Micromobility, Equity and Sustainability
Summary and Conclusions

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Roundtable

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Cite this work as: ITF (2021), *Micromobility, Equity and Sustainability: Summary and Conclusions*, ITF Roundtable Reports, No. 185, OECD Publishing, Paris.

Acknowledgements

This report was written by Tatiana Samsonova (ITF) and benefitted from input provided by Stephen Perkins (ITF).

The report is based on expert discussion held at the ITF virtual Roundtable on “Micromobility, Equity and Sustainability” on 17, 18 and 19 March 2021.

We would like to thank the authors of two discussion papers prepared for and presented at this Roundtable:

- Brown, A. (2021), “Scooters are Here, but Where Do They Go? Aligning Scooter Regulations with City Goals”, (University of Oregon).
- Licea, K. (2021), “Micromobility Policies for Sustainable Transport: Bogota and Mexico City case studies”, (Independent Consultant, Mexico City).

We would also like to thank the speakers who made presentations at the Roundtable:

- Rosa Pierce “New Zealand’s Regulatory System for Shared/Rental Micromobility” (New Zealand Ministry of Transport)
- Erdem Ovacik “Donkey Republic Sustainability Framework” (Donkey Republic bike share)
- Sebastian Schlebusch “Enabling micromobility’s full potential through good regulation” (Dott)

We would like to thank Richard Cross, Manager Strategic Policy and Innovation at New Zealand Ministry of Transport, for chairing the Roundtable discussions. The ITF Secretariat also wishes to thank the 38 participants, who joined from 12 ITF member countries and commented on the report. ITF colleagues Philippe Crist, Pierpaolo Cazzola, Alexandre Santacreu, Rex Deighton-Smith and Luis Martinez also provided valuable comments.

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Executive summary

What we did

This report examines how micromobility (e-scooters, electric bikes and pedal bikes, whether docked or dockless and other forms of light mobility) can address congestion, CO_2 emissions and air quality in cities and benefit users. It reviews benefits and social costs to inform the development of governance and regulatory frameworks that can maximise the contribution of shared e-scooters, electric bikes and pedal bikes to accessibility and sustainable mobility and minimise negative effects, particularly for pedestrians.

What we found

Existing urban mobility solutions cannot keep up with the growth of cities and struggle to contain congestion, noise, pollution and inefficient use of limited space. Shared micromobility can reshape urban mobility by offering a sustainable transport option that improves accessibility. Shared micromobility predominantly replaces walking, cycling and public transport trips yet could also substitute short car trips. The broadest benefit of integrating shared micromobility services into urban transport could be increasing the catchment area of public transport. Their widespread availability, particularly for first/last-mile connections, could improve access while shortening commuting time and reducing reliance on cars.

However, micromobility – especially e-scooters – raise concerns of nuisance on sidewalks, the safety of users and pedestrians, its substitution over walking reducing the health benefits of physical activity, and potential adverse environmental impacts from the production and disposal of vehicles and batteries and generation of electricity. Negative effects of micromobility need to be weighed against the significant consumer benefits they offer and their potential to replace less sustainable trips. Data on the negative impacts of micromobility suggests these are comparatively small. The whole transport system must be considered from this perspective to make informed policy decisions.

Most city authorities agree that micromobility enriches urban mobility, has the potential to change user behaviour and thus help transition to low-carbon urban mobility. Operators and authorities concur that the extent to which such benefits will be reaped depends on getting the regulatory framework for micromobility right. Finding agreement on what interventions work best is challenging, however.

What we recommend

Base regulation on sustainable urban mobility policy objectives

Micromobility regulation should support the objectives of sustainable and equitable urban mobility planning. This means facilitating service availability across the urban area and promoting accessibility. It should also foster innovation and competition between operators and manage their use of street space. Integration with other modes, particularly public transport, will create social welfare benefits and replace car travel offered by these new services and improve accessibility. For micromobility to contribute to reversing car-dependent mobility will depend primarily on broader regulatory and fiscal policies to contain car traffic.

Consult micromobility companies on public policy issues early and often to avoid distorting regulations

Proactive engagement and collaboration with micromobility companies should help reduce the need for distorting regulations. City authorities should consider constructive proposals from micromobility companies for meeting overall mobility objectives in the way they regulate and award concessions. On their end, micromobility companies should be proactive in addressing public concerns.

Apply outcome-based regulations linked to specific performance criteria

Cities should focus on the expected outcomes from a regulation instead of specific, mandatory processes or actions. Identifying clear performance indicators is helpful to understand how successful operators are and where they can improve. Criteria such as the number of trips per micro-vehicle per day should be used to regulate fleet size instead of static fleet caps. Targets for stationing vehicles in areas with poor transit access could ensure that micromobility serves sustainability and equity objectives. Cities should work with operators on performance criteria and base regulation on factors within micromobility providers' control.

Ensure limits on market access allow competition; avoid static caps on shared micromobility vehicle fleets

Cities need to monitor markets to ensure that any limits imposed on the number of operators do not unduly limit availability or competition. Sharing a restricted number of permits equally between many operators may compromise the sustainability of operations. At the same time, markets with only three players raise concerns over potential oligopolistic behaviour. Instead of arbitrarily restricting the number of operators, cities should encourage competition among them and accept multiple operators as part of the city's mix of mobility services. Where a city sees a need to manage the number of shared micromobility vehicles on its streets, it should use dynamic caps based on specific performance indicators, such as the utilisation rate of vehicles, rather than by a static limit. Lower utilisation rates might be appropriate in neighbourhoods of concern in respect to inclusivity.

Limit data-reporting requirements to information used for mobility planning

Data reporting is an essential aspect of designing outcome-based regulations. When mandating data reporting, cities need to consider how the data will be used. Thought should be given to the strategic goal and the most valuable data to reach it. Producing performance indicators for sustainability and accessibility requires data on deployment, repositioning, use and lifetime of vehicles. Mandates should limit the reporting burden on operators to data needed for agreed performance benchmarks. Generally, all transport modes should have fair and balanced reporting requirements. Such data would enable cities to identify priorities for improvement and understand their impact on the whole transport network.

Set regulatory fees in light of the potential value of micromobility for sustainable mobility and the uncertain viability of business models

High regulatory fees imposed on micromobility companies are likely to limit the supply, reduce socio-economic welfare and make operations unviable. Cities should ensure that any fees are consistent with the negative impacts they are intended to address. Governments could consider bearing (the majority of) regulation administrative costs when justified by the benefits of more widespread use of micromobility.

Support equitable and affordable micromobility services

Shared micromobility should be promoted in areas of cities that are not currently well served by public transport networks. To ensure that it is financially viable for micromobility companies to provide service in all areas of the city, cities should minimise the burdens on providers from fees and caps on fleets. Cities might consider subsidies to service providers to achieve desired connectivity improvements.

Follow the principle of mode-neutrality when developping an urban transport system

City authorities should consider all transport modes when planning, regulating and funding transport services. They should assess their respective contribution to positive social, economic, and environmental outcomes. Governments should treat all transport modes fairly when imposing limits on access, speed or parking. They should evaluate the rules and fees applied to different transport modes – particularly to private cars – before putting in place restrictive regulations for micromobility. Comparing the full costs and charges for different types of transport will improve decisions on policy interventions.

Reallocate road and parking space to micromobility users, cyclists and pedestrians

Roads and parking spaces are disproportionally allocated to cars. Shared micromobility has increased the demand for redistributing urban space. Expanding dedicated cycling lanes to accommodate micromobility will also improve conditions for cyclists and enhance safety and safety perceptions. This will make it more attractive to cycle and use electric micromobility. Getting parking right is crucial. Sharing schemes as well as personal micromobility will benefit from repurposing private car parking spaces. This can maximise the take-up of these modes and thus help realise their wider benefits for urban policy. At the same time, it would reduce nuisance and minimise conflicts between modes.

Address motor vehicle speeds when regulating micromobility speed

Speed limits for micro-vehicles should recognise the value of speed for establishing micromobility as an alternative to car trips. A speed limit of 25 km/h on appropriate infrastructure makes micromobility more competitive with cars than limiting speed to 20 km/h. Lower speeds may be appropriate in areas with heavy pedestrian traffic. More broadly, 30 km/h is the maximum limit recommended for cars in city streets to reduce the risk of death or serious injury from a collision of cars with pedestrians and other vulnerable road users. Limiting cars, motorised two-wheelers and micromobility to the same low speeds on streets with mixed motorised and non-motorised traffic is a logical approach.

Apply coherent regulation that treats micromobility operators equally

Agreeing on a single set of rules applied uniformly across all operators in a city will facilitate the use of micromobility and reduce the regulatory burden on companies. Micromobility should be regulated as a class, not device by device, given similar operational characteristics in terms of speed and size. Neighbouring cities should also co-ordinate to harmonise approaches. Direction from national-level governments can help to standardise regulation but should avoid suppressing innovation by operators and regulators. Safety characteristics of vehicles also require coherent regulation.

Adopt a permissive and adaptive regulatory approach to micromobility

Governments should ensure that regulatory interventions do not impede innovation. Regulation should allow service providers to adopt new business models and technologies and respond to demand. Regulatory barriers should be minimised to enable operators to gain footholds in urban mobility markets. Micromobility is at an early stage of innovation and requires flexible regulation for market access that is updated as the market evolves. Trialling regulatory approaches has proven valuable in many cities. Pilot projects produce data for evaluation and allow insights into how behaviours and outcomes change. They allow experimentation, bedding-in and solving problems through experience and negotiation before regulatory intervention. Evaluations and amendments should be planned and clear timelines provided to micromobility companies to reduce uncertainty and risks to their business models.

Introduction

Congestion, emissions and air quality remain the most vexing transport challenges for urban areas. Micromobility (e-scooters, electric bikes and pedal bikes, whether docked or dockless and other forms of light mobility) presents decision makers with an opportunity to address these challenges apace with urban growth. These services also have the potential to better connect people to public transport, reduce reliance on private cars and make the most of scarce space for mobility in cities. The micromobility sector has matured and innovated at tremendous speed. Shared e-scooters and e-bikes have resonated with consumers, as demonstrated by their rapid adoption in the last three years. For instance, in the United States, the total number of trips taken via all forms of micromobility increased by 60% between 2018 and 2019, reaching 136 million trips on shared bikes, e-bikes, and scooters (NACTO, 2019a. The strong uptake indicates promising potential for driving behavioural change.

