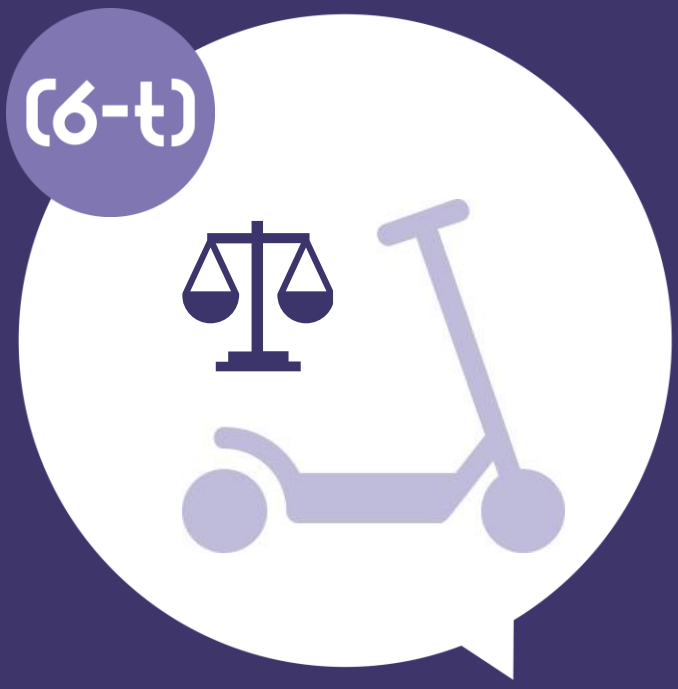

Micromobility for all

A roadmap to inclusive micromobility

Study conducted by 6t for

voi.

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Comments

6t Research in a nutshell

6t is a Paris-based research company specialised in mobility practices, transport, urban ways of living and new mobility trends. Since 2002, 6t has placed itself at the interface of academic research and applied studies in order to provide its clients with a high-level expertise.

6t is able to mobilize a wide variety of methods, from qualitative analysis to quantitative and spatial analysis. This diversity of skills is ensured by a multidisciplinary team made up of sociologists, geographers, political scientists, engineers, economists and urban planners. 6t's consultants support and advise local authorities on mobility practices and urban lifestyles in Europe as well as abroad.

6t has been one of the first research team globally to study the uses and users of shared micromobility services using a scientific protocol, and our results have been widely cited. Our expertise, acquired both through independent studies (6t R&D), publicly sanctioned research projects funded through the subsidies by the French National Environment and Energy Management Agency (ADEME), and studies for private clients (Voi, Lime, Dott) is unique among consultancy firms. 6t has entered an exclusivity agreement with Voi for the year 2021-2022 around an ambitious research program on micromobility inclusiveness.

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Executive summary

Since 2018, micromobility services have developed all around the world. Their contribution to urban mobility ecosystems is now widely recognised. However, a key concern remains: these services rely on a very limited user-base, composed by a majority of upper-class working men. Voi is the first operator to tackle this project through an ambitious research project, leading to the definition of a new roadmap towards inclusive micromobility. This executive summary highlights some key results. It is organised around three research questions.

1. What does it mean for a mobility service to be "equitable" or "inclusive"?

The question of inclusiveness, equity and justice in mobility is a complex, multidimensional one. Its challenges apply to all transport services, beyond micromobility alone. Past research has adopted three key approaches to conceptualise it:

A first set of approaches has focused on **accessibility**: all citizens should benefit from the same level of access to key life activities, such as work, education, healthcare or culture. This implies an equal level of service in all areas, as well as affordable service for low-income users. These approaches have been championed by public authorities around the world. For micromobility operators, they imply a careful management of dockless fleets to make sure disadvantaged neighbourhoods are not under-served. Spatial accessibility should be ensured while limiting any public space clutter ; local authorities can assist by providing dedicated parking spaces.

A second set of approaches has focused on **capabilities**, that is, each individual's capacity to take advantage of an accessible transport mode, given specific constraints and preferences. Constraints may be financial, time-related, cognitive, or related to a physical disability. Preferences refers to individual's representations of transport modes and of their attractiveness and adequacy for daily mobility. Accounting for capabilities implies the following : it is not sufficient for an e-scooter to be sitting in front of someone's door for that person to use it. Offering a truly inclusive service implies understanding the needs and constraints of under-represented users, and adapting the service to those. These adaptations will, in some instances, require the support of the local authority. For instance, past research on women's cycling practices has shown that women tend to cycle less due to a higher risk aversion ; this risk aversion can only be addressed through the provision of secured infrastructure by the local authority.

The final approach is the most ambitious of all : **mobility justice** implies letting under-represented users shape the service to their needs and monitor its performance. These approaches give users an agenda-setting power, and make micromobility operators accountable to their representatives. Technically, this implies setting up a grassroots performance monitoring group with a true impact on service operators.

These approaches amount to three key steps towards mobility inclusiveness, from the most basic – ensuring everyone has physical and financial access to a vehicle – to the most ambitious – including under-represented users within the governance of the service.

Pictogram credits: Brandon Shields and Sumit Saengthong for the Noun Project.

2. What is the current state of inclusiveness in micromobility?

The lack of inclusiveness of micromobility services has received a lot of attention from the media and local authorities. In this report, we endeavour to place this issue within the wider shared mobility landscape: is micromobility's lack of inclusiveness unique? What sets the service apart from others that have existed for a long period of time?

Available evidence on shared mobility user profiles reveals that they are in line with the "early adopter" profile: they tend to be wealthy, highly-educated, full-time working men living in urban areas. Their age differs from one service to the other: carsharing users vary little from the general population, while dockless bicycle service users tend to be much younger.

Shared bicycle and shared e-scooter services are the most comparable in terms of use case; compared to bicycles users, dockless e-scooter users display a more inclusive profile in terms of age and income. This may be related to the nature of the service itself, or to the already ongoing efforts of micromobility operators.

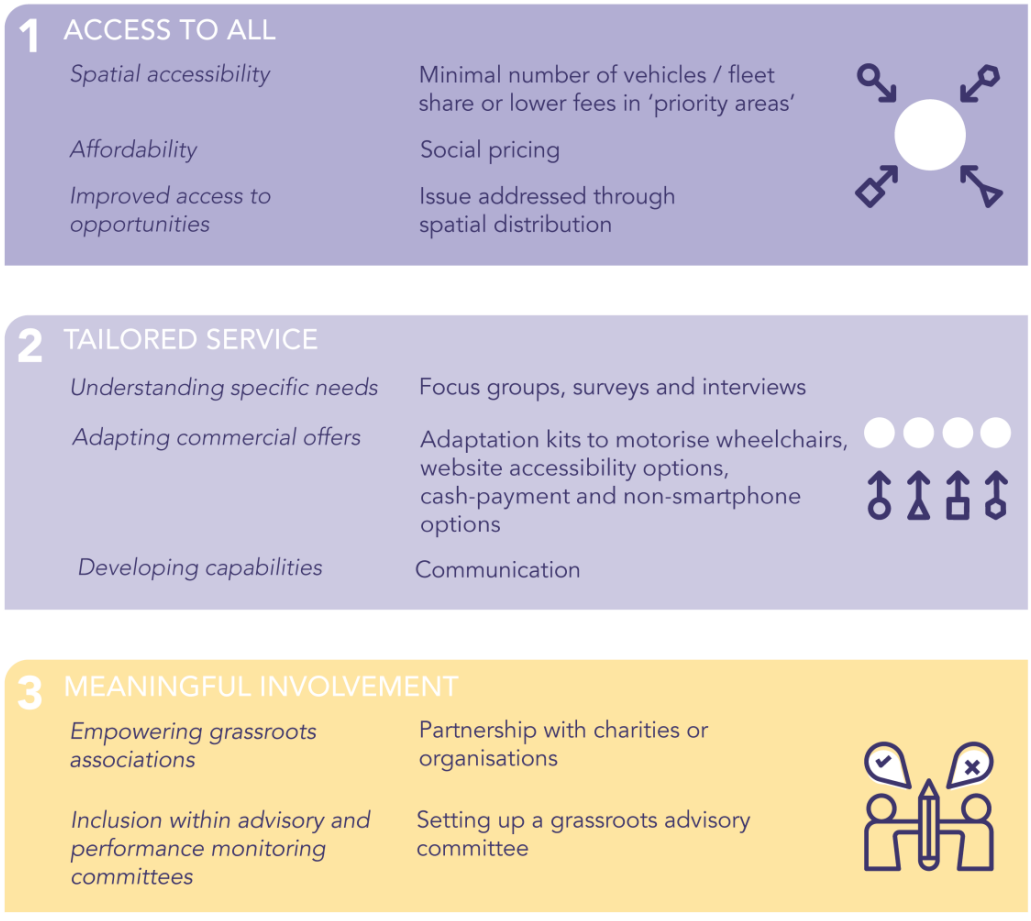
Yet, more needs to be done to answer the needs of women and low-income users, strongly under-represented among e-scooter users. Careful fleet management and social pricing can be used to address the latter. Regarding the former, evidence suggests that even when women do use the service, they do it less frequently, and more often than not, for leisure. Given that women tend to be most often in charge of household-serving trips than men, this suggests that e-scooter services have not yet managed to answer their daily needs. The priority for operators is thus to better understand barriers, and co-construct answers to these barriers with under-represented users.

All in all, micromobility services display the same shortcomings as other shared mobility services. This is an important point to keep in mind: if all these services face the same problem, the solution should be holistic.

Local authorities have, again, a key role to play in setting an inclusive "playing field" for operators. Mobility as a Service (MaaS) applications, including social pricing, may be a way to address this. Infrastructure provision, again, will be key to the inclusiveness of shared e-scooter and bicycle services.

