detailed emissions modelling and calculations. 22. Once targets are defined, implementation strategies covering all aspects may then be developed to ensure

	achievement of those targets in an equitable and sustainable manner.

3.11 Marketing & Communication

Marketing and communication are a critical element in the deployment of a shared e-scooter programs and are ideally conducted in partnership between the operator and the local authority. This communication process will be altered depending on whether there have been shared e-scooters operating previously or if it is to be the first roll-out.

The communication strategy should begin in advance of the deployment and a key strategy in the process is to continue to build community knowledge of the safety features associated with shared e-scooters especially when compared to other forms of transport or urban activity. These features include:

- 24-hour GPS tracking;
- Geofencing technology;
- Rider education and enforcement; and
- 24-hour support.

It is also important to consider two segments of the community – riders and non-riders – both will have different views and messaging needs to be cognisant of both. This messaging can also include further division by ensuring people understand basic safety requirements but also consider the broader ramifications of their behaviour and be respectful others.

Implications for Malaysia	23. Partner with an operator to deliver a communications strategy that begins in advance of deployment and is focused on the safety features of shared e-scooters and considers both riders and non-riders.


Shah Alam, Malaysia

4.0 Implementation

4.1 Kuala Lumpur Pilot Opportunity

DBKL manages the municipal affairs of Kuala Lumpur – Malaysia's capital and largest city. It is the country's largest urban area and its cultural, commercial, and transportation centre. In 1972 Kuala Lumpur was designated a municipality, and in 1974 this entity and adjacent portions of surrounding Selangor state became a federal territory.

In line with the global trend of reduced congestion during COVID-19 lockdowns, the lifting of restrictions has seen congestion in Kuala Lumper continue to grow. The recent release of the Traffic Master Plan 2040 (PITKL2040) seeks to achieve a modal split of 70:30 for public transportation and private vehicles by 2040.

In addition, the Kuala Lumpur Low Carbon Society Blueprint 2030 (KL LCSBP 2030) defines the city's strategy to reduce carbon emissions for Kuala Lumpur. The KL LCSBP 2030 serves as a key policy instrument to integrate higher level sustainable, low carbon development policies (including the recent Sustainable Development Goals 2030, the Paris Agreement, and the New Urban Agenda) and the city-level development policies.

Workshop review (see table 9 for further notes) highlighted the following opportunities in the delivery of a pilot:

- Commercial operators are currently operating in the city and generating reasonable trip numbers – this confirms demand;
- A pilot project to be delivered in partnership between DBKL, Urbanice, Beam and University of Technology Malaysia; and
- The opportunity to use existing dedicated blue bike lanes for e-scooters.

Table 9 DBKL Sandbox

DBKL Sandbox Strategy	
Previous Experience	• Currently have e-scooters operating.
Benefits	• Opportunity to achieve 30:70 public transport, private vehicle split by 2040. • Support first and last mile to high quality public transport nodes such as MRT • Reduce road congestion. • Provide low-cost personal transport option
Challenges	• Footpath infrastructure sometimes incomplete or used for other activities. • Incomplete bike lanes. • Potential for riders to have to use road.
Procurement of Operators	• No formal arrangement has occurred.
Infrastructure & City Form	• Series of 1.5m blue bike lanes often demarcated by flexible bollards. • Footpath infrastructure.
Sustainability	• Opportunity to meet the ambitious goals of the KL LCSBP 2030.
Operations / Geofencing	• Geofence to consider high speed roads, high pedestrian nodes and virtual docking locations.
Rider education & training	• Potential for dedicated rider training days associated with pilot project initiatives.

Kuala Lumpur, Malaysia

4.2 Shah Alam Pilot Opportunity

Shah Alam is located within the district of Petaling and a portion of the district of Klang in the state of Selangor. The state capital is Shah Alam and has a population of nearly 700,000. The Majlis Bandaraya Shah Alam (MBSA) has a strong policy framework to provide improved transport options (*Shah Alam Towards Friendly Public Transport 2035*) and significantly reduced carbon emissions *(Low Carbon City Action Plan Sha Alam 2035*). Micromobility and shared e-scooters are seen as important contributors to achieving the ambitions of these policies.

Like most cities, the private motor vehicle is the dominant mode of transport however there are continued efforts to grow the public transport network and improve active travel connections. By 2035, Shah Alam hopes to increase public transport use from 10% to 30% and reduce private vehicle use from 90% to 60%. Initiatives like free buses and shared e-scooters are being trialled to meet these objectives.