Despite this promise, micromobility – especially e-scooters – has raised concerns among many local governments and citizens that the lack of concertation and unilateral deployment of ride-sourcing services and some dockless bikeshare systems may repeat themselves. In many urban areas these services began operating in a legal grey zone. Officials responding to citizen complaints are resisting shared micromobility, especially e-scooters. Common concerns are cluttered sidewalks and oversupply of first-generation shared bikes placed on the streets by operators aiming to achieve market domination through saturation. Increasing criticism around the negative environmental impact of these services, unsafe riding behaviour and poor parking fuelled the debate, leading some officials to call for an outright ban of e-scooter sharing services. Many local governments have already put in place strict regulations or bans on new mobility services. Other authorities have welcomed the arrival of shared micromobility because of its propensity to increase demand for protected cycling space, allowing them to accelerate existing plans to invest in safe cycling networks. Attitudes differ among authorities that run dockless shared bike schemes too. Some see them as a valuable extension and lower-cost substitute for docked schemes. Others view them as unwelcome competition for the operators of the systems they currently subsidise.

The Roundtable meeting convened by the International Transport Forum virtually in March 2021 analysed governance approaches for commercially operated shared micromobility schemes. It identified regulatory frameworks that maximise benefits for users and incentivise providers to innovate and maximise their contribution to sustainable mobility whilst containing external costs. It discussed how to align regulations for micromobility with goals for achieving sustainable mobility, equitable access and integrated transport and land-use policies. It explored evidence for the potential contribution of shared micromobility services to these goals, establishing how these services are used and how regulatory intervention has affected patterns of use. Regulation was examined from the perspectives of efficiency and competition policy, equitable accessibility and urban planning and road-space allocation. Road safety is also a consideration but was examined in depth in Safe Micromobility (ITF, 2020c).

The discussions focused on:

- the adoption trends of different forms of micromobility, whether docked or dockless, including shared e-scooters, electric bikes and pedal bikes
- the impact of these services on health, access, economic activity, congestion and emissions and on different groups in society

- adaptation of the transport system in terms of both infrastructure allocation and regulation to manage the increase in their use
- appropriate regulatory frameworks to maximise the potential of these services to contribute to sustainable mobility options while curbing externalities
- appropriate charging regimes and principles for their application
- integration of shared e-scooters and e-bikes with public transport to contribute to multimodal and integrated sustainable transport policy goals and to serve all groups of society.

The report is organised in two parts, first reviewing the *costs and benefits* of micromobility and then examining how best to *regulate* shared micromobility.

Socio-economic costs and benefits of micromobility

Most city authorities seem to agree that micromobility enriches urban mobility and has the potential to change behaviour and transition to low-carbon urban mobility. However, the choice of appropriate instruments for regulating micromobility is contingent on a clear understanding of the value that these new mobility services bring. Their contribution to broader sustainable mobility goals as well as potential negative impacts that need to be contained. The most profound benefit of integrating shared micromobility services into a city's transport system is to improve accessibility. This is done through direct short-distance trips or access to public transport stops. To understand the determinants and obstacles and perceived benefits of micromobility, many surveys have been conducted to assess who uses it, for which type of trips, and what barriers are faced.

Micromobility and mode shift

Available data suggests that shared e-scooters and bikes are particularly suitable for short trips in urban areas. The typical scooter user or bikeshare pass-holder rides for 11-12 minutes and 1-3 kilometres on an average trip in major cities across the United States (NACTO, 2019a). The same trend is observed in European cities. Research institute 6-t found that in Paris, median travel time for an e-scooter trip is approximately 11 minutes (6-t, 2019). E-bikes are often used for longer journeys where walking is not a viable option. According to research by Cairns et al. (2017), the average trip length for e-bikes is 11.4 km. Micromobility has been found to substitute for walking, cycling and public transport trips (Reck and Axhausen, 2021; 6-t, 2019; Fishman et al., 2014; ITF, 2020a). However, micromobility also has the potential to substitute for short car trips and thereby help to reduce traffic congestion and decrease vehicle emissions. An INRIX (2019) study revealed that 48% of all car trips in the 25 most-congested US cities are less than three miles.

Indeed, data from several surveys suggest that across six cities in North America[1], around 45% of micromobility journeys replace car travel (a combination of private car use and ride-hailing, e.g. taxi, Uber or Lyft) (NACTO, 2019a). Data compiled by the International Transport Forum (ITF, 2020a) suggests that the average substitution effect across US cities is lower: around 15% of private car trips. In New Zealand, 24% of all micromobility trips replace a car trip, while 50% of e-scooter trips replace walking. Availability of micromobility may also affect car ownership. In Oslo, 2% of respondents to a survey of shared e-scooter users confirmed that they got rid of their cars due to the use of e-scooters and another 8% had considered doing the same. Surveys also suggest that micromobility substitutes trips by taxi. In Oslo, 46% of respondents stated that they use taxis less often (TOI, 2020). Similarly, bikesharing – both dockless and station-based – has been linked to an observed decline in motorised vehicle use in cities across Europe and the United States (Fishman et al., 2014).

The congestion reduction effect is more noticeable in cities where car use and ownership are higher and ride-hailing is more common (ITF, 2020a). In dense European cities with lower car use, such as Paris or Oslo, only 8-10% of e-scooter trips displace car trips (personal or ride-hail/taxi) (Fearnley et al., 2021; 6-t, 2019). Even with a substitute effect of 10%, shared micromobility replaces enough car trips to materially impact traffic flow and air quality.

There are concerns about micromobility competing with cycling and walking. What are the potential ramifications for individual and population-level physical activity? Data from French cities shows that 44%

of e-scooter users would have walked had the scooters not been available and 30% used public transport. However, the same survey suggests that only 6% of users walked less overall since they have started using e-scooters (6-t, 2019). In Brussels, 15% of micromobility trips replace cycling trips, 20-26% walking trips and 26-28% car trips (Moreau et al., 2020). Similarly, surveys across the United States show that around 25% of respondents would have used a car (personal or ride-hail/taxi), while 57% would have walked and 8% would have biked (8%). However, only 15% of respondents indicated that they walk and bike less overall (Sanders et al., 2020). Walking is also the most replaced option in Brazil (58%), followed by car-based ride-sourcing (25%), car travel (14%) and public transport (8% for buses, 6% for BRT and 6% for metro or train) (ITF, 2020a).

Another concern is that e-scooters compete with bikesharing. However, data suggest that average bikesharing trip tends to be longer than trips taken by e-scooters. In France, bike sharing is used for trips having similar distances to shared e-moped/motor scooters (5.25 km/trip). A user survey in Paris highlights that only 9% of respondents would have used a shared bike and 3% would have ridden their own bike to take their last trip instead of a free-floating e-scooter if the latter was unavailable (6-t, 2019). This suggests that e-scooters occupy a clear niche compared to other modes, including walking and cycling.

Role of micromobility for intermodal trips

Easier access to public transport is one of the key determinants for choosing between a car ride or public transport (Holmgren, 2020). Micromobility can increase the catchment area of public transport. It provides a quicker trip to/from public transport or increases the distance that people are willing to travel to/from homes and public transport when compared to walking.

Some micromobility trips may replace public transport trips. For instance, in Brussels, around 30% of users stated that the e-scooter replaced a public transport trip (Moreau et al., 2020). However, a large proportion of both bike-sharing and e-scooter trips are part of longer intermodal trips, therefore increasing the catchment area of public transport (Shaheen and Cohen, 2016; ITDP, 2018). In Paris, 15% of free-floating e-scooter trips and 18% of dockless bike trips are combined with public transport (6-t, 2019).[2] In Oslo, 57% of e-scooter users combined their trips with public transport (TOI, 2020). Similarly, Lime (2018) reports a 20% share of e-scooter trips to/from public transport across their services. The Micromobility Coalition (2019) reported that the widespread availability of micromobility services, particularly for first-/last-mile connections, would increase access to 35% more jobs for Seattle city residents while shortening commute time and reducing reliance on cars. In Zurich, dockless e-scooters and docked bikes are mostly used in the city centre with clear hotspots at the main public transport stations (Reck and Axhausen, 2021), suggesting that the integration of bike- and scooter-sharing with public transport can increase the number of multimodal trips.

Environmental performance of micromobilty

The first generation of e-scooter and dockless bikeshare systems created environmental performance concerns. Their poor quality, particularly the initial short lifetime of e-scooters, was exacerbated by vandalism. As a result, the first generation of e-scooters had a life expectancy of just a few months, which was not enough time for operational CO_2 emissions savings to outweigh embedded greenhouse gas emissions.

Battery recharging is an important issue. E-scooters are typically collected by larger vehicles for their batteries to be recharged, usually during off-peak hours. They are spatially dispersed, which generates irregular and long travel patterns for scooter collection. During the initial deployment of e-scooters by operators, little thought was given to controlling the method of this collection, with diesel vans often used.

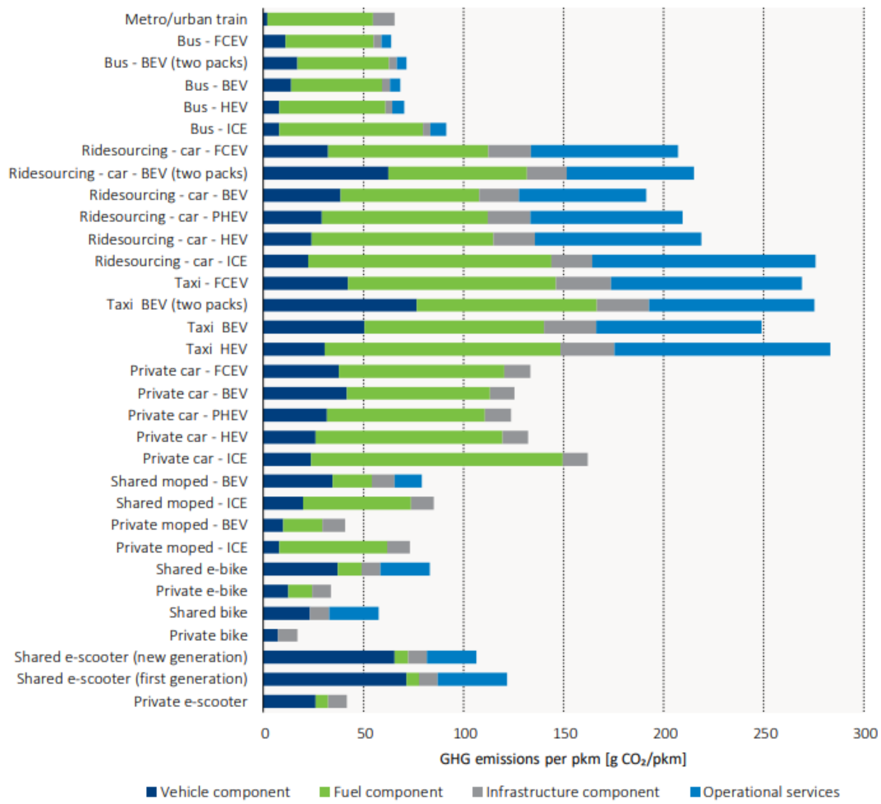
The industry has made improvements in terms of hardware design, lifecycle emissions performance and operational sustainability due to technology advances. Voi's latest Voiager 4 scooter is estimated to have an average operational lifespan of 60 months (Voi, 2021. The carbon footprint of e-scooters has reduced since their initial implementation, as documented by reports from Voi Technology, showing a 70% reduction in CO_2 per km, down to 35g CO_2 per km since January 2019 (Voi, 2020). Assessment of the environmental performance of e-scooters in Paris, based on Consequential Life Cycle Assessment (CLCA), highlights that extending the life span of vehicles in the city[3] is not sufficient to get a positive balance in terms of GHG emissions (de Bortoli and Christoforou, 2020).