3. How can micromobility inclusiveness be achieved?

Having clarified what it means to achieve micromobility inclusiveness, and analysed key data to characterise the current situation, we moved on to exploring the measures to address it. A benchmark of all measures taken by micromobility operators was conducted.



Pictogram credits: Brandon Shields and Sumit Saengthong for the Noun Project.

These measures were analysed, and confronted to the three steps towards micromobility inclusiveness. The benchmark revealed that micromobility operators' efforts have concentrated on the first two steps; addressing the third step would be ground-breaking. It should also be noted that measures in the first two steps could also be greatly improved.

Step 1 – Access to all

Universal spatial accessibility requirements have been experimented as part of e-scooter pilots, but no operator so far has committed to equitable fleet distribution in all the cities where it operates.

Social pricing has been offered by the majority of operators; however, the efficiency of this measure has not been evaluated. Rigorous evaluation would be necessary to ensure that social pricing options are properly defined, and that they are known and accessible to eligible users.

Step 2 – Tailored service

Several operators reported conducting focus groups with users, or distributing surveys. Yet, so far, the link between these approaches and service operation does not appear to be clear. Most of the measures implemented seem to be generic (social pricing, targeted communication) rather than grounded in user feedback. All in all, a structured approach to user consultation appears necessary, and it is one that Voi is currently developing.

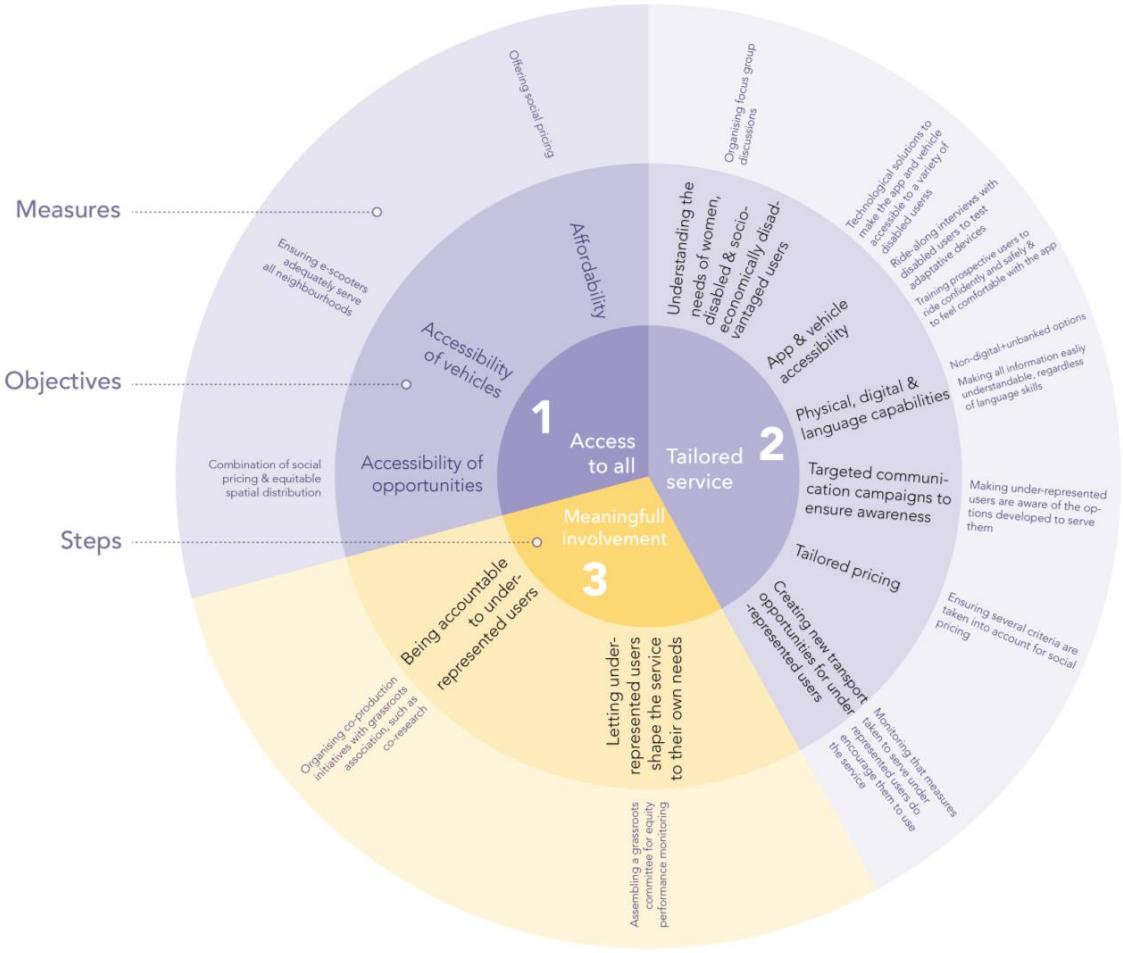
Step 3 – Meaningful involvement

So far, under-represented users or non-users have had little involvement in service design and monitoring. To achieve mobility justice, operators need to involve the public in setting the agenda, and to form institutions, thus making companies accountable to grassroots community representatives. The work conducted by Voi with the Royal National Institute for Blind People (RNIB) is an encouraging exception, and opens up the way for co-design in the future.

4. Next steps: Voi's roadmap towards micromobility inclusiveness

Voi has already demonstrated a commitment to inclusiveness, and has developed satisfactory responses to the three steps towards micromobility inclusiveness. The company now wishes to structure its strategy and to achieve the most ambitious level of commitment on all three dimensions. This research work has resulted in a structured roadmap towards micromobility. This roadmap organises measures across cities of operation, and plans for user consultation as well as direct involvement through performance monitoring groups. This overarching framework should be adapted at the level of each city; it would then result in the adoption of local inclusiveness plans, presented to a committee of underrepresented users.

Roadmap towards inclusive micromobility



Introduction and methods

1. Context

1.1. The challenge of providing inclusive micromobility

Since 2018, micromobility services have developed all around the world. After initial concerns around parking management and street clutter, micromobility has now shown its contribution to urban mobility ecosystems. Nevertheless, **a key concern remains: that of social equity and inclusiveness in micromobility.**

The first user surveys conducted since the launch of these services have allowed us to define the profile of the average dockless micromobility service user. It tends to be an **upper-class, wealthy working male**. In Paris, for instance, 6t found that dockless e-scooter users were young (36 years old on average), male (66%) and working as executives or in higher intellectual professions (53%).

This data reveals two key issues: **social inclusiveness and gender inclusiveness**. Shared mobility services tend to be too expensive for low-income users, especially when compared to subsidised public transport. However, the barriers may go further than price only: in most European metropolises, bicycle users also tend to be wealthier than the average population. This could be explained by a cultural valorisation of this mode of transport in these social classes, but also by the fact that bicycle infrastructure provision, as well as shared mobility offers, tend to concentrate in privileged dense city centres.

Lack of gender inclusiveness is also a key issue. **Women are underrepresented among e-scooter service users** (34% in Paris according to 6t, 2019). This is not exclusive to e-scooters: in most European countries as well as in North America (J. R. Pucher and Buehler 2012), women only represent a minority of cyclists. Past academic research on the barriers to women cycling have led to two key results (Ravensbergen, Buliung, and Laliberté 2019): (i) women would be more risk-averse than men, and thus less likely to cycle in the absence of secured bicycle lanes; (ii) women would suffer from the weight of unequally shared domestic tasks. Travelling with children or while carrying groceries is less easily done on a bicycle than commuting on one's own. The way these barriers could apply to micromobility has not been investigated yet.

Finally, the micromobility revolution can be perceived as **leaving aside those who live with disabilities.** Not only are they less likely to take advantage of this new mode, but disabled citizens also tend to suffer more from the possible negative externalities associated with micromobility such as disorderly parking, or pavement riding. Both of these dimensions should be investigated: increasing disabled users' capacity to use micromobility vehicles, but also making sure those who cannot – or do not want to – are not negatively affected by service development.

These examples highlight an important fact: **inclusive micromobility can only be achieved through the joint efforts of local authorities and operators**. Operators need to ensure that their service fit the specific needs of under-represented users, and that they are accessible and affordable to these all. Conversely, they need to ensure that they do not impose any negative externalities on non-users. Nevertheless, the accessibility of service, and the negative externalities they may cause, will be greatly determined by the urban environment: women's risk aversion is a product of public space sharing between motor vehicles and other vehicles, and operators have no influence on this factor. Similarly, orderly parking can only be ensured if public space is planned accordingly. It is thus important for operators and local authorities to enter a productive dialogue on these issues, as operators will not be able to achieve this goal of inclusivity on their own.

Micromobility's lack of inclusivity has become a key concern for local authorities, some of them even questioning whether they should support a mobility offer that mainly serves privileged citizens. **So far, no operator has developed a position on the topic, or outlined a roadmap to address this equity concern. This is what Voi wishes to do with this report.** The company wants its strategy for inclusiveness to be ambitious, purposefully defined, and associated with a rigorous performance management plan. This report thus endeavours to answer the following research questions:

- What does it mean for a micromobility service to be "equitable" or "inclusive" ?
- What is the current state of inclusiveness in micromobility ?
- How can micromobility inclusiveness be achieved ?

After reviewing the academic literature on transport equity, inclusiveness and mobility justice, this report applies these findings to micromobility operations and outlines the key steps to achieve micromobility inclusiveness.

1.2. Key terms: inclusiveness, equity and justice

The topic of transport inclusiveness and mobility justice is a complex, multidimensional one. This research aims at exploring ways forward to make micromobility more inclusive, that is, accessible and relevant to a wide variety of users. Different terms may be used to refer to this project; we have chosen **inclusiveness as a keyword to refer to Voi's project to ensure that no category of user is unable to benefit from its services**. In addition to this term, used to express a commitment to developing a diverse user base, the concepts of **transportation equity** and **mobility justice** will be regularly used in this report. While there is no widespread agreement around the definition of these key concepts (Pereira, Schwanen, and Banister 2017; Schwanen 2020), some key features may be outlined.