To facilitate the success of shared e-scooters it is acknowledged that ongoing investment in new and degraded active travel infrastructure (*Shah Alam Bicycle Lane Master Plan*) is necessary. It is also noted that in more established parts of the city the road reserve is constrained whilst in green field developments (e.g., Elmina), the provision of active travel infrastructure is being integrated into the design. This is a challenge for all cities and presents the opportunity to reconsider the allocation of road reserve to transport modes.

The shared e-scooter pilot program was delivered between April 2021 and August 2022. It operated in Seksyen 14 and Seksyen 7. 500 e-scooters were deployed, and these were operational 24 hours a day. Whilst the pilot was generally viewed as a success it was noted that issues associated with rider behaviour and poor parking need to be addressed.

It was noted that future pilots will likely expand the operational area and that refinement of the geofencing, and speed would occur.

Workshop review (see table 10 for further notes) highlighted the following opportunities in the delivery of the next pilot:

- Expand operational area;
- Limit speed in higher pedestrian areas such as surrounding the lakes;
- Review and map separated lanes and roads;
- Consider deployment density to maximise trip generation;

- Consider reallocation of road reserve in established parts of the city;
- Ensure integration with transport infrastructure delivery (eg LRT 2024);
- Define the preferred user profiles (eg commuter, student, tourist etc) and design the deployment strategy to suit; and
- Define an evaluation criteria to determine lessons learned for the benefit of other Malaysia cities.

Table 10 Shah Alam Sandbox

Shah Alam Sandbox Strategy	
Previous Experience	• Currently have e-scooters operating.
Benefits	• Opportunity to reduce private vehicle mode share from 90% to 60% by 2035. • Opportunity to contribute to reduction in carbon emissions by 45% by 2035. • Reduce road congestion. • Provide low-cost personal transport option.
Challenges	• Limited bus network. • Limited public transport infrastructure. • Poor public transport integration. • Limited active travel infrastructure integration. • Poor rider behaviour.
Legislation & Regulation	• MBSA can only enforce under Act 171.
Procurement of Operators	• Current collaboration between Urbanice Malaysia and Beam. • Trial between April 2021 and August 2022 with the following conditions: - Operational area only at Seksyen 14 & Seksyen 7. - Operational time (24 hours). - 500 units of e-scooters. - Lake garden is restricted area for e-scooters. - Place e-scooters at the station provided. - Service management must be using smart application and apply geofencing. - E-scooters must not cause any obstruction.

	- Provide insurance. - Guaranteed bon. - Participate in MBSA program especially in promoting public transport with free ride. - Provide data usage to MBSA. - Provide enough technical team.
Infrastructure & City Form	• Investment occurring in active travel infrastructure (phase 1 – 9km, phase 2 – 5km). • 20 micromobility stations. • Shah Alam Bicycle Lane Masterplan – 60km. • New Township – Elmina delivering 96km of bike lanes.
Sustainability	• Opportunity to contribute to reduction in carbon emissions by 45% by 2035.
Operations / Geofencing	• Geofence has reduced conflict but there has been concern about accuracy and e-scooters stopping too quickly. • Averaging around 3,000 trips per month.
Rider education & training	• Shah Alam car free day. • Shah Alam Friday Prayers Promotion.

4.3 Putrajaya Pilot Opportunity

Putrajaya is Malaysia's administrative centre, 15km south of Kuala Lumpur. It was developed in the late 1990's in response to growing congestion and logistics issues associated with government offices in Kuala Lumpur and difficulty moving between offices. In 1999 the Prime Minister's office moved in and in 2001 it was declared a federal territory.

As a recently master planned city, Putrajaya has a generous active travel network which caters for pedestrian and bike movement around the city and links work, residential and recreational activities. It is expected that this infrastructure could easily support e-scooters and e-bikes.

Workshop review (see table 11 for further notes) highlighted the following opportunities in the delivery of the next pilot:

- A small scale, low risk opportunity that can be evaluated and scaled if successful;
- A logical pilot would consider movement between different office blocks and cater for movement required to support meetings in different building or lunch time activities;
- As development is large scale and buildings are separated by open space and path networks there is opportunity to provide virtual docking stations at the base of buildings; and
- In time the pilot could be scaled to include surrounding residential and recreational sites such as the lake.