Reductions in servicing emissions are also required. For example, the collection and distribution of e-scooters for battery charging. Micromobility companies argue that with the introduction of replaceable batteries, fewer large diesel vans to transport the vehicles to and from recharging sites are needed (only for repositioning), with operators increasingly using cargo bikes. Only batteries are transported to be charged and are swapped on the spot, drastically reducing the service's energy consumption and contribution to congestion on the roads (TIER Mobility, 2019; ITF, 2020a). The use of replaceable batteries also ensures that vehicles stay in the field, increasing their usage and reducing their GHG emissions per km ridden. However, emissions related to production of additional batteries also need to be considered.

With rapidly changing technology, appropriate assessment methods are needed to calculate direct and indirect environmental impacts of new mobility options (de Bortoli and Christoforou, 2020). ITF (2020a) highlights that defining common and transparent methodologies to evaluate life-cycle emissions and requiring third-party verification of the resulting assessments is important in setting environmental and energy-related performance requirements for micromobility vehicles.

ITF (2020a) analysed the differences in climate impact between personal and shared electric kick-scooters, bicycles, e-bikes, electric mopeds, as well as car-based ride-sharing services. The report assessed the life-cycle performance of these new vehicles and services based on their technical characteristics, operation and maintenance, and compared it with that of privately owned cars and public transport. This analysis suggests that the lifecycle GHG emissions from an e-scooter, calculated on a per pkm basis, may be around 37% lower than those of conventional private cars and those of shared bikes 60% lower. The report also highlights that private bikes and e-bikes that are regularly used have the lowest life-cycle energy requirements and GHG emission impacts per pkm, which is several orders of magnitude lower than the shared model (Figure 1).

Figure 1. Central estimates of life-cycle greenhouse gas emissions of urban transport modes per pkm



Notes: BEV = battery electric vehicle; HEV = hybrid electric vehicle; ICE = internal combustion engine; FCEV = fuel cell electric vehicle; PHEV = plug-in hybrid electric vehicle. These estimates have been developed using key inputs (such as average number of passengers, the electricity mix and the ratio of operational km per active km) defined by global averages observed prior to the Covid-19 pandemic. Specific circumstances occurring in different world regions, changes in operational practices and the Covid-19 pandemic should therefore be modelled as individual-specific cases, modifying input data accordingly.

The infrastructure component represents the ratio between CO_2 needed to construct and maintain one km of the one-way lane (nominator); and vkm (or pkm) taking place on that one-way lane during its lifetime. The infrastructure results are heavily dependent on the infrastructure attributed to each mode. Cars are assumed to use only car lanes. Bikes and e-scooters are assumed to use a mix of bike lanes (20%) and urban roads (80%).

Source: ITF (2020a).

Energy use and GHG emissions from shared micromobility - e-scooters, bikes, e-bikes and mopeds - are comparable in magnitude to those of metros and buses. This is the case especially when actions are taken to extend lifetime mileage and minimise energy use and GHG emissions from operational services (ITF, 2020a).

GHG savings and health benefits of micromobility: dockless pedal bikeshare in Copenhagen

A very limited number of studies calculate health costs and benefits, GHG and cost savings associated with the effects of different shared micromobility options. Donkey Republic – a bikeshare company, based in Denmark – collaborated with Dresden University to examine the overall value of bikeshare in Copenhagen by putting numbers on health benefits, GHG savings and cost savings to society and individual users.

The health impacts of the different transport modes were assessed in relation to physical activity, accidents and air pollution. Effects on physical activity were evaluated in terms of gains per marginal km for cycling, cars and walking using unit prices developed for the Cycling Embassy of Denmark (COWI, 2020). Air pollution (losses per marginal pkm) and safety costs were assessed with prices from the EU Handbook on the External Costs of Transport (EU, 2019). The study also assessed impacts on congestion using a cost for marginal pkms on urban roads based on a value of time for Denmark from the EU Handbook. Greenhouse gas emissions were evaluated using ITF estimates for the life-cycle impacts of new mobility services (ITF, 2020a). This data was expanded to include Donkey bikes and e-bikes, considering vehicle lifetime, the average number of trips per day and the technology used to charge and reposition swappable batteries for e-bikes (Table 1). These co-efficients were combined with the estimates provided by Dresden University on modal shift effects to determine the impact of bike-sharing. The Dresden team based their estimates on the analysis of comprehensive GPS tracking data. The effects of bike-sharing on individual travel behaviour were assessed through two online surveys.

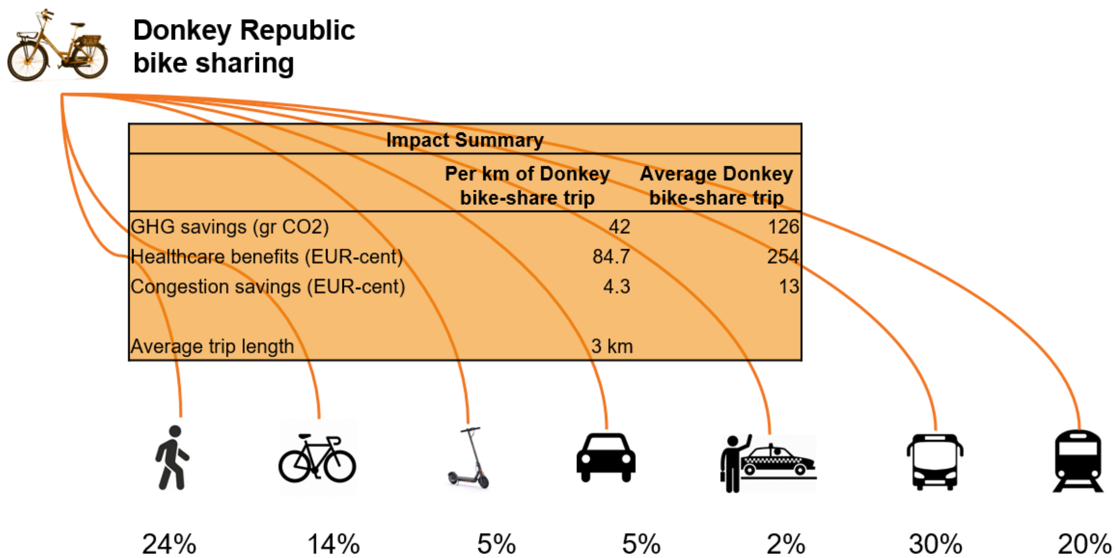
Table 1. Cost savings and GHG impacts across different transport modes in Copenhagen

	EUR-cents per marginal passenger-km in urban areas		**CO_2 emissions per passenger kilometre** (pkm)	**Modal shift**
	Congestion cost	Health benefit	GHG (LCA)	Share of trips replaced by Donkey bikeshare
Donkey	0	131	17	-
eDonkey	0	88	45	-
Car (ICE)	35	-12.2	162	6%
eCar	35	-126	124	1%
Bus (ICE)	6	-2	92	30%
Rail	0	-1	66	20%
e-Scooter (shared, 2nd gen)	0	-140	107	5%
Bike	0	131	16	14%
eBike	0	88	34	
Walk	0	151	0	24%

Source: Donkey Republic and Dresden University (2021).

The average Donkey Republic user makes two trips a day and cycles approximately 3 km per trip. This translates into gains of EUR 2.54 at average rates of substitution for other modes. Average benefits of each car substation to Donkey Republic pedal bike in Copenhagen results in EUR 1.1 in congestion savings per trip; EUR 4.3 in health benefits per trip and 434g in saved CO_2 emissions per trip (Donkey Republic, 2021). This illustrates the potential positive impact that pedal bikeshare can have (Figure 2).

Figure 2. GHG savings and health benefits of dockless pedal bikeshare, Copenhagen



Impact Summary	Per km of Donkey bike-share trip	Average Donkey bike-share trip
GHG savings (gr CO2)	42	126
Healthcare benefits (EUR-cent)	84.7	254
Congestion savings (EUR-cent)	4.3	13
Average trip length	3 km	

Source: Donkey Republic and Dresden University (2021).

The benefits of bike-share and e-scooters can differ widely between geographic areas. The higher the ratio of car journeys replaced by e-scooters, the higher the overall CO_2 reduction of the system and higher the overall benefits and cost savings. Additional independent studies of the costs and benefits of different micromobility options in different environments are needed. But these results set the stage for an informed discussion on the benefits and trade-offs associated with new mobility options.

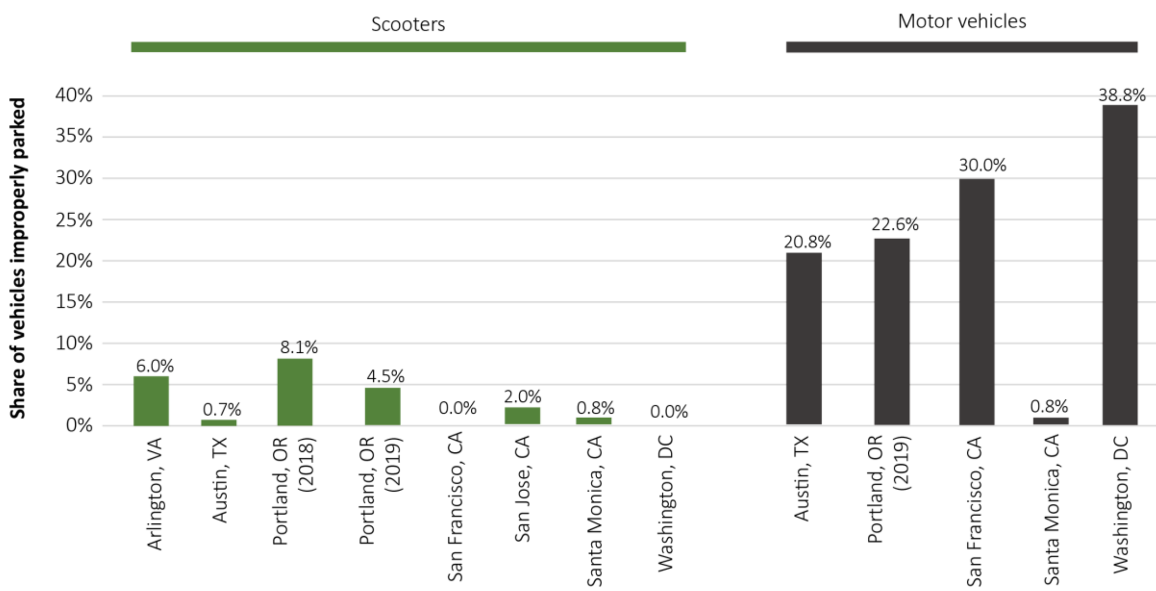
Sidewalks, streets and public space

Space is one of the scarcest resources in cities. Real or perceived conflicts over the use of public space underlie many of the concerns with the emergence of shared micromobility. The use of pavements by e-scooter riders in cities where they are restricted to sidewalks and in other cities where they contravene regulations that ban them from sidewalks creates potential conflicts with pedestrians. And shared micromobility competes for space with cyclists using their own bikes on bike lanes. Dockless shared bikes and scooters also compete for parking space and can clutter and obstruct sidewalks and other public areas (Gössling, 2020).