The term '**equity**' tends to be used to refer to the equal and fair distribution of the benefits and costs associated with a certain project. When applied to transportation, it can be understood in the following way: all inhabitants of a city, whatever their living area and socioeconomic status, should benefit from transport services equally, and the negative externalities of these transport services (noise, pollution, clutter) should not be overwhelmingly born by disadvantaged citizens. This approach is influenced by a focus on **distributive justice, that is, "*the distribution of benefits (resources and opportunity) and costs, harms, and risks associated with particular decisions, actions and changes*"** (Schwanen 2020, 132). This term refers to the conception of inclusiveness most commonly used in policy analysis and evaluation.

The term '**mobility justice'** suggests a broader understanding: justice goes beyond the equal distribution of benefits and costs ; it also involves the **inclusion of under-represented citizens in the decision-making process**. Applied to transportation, it implies participatory planning, and an understanding of the different needs and constraints of different groups. Not only should resources be equally shared, but some citizens (e.g. mobility-impaired people) may need different resources to seize mobility opportunities. As summarised by Juárez (2020, 440), transportation justice "*describes a normative condition in which no person or group is disadvantaged by a lack of access to the opportunities they need to lead a meaningful and dignified life. […] Also essential to this notion of transportation justice is that residents and other stakeholders should be able to actively participate in and influence the decisions that affect their lives*".

2. Methods

To develop this framework towards inclusive micromobility, 6t first conducted a literature review of academic articles and technical reports. This theoretical, academic literature review aims to:

- Properly define concepts of inclusiveness, equity, justice, and outline their associated objectives and limits;
- Identify those groups concerned by transport disadvantage and the barriers they face;
- Discuss the current state of inclusiveness in shared mobility, and locate micromobility within this ecosystem;
- Review the operational steps taken by operators around the world to address this lack of inclusiveness.

This literature review thus brings together a theoretical review, aimed at clarifying what Voi should seek to achieve with this roadmap towards inclusive micromobility, and an operational benchmark, aimed at outlining the measures that need to be taken to address these goals.

This literature review work is used to define a 'roadmap to inclusive micromobility'. This operational framework is structured around goals identified from the academic literature; to each of these goals are associated sub-objectives, operational measures, and a performance monitoring plan. **Mobility justice is not a state-of-affairs, it is a process** (Verlinghieri and Schwanen 2020) **implying constant monitoring, correction, and new actions**. To account for this, the framework is incremental, and identifies different steps, associated with different actions. The framework is designed to be immediately applicable by Voi; in a later stage, the performance monitoring plan will be used to evaluate the state of micromobility inclusiveness in some of the cities where Voi operates.

It is necessary to note beforehand that mobility justice and inclusiveness rely on various factors, some being associated with service provision and vehicles, and others associated with infrastructures and regulation and thus depending on public stakeholders and local authorities. This report focuses on the role played by operators in achieving inclusive micromobility. Therefore, the aspects depending on local authorities are not specifically addressed here, but it should be kept in mind that they do play a part in the way private services are provided and used.

Section 1
Literature review

1. Understanding transportation equity and mobility justice

Key findings
• Achieving transport inclusiveness is a **longstanding challenge**, across transport systems and services. • **Accessibility** implies that all citizens should benefit from the same level of access to opportunities, wherever they live and regardless of their sociodemographic profile: it is a necessary first step to build inclusive mobility • **Capabilities and motility** approaches refer to individual's capacity to convert available resources into opportunities and take into account the multiple factors that may limit one's mobility, in addition to physical or financial barriers • **Mobility justice** can be reached by getting disadvantaged citizens involved in designing and monitoring the performances of a mobility service ; the pursuit of mobility justice implies that operators engage with civil society organisations at the definition, deployment and evaluation phases of a service • **Transport poverty** refers to the reinforcing cycle connecting social disadvantage and mobility: mobility is necessary to reach life opportunities (work, employment, social networks, culture), and limited mobility thus lead to social disadvantage. Similarly, resources are necessary to be mobile (money, time, skills). Socially disadvantaged people thus tend to be less mobile. Immobility fuels poverty, and poverty fuels immobility.

Research on equity and justice in transport has unfolded over different stages (Verlinghieri and Schwanen 2020). Early research focused on physical accessibility to opportunities as allowed by transport networks; later works on transport poverty have investigated the link between limited transport options and social exclusion (Lucas 2012) ; recently, the development of mobility justice approaches has shed light on the importance of accounting for the fact that **different under-represented groups may have different needs, and should thus be meaningfully consulted and involved in decision-making**. This section discusses these concepts and explores their operational implications for shared mobility in general, and micromobility more precisely.

This first section presents a theoretical discussion of conceptions of equity and justice, and their implications for inclusiveness transport service provision. It concludes by identifying some incremental steps to achieve mobility justice, from the necessary, most basic steps, to more ambitious approaches. **The following section will operationalise these theoretical orientations by applying them to the specific case of micromobility**; by bringing these two together, we will be able to outline the structure of the roadmap towards inclusive micromobility.

1.1. Accessibility: a necessary first step to build inclusive mobilities

Early research on equity in transport was influenced by the **spatial mismatch hypothesis**: research originating from the US showed that lower-income citizens (Wachs and Kumagai 1973) as well as discriminated African American citizens (Kain 1968) tended to live further away from work opportunities, but also to be poorly served by public transport. Equitable transport planning should correct this mismatch, and allow all citizens to benefit from the same level of access to work, education and socialisation opportunities, wherever they live.

These approaches now constitute the keystone of governments' evaluation of transport equity (Verlinghieri and Schwanen 2020). Three key types of indicators are most commonly used (Pereira, Schwanen, and Banister 2017):

- People's proximity to transport services (e.g., access and egress time from nearest shared vehicle or public transport stop);
- People's daily travel behaviour (e.g., average number of trips per day, average trip distance): people who travel less or shorter distances are identified as disadvantaged;
- Access to opportunities through transport services from a given neighbourhood (e.g., number of jobs reached in 30-minutes from a given area).

While these three types of indicators are those most commonly used, decades of research have allowed for a substantial diversification and refinement of methods to measure accessibility (Currie 2004; 2010) :

- Accessibility indicators: used to measure the accessibility offered by transport services:
    - In London, the **PTAL** (Public Transport Availability Level) is a general accessibility indicator. It takes into account access time to public transport as well as the availability of service (frequency) to rate areas according to how well they are served by public transport;
    - **Core accessibility** indicators are used to measure the accessibility of core activities for different social groups. Such an indicator could be, for instance, the share of school-aged children able to access a school on public transport in 15 to 30 minutes.
- **Targeted indicators**: aim at measuring the accessibility of transport modes given the specific needs of disadvantaged users. Such an indicator could be the share of buses with low floors, accessible to mobility-impaired users as well as parents with strollers. These indicators are useful to evaluate the lack of accessibility certain groups may face, regardless of their residential location.
- **Accessibility models**: use GIS mapping to generate accessibility maps. These accessibility maps are usually based on a combination of core accessibility indicators (accessibilities to schools, to employment, to cultural institutions, etc.). They usually rely on isochrons – maps showing the geographical reach from a specific area in a given time.
- **Generalised cost models**: used to connect the geographical dimension of accessibility (transport services and infrastructure) and the social dimension (cost and time). GIS techniques may be used to map composite indicators assembling, for instance, access time to a mode of transport, opportunities accessible in a given travel time, and the share of the fare within the average household's budget in the area.

One could argue that e-scooters could fit well into these approaches, initially developed to study public transport investments. Indeed, past research has shown that about one in four e-scooter trip is intermodal, the majority of these trips being connected with public transport (6t-Bureau de recherche 2019b).

These approaches offer powerful ways to quantify who is served by a transport service, the quality of the service offered, and its contribution to accessing life opportunities. However, they display a key limit: these

methods tend to rest on the premise that every single person will be similarly able to take advantage of a new mobility option, as long as it is affordable and delivered to that person's door. This is a simplified understanding of modal choice: daily time constraints related to work and care, physical ability, digital skills, all these factors impact the way we organise our mobility and choose our transport modes. As noted by Verlinguieri and Schwanen (2020, 2), "*a 'resource' in the abstract is not necessarily enabling every person in a particular situation*". Capabilities approaches have been developed to account for difference across and within disadvantaged groups.

1.2. Capabilities approaches and motility: the multiple factors that may limit one's mobility

The models discussed in the previous part suggest the following key point: for a service to be used by a variety of users, it needs to be both physically accessible, and financially affordable. While this is a necessary precondition, it is not sufficient to ensure inclusivity. Indeed, it is not because a new mobility service is sitting by your door that you will necessarily use it: each person has different preferences, values, constraints, skills, and all these factors will influence his or her appropriation of a transport mode. As noted by Verlinguieri and Schwanen (2020), "*a resource such as accessibility, or even mobility understood as the ease of moving through physical space, cannot duly account for the diversity in needs, aspirations and abilities*".

Capabilities approaches have been developed from the work of Amartya Sen (2005) and Martha Nussbaum (2011) to account for this complexity. These approaches start from the following premise: **focusing only on the distribution of resources (in our case, transport services) would give an incomplete picture of the opportunities accessible to citizens**. Mapping widening isochrons after the launch of a new mobility service suggests that each and every citizen living in the newly serviced area is similarly able to take advantage of this mode. This is, however, not the case. Each person's ability to seize transport opportunities when supply is available depends on his or her own skills, representations, and social context. **Capabilities refer to the individual's capacity to convert the resource available (e.g. transport offer) into opportunities (e.g. accessing more employment opportunities)** (Pereira, Schwanen, and Banister 2017).