Table 11 Putrajaya Sandbox

Putrajaya Sandbox Strategy	
Previous Experience	• E-scooters have operated in the past although issues have been raised regarding the suitability / functionality of the geofence. • Some e-bikes operating on the Cyberjaya side of the lake.
Benefits	• Use the world class public realm infrastructure. • Reduce road congestion. • Provide low-cost personal transport option.
Challenges	• High personal vehicle mode share.

Procurement of Operators	• No formal arrangement has occurred.
Infrastructure & City Form	• Dedicated bike lanes. • Wide footpaths. • Defined crossings. • Large format discrete buildings (work, residential).
Sustainability	• Support significant policy agendas including Putrajaya Low Carbon Green City; Local Agenda 21 Putrajaya; Putrajaya Towards Global City 2040 and Sustainable Putrajaya 2025.
Operations / Geofencing	• E-scooters have operated in the past although issues have been raised regarding the suitability / functionality of the geofence. • Opportunity to work closely with an experienced operator to review geofence and slow speeds where required.
Rider education & training	• Potential for dedicated rider training days associated with pilot project initiatives.


EMERGENCY
ZON TUNDA
BERHENTI

5.0 Summary

The Shared Micromobility Reference Guide has been developed as a reference guide to assist all levels of government in Malaysia in the successful adoption of micromobility. It should be read in conjunction with other guidance documentation including PlanMalaysia's *Active Mobility Guideline* and Ministry of Transport's Micromobility *Safety Guide*.

Whilst the benefits of micromobility such as reduced congestion, transport equity and reduced carbon are understood the issues associated with an emerging form of transport such as safety, poor rider behaviour and public clutter must be overcome. This Guide seeks to provide guidance on how to approach these issues by reviewing the journey of other cities and providing a framework which will assist cities in the development and management of deployment strategies. This framework considers elements such as infrastructure, public transport, land use, population density, employment nodes, destinations, deployment density, sustainability, regulation and marketing & communications.

The development of this Guide has been focused on defining the best approach for Malaysia and more specifically the implications for Malaysia in terms of policy, regulation and operations and a consolidated list of these implications is provided below:

1. Consider the delivery of a pilot which will inform future infrastructure investment.
2. Use IoT trip data to understand rider preferences and deliver supportive infrastructure.
3. Consider the reallocation of existing infrastructure.
4. Consider the value of shared micromobility for increased public transport use and develop a deployment plan and geofencing that supports increased catchment.
5. Consider the research from other cities that confirms the economic benefit of supporting the emerging micromobility sector and the flow on benefits to local traders.
6. Determine the value that micromobility could play as a demonstrated tool in reducing congestion.
7. Ensure that review of the city includes consideration of land use and urban form with geofencing and deployment to reflect the values of a city whilst optimising the success of the program.

8. Consider population density and the impact that will have on deployment. As a rule, higher density development provides more opportunity for shared micromobility
9. Review of the City's destinations will inform the deployment strategy and generate increased tourism expenditure.
10. In order to accurately determine the optimal range of shared e-scooter deployment, a level of regulation and monitoring of private e-scooters will be critical.
11. Emission reduction targets can significantly benefit from setting target transport mode switches in a reasonable and achievable manner. Consider setting target mode switch percentages and tying these into emission reductions against official 2030 and 2050 Paris Agreement targets.
12. At this stage, optimal deployment levels for any city are best determined using a mix of calculation and benchmarking approaches, based on international findings on a per capita, per area and as against emission reduction targets. Additional trends will likely be informative using an active/ micro mobility infrastructure-based approach.
13. MRP research will continue to investigate optimization approaches based on international collaborative research across a number of cities to determine optimal deployment density based on actual operator data analysis.
14. This research will also identify significant factors impacting on the deployment of shared e-scooters, as well as a potential mathematical modelling arising from globally comparative research the MRP is currently conducting with a number of collaborative universities.
15. Develop a geofence strategy that suits your city or precinct and continue to refine it through ongoing evaluation.
16. Engage an operator who provides best practice rider education and safety features.
17. Micromobility, including shared e-scooters, can make a significant contribution to support city and national transport emission reduction targets through mode switching and other impacts.
18. Transport planning, including emission reduction strategies, should factor in target mode switch percentages by key dates (2030 and beyond), to project the desired switch over to support defined emissions reductions against targets.
19. A full calculation of social savings from more sustainable transport modes and investments should also be calculated as Return on Sustainability, to compare different capital investment alternatives and options in a rigorous fully inclusive manner.

20. Any such targets (emissions reductions and RoS) should be based on detailed emissions modelling and calculations.
21. Once targets are defined, implementation strategies covering all aspects may then be developed to ensure achievement of those targets in an equitable and sustainable manner.