These issues reflect fundamental deficiencies in many cities' infrastructure, which for decades has prioritised cars at the expense of other modes (ITF, 2021b). And the emergence of shared micromobility has increased existing pressure for redistribution of space to more sustainable modes (Gössling, 2020).

Cluttering and improper parking is another major negative discussion point in cities. Many have voiced concerns about devices left clogging up sidewalks, blocking access to ramps and pathways, which can be especially problematic for people with impaired vision, difficulty walking or using wheelchairs. However, observational research shows that scooters impede access relatively infrequently.

Figure 3. Observed scooter and car parking behaviours in selected cities in the United States



Source: Anne Brown et al. (2020).

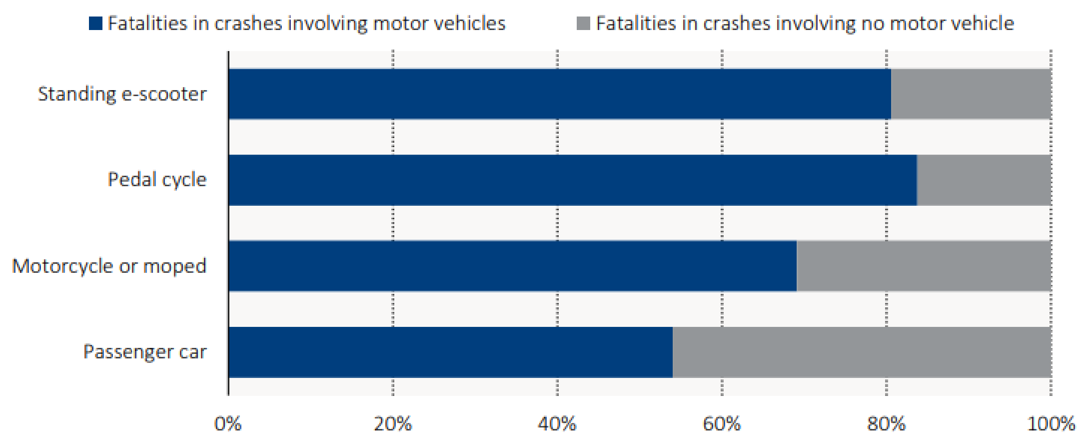
Anne Brown et al. (2020) collected 3 666 observations of e-scooters, bikes, motor vehicles across five US cities – Washington D.C.; Austin, Texas; Portland, Oregon; San Francisco and Santa Monica, California. They found bikes and scooters were parked incorrectly in only 0.8% of insistences, while the rate for cars was 24.7% (Figure 3). While scooters can impede access, focusing only on scooters may miss a broader landscape of challenges faced by pedestrians.

Is micromobility safe?

The safety concerns of micromobility dominate policy discourse in many cities and remains an issue. Perhaps the novelty of shared e-scooters was responsible for the misconduct of some riders. In New Zealand, for instance, surveys suggest that 31% of non-users are not willing to try e-scooters due to safety concerns. Inexperienced riders on vehicles with small wheels created a widespread perception that shared micromobility could become a crash hazard, endangering both riders and pedestrians. Vehicles have improved over time, with larger wheels and tyres, suspension and changes in geometry in both shared e-scooters and bicycles.

ITF (2020c) complied crash and injury data from two years of e-scooters operations and compared these data with crash and injury data for other transport modes. The report found that a trip by shared standing e-scooter is no more likely to result in a road traffic death than by bicycle trip. Findings were controlled for the number of trips made.[4] A trip by car or by motorcycle in a dense urban area is much more likely to result in the death of a road user – this includes pedestrians – than a trip by a micro-vehicle. The report also highlights that motor vehicles are involved in about 80% of crashes that result in the death of bicycle or e-scooter riders (Figure 4).

Figure 4. Vehicle occupant fatalities by third-party involvement



Source: ITF (2020c).

Injury data is more mixed: the risk of hospital admission may be higher on e-scooters, but there have been too few studies to draw firm conclusions. The very limited data available suggests that injury rates are falling. This is because in the last two years, micromobility operators have improved vehicle design and consumers are becoming more familiar with devices and traffic rules.

Good quality data on both crashes and exposure is difficult to obtain. In Oslo, where such data was collected, studies have concluded that crash risk is higher for e-scooters than for bicycles, per kilometre travelled, taking averages for all categories of e-scooter and for all kinds of bikes, including e-bikes[5] (Fearnley et al., 2020). Future research should focus on fatal and serious injury rates instead of a broad crash rate.

More generally, e-scooters are seen to have the potential to contribute to safer streets: if they reduce car trips, there are fewer car crashes, which tend to be more serious than e-scooter accidents (ITF, 2020c). For this reason, cities should aim to compare micromobility crash data to overall motor vehicle crashes (e.g. as a percent of total crashes/ injuries) to provide the public with a more complete perspective.

Principles for regulating micromobility

Micromobility regulation should harness potential net welfare benefits for society and individual users while negative impacts associated with new services are contained. There is general agreement between operators and authorities on the need to regulate micromobility in a way that will contribute to a fundamental shift in mobility habits. But many authorities have been slow to adopt regulatory frameworks that recognise e-scooters as a means of transport. One fundamental point is to decide whether to treat the use of urban space by shared micromobility vehicles in a similar way to other private and public vehicles or to apply laws that regulate the use of public space by street vendors instead, effectively treating the vehicles like food trucks. The use of public rights of way is the more relevant basis for managing and regulating these new mobility services (Fearnley, 2020). Competition policy is also a relevant consideration, both in relation to the business initiative and to the attribution of public property rights to mobility businesses.

Considering broader sustainable urban mobility policy for regulating micromobility

Only a few cities have designed micromobility regulations specifically to make progress toward broader environmental and socio-economic goals. In many cities, overly restrictive regulations have often been at odds with sustainability objectives. Regulation of shared micromobility has sometimes lost sight of how the system can be made most effective, convenient and reliable for users and how it can be integrated with other transport modes. This has limited the extent of these services in some cities, reducing the value of micromobility to the community.

Transport policy needs to shift from a focus on moving people and goods farther and faster to one focused on accessibility through reliability, quality and proximity, serving all people, with a focus on those most poorly served, whether it be because of location, income, gender, physical or cognitive impairment. Prioritising more sustainable forms of transport – walking, non-motorised vehicles, public transport and low emission vehicles – will reduce damage to the environment, make street space more attractive and improve road safety for non-motorists.

At the supra-national level in Europe, the European Commission includes specific guidance with respect to *re-prioritising urban mobility around people* over *solely focusing on vehicular traffic flow outcomes*. This is reflected in the guidance for developing Sustainable Urban Mobility Plans (SUMPs) (Eltis, 2021). Governments are increasingly emphasising this approach. At the national level, the new Mobility Law in France is a notable example. The *Loi d'orientation des mobilités* (mobility orientation law) allocates investment to improving daily transport and getting the most out of the digital revolution as its top priorities (Ministere de la Transition Ecologique, 2021). Many cities have made the same change in policy orientation. For example, Mexico City's 2014 Mobility Law inverted the traditional focus on provision for cars to prioritise walking and cycling, and the object of the City's 2018 *Strategic plan for mobility – One city one system* is to improve quality of life by reducing social inequalities, cutting emissions of air pollutants and greenhouse gases, and improving accessibility with services that are decent, safe and secure (SEMOVI, 2018).

The Covid-19 pandemic and the easing of lockdowns has highlighted the importance of individual, low-carbon, socially distanced transport as governments try to prevent spikes in car use and pollution (ITF, 2020b). The pandemic has accelerated the growth in micromobility stimulated by shared bikes and especially the arrival of dockless systems and shared e-bikes and e-scooters. Micromobility can contribute much to improved urban mobility but will deliver most in terms of sustainability when it is well-integrated with public transport and mobility policy overall.

Regulation of privately operated dockless micromobility is also often at odds with the regulation of docked bike-share systems. Cities either own and operate the assets of these docked bike-share systems (bicycles and station infrastructure) or contract a single private operator to run the system. Cities, such as Paris or Mexico City, were motivated to introduce these systems as part of their sustainable mobility strategies and subsidise them with direct support or through concessions for the use of public space for other purposes such as advertising. For instance, Los Angeles' Metro Bike Share receives more than USD 15 million in funding per year from the city and the LA Metro transportation agency (Guaquelin, 2021; Westervelt and Zipper, 2020). In the case of new privately operated systems, cities have less at stake; hence encouraging the use and growth of privately operated shared systems has often not been a priority. Reck and Axhausen (2021), however, highlight that docked modes are preferred for commuting in Zurich, suggesting that docking infrastructure could be vital for promoting micromobility as an alternative to private cars. Essentially, however, dockless micromobility provides similar benefits to "traditional" docked bike-share systems, and therefore should be supported in a similar way through regulatory facilitation even if subsidies are not needed.

To yield its full potential, policies toward micromobility need to be fully integrated with transit, parking, road safety and pedestrian accessibility policies (Gössling, 2020; ITF, 2020a; ITF, 2020c). Physical integration is important, including through the provision of parking space at transit stations (Ramboll, 2020). Incorporating the new shared modes into travel card payment systems is useful and they should have access to MaaS platforms, whether supported by subsidies or not. Payment integration between micromobility and other transport modes is growing. In Berlin, for instance, users can pay for public transport, the Nextbike bike-share system, and other shared mobility options, including e-scooters and mopeds through the Jelbi app. Similarly, in Denver, users can pay for metro, ride-hailing services and e-scooters via the Lyft app (RTD, 2020).