How can these capabilities be measured? Kaufman et al. (2004) coined the concept of **motility capital** to refer to an individual's capacity to be mobile. Motility is determined by three components:

- **Accessibility** refers to the material conditions of this mobility. To be mobile, I need to have access to public transport, to a car, to a bicycle, to a road, etc. This access refers to both physical accessibility and financial affordability. This first factor echoes the accessibility approaches detailed in the previous sub-section.

- **Skills** refer to the physical and cognitive competences to be mobile. These skills may be the skill of driving a car, riding a bicycle, but also of using an app to book and unlock a shared e-scooter. IT skills are particularly important when it comes to new mobility services (Pereira, Schwanen, and Banister 2017).

- **Appropriation** refers to individual preferences, representations, norms and values. For instance, a user needs to consider e-scooters as a legitimate mobility options to integrate them to his or her daily commute.

All three components are necessary for someone to have the capacity to be mobile. This has important consequences: having an e-scooter sitting in front of your door (accessibility) will not improve your access to job opportunities if you do not feel confident riding, or are physically unable to ride the vehicle (physical

skill). It will also make little difference to your daily life if you are unable to book the e-scooter through an app (cognitive skills), or if you consider e-scooters as leisure modes used for fun or by tourists (appropriation). A **holistic approach** is thus necessary to understand whether a new mobility service will make a difference to the users it endeavours to serve.

Motility – the capacity to be mobile - is considered to be a capital, that is, a resource that people can use to improve their life opportunities. This resource can be used to acquire more resources, such as money by accessing a job (economic capital) or education by accessing a school (human capital); the capacity to be mobile also allows people to maintain social networks and rely on friends and families (social capital). Being unable to take advantage of mobility options may thus lead to social exclusion.

1.3. When lack of transport opportunities leads to social exclusion: transport poverty

Indeed, mobility is not an end in and of itself: we travel to access opportunities, may they be work-related, educational, or social (Verlinghieri and Schwanen 2020). Being mobile allows us to go to work and receive a salary, to attend school and receive an education, to develop and maintain our social networks. All in all, mobility is key to a fruitful life. However, mobility is also only possible as we use certain resources to be mobile: being mobile takes money and time. All in all, a low-income or time-stretched person is less likely to be mobile; similarly, a person who is not mobile is less likely to develop his or her resources and skills. Indeed, **in most countries, the poorest socioeconomic groups also tend to be the least mobile (Lucas et al. 2016).** Transport disadvantage and social disadvantage are thus mutually reinforcing.

The concept of transport poverty refers to this link between transport disadvantage and social disadvantage. Transport-poor people tend to suffer from (i) a limited access to mobility options, that is, access; (ii) a limited capacity to seize these mobility options, that is, a limited motility. The concept of transport poverty thus also brings together distributive justice – universal service provision – and capabilities – the individual skills and constraints that mitigate each individual's capacity to seize opportunities for mobility.

The concept of transport poverty is mostly discussed to refer to lower income people. However, it is worth keeping in mind that women have also been identified as transport-poor users (Dobbs 2007): within a day, they tend to perform less trips that men, and their trips tend to cover short distances (Hanson 2010). This is due to several constraints: first, women tend to have a lower income than men, and household resources tend to be spent on men's mobility rather than women's (Cook and Butz 2018). Not only do women have less resources for mobility than men, they may also be compelled to spend more on their mobility than men do. Plyushteva and Boussauw (2020), for instance, found that women are more likely to use taxis to ensure their safety when travelling at night, leading to higher mobility-related spendings. This points to another key aspect: **lack of safety is a key determinant of women's mobility choices, especially at night**[1]. These safety issues do not concern only women, but also transgender and gender non-conforming people. Finally, women tend to suffer from unequally shared domestic constraints, leading them to look for work closer to home; due to these unequally shared domestic constraints, women are also time-poor, and time is a key resource to be mobile (Scholten, Friberg, and Sandén 2012).

As transport-poor subjects, women tend to be under-represented among certain transport mode users. The gender gap is specifically large for the bicycle: in most Western cities – with the notable exception of

[1] Voi, alongside Tier and Lime, has signed up to the GLA's Night Time Safety Charter - https://www.london.gov.uk/what-we-do/arts-and-culture/24-hour-london/womens-night-safety-charter

Dutch and Danish cities[2] (J. R. Pucher and Buehler 2012) – **women tend to represent only 30% of cyclists or less** (J. Pucher and Buehler 2008; Aldred, Woodcock, and Goodman 2016). The gender gap tends to be even greater for shared bicycles (Goodman and Cheshire 2014; Fishman 2016). This is interesting insofar as bicycles can be considered to be relatively similar to e-scooters, but have been studied for a longer period of time. Research has explored the barriers to women cycling, and reached two explanations: women would not cycle as much as men because they would be more risk averse, and more in demand of protected infrastructure ; the weight of unequally shared domestic tasks would also prevent them from cycling, as this mode would be little adapted to chained trips, to escorting relatives, or to carrying heavy things (Ravensbergen, Buliung, and Laliberté 2019). **It is worth noting that these barriers would probably apply to e-scooters as well, and that they are structural and difficult to address by private operators alone**. However, women's experiences riding e-scooters, and outlook on that mode of transport, have never been studied so far.

Disabled citizens can also be considered to be transport poor, as some disabilities make it difficult to use certain modes, or to navigate app-based systems. **Disabled citizens – using a wide definition including not only physical disability, but also dyslexia and colour-blindness that may impact one's digital experience – would make up 15% to 20% of the population of OECD countries** (Jeekel 2018). Transport services that do not take into account the specific experiences associated with disability are, de facto, forcing these users into transport disadvantage. This disadvantage may, in turn, lead to transport poverty when disabled citizens lack access to work and social life opportunities. It is worth keeping in mind that not all transport modes can adequately answer the needs of disabled users; however, as public space is invested by new services, disabled users may suffer from the negative externalities associated with these modes – road safety, clutter – without being able to take advantage of them. **A first responsibility of transport operators towards disabled users is, thus, safe and sound management of vehicle parking and circulation.**

How, then, can a transport policy or service answer transport poverty? This has been well summed up by Pereira et al. (2017, 184) who note that it should "*distributes transport investments and services in ways that reduce inequality and opportunity. While aiming to enhance overall levels of accessibility,* ***policies should prioritise vulnerable groups and thereby mitigate morally arbitrary disadvantages that systematically reduce the accessibility levels, such as being elderly, disabled, or born in an ethnic minority or poor family***". All in all, to alleviate transport poverty, a mobility service should both improve overall levels of accessibility, but also specifically aim at improving transport access for those who need it the most.

1.4. Mobility justice: the need to engage with community representatives

The concept of mobility justice directly engages with this wish to understand the needs of different user groups. Mobility justice approaches go beyond distributive justice to add two additional factors: **procedure** and **recognition** (Schwanen 2020; Verlinghieri and Schwanen 2020). Procedure refers to the policy-making - or in the private sector, project development - process; for it to be just, those who will be affected by the project should be consulted in a meaningful way. That is, they should be able to **influence the outcome of the process and the nature of the project**. Recognition refers to the "acknowledgment of and respect for the rights, needs, values, understanding, and customs of groups involved in, or affected by, decision-making and governance" (Verlinghieri and Schwanen 2020, 3). It takes procedure one step further: **the outlook of**

[2] The high representation of women among cyclists in Denmark and the Netherlands has been related to extensive infrastructure provision – women being more risk-averse than men – and to the equal sharing of domestic tasks. Indeed, chained trips, care trips and encumbered trips (e.g. grocery shopping) would be incompatible with cycling, and more likely to be performed by women. Men taking on a greater share of these trips would contribute to women cycling. (Prati 2018; Ravensbergen, Buliung, and Laliberté 2019)

those who will be affected should be truly understood and respected; any procedure that does not leave enough space to truly understand these dimensions is not just.

A first, necessary step, would be to **consult these under-represented publics**. Focus group discussions, qualitative interviews, surveys can all be used to explore their needs, constraints, and representations. However, this still leaves them outside of the decision-making process. To answer this limit, academics suggests **engaging with civil society organisations - grassroots associations, charities, activists – as the service is defined, managed, and monitored**. That is, under-represented publics should not be only beneficiaries of initiatives developed by companies and local authorities, but co-construct these. This is an approach that has been little followed by private companies so far; in the public sector, public consultation is now common practice, and mandatory for certain projects in many European countries. However, the meaningfulness of these procedures is often challenged by researchers. Championing mobility justice would thus be a ground-breaking step for a private operator such as Voi.

1.5. How can operators ensure mobility justice in practice?

Operators can engage with activities organised by grassroots associations, and explore how their service could fit into such activities. This is particularly beneficial given that the "*activities and schemes [organised by community associations] tend to cater to the needs of specific disadvantaged social groups, such as those with disabilities, cultural and religious minorities, refugees and asylum seekers, women and gender-variant people, low-income residents of deprived neighbourhoods, children, and other people*" (Schwanen 2020, 133). However, Schwanen also underlines that these initiatives tend to be limited by lack of resources or funding; of course, **companies should not free-ride on these actions, but rather empower grassroots associations.**

In these examples, private companies take the initiative of engaging with these grassroots organisations; as a consequence, they decide on which terms they will engage with these civil society actors. Researchers underline that under-represented users should be given as much capacity as possible to set the agenda, so as to limit bias. Juárez Muñoz (2020) identifies different ways to achieve this. According to Muñoz, **representatives from grassroots organisations, representing under-represented groups, could sit on advisory committees**. These representatives could also **provide feedback on performance assessment plans**. Plus, community-based analyses could also be planned: representatives could be asked to produce their own evidence, or their own plan. In that case, again, they should be given the financial resources to do so.