To continue moving forward the delivery of pilot projects or "sandboxes" has been proposed. Review of Kuala Lumpur, Putrajaya and Shah Alam, (which has had a shared e-scooter program for the last year) highlights opportunity to move forward in a way that can be evaluated and scaled across other Malaysian cities.

Micromobility presents significant opportunity for Malaysia to reduce congestion and carbon emissions whilst improving transport equity and generating economic benefit. This Guide when reviewed in collaboration with other noted documents provides a platform for government and the private sector to collaborate in the successful growth of the micromobility transport mode.

GLOSSARY

- E-mobility
  Method of travel using wheeled electric devices, excluding motorised wheelchairs, with powered speeds of no more than 25 km/h. E-mobility is sometimes also referred to as e-wheeling.
- E-devices

  Electric devices, excluding motorised wheelchairs and motorised scooters (mopeds), with powered speeds of no more than 25 km/h. E-devices are sometimes also referred to as rideables.

- E-bike

  A bicycle that is power assisted by an electric motor of no more than 200 watts and with powered speeds of no more than 25 km/h. E-scooter A two-wheeled device with handlebars and with powered speeds of no more than 25 km/h.

- First-and-last mile

  The journey between a public transport service or a transport hub and the origin/destination.

- Global Positioning System (GPS)

  A satellite-based system that calculates the position of a device on the earth's surface.

- Internet of Things (IOT)

  The interconnection via the internet of computing devices embedded in everyday objects, enabling them to send and receive data.

- Micro-mobility

  A term that encompasses travel by a range of small, lightweight devices operating with powered speeds of no more than 25 km/h.

- Mobility as a Service (MaaS)

  The integration of various forms of transport services into a single mobility service accessible on demand, typically via an app on a smart phone or device.

- Mobility Data Specification (MDS)

  A specification to enable sharing schemes to provide e-mobility data in a standard format to other agencies.

- Sharing scheme

  A scheme where devices are publicly available for hire from a licenced operator.