Applying outcome-based regulation linked to performance criteria

Regulatory intervention in shared micromobility markets should be determined above all by mobility policy and informed by monitoring and analysis of impacts on public policy objectives. Outcome-based regulation using performance criteria is more likely to ensure that new mobility options serve broader city goals than prescriptive regulations such as fixed arbitrary caps on fleet size. Cities need to specify their mobility objectives and work together with operators to define performance criteria accordingly to develop outcome-based regulation. Regulation should then be based solely on factors that lie within micromobility providers' control.

Managing fleet size

Problems with shared bikes and electric scooters cluttering streets and complaints to the government from local residents have led many cities to limit the number of vehicles permitted for operation. Acute problems arose in cities where some first-generation dockless bike operators swamped markets to crowd out the competition (ITF, 2019). In principle, the problem is less likely to arise with electric vehicles that have higher unit costs and there are no reports of oversupply of shared electric bicycles (Licea, 2021). In practice, there have been examples of problems with a fully unregulated supply of e-scooters. After authorisation for legal operation in Norway, 20 000 electric scooters were deployed in Oslo, implying one electric scooter for every 50 inhabitants. This resulted in chaotic conditions in popular locations, blocking sidewalks (Fearnley, 2020). Recently, Oslo Municipality enacted a new regulation limiting the number of micromobility vehicles to 8 000 (shared between all companies that fulfil a set of requirements). This may lead to more companies operating fewer vehicles, resulting in a poorer user experience.

Experience under Paris' successful, initially permissive approach was more positive. The city allowed open access for e-scooter operators with incremental intervention to manage problems that proved persistent. Early problems of clutter were resolved to a large extent by co-ordinated measures, with the city providing a rapidly expanding number of authorised parking spaces, operators introducing incentives and penalties with geofencing technology, and fines for using or parking vehicles improperly on sidewalks. Dott (2021) reports compliance with parking regulations rising from 35% to 97% as a result of these measures (see the section on management of street and parking space below). Subsequently, due to the increasing number of shared vehicles, the city nevertheless decided to limit the supply of vehicles via competitive tender.

Licencing of micromobility varies from city to city in terms of the number of operators and vehicles authorised. Jurisdictional responsibilities vary by city, often with the lowest level of government responsible for authorising use of public space, which sometimes results in fragmented markets. Some city mobility departments and some regional metropolitan transport authorities provide guidelines for regulation and others licence operation directly. Micromobility sustainable operation is compromised where markets are fragmented or the number of licenced vehicles is low. Madrid, for example, has authorised 22 companies to provide shared electric scooters, each assigned to a specific neighbourhood, and Copenhagen split a city tender to provide 3 000 e-scooters between 10 operators. In these cities, companies struggle to achieve profitability, impeding long-term investment in sustainable operations. This approach also risks harming the user experience while increasing the complexity of management for the city. Restrictive fleet caps for operators also cause problems in integrating micromobility effectively with public transport.

Other cities have opted to select a small number of providers that apply for permits allocated according to pre-determined criteria. This is now the case in the City of Paris. In 2019, there were 12 firms offering a total of around 20 000 dockless electric scooters in the city. Tenders were awarded in 2020 to three companies for the right to operate up to 5 000 units each. Tender applications were rated according to three sets of criteria: 1) user safety, 2) operations – management, maintenance, and charging, and 3) environmental responsibility. As a result, micromobility companies Dott, TIER and Lime have been awarded two-year concessions to operate scooters (AFP, 2020).

Similarly, in London, Dott, Lime and TIER have been selected by TfL and six London Councils for a one-year e-scooter trial. Throughout the trial, operators that demonstrate strong performance and compliance with safety standards and control of parking locations could increase the number of vehicles deployed. Those unable to comply with the requirements set out may be required to reduce the number of vehicles (TfL, 2021). Capping the number of operators may make it easier for cities to manage these services and capping fleet size can avoid problems of oversupply, but cities need to monitor markets to make sure that permit caps do not unduly limit availability and competition. In markets with only three players, concerns over potential oligopolistic behaviour are acute (Deighton Smith, 2021). There is also a risk that if one of the operators exits, the city will be under-supplied, at least until new concessions can be let.

Overly restrictive fixed fleet size caps could prevent services from expanding as demand grows and may hinder operators from providing service equitably to all parts of a city. Any permitting structure initially based on fleet size should establish clear, performance-based indicators for the expansion of operator fleets once operations commence to avoid degradations in service reliability as demand grows. Instead of imposing fixed caps on the number of scooters each company can deploy, cities should use dynamic caps that can be adjusted depending on operators' performance linked to the city's strategic goals (Licea, 2021). A clear and transparent methodology that sets thresholds to adjust the fleet size according to specific indicators is needed in order to give predictability to operators. NACTO (2019b) highlights several potential criteria that cities can use to establish dynamic caps (Box 1).

Dynamic caps create an incentive system that rewards the operators that perform best and incentives others to perform better. Many operators prefer dynamic fleet caps, which allow them to increase or decrease the total number of vehicles they deploy based on specific metrics, such as rides per vehicle per day. This is a superior approach to limiting fleet size as the metric chosen can directly translate permit terms and objectives of optimising vehicle use and positioning to maximise benefits and minimise external costs.

Box 1. Examples of performance metrics to adjust fleet size

- Number of trips per scooter per day measured over an identified time frame: If an operator meets this performance measure, they are allowed to increase their fleet size. If an operator fails to meet performance measures, the allowed fleet size decreases.
- Number of trips per scooter per day originating or ending in city-identified targeted service areas: If an operator meets/exceeds performance standards for available vehicles in areas that have poor transit access and/or low rates of car ownership, they are permitted to increase their fleet size. If an operator fails to meet performance measures, the allowed fleet size decreases.
- Strategies that address barriers to use: Operators may increase the fleet size if they meet targets for providing services to target groups such as unbanked populations or providing adaptive vehicles.
- Strategies that encourage preferred parking or riding behaviours: If an operator demonstrates actions to meet the city's goals for parking and use, they are permitted to increase their fleet size.
- Permit compliance: Cities could adjust the allowed fleet size to reflect compliance infractions, measured in the number of infractions per established timeframe.

Source: Adapted from Nacto (2019b).

Dynamic fleet caps have been successful in several cities across the United States. Santa Monica was the first city to introduce them. It originally had a fleet of 2 500 vehicles distributed among four mobility companies. After the introduction of dynamic caps, the number of vehicles in the city increased to 3 250 (City of Santa Monica, 2019). Similarly, St. Louis is an example of a city that uses dynamic caps for its bikeshare. The city started with a pilot programme of 500 bikes. Every month, companies could add 350 bikes to each fleet until they reached a maximum of 2 500. After reaching a maximum, companies could further expand their fleet only if they could demonstrate rising demand for their bikes and had an education and social equity plan (Hall, 2020).

Data-reporting for guiding micromobility outcomes

Public authorities require micromobility operation data for monitoring performance in relation to policy objectives and licencing conditions. Access to data is typically required to monitor the adequacy of supply, equitable distribution across neighbourhoods, temporal and spatial characteristics of use to guide infrastructure investments, and what safety concerns may require action. Data reporting also enables the use of dynamic caps on scooter fleets by adjusting the total number of vehicles operators can deploy based on specific metrics, such as rides per vehicle per day. Authorities should also monitor the characteristics and environmental performance of all vehicles and vehicle fleets to reduce the overall environmental burden of vehicle travel. This evaluation should be based on broad and transparent life-cycle analysis methodologies (ITF, 2020a).

To avoid the emergence of data availability bias, data reporting obligations on micromobility companies should be proportionate to data collection processes from other modes. Micromobility is a digital service; hence data is easy to collect. Yet, there is a lot of analogous data that is not collected, in particular from cars that represent the largest source of burdens from urban traffic. More generally, fair and balanced reporting requirements across all transport modes should be considered.

Many cities have mandated data reporting as part of a scheme’s licence to operate. Micromobility operators, for their part, appear increasingly willing to report data to cities, including information on vehicle locations and trips. Some cities, however, are uncertain what to do with the data once they have it or have data that provides no focus or purpose (Eurocities, 2020). When mandating data reporting, cities need to identify exactly what data will be used for and in what form it should be delivered to facilitate analysis, minimising the reporting burden and facilitating processing and analysis. Some analysis will also require data from public transport and parking ticketing data to understand the impact of micromobility on the transport network as a whole.

Collection and analysis of these data can provide important insights but may raise privacy issues, which are of concern to both public authorities and operators. Operators have access to sensitive information, such as the start and end of trips, history of locations and personal information. Robust data privacy policies should be in place to mitigate risks (Eurocities, 2020). All parties should employ techniques to make data reporting compatible with privacy concerns through data aggregation, pseudonymisation and encryption, and undertake privacy impact assessments (ITF, 2021a).

Regulatory fees

Most shared micromobility operators are commercial businesses. Common with many new digitally-enabled services, sustainable profitability takes time to achieve and business models evolve with a fairly high level of mergers and acquisitions. Rates of market exit and turnover have been accelerated by changes in regulatory intervention. Lockdowns in response to the Covid-19 pandemic saw plummeting usage, with companies exiting many markets around the world (Hall, 2020). At the same time, as lockdowns ease, shared micromobility is seen by some commuters as preferable to crowded public transport and by public authorities as a more sustainable choice than recourse to private cars or motorcycles. Temporary bike lanes in response to Covid-19 have benefited micromobility and the crisis has made all forms of micromobility more central to urban mobility planning (ITF 2020b).

Several advocates argue that micromobility should be treated as public transport, which – with a few exceptions – does not generate profit (Westervelt and Zipper, 2020; Guaquelin, 2021). For all these reasons, governments should not see it as a source of revenue. They should not seek to recover the full costs of administering regulatory requirements in recognition of the social (external) benefits of more widespread use of micromobility, except where warranted.

Cities should carefully assess the charges that are imposed on different transport modes, especially private motor vehicles. Most drivers in urban areas only pay a fraction of the costs associated with car traffic. Underpriced parking is widespread and leads to inefficient use of space and excessive parking demand (ITF, 2021b). While car users often do not pay the full costs of their use of urban space, in terms of parking space and traffic congestion, under the status-quo, cities often impose substantial regulatory fees on micromobility companies on the basis of their new demands on-street space. These fees can be imposed per scooter, per operator permit or per ride and may be additional to penalties imposed for violations of various rules. These fees are often inconsistent with potential negative impacts they seek to address. In some cities, fees imposed on operators are disproportionately high relative to the space micromobility requires and fail to consider the positive social, economic, and environmental benefits that micromobility can provide (Kyrouz, 2020). Cities have justified fees by the need to cover the cost of operating the scooter permit programme and overseeing compliance with the rules. In some instances, these costs are significantly lower than the number of fees being charged.