Figure 1: Transport equity and mobility justice, elements from the literature

2. Outlining the first steps of our roadmap

Key findings
At this stage, it is possible to delineate three main steps towards inclusive micromobility: • Step 1: Ensuring **access to all** through spatial accessibility, economic accessibility and improved access to opportunities; • Step 2: Offering **tailored service**, by understanding users' specific needs, developing users' capabilities and adapting commercial offers; • Step 3: Implementing **meaningful involvement**, by empowering grassroots associations, setting up inclusive advisory and performance monitoring committees.

Many cities around the world are currently undergoing a "low carbon mobility transition" (Geels 2018), that is, "*a structural transformation in technology, physical infrastructure, markets, regulation and governance, cultural values, and user practices toward greater environmental sustainability*" (Schwanen 2020, 132). Considering the case of London, Schwanen (2020) raises the following question: is this transition just? The green mobility revolution may only happen if users adopt multimodal practices, that is,

if they do not use the car by default but combine a variety of modes depending on their motives and constraints. However, in European countries, multimodality is a practice found mostly in high-income groups. Heinen and Mattioli (2019) have actually showed that multimodal behaviours among low-income groups in the United Kingdom actually decreased between 1995 and 2015. To Groth (2019), transport poverty should be understood as the exact opposite of multimodality: transport poverty implies restrictions on mobility options, while multimodality implies access to a variety of options. How, then, could an operator contribute to improving this unequal ecosystem?

The literature review allowed to identify **three important steps towards mobility justice**. Those can be understood as **incremental actions** to take for operators, from the least ambitious to the most ambitious. They are not necessarily chronological, but rather differ in the degree they engage with under-represented users and get them involved in the decision-making process. Step 1 should thus be considered as a basic, necessary pre-requisite for service operator. The following steps denote ambition and a will meaningfully answer the needs of those groups who are under-represented among service users.

The details of each step are outlined below; in the following part, they will be confronted to the current state of equity and justice in micromobility. We will then bring the theoretical and operational streams of our research together to build the roadmap.

Pictogram credits: Brandon Shields and Sumit Saengthong for the Noun Project.

Figure 2 – Steps towards micromobility inclusiveness

2.1. Step 1 - Ensuring access to all

First, e-scooters should be **spatially accessible to everyone, as well as affordable**. This should be a basic pre-condition for services to operate; it is also necessary to maximise a service's contribution to improving access to opportunities within a city.

Applying this to micromobility raises a certain number of business-model related challenges. Shared micromobility services are most efficient and highly used in densely-populated areas, and where the concentration of prospective users – displaying an 'early adopter' profile – is highest. Extending beyond dense city centres at lower fares is an investment few shared mobility operators have been willing to make. The following part discusses the current state of financial and spatial accessibility in micromobility.

2.2. Step 2 - Tailoring the service to under-represented users

The literature reviewed here suggests that having an e-scooter sitting on one's doorstep is not necessarily enough to seize the opportunities it offers. Capabilities approaches, and transport poverty studies, have shown that under-represented users face many barriers beyond accessibility. Specific competences are necessary to use the service, daily life constraints may not be best accommodated by the e-scooters, and negative preconceptions may discourage certain users from experimenting the mode of transport. The needs and constraints of different sub-groups of under-represented users should be understood and engaged with; in turn, tailored responses should be developed.

Micromobility offers a very specific, embodied transport experience that makes it appear readily unsuitable to many groups. **Shared e-scooters may not be suitable to all types of users, but operators have a responsibility to ensure that under-represented users are in a situation to choose to use it if they wish to do so**. To achieve this goal, operators necessarily need to partner up with local authorities, and they will not be able to achieve this goal on their own. Transport poverty and transport disadvantage are systemic issues that can only be understood within a broader urban ecosystem.

Disability has proven to be a challenging for the micromobility sector to address. As will be discussed in the following part, technological innovations may allow a growing number of prospective users to take advantage of these services; however, technology will not make it compatible with all disabilities. For some other citizens, micromobility services will remain nothing more than a vehicle parked in the public space, which raises an important equity question. The implication is the following: ensuring sound parking and safe driving is a responsibility operators have towards all citizens, but particularly disabled citizens.

2.3. Step 3 - Getting under-represented users meaningfully involved

This is **the most ambitious step and one that has not been, to our knowledge, meaningfully taken in shared mobility so far**. This implies understanding the needs of under-represented users through the organisations that represent those, and letting these users shape and monitor structuring decisions, as well as service evaluation.

The mobility justice literature underlines that, to be truly transformative, mobility should allow citizens to engage with the city differently, to transform it by the new uses they make of it and in turn, to change the conceptions policymakers have of the city (Castañeda 2020). Micromobility has a unique potential to achieve this: e-scooters offer a unique and specific transport experience, and past research has suggested that fun and enjoyment were key drivers of practice (6t-Bureau de recherche 2019e; 2019b). This may appear to be a detail, but it is one that sets micromobility – understood as e-scooter and bicycles - apart from other modes. Castañeda (Castañeda 2020) has argued that playfulness can be transformative. Studying bicycle activism in Bogotá, she highlights the importance of playfulness and fun for activists to reclaim the city space. Playful night rides, for instance, allow participants to re-appropriate a city which may be perceived as unsafe. This dimension should be kept in mind when engaging with grassroots organisations.

For micromobility to be transformative, it should also be approached as a wide ecosystem encompassing shared e-scooters and (e-)bicycles, but also private e-scooters and bicycles. Shared e-scooters, specifically, have often been portrayed as a "nice-to-have" rather than a "must-have". However, they contribute to challenging a current state of affairs which is far from inclusive. In Amsterdam, for instance, 48% of public space is allocated to cars while they are only used for 20% of daily trips (Petzer, Wieczorek, and Verbong 2020) To Petzer et al., this is a first injustice, and shared mobility services (in the context of their article, dockless bikeshare) may contribute to addressing it.

3. The state of inclusiveness in shared (micro)mobility: an 'early adopter' profile of users but a potential for diversification

Key findings
• The **profile** of shared micromobility users is very limited, with men, young and highly educated individuals belonging to higher socio-professional categories being over-represented. To make services more inclusive, social pricing and communication-based actions have been implemented. For example, some operators have translated information to make their service accessible for all communities, regardless of the language spoken. • Shared micromobility services are also more often offered in **central and wealthy urban areas**. Pilot programs or public experimentations include spatial equity requirements, minimum numbers/shares of vehicles being defined for 'priority areas'. Many cities in North America require a certain proportion of vehicles to be deployed in these areas. • People with certain **disabilities** cannot use micromobility services, unless adaptative solutions are provided (such as kits to attach wheelchairs to e-scooters, but these remain experimental). Moreover, disabled people are more negatively affected by poorly parked vehicles. Solutions to reduce street clutter are developed by operators (parking racks, contact information to signal improperly parked vehicles). • Individuals who do not have a smartphone or a bank account cannot access to shared micromobility services relying on mobile applications. To date, **non-smartphone** and **cash-payment** options are very limited. • While several initiatives have been tried by operators to date, few have been rigorously evaluated. As a consequence, there are still many questions around the efficacy of initiatives to date. Thorough monitoring would be necessary to advance micromobility inclusiveness.

Sustainability has emerged as the new mobility paradigm (Banister 2008). It encompasses three major pillars: environmental protection, economic viability and social equity. In this paradigm, mobility cannot be regarded as sustainable if it is not socially inclusive. Over the past decade, many new, shared mobility solutions have emerged, stating a wish to contribute to sustainable mobilities. How are they faring on this social equity aspect?

The previous part has allowed to identify broad principles to ensure transport inclusiveness, in general. Those will be used to develop an inclusiveness plan, specifically tailored to micromobility services. To achieve this plan, a first necessary step is the following: evaluating the current state of inclusiveness within micromobility, and the initiatives that have already been taken. This will be discussed in this section. First, **the current profiles of shared micromobility users will be explored**. The following questions will be discussed: are these shared mobility offers equally accessible to all profiles? By whom are they actually

used? What are the main equity issues associated with these new mobility solutions? How does shared micromobility differ from other services? It will be argued that shared mobility service users tend to be display niche, privileged profiles; it is also the case for micromobility users, but micromobility is not unique within this ecosystem. This should encourage policymakers and operators to take a step back and reflect at the level of the mobility ecosystem.

Second, different **initiatives implemented to foster shared micromobility's inclusiveness** will be reviewed. Their objectives, modalities, and results – when available – will be outlined. These initiatives will be confronted to the steps for inclusiveness identified in the previous part (Figure 2) to identify those areas where progress is already being made, and those where new solutions still need to be experimented.

3.1. Shared mobility and shared micromobility's state of inclusiveness

As detailed in the first part, various approaches can be adopted to evaluate the inclusiveness of a mobility service. The following dimensions can be used to evaluate the inclusiveness of shared mobility services, and to locate micromobility within these services:

- The sociodemographic **profile of users**: do all types of individuals use the service? or is it de facto limited to a specific type of users?
- The socio-spatial equity and **spatial distribution of the fleet**, considering the variation of social characteristics from one neighbourhood to another: is the service available everywhere and especially outside the city centre?
- The accessibility of the service regarding the **materials and competences of various types of users**: what are the materials or competences required to use the service?
- The **involvement of users and affected third parties** in shaping the service.

The following section presents the current knowledge and available data regarding the inclusiveness of (micro)mobility services.

a) Shared mobility and micromobility users: a specific profile of "early adopters"

The term "shared mobility" refers to mobility services that make vehicles accessible to a pool of users who will use these vehicles successively. These vehicles may be cars, bicycles, e-scooters or e-mopeds. Services can be station-based – vehicles are rented and returned at pre-defined stations (e.g., station-based bikesharing systems such as Santander Cycles in London, Vélib' in Paris, Bicing in Barcelona) - or dockless – vehicles can be found and parked anywhere within a pre-defined service area (e.g. Voi's current e-scooter services). Such mobility services are almost always provided by private companies; in certain cases, these companies are supported or regulated by local authorities through subsidies or operation licences.