Appendix A-1

Figure 3 Road Safety Plan 2022 – 2030

Appendix A-2

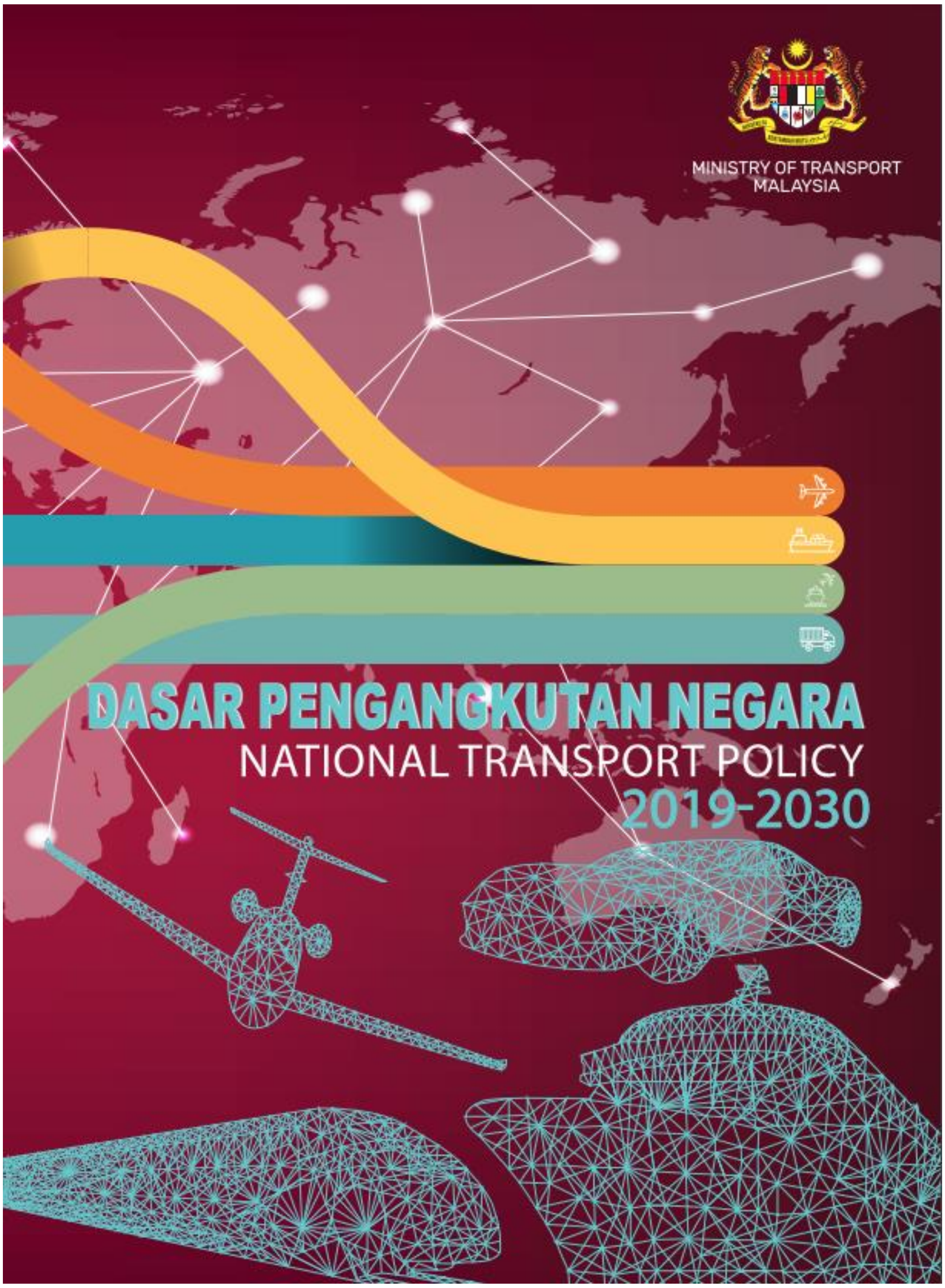

Figure 4 National Transport Policy 2019 – 2030

Appendix A-3

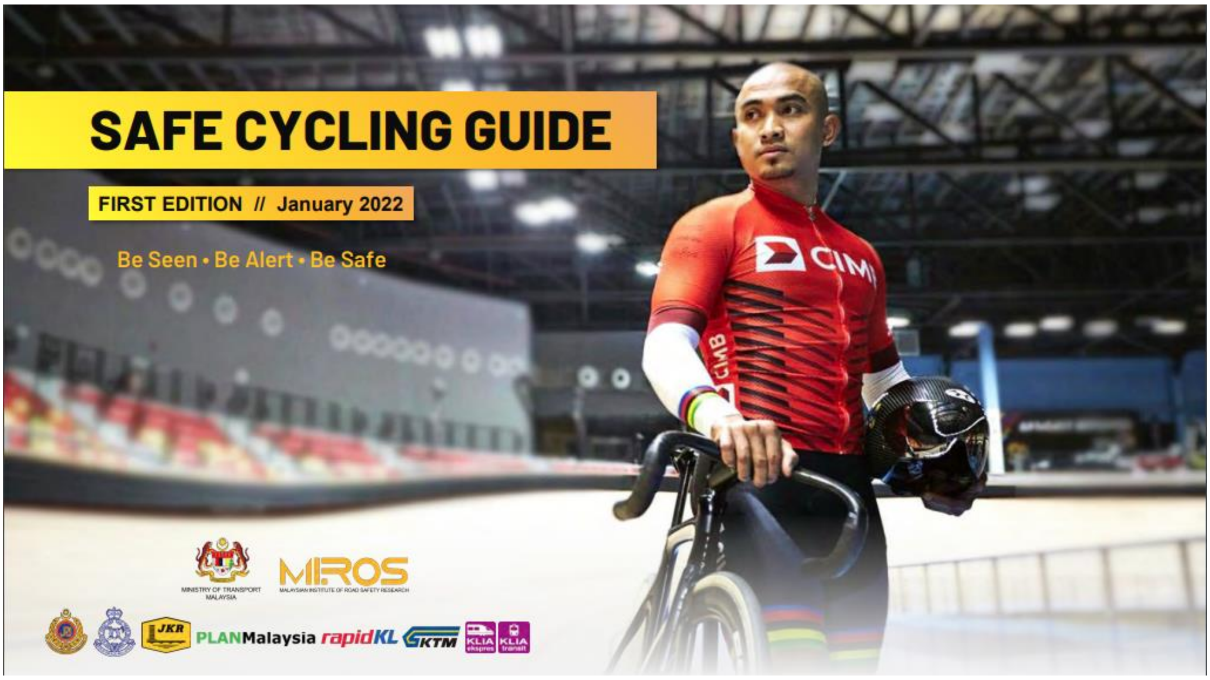

Figure 5 Safe Cycling Guide

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