Micromobility operators use public space to supply their mobility services. Some cities use a commercial model for the use of this space by charging a license fee for usage of the right-of-way and public infrastructure, similar to rent. Cities such as Bogota and Mexico City base regulatory fees on the need to invest in additional infrastructure to accommodate new mobility options. Mexico City licensed dockless bikes and e-bikes and electric push scooters for use in a limited area of the central-western part of the city. Rights to operate were allocated in 2019 through a competitive tendering procedure. A floor price was set, calculated according to the cost of reallocating space to provide designated parking places near metro stations and at other strategic locations on the streets. This floor price was carefully calculated in relation to the costs imposed.

The City's Mobility Ministry calculated the cost of accommodating bicycles to be USD 45 and electric scooters USD 60. The estimates were based on prices paid for parking lots for motor vehicles and the number of micromobility vehicles that can be parked in a standard lot, construction costs for allocating dedicated space for parking shared bikes and scooters, and the impact of these vehicles on the city. However, the bidding process resulted in excessively high winning bids. This was the result of strategic behaviour by some of the competing firms aiming to exclude rivals in an auction without safeguards. In some cases, operators believed they could challenge the legality of the charges after the fact or simply not pay the fees (the licence was subsequently withdrawn for the operator that took the latter route). This resulted in unsustainably high charges per vehicle operated by the small number of winning bidders, up to MXN 14 000 (USD 720) per scooter, per year (Table 2).

The auction collected USD 1 698 654, destined for a public fund for investment in infrastructure for cyclists and pedestrians (Licea, 2021). This amount exceeds the annual regulatory fee paid, for instance, by taxi services that take up more space and contribute far more to road congestion. Ultimately, high regulatory fees forced many operators to exit the market, harming consumers and the city by making the service infeasible for all of the scooter operators and most of the bike operators.

High regulatory fees are likely to limit the supply of micromobility and reduce socio-economic welfare. Ultimately, it may make micromobility businesses unviable. Micromobility should be made available in such a way that all costs are understood and that these costs are fairly shared between the public and private stakeholders (Ramboll, 2020). In some cities, where demand may be expected to be exceptionally large and robust (i.e. Paris, London, New York City), it may be reasonable to seek a fee. However, it is important to consider that costs, service expectations and operational complexity may also be high in these locations. If fees are introduced, they should be specific, targeted and realistic. Fees should not be large and generic irrespective of the actual service being provided, the income generated, or the ability to pay local operators. Public authorities will need to monitor outcomes and adjust fees accordingly.

Table 2. Taxes on micromobility in Mexico City by operator

Company	Units	Annual fee per unit	Total annual payment
Bikes			
Dezba (electric)	500	MXN 1 800	MXN 900 000
Jump (electric)	1 900	MXN 1 300	MXN 2 470 000
Mobike	2 400	MXN 2 600	MXN 6 240 000
Total for three companies	4 800		MXN 9 610 000
Electric micro scooters			
Lime	1 750	MXN 7 200	MXN 12 600 000
Grin	1 750	MXN 14 000	MXN 24 500 000
Total for two companies	3 500		MXN 37 100 000

Source: Licea (2021).

A careful analysis should determine the appropriate amount and type of fees for the deployment of micromobility. A well-planned permit system can be a good mechanism to manage e-scooters and permit fees can be used to cover some costs the e-scooters generate (Ramboll, 2020). Striking the right balance is key, as high fees increase ride costs and limit the number of potential users and operators, or even deprive the city completely of micromobility options.

Promoting equitable access and affordable service

One of the greatest potential benefits of micromobility is improved accessibility in areas and times of day that are lacking public transport. However, deployment in such underserved neighbourhoods has often been limited. The use of localised or geographical restrictions is a common regulatory approach, which in some cases limits operations to specific, often central, areas of cities. Previously, station-based bikesharing systems were criticised in some cities for disproportionately establishing stations in wealthier communities, with limited accessibility in low-income and minority neighbourhoods. For instance, Ecobici – a docked bike-share system – established by the Environment Ministry in Mexico City is operated under concession and serves only the most affluent central-western part of the city. Despite innovation by the city to make Ecobici useable by people without smart phones, through SMS messaging, and providing free public wifi at bike stations, the operating area remains limited and the private dockless systems are limited to the same inner areas. Pilot extensions to public transport nodes in less affluent adjoining areas have been very limited.

Aware of equity concerns, some cities have created equity mandates by selecting zones where a certain portion of e-scooters should be located. In the trial in Zapopan, Mexico, operators were required to maintain an even distribution of vehicles throughout the operating zone and are encouraged to incorporate payment methods other than bank cards for unbanked users and for users without mobile data plans. Similarly, cities, such as Columbus, Ohio, and Washington, D.C., are requiring companies to deploy in underserved areas in order to ensure these new services align with their equity goals (Johnston et al., 2020). Many cities are now working with companies to provide solutions and access for unbanked users, with alternative activation options. In Los Angeles, for instance, Bird offers an SMS messaging service to unlock an e-scooter, and riders can pay with cash (Bird, 2021). In some US cities, micromobility companies also offer discounts to individuals who are part of an eligible local, state or federal public benefits programme (Johnston et al., 2020).

Micromobility companies tend to agree that it is fair to serve all neighbourhoods in the city and provide service to all population groups. However, unlike public transport services, micromobility companies do not operate under formal public service obligations and thus do not receive subsidies to provide vehicles in neighbourhoods where operating is unprofitable, with lower ridership and significant operational costs. On the contrary, cities often charge companies the same fees in communities where service is lacking that they charge elsewhere regardless of the financial viability of providing service in those neighbourhoods.

To ensure that it is financially viable for micromobility companies to provide service in all areas of the city, cities should lessen the burden of these equity-zone deployments by reducing fees and cap requirements in those areas. With dynamic caps, the use of scooters in targeted, underserved neighbourhoods could be excluded from the calculation of fleet limits. This would reduce the financial loss and decrease the operational burden of trying to rebalance the fleet without exceeding caps. For instance, in Portland, Oregon, following a dramatic drop in public transport ridership due to the Covid-19 pandemic, the Portland Bureau of Transportation (PBOT) waived the fees it charged Spin – a shared micromobility operator and allowed the operator to increase its overall fleet size by 250 scooters. This provided readily available access to safe mobility in the midst of a public-health crisis while also helping to ensure remunerative returns for Spin. This has led to a 46% rise in ridership overall and a 137% increase in ridership in East Portland – a priority underserved area (Spin, 2020). Additionally, cities can incentivise providing trips in these neighbourhoods through bonus structures, allowing more vehicles throughout the city when rides in equity zones increase. In some cases, it might be appropriate to provide direct subsidies for operations in these areas.

Applying principles of mode-neutrality

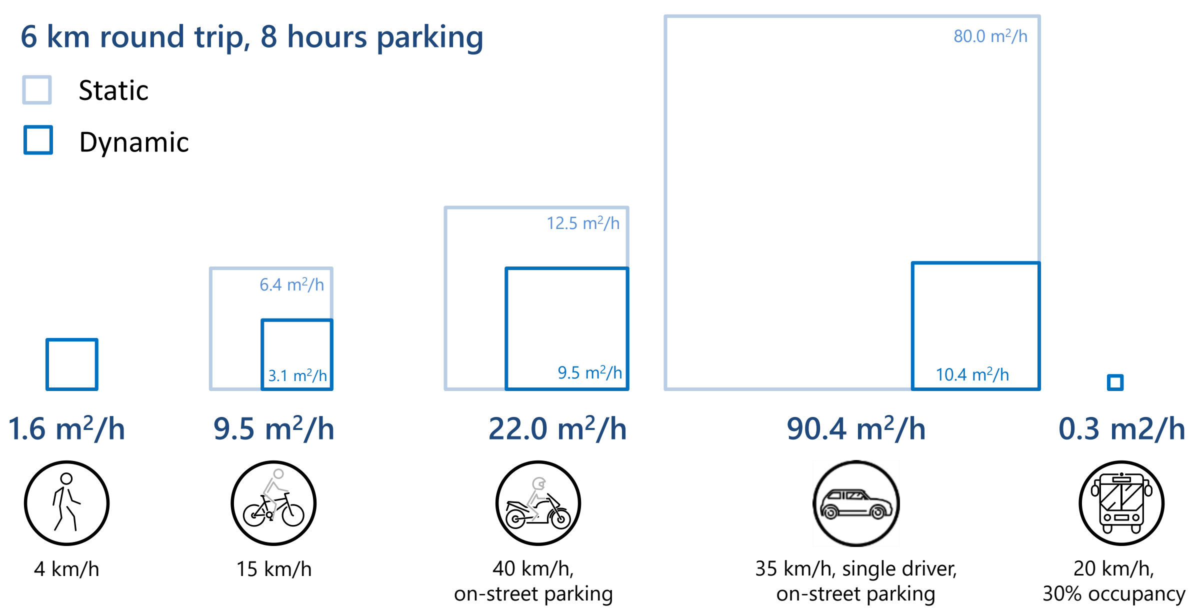
When establishing a regulatory framework for new mobility services, governments should follow a principle of mode-neutrality in considering what will best deliver on the city's strategic priorities. They should consider and evaluate all modes and options to find the best system solution. Principles of mode-neutrality also require removing distortions and biases that favour particular modes, taking full account of their social, economic and environmental costs and benefits instead. In this context, it is useful to assess which rules and fees cities apply to other transport modes – in particular, private vehicles – and to what extent they reflect external costs.

Management of street and parking space

The car is the most space-intensive mode of transport and, in many cities, road and parking space are largely devoted to cars (Figure 5). Governments should review how much road and parking space is allocated to the different transport modes. Several studies highlight a mismatch between the amount of space given to each transport mode and their relative mode split, with car travel unfairly advantaged (ITF, 2021b; ITF, forthcoming). This bias towards private cars often limits the potential for deployment of more sustainable modes, including micromobility.

Urban design and planning should incorporate space for shared micromobility. This includes dedicated lanes and safe and dedicated parking. People feel more comfortable using active modes of transport when protected infrastructure separate from high-speed car traffic is available (Buehler and Dill, 2016). Expanding dedicated cycling lanes for these modes will greatly increase safety and safety perceptions and make it much more attractive to cycle and use electric micromobility (ITF, 2013). ITF (2021b) highlights that the re-allocation of space for the safe use of active travel and micromobility is not a matter of discouraging car use but correcting policy bias that favours automobile travel over other modes while giving those who own a car the ability to change to more sustainable modes.

Figure 5. Space consumption by different transport modes, m^2 per hour



Source: Calculations based on Heran (2011) and ITF (forthcoming).