As private companies, operators aim for profit and cost-efficiency. Pricing and fleet features – vehicle type, spatial distribution, fleet size - are defined so as to maximise rentals and profits and, in turn, ensure the service breaks even. These commercial strategies may influence the type of users, and even exclude certain types of users. It should also be noted that, apart from **financial accessibility** and **material accessibility** (material and competences required to use the service), **social representations** associated with a mode of transportation or service can affect the profile of users (self-censorship effects, role of the habitus). Keeping this in mind, what is the profile of shared mobility and of shared micromobility services users? (see Figure 3 for summary)

Carsharing services

Surveys conducted in different countries show a consensus on the specific profile of carsharing users. In all countries considered, most carsharing users live in **urban areas** (Giesel and Nobis 2016; Münzel et al. 2019; Namazu and Dowlatabadi 2018; 6t-Bureau de recherche 2014; 6t-Bureau de recherche, de recherche, and 6t-Bureau de recherche 2016). This makes sense given that services tend to be provided mostly in cities.

They tend to have a higher level of education (Giesel and Nobis 2016; Becker, Ciari, and Axhausen 2017; Namazu and Dowlatabadi 2018; Shaheen 2018; Le Vine and Polak 2019; 6t-Bureau de recherche 2014; 6t-Bureau de recherche, de recherche, and 6t-Bureau de recherche 2016) and to live in households with higher-income levels (Clewlow 2016; Giesel and Nobis 2016; Becker, Ciari, and Axhausen 2017; 6t-Bureau de recherche 2014) However, contrary to the general urban population, the vast majority of carsharing users are **males** (Cervero, Golub, and Nee 2007; Firnkorn 2012; 6t-Bureau de recherche 2014; 6t-Bureau de recherche, de recherche, and 6t-Bureau de recherche 2016). There are exceptions to this trend: earlier studies conducted in the San Francisco area indicated a slight overrepresentation of women amongst carsharing users (Concini and Katzev 1999; Cervero and Tsai 2004).

Moreover, carsharing users are also more **highly educated** than their city's general population. They are also more likely to be **employed** and to display a **high income** (Giesel and Nobis 2016; Becker, Ciari, and Axhausen 2017; Namazu and Dowlatabadi 2018; Shaheen 2018).

A national survey of French carsharing users, conducted by 6t-bureau de recherche (6t-Bureau de recherche 2019c) confirms these international results. It indicates that carsharing users are most likely to be men (55% of male users), highly educated (86% have a higher education diploma), full-time working (73% of users) and white collars (61% are executive and white collars). Most of them (75%) live in urban areas. The average age of carsharing users is 47 (median of 46) and **their age distribution do not differ from that of the general population**; this sets carsharing apart from other shared mobility services.

Ride-hailing services

Past research on ride-hailing services has shown that users are generally **younger**, **more educated** and display a **higher income** than the general population (Rayle et al. 2016; Clewlow, Regina R. Mishra 2017; Henao 2006; Young and Farber 2019; Tirachini and del Río 2019). This profile can be illustrated through a study conducted by 6t in the Paris area (6t-Bureau de recherche et al. 2018). We found that there is **a majority of women** amongst ride-hailing services users (62%). Students make up 12% of Uber users, while full-time employed people represent 73% of users. More than half of them are executives or white collars. Users are also slightly younger than the general population. These results differ from the literature on one account: the over-representation of women. One may assume that, in Paris, ridehailing service are used in the nightime by women to ensure their own safety.

Shared dockless e-moped services

Shared e-moped users display a similar profile, but set themselves apart by the even higher over-representation of men.

An online survey of Cityscoot users in **Paris** (6t-Bureau de recherche 2019a) reveals that shared e-moped users are mostly **men** (87%) and are **younger** (55% below 35), more **highly educated**, more frequently **full-time employed** (81%) and **wealthier** than the Paris general population. Their profile tends to be similar to that of personal mopped users in Paris.

A survey conducted in **Spain**, where shared electric moped services are particularly widespread (Aguilera-García, Gomez, and Sobrino 2020), confirms these results. It indicates that males are overrepresented amongst users (68% of users), as well as young people (72% of users under 34) and highly educated individuals (83,5% went to university). However, contrary to our French findings, Spanish survey results show a strong representation of students (35% of users); there is no overrepresentation of high-income levels.

A survey of shared e-moped users in **Germany**, where this type of services is also widespread (Degele et al. 2018), shows a significant gender gap: more than three quarters of users are male. Plus, the most represented age group is that of 'late twenties', which is consistent with the overrepresentation of young users observed in Paris and in Spain.

Shared dockless bicycle services

There is little available data on the profile of dockless bicycle services in Europe. A study of shared dockless bicycles in Paris (6t-Bureau de recherche 2018) shows that shared dockless bicycle users are mostly **men** (68%), **young** (59% below 35), **full-time working** (65% of them, while 20% are students), **white collars or executives** (49%), **highly educated** (60% have a bac+5 diploma or higher diploma). Compared to that of Paris' public docked bikesharing system, Vélib', shared dockless bicycle users are more frequently men, but are similar regarding age. Moreover, more than half of shared dockless bicycle users have never used a Vélib' before, which confirms that these services attract different types of users.

A comparative study of **(docked) bikesharing systems in North America**, that is USA and Canada (Shaheen, Martin, and Cohen 2013), also reveals that men, young and highly educated people are overrepresented amongst bikesharing users.

Regarding dockless bicycle services, it is worth noting that there might be differences between shared electric bicycles and shared regular bicycles, even if there is no available data to assess this hypothesis.

Shared dockless e-scooter services

Shared dockless e-scooter services appeared more recently. As a consequence, the academic literature about the users' profile of this mode is scarce (Reck and Axhausen 2021). The most detailed data was produced in the French context. 6t conducted two surveys on shared dockless e-scooter users and uses. A first survey was conducted in 2019 (6t-Bureau de recherche 2019e). About 4,400 dockless e-scooter users were surveyed in Paris, Lyon and Marseille, the three French cities where these services where then available. Survey results distinguish between a majority of local users (58%) who use e-scooters in the city they live in and 42% of visitors (French or foreign tourists). Among local users and compared to the general population, **men** are overrepresented (66%), as well as **young people** (52% of local users below 35), **students** (19%) and **people working as executives or in higher intellectual professions** (53% of those belonging to the working population). In addition, local e-scooter users display a **higher income** than the general French population. A second study, conducted among Dott users in Paris (6t-Bureau de recherche 2019b) confirms these results, and shows an even greater overrepresentation of men (75%), of young people (77% below 35), of students (30%) but a similar proportion of executives amongst users belonging to the working population (50%). In both surveys, e-scooter users are also highly educated. The profile of shared e-scooter users in Vienna (Laa and Leth 2020) is similar to that of French e-scooter users: they are more likely to be young, male and highly educated. More precisely, 67% are below 35, 74% are male and 64% have a university degree.

A recent survey conducted in **Zurich, Switzerland** (Reck and Axhausen 2021) on a sample of 1,454 respondents compares user profiles for three types of micromobility services: dockless e-scooters, docked (e-)bicycles and dockless e-bicycles. Survey results reveal similarities between all three shared micromobility services users: Zurich micromobility users tend to be young, males, university-educated, full-time working and living in wealthy households without children or car. Differences can be noted between shared e-scooter users and shared bicycle users: the former are younger (83% of them are below 40), more frequently females despite a significant gender gap compared to the general population (32% of e-scooter users are females, versus 29% of docked (e-)bicycles users and 18% of dockless e-bicycles users). Dockless e-scooter users also display a lower university education level and full-time employment level than shared bicycles users, along with a lower household income. These results suggest that **shared dockless e-scooters can be regarded as slightly more inclusive than other shared micromobility services**.

Many **North American cities** (and some New Zealand cities) have authorised e-scooter services as part ofpilot programs (shared e-scooter pilot programs) and thus conducted evaluations, the results of which were published. Evaluation reports confirm that shared e-scooter users appear to be more frequently male, young, and highly educated (Portland Bureau of Transportation 2018; Arlington County 2019; City of Calgary 2020; Chicago Department of Transportation 2020; City of Minneapolis 2019; San Francisco Municipal Transportation Agency 2019; City of Santa Monica 2019; City of Tucson 2019). Academic research conducted in North American confirmed these trends (Sanders, Branion-Calles, and Nelson 2020). In **New Zealand**, a survey of e-scooter users shows that they are more likely to be men, young and with a high level of education (Fitt and Curl 2019).

Lack of gender inclusiveness has emerged as a key point of attention in several US pilot evaluation reports. Using Portland's pilot survey results (Portland Bureau of Transportation 2018), Jennifer Dill, professor at Portland State University, proposes an analysis of the gender gap in e-scooter use in Portland (Dill 2019). First, men make up the majority of e-scooter users (64% of men, versus 34% of women and 2% of transgender and non-binary people). **These female users ride e-scooters less frequently than male users and do not think they will use e-scooters as much as men in the future**. Men and women do not use e-scooter for the same type of trips: "fun and recreation" is the top trip type for more than a third of the women surveyed, while it is only the top trip type for a quarter of the surveyed men. 22% of men selected commuting as their top trip type, while it was the case for only 15% of women. When asked about their motivations to ride an e-scooter, women appear more likely to mention fun and curiosity, while men are in contrast more likely to cite functional advantages associated with shared dockless e-scooters (fast and reliable option to get around): thus, **while e-scooters can become a daily mobility solution for men (high frequency of use plus importance of functional advantages), it is not currently the case for women (low frequency of use and mode associated with fun and curiosity).**

Yet, men and women tend to display similar opinions about e-scooters: In Portland, a majority of both men and women state that they are "extremely likely" to recommend e-scooters to a friend (65% of surveyed women and 62% of surveyed men). Combined with the results on trip frequency and motive, **this suggests that while women have a positive image of shared e-scooters, this mode may not meet their transportation needs for utilitarian trips.**

Dill (2019) outlines that having safe places to ride would make a particular difference to female e-scooter users': women tend to display a stronger preference for riding in segregated cycling lanes. While 26% of men ride "most of the time" in shared travel lanes with cars, this is the case for only 19% of women. This echoes findings from a survey of 1,256 university staff at Arizona State University (Sanders, Branion-Calles, and Nelson 2020) : this survey revealed that female users were more likely to perceive **safety as a barrier to e-scooter use** than male users. Among non-users, women are significantly more likely to cite concerns

regarding safety from crime and road safety. Safety thus arises as a critical point regarding e-scooters' gender gap.