Parking – on-street and off-street – is also responsible for the consumption of vast amounts of land and accounts for a substantial share of the social costs of car ownership and use (See figure 5). To better accommodate more sustainable modes of transport, cities must rethink parking policy. Estimates suggest that in the United States there are approximately four parking spaces per vehicle (ITF, 2021b). This suggests that car parking could be limited and a proportion reallocated to use by personally owned as well as shared micromobility. A single converted car parking space can store up to 12 micromobility vehicles (Polis, 2019). The low turnover of parked cars when compared with shared e-bikes and e-scooters means the number of people benefitting from this conversion is even higher (Polis, 2019). The default measure should be converting on-street car parking space into bike and e-scooter parking to accommodate micromobility, with space on sidewalks considered a last-resort solution. In this way, cities can use urban space more efficiently while also addressing the issues of improper parking on sidewalks.

The city of Paris is one of the most prominent examples of addressing cluttering and promoting proper scooter parking. The city defined clear goals to 1) ensure that riders do not park on the city's narrow sidewalks and 2) ensure that riders end their rides in dedicated "preferred parking". Paris established 2 500 dedicated parking bays (with an average of six spaces per bay) across the city, reallocating public space from cars and two-wheelers (mopeds and motorcycles) to micromobility. The average distance between parking bays is 100 metres (or two minutes walking distance). The network has been planned not to exceed 2 minutes as, based on the 6t study from 2019, commissioned by Dott, 90% of Parisians would find that an acceptable distance to walk to the nearest scooter. As reported by Dott (2021), the availability of parking spots, combined with in-app enforcement, increased parking compliance from 35% in 2019 to 97% in 2020. Similarly, in London, Boroughs, Canary Wharf and the City of London provided designated bays to protect against street clutter and ensure footways are kept free. Dott (2021) reports that three weeks into the trial, 94% of shared e-scooters were properly parked in the bay or next to it.

It is important to work with service providers when deciding on the location of parking stations. For instance, in Mexico City and in Bogota, the cities earmarked revenues from licence fees imposed on micromobility operators to build parking stations for shared micro-vehicles and bikes. However, operators have complained that the location of these stations was not aligned with demand and the origin-destination of trips, making them inconvenient for users (Licea, 2021).

Safety and speed limits

There is a large variation in the regulated maximum speeds of e-scooters and e-bikes globally. Some are subject to national legislation; others set locally. Norway and Sweden set a 20 km/h speed limit. Paris introduced speed limits of 25 km/h for shared e-bikes and 20 km/h for e-scooters as a whole and 8-10 km/h in slow zones. Some countries, like Belgium, have recently increased the speed limit for e-scooters from 18 km/h to 25 km/h to improve the value of trips by scooter to users. In some cities, however, the speed limits imposed are as low as 15 km/h on streets, making scooters ineffective in providing a mobility service. This could also increase time-based trip prices, decreasing affordability (ITF, 2020c). Low-speed limits could also contribute to increased ridership on footpaths in highly pedestrianised zones because riders judge that to be safer than riding on the road with faster vehicles and also seeing the low speed as compatible with walking. Very low on-road speed limits can severely limit micromobility devices' ability to compete with cars for trip speed, making people much more likely to choose other alternatives, including cars, for their trips.

Micromobility speed limits should take into full account the value of (reasonable) speed to making micromobility an effective alternative to cars. Car traffic flow is maximised on city streets at speeds of between 25-35 km/h (ITF 2021b) and an on-street speed limit of 25 km/h may be more appropriate than 20 km/h in order to make micromobility competitive with cars, although limits may need to be lower in areas where pedestrian traffic is heavy. Conventional bicycles also typically reach speeds over 25 km/h, making generalised shared micromobility speed limits of less than 25 km/h questionable. Where micromobility is limited to a 25 km/h maximum to protect users from death through collision with motor vehicles, it would be logical to consider limiting cars to the same speed. A single speed limit for all in mixed-use streets would be easier to enforce and make traffic more homogenous (ITF, 2020c). Cities around the world are increasingly limiting car speeds to 30 km/h on all but expressways, in line with the recommendations of the Stockholm Declaration of the Global Ministerial Conference on Road Safety (Sweden, 2020).

Lower speed limits may be appropriate for certain types of infrastructure – pedestrian zones and traffic calming zones with posted speed limits of 20km/hr or less. Some cities have implemented these infrastructure and location-based speed restrictions – or geo-fencing – in particular in places with high pedestrian traffic. Condition-based speed limitation adds complexity and costs to operations when application differs between cities and the current GPS margin of error is around 10 m, making geo-fencing suitable to protecting broad areas but not differentiating between use on roads and adjacent sidewalks.

Limiting e-scooters to lower speeds than shared e-bikes is debatable except where e-scooters are required to use sidewalks. Exposure to the risk of minor injury may be higher and collisions with pedestrians may be more frequent, but very little data is available. High-quality studies of the risks of serious injury need to be undertaken and will be particularly instructive in cities where e-scooters and e-bikes are both limited to 25 km/h.

It makes sense to reduce speed in pedestrian areas, but speed regulations should ensure that all vehicles face the same requirements. Speed limits should apply to all non-pedestrian users of those spaces and not just to micromobility devices. Regulations should ensure that all operators face the same requirements and implement them in the same way. Different speed limits for e-scooters and e-bikes may cause unnecessary confusion between riders of these forms of electric transport, particularly given many riders of traditional bikes operate at a similar speed. Thus, speed regulations should apply broadly to all vehicles in these spaces and, more specifically, to all micromobility options (ITF, 2020c). It is important to note that shared e-scooters are more easily regulated and controlled than privately owned e-scooters, and overly stringent regulations of shared operations could push people towards privately owned scooters where the safety risks are more significant.

ITF (2020c) recommends that authorities at all levels should intensify their efforts to address risky driver behaviour, including speeding. Speed limits for all motor vehicles should be no higher than 30 km/h where motorised vehicles and vulnerable road users share the same space. Imposing strict speed limits on micro-vehicles is disproportionate if limits applicable to heavier and faster vehicles are not as strictly enforced. As with speed limiters required by micromobility companies, intelligent speed adaptation (ISA) is a solution for cars. ISA helps drivers to ensure that vehicle speed does not exceed a safe or legally enforced speed.

Adopting standard rules that can be applied uniformly across cities

The regulation of shared micromobility differs from city to city and even within cities. Rather than addressing common issues in a similar way, many local authorities have created inconsistent and unnecessarily complex regulations. This imposes costs on operators in customising vehicles and operations to fragmented markets and can make service provision infeasible. This affects consumers by making shared micromobility rides more expensive and inconvenient, especially when arriving in a new city for work or leisure. Instead, regulations should promote ease of use and interoperability through a standardised minimal approach.

Agreeing on a common set of shared principles that can be applied uniformly across all cities would reduce the regulatory burden on micromobility companies and municipal staff. Micromobility should be regulated as a vehicle class, not operator by operator or device by device, given their similar operational characteristics in terms of speed and size. Thus, cities should establish a single set of rules for all bikes and scooters, whether owned or shared. In areas where multiple jurisdictions are close together, it is important to recognise that shared micromobility vehicles will migrate across boundaries and should be able to cross administrative boundaries in order to serve typical commuting patterns in particular. Neighbouring cities should discuss regulatory co-ordination.

Micromobility providers and local officials agree that state or national legislatures are the appropriate entity to establish general rules and guidelines that could be then adapted to local context. A national framework for micromobility regulation could also require regulations within a city to be uniform regardless of the operator or district of the city. In some countries, national legislation already provides some requirements, such as age limits for electric scooter users when riding on a road or requirements to wear protective equipment (e.g. helmet or safety vest). Since 2018, European countries have started to include e-scooters in road safety codes and national laws. France updated its national transport law in 2019, replacing it with a mobility law, the Loi d'orientation des mobilités (LOM), which makes harnessing the potential of new digitally enabled services one of its top priorities and assigns authority to regulate e-scooters to cities. Article 41 of the LOM presents "a toolbox, enabling a dialogue between operators and public authorities for good usage of public space while helping to integrate and make free-floating services sustainable". The law authorises cities to regulate beyond the rules of the Highway Code (Box 2).

Box 2. Regulation of micromobility in France

In France, users of electric scooters must comply with the requirements of the Code de la Route (Highway Code). In urban areas, users must use cycle paths when available or roads limited to 50 km/h or less. The maximum speed limit for scooters is set at 25 km/h. In addition:

- E-scooters are not allowed on sidewalks (fine of EUR 135) unless authorised by the mayor. In this case, the maximum speed is 6 km/h only for non-electric vehicles
- Users must be at least 12 years old
- Carrying additional passengers is prohibited
- The use of headphones is prohibited
- Parking on the sidewalks is authorised, provided it does not obstruct pedestrians. The mayor can decide to forbid it. For instance, in Paris, parking of shared e-scooters on the sidewalks is illegal and subject to a fine of EUR 49 for users.

The 2019 *Loi d'orientation des mobilités* (LOM) is a national framework that accounts for public space occupation by free-floating services. Operators require a permit from local authorities through tender or expression of interest. Article 41 of the law instructs authorities on regulating free-floating services:

1. Data sharing: Public authorities can ask operators to share data (GDPR format) to ensure compliance with licencing criteria. The number of available vehicles, number, duration and length of trips, origin-destination, and the number of unique users, are among the most common data required.

2. Fleet size: The LOM allows public authorities to cap fleet sizes. Caps must take into account the minimum fleet size required for a service to be economically viable, and the maximum fleet size should not flood the public space with shared vehicles. Public authorities can choose to leave fleet sizes and number of operators unregulated or to deliver a limited number of permits via the competitive tender procedure.

3. Spatial conditions for vehicle deployment: The law allows local authorities to define the operational area (including parking and no-ride zones) after consultation with operators.

4. Compliance with riding and parking rules: In addition to the Highway Code, the LOM allows public authorities to implement additional rules, especially in places of potential conflicts with other road users. Operators have to use technical means such as GPS solutions to enforce safety rules.

5. Removal of unavailable vehicles: Permits can set requirements and deadlines for removal of any out of order vehicle to avoid impeding access in public spaces. It also allows for removal requirements for specific situations, such as for operators withdrawing from a city. A good practice is set at between 24 and 48 hours for light vehicles.

6. Polluting emissions and greenhouse gases: Electric vehicles are preferred and full-lifecycle costs are to be considered.

7. *Advertising restrictions on the vehicles:* Local authorities are authorised to ban advertising, other than for the shared mobility service itself, on the shared vehicles.