Finally, the Arizona State survey (Sanders, Branion-Calles, and Nelson 2020) also highlighted that a high share of women non-users cited the need to carry things or children as a barrier to e-scooter use. Similar to findings regarding bicycle riding, it appears that **the unequal sharing of household-serving trips** impacts women outlook on e-scooters.

All in all, all studies reveal that **shared micromobility users are more frequently men, young, highly educated, employed full-time, executives or white collars and earn high incomes**. Their profile can be considered as the socially 'dominant' profile, the least likely to be discriminated against, which raises inclusiveness issues. This profile is in line with that of **early adopters** as described by Rogers with his model of diffusion of innovation (2003). This appears logical, as far as shared mobility, and especially shared micromobility services have appeared quite recently on the market (and count as the latest innovative disruption in mobility). According to this diffusion of innovation model, **the profile of shared mobility services users will diversify as these services develop**. This is something that 6t found, for instance, for ridehailing users (6t-Bureau de recherche et al. 2018): between 2015 and 2017, gender inclusiveness greatly improved. While male users where slightly overrepresented amongst ride-hailing users in 2015, female users made up more than 60% of the 2017 sample. Moreover, the average age of users increased between 2015 and 2017.

Locating shared e-scooters within shared mobility

To replace micromobility services within this shared mobility ecosystem, it is necessary to compare data produced using similar methods, in similar contexts. The following table summarizes the **socio-demographic characteristics of different shared mobility services**, based on user surveys conducted by 6t in France using similar research protocols. This data has been produced to ensure comparison across services; while it has been collected in the French context, the literature review discussed above suggests that it is in line with findings from other European countries, as well as North America and New Zealand. We thus believe it is safe to use it to make more general claims.

This comparison suggests **shared e-moped is the less gender-inclusive** of all shared modes while ride-hailing and, to a lesser extent carsharing are more inclusive. Regarding age, **shared dockless micromobility services** (e-mopeds, bicycles and e-scooters) **appeal to a younger audience**. The share of **higher socio-professional categories** (executives and higher intellectual professions) is highest amongst **carsharing users**,

All variables considered, shared dockless e-scooters is the **less gender-inclusive of shared modes**, except for e-mopeds. They appeal to the youngest users. Regarding social inclusiveness – measured using the share of users working as executives or in higher intellectual professions -, dockless e-scooters do not differ from other service. Finally, these services appear to be **slightly more inclusive in terms of level of education**.

All in all, dockless e-scooters appear to differ only marginally from other shared mobility services, suggesting that answers to the lack of equity should be developed at the level of this whole mobility ecosystems. Results suggest, however, that **gender inclusiveness should be a specific point of attention for operators**.

Type of service	Source	Gender	Age	Occupation	Diploma	Place of residence
Ride-hailing	6t-Bureau de recherche et al., 2018	**62%** females	**31%** below 29 Average age: **40**	**12%** students **73%** full-time working **55%** of executives	**76%** higher education diploma	**39%** live in the city centre of the agglomeration

Carsharing	6t-Bureau de recherche, 2019	**45%** females	**19%** below 35 Average age: **47**	**2%** students **73%** full-time working **61%** executives	**86%** higher education diploma	**75%** live in the city centre of the agglomeration
E-mopeds	(6t-Bureau de recherche 2019a)	**13%** females	**55%** below 35 Average age: **36**	**11%** students **81%** full-time working **55%** executives	**86%** higher education diploma	**67%** live in the city centre of the agglomeration
Dockless bicycles	6t-Bureau de recherche, 2018	**32%** females	**59%** below 35 Average age: **35**	**20%** students **65%** full-time working **49%** executives	**81%** higher education diploma	**65%** live in the city centre of the agglomeration
E-scooters	6t-Bureau de recherche, 2019b, 2019e	**25/34%** females	**52/77%** below 35 Average age: **29/36**	**19/30%** students **55/66%** full-time working **50/53%** executives	**61/73%** higher education diploma	**65/69%** live in the city centre of the agglomeration

Figure 3: Users' sociodemographic characteristics of different shared mobility services: the example of France

Regarding users' **ethnicity**, note that if ethnic statistics are widespread in the United States, in Europe, their use differ from one country to another (Le Monde 2010). In the United Kingdom, they are commonly used (Gov.uk 2021), as well as in the Netherlands or in Greece. In Romania, the population census includes information about ethnical origin, as well as religion. In Poland, Czech Republic or Slovakia, respondents can voluntarily indicate their ethnicity. In Sweden, the country of origin in included in public census data. In Italy and in Germany, the country of origin is also used, rather than ethnicity. In other countries, ethnic statistics are much more strictly regulated and only allowed in a few specific situations. In France, for instance, the use of ethnic statistics is usually prohibited except in some particular cases such as scientific research (INSEE 2020; Dagorn 2019). Evaluation reports of shared dockless e-scooters pilot programs in the US suggest that the vast majority of users are white (City of Alexandria 2019; Portland Bureau of Transportation 2019; Arlington County 2019; Chicago Department of Transportation 2020; City of Minneapolis 2019; San Francisco Municipal Transportation Agency 2019).

b) Spatial distribution of shared micromobility devices

In addition to user profiles, micromobility service inclusiveness can be approached through a **socio-spatial lens**. Indeed, social inequalities are spatially reflected and the profile of residents can vary from one neighbourhood to another. Plus, the density and quality of transportation solutions also varies across cities. Shared micromobility services can be regarded as a solution to enhance access to employment and services, especially in areas with poor public transit connections. Then, the spatial distribution of shared micromobility devices (where is the service available?) is closely related to equity issues. Shared micromobility services are **often limited to dense urban areas**, that is **city centres** of metropolises. This is directly related to operators' business models (6t-Bureau de recherche 2019d), which rely on a minimum vehicle density or fleet size to ensure service efficiency and thus need a sufficient number of users to reach the break-even point. Some operators are committed to geographical diversity: in the UK, Voi has launched in mid-size cities such as Peterborough, Cambridge, Rushden or Kettering [3]. This is an important development, and it remains a rare situation for micromobility service operators.

This focus on privileged city centres is not specific to micromobility, but observed for all shared mobility services. In Europe, neighbourhoods served by shared mobility operators tend to be **socio-economically advantaged** compared to surrounding areas. One of the most advanced shared mobility market in Europe is Paris: in Paris, shared mobility services tend to be available only within the limits of the central cities.

[3] https://www.voiscooters.com/locations/ (accessed on 14/05/2021)

When they are offered in the suburbs, operators tend to privileged the nearest suburban cities and those where socio-economic indicators are higher and match their customer profile. Socio-spatial discrimination can also be present when services is offered in all neighbourhood, but with differing levels of quality : in Washington D.C., for instance, two journalists observed that "*Uber seems to offer better service in areas with more white people*" (Stark and Diakopoulos 2016), "*better service*" referring to shorter waiting time. However, this waiting time difference can be the result of the balance between supply and demand, which varies from one neighbourhood to another. This supply/demand balance is influenced by a variety of factors, including social class, and is thus related to the multiple dimensions of inclusiveness. As explained in Stark and Diakopoulos' paper, Uber practices surge-pricing and, when prices are higher, drivers are redistributed geographically to serve areas with more demand, which can happen to be areas with the greatest share of white people, resulting in shorter waiting times in those areas. The observed difference in service quality thus appears to be a complex phenomenon, which is an indirect result of service accessibility for various groups and, therefore, of the variation of service demand across different areas.

Socio-spatial equity has been evaluated in some North American e-scooter pilots, such as the one organised by the city of Arlington. The map below plots the link between income level and number of e-scooter trips in different neighbourhoods of the city (Arlington County 2019). This illustrates the variability of ridership by income levels. Four combinations are distinguished: higher-income and higher use (black), higher-income and lower use (blue), lower income and higher use (red) and lower income and lower use (white). It is worth noting that, as part of this pilot program, e-scooter companies offered social pricing for users who qualified for a state or federal assistance program. Different social pricing options were experimented depending on the operator, from suppressing the unlock fee to offering a 50% discount. Authors of the evaluation report conclude that in some lower-income areas, low availability of vehicles limited take-up. However, mapped results (Figure 4) suggest that **shared dockless e-scooters can also be extensively used in lower-income areas** in the presence of a social pricing options. Thus, it can be assumed that shared micromobility services can fill in the gaps of other mobility services.

Therefore, ensuring the distribution of vehicles across the city represents a pressing challenge.