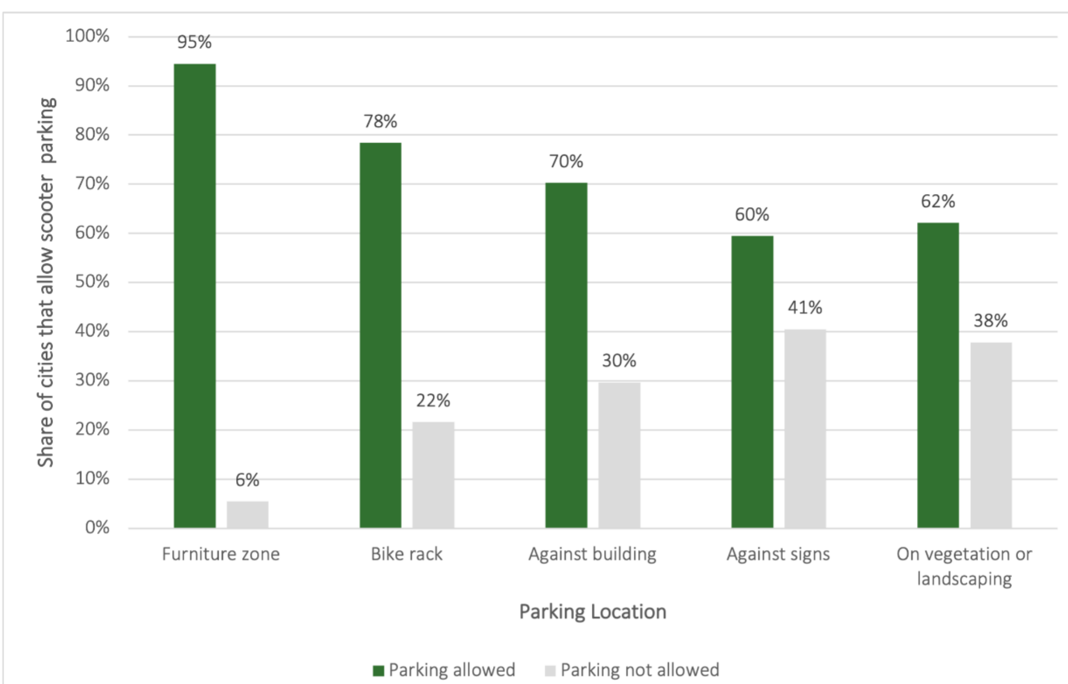
8. Respecting neighbourhood tranquillity: Public authorities need to take into account noise pollution impacts (including maintenance, charging, removal of vehicles, or vehicles' alarms).

Adapted from the French government (2019, 2020).

Parking regulations

Inconsistent and overly-restrictive dockless micromobility parking regulation is proving problematic in many places, undermining the value of services. Most regulations focus on keeping sidewalks accessible and clear for pedestrians. However, differences between cities – or even within the same city – create unnecessarily complex regulations that may be challenging for cities to communicate to the public or enforce (Figure 7) (Brown, 2021). The numerous and often subtle distinctions between and within city e-scooter regulations tend to lead to confusion among riders over parking requirements. For example, Figure 7 below shows the proportion of US cities that allow or prohibit a range of different parking locations for e-scooters.

Figure 7. Share of cities allowing scooter parking across five US cities



Notes: Original data on 3 666 e-scooters, bikes, motor vehicles, and sidewalk objects in five cities across the United States: Austin, TX, Portland, OR, San Francisco, CA, Santa Monica, CA, and Washington, DC.

Source: Brown (2021).

To address parking violations and to help tackle vandalism and clutter, several cities across the United States have made so-called “lock-to” technology mandatory. Requiring vehicles to be locked to external racks or other specific parking infrastructure effectively banned one of the most common bike models that first emerged, which relies on wheel-locks that looped between the bike’s spokes on the back wheel. Mandatory lock-to requirements effectively positioned dockless bike companies that already incorporated lock-to cables in their design to be the only vendors able to operate in these cities legally.

Research by Anne Brown (2021) highlights that lock-to requirements do not necessarily prevent parking violations. Scooters may be locked to unpermitted infrastructure (e.g., parking meters, light posts) or “free locked” – left free-standing unattached to a stationary object despite locking capability. Brown et al. (2020) find similarly low rates of scooters blocking sidewalk access in cities both with and without lock-to requirements, suggesting that lock-to requirements are not a precondition for keeping sidewalks clear. Where insufficient designated parking infrastructure exists, lock-to requirements complicate the use of shared micromobility services and requires that cities invest in filling the gap. Current research suggests that lock-to requirements are an ineffective, unnecessary and counterproductive form of parking control.

From the user perspective, the use of geolocation technology and geofencing for parking seems to be the most convenient option. It is important to ensure that the rules are the same for all operators within the city if users are to be able to comply consistently. The accuracy of GPS means geofencing leaves a margin for users to park up to 10 m away from the parking spot and photo enforcement technology in combination with dedicated, clearly marked hubs has been an important element of ensuring parking compliance.

Fostering innovation through a permissive and adaptive regulatory approach

Micromobility is a rapidly evolving sector, where technologies, service offers and business models are changing quickly as service providers seek to respond to user needs and demands. Minimising regulatory barriers is particularly important for innovation to thrive (ITF, 2019). Overly restrictive regulation, particularly in determining market access, risks distorting the market while inhibiting innovation and reducing value to users (Deighton-Smith, 2021). The principles for regulating app-based mobility set out by the ITF (2019) conclude that

> “Regulation should reflect an essentially permissive and facilitative approach to innovation, which accepts market disruptions, rather than seeking artificially to slow or impede the adoption of new business models and technologies.”

Micromobility is at an early stage of innovation. A flexible approach to regulation is required, with rules that can accommodate the market as it evolves (ITF, 2019; Fearnley, 2020). This does not mean frequent changes in regulations, as this is itself a barrier to operators and users and adds to the costs of regulatory compliance. Adopting indicators related to system performance and avoiding over-specifying regulation is preferable to a focus on fleet size, vehicle characteristics and operating areas. Many authorities have not adapted their legislation with sufficient flexibility to tackle the fast-paced emergence of new services. Many cities have shifted from unregulated micromobility to overly strict regulations. As experience grows and the market matures, some cities have fostered more flexible regulatory frameworks that are linked to operators’ performance, using data to design incentives and penalties. Cities in France, Germany and Belgium have been at the forefront of creating frameworks for collaborations between local authorities and operators through licences with built-in flexibility.

Some cities have adopted pilot programmes, which allow authorities to learn about services, providers, operations and their impacts before settling on a formal permit or licensing structure. Trials and pilots have also proved to be valuable in helping build trust and a mutual understanding of objectives and strategies – and they encourage innovation (Fearnley, 2020). Pilots via temporary operating permits allow cities to collect data needed and produce performance indicators (e.g. utilisation rates, hotspots for parking demand) that should later be included in more formal regulation or bylaws. In Washington D.C. and Los Angeles, an initial set of rules for e-scooters is in effect for one year, enabling city authorities to learn from that trial period and modify regulations before more permanent rules are introduced.

The need to plan evaluations and amendments is equally important (Fearnley, 2020). Lack of clarity represents considerable regulatory risk. Clearly formulated regulations with clearly communicated plans for revisions and amendments will help to stabilise the regulatory environment and give micromobility operators some predictability to base decisions upon.

Conclusions

Micromobility is a new urban challenge for governments, with many cities being in an early phase of market deployment. Some countries are proactive and make it clear that new forms of micromobility contribute to sustainable mobility. They recognise the value of an alternative to dependence on cars, motorcycles, taxis and shared cars, which all pose greater climate burdens, consume much larger amounts of urban space, pollute the air, emit noise and present much higher crash risks to vulnerable road users.

Given the fast-evolving nature of new micromobility services, local authorities are unavoidably going through a period of trial and error. They are learning from experience that some regulatory approaches or specific rules work better than others. Some of the most successful have proven to be incremental approaches that have welcomed entrance to the emerging market and addressed problems where warranted while at the same time regulating and providing space for the new modes. Cities that are advancing in this approach include Brussels and Paris.

Importantly, governments need to align regulatory frameworks with goals for achieving sustainable mobility, equitable access and integrated transport and land-use policies from the outset. Regulatory interventions should assess how to maximise net welfare benefits for society and create user benefits from shared micromobility services whilst containing potential negative impacts. Regulation should take into account efficiencies, environmental performance, beneficial competition outcomes, equitable accessibility and urban planning and road-space allocation consistent with sustainable mobility policy.

Outcome-based regulation should be preferred to static, overly specific, prescriptive regulation. Performance criteria should therefore be preferred to vehicle fleet caps when managing the supply of shared vehicles. Some cities are now more actively working in collaboration with service providers to establish regulatory frameworks that focus on equitable, sustainable and accessible outcomes. In particular, defining performance criteria to regulate fleet size, environmental performance and targets for servicing areas with poor access will help ensure that micromobility serves broader city goals. And cities should carefully revise fees imposed on operators, which in many instances are disproportionately high relative to the space micromobility consumes and the contribution these services make to a multi-modal sustainable transport system. Directions from national-level government are needed where appropriate in order to standardise regulation and treat micromobility operators equally. Importantly, to advance policies for sustainable and efficient transport systems, there is the need to correct policy biases that favour automobile travel over other modes.

Notes

1 According to NACTO (2019a) 45% of users in Santa Monica, CA, Alexandria, VA, Bloomington, IN, Brookline, MA, Hoboken, NJ, Oakland, CA, and San Francisco, CA report that if a shared dockless scooter had not been available, their trip would have instead been completed using a personal or ride-hail vehicle.

2 The study reported that in Paris 23% of free-floating e-scooter trips and 27% of dockless bike trips are “intermodal”: 66% with public transport and 19% with walking. The figures quoted in the current report assume the 66% share of public transport applies equally to e-scooter and bike trips.

3 These results are specific to the case of Paris due to high substitution of micromobility with public transport (in particular metro and light rail (RER)) and very low GHG emissions from metro and light rail (RER) running on nuclear electricity.

4 When comparing crash risk across modes, one could control for three exposure metrics: distance travelled, time spent travelling or trip numbers. ITF “Safe Micromobility” (2020) adopts trip numbers as the denominator in risk comparison due to limited data available on the total distance or total time spent travelling on e-scooters. In some cases e-scooter trips could be shorter on average than bike trips, which may affect the comparison on per km basis.

5 Fearnley (2020) reviews several sources of information based on data on ICU visits. For e-scooters, data was obtained from two main shared e-scooters operators and calibrated to include other operators and privately owned e-scooters by adjusting the number of kilometeres travelled. This data was compared to a study on bicycle crash data (Bjørnskau and Ingebrigtsen, 2015) who calculated the crash risk for bicycles to 8.00 per million km.

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Micromobility, Equity and Sustainability

Micromobility offers cities an opportunity to address congestion, emissions and air quality. This report examines micromobility trends and reviews its benefits and social costs, with the aim to help develop governance frameworks and regulations that maximise the contribution of e-scooters, electric bikes and pedal bikes to more sustainable mobility and minimise any negative effects, particularly for pedestrians.

All resources from the Roundtable on Micromobility, Equity and Sustainability are available at:
https://www.itf-oecd.org/micromobility-equity-sustainability-roundtable

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Published: 06/2021| Photo credit: r.classen/Shutterstock