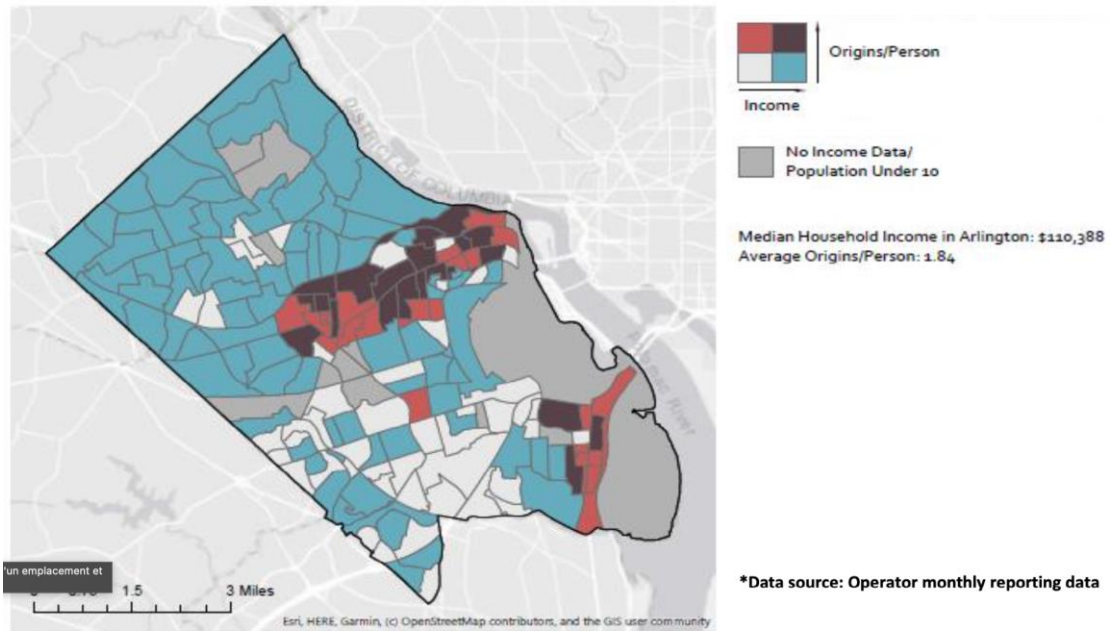


Figure 4: Map of shared e-scooter trips and income levels in Arlington (Arlington County, 2019)

c) Shared micromobility access and impact for disabled people

Like most services, shared micromobility services are designed to suit the greatest number of users. This "one size fits all" approach can make it difficult for disabled people to use them. It should be noted that there are a **variety of disability types and levels**, which raises specific issues regarding shared micromobility services.

To this regard, two main issues can be identified:

- On the one hand, disabled people willing **to use micromobility services** encounter difficulties and barriers in doing so;
- On the other hand, **disabled people who are non-users are negatively impacted by shared dockless micromobility services in their daily life**, and more so than the general population when improperly parked dockless vehicles result in **sidewalk clutter**. This clutter is harmful to sight-impaired or mobility-impaired people.

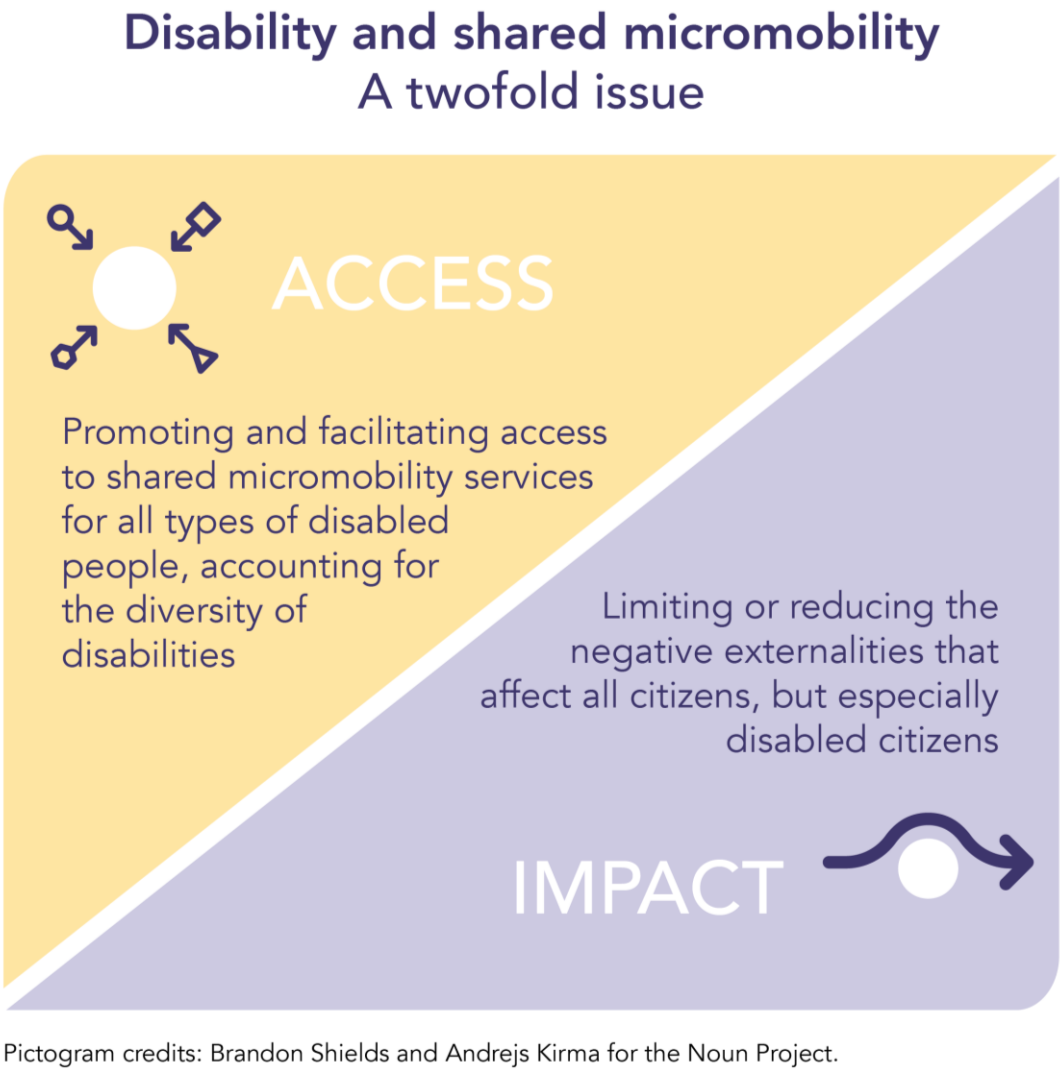


Figure 5: Disability and micromobility issues

Shared micromobility services' use for disabled people

First, disabled citizens are **hardly represented amongst shared micromobility users**. The Portland e-scooter pilot program survey (Portland Bureau of Transportation 2018) explored the issue of disability. To the question "*Do you identify with having or living with a disability?*", 4.4% of the 3,444 e-scooter users living in Portland surveyed answered "yes". The majority of them specified that their disability was a mobility- or dexterity-related disability. These results are difficult to interpret, as they are not compared to the share of disabled citizens in Portland. However, one may assume that they suggest a strong under-representation of disabled users among e-scooter users.

The use of e-scooters by disabled users has still been little explored; results from research on disabled cyclists can be used to outline some possible features of disabled users' constraints and needs. A 2019 survey conducted by the British inclusive cycling charity Wheels for Wellbeing (Wheels for Wellbeing 2020) amongst a panel of 200 disabled cyclists in the United Kingdom provides interesting facts and statistics. Almost two thirds of the respondents cycle at least once a week. Most of them use a two-wheeled bicycle

(while people with a more severe disability often use a tricycle, a handcycle, a recumbent cycle or even a tandem to be accompanied by a valid person). Two thirds of respondents declare using their cycle as a mobility aid. This data show that **people with disabilities do also cycle** and use this mode to accommodate daily life constraints; cycling can, thus, be a vector of inclusiveness. However, **barriers** to cycling for disabled people remains: the cost of adapted bicycles, the lack of appropriate cycle infrastructure (narrow lanes or parking spaces), as well as negative preconceptions associated with disabled cycling are some key factors to take into account. An analysis of over 50 London strategy documents (Andrews, Clement, and Aldred 2018) reveals that, when disabled people are represented as cyclists or potential cyclists, it mostly refers to leisure activities instead of an everyday mobility solution..

The answer to this underrepresentation of disabled users in micromobility is not self-evident. A combination of technological innovation and changes in perceptions appear necessary to make services accessible to all.

Negative externalities engendered by shared micromobility services' for disabled people

The impact of shared micromobility services for disabled people as non-users constitutes another issue. Indeed, disabled citizens are strongly affected by the negative externalities associated with shared micromobility devices. Since equity rests on the equal sharing of opportunities and costs, this appears highly problematic.

Blind and visually impaired people or people using wheelchairs may have difficulties getting around when dockless vehicles are improperly parked and are obstructing the way. Portland's 2018 first e-scooter pilot program report (Portland Bureau of Transportation 2019) highlights that **sidewalk accessibility** for disabled people has degraded due to the presence of shared dockless e-scooters. Various organisations and associations voiced their concerns, such as the Pedestrian Advisory Committee (PAC), TriMet's Committee on Accessible Transportation (CAT) and the Portland Commission on Disabilities (PCOD). Moreover, as part as the evaluation of the 2018 pilot program, a focus group with nine Portlanders with a wide range of disabilities (mobility, hearing, vision) was organised. The results of this focus group confirm that shared dockless e-scooters represent a major concern for disabled people, **parking issues** being the most commonly mentioned drawback. Note that only two of the nine focus group participants had already ridden an e-scooter, the others facing barriers related to balance or sight-impairment.

Figure 6: Excerpt from Portland's e-scooter pilot evaluation report (Portland Bureau of Transportation 2018)

Reacting to the launch of the Chicago e-scooter pilot program, the disabled community expressed its concerns about the possible impacts of shared dockless vehicles used and parked in public space. Since e-scooter are quasi-silent, blind and visually impaired people fear being hit by an e-scooter user. The risk does not only come from moving e-scooters: improperly parked e-scooters turn into obstacles and barriers mobility-impaired users. The Chicago pilot evaluation (Chicago Department of Transportation 2020) included questions about dockless e-scooters' impact for disabled people. It should be noted that only 2.7% of respondents reported having a disability. As exposed in the chart below, survey results indicates that **people with mobility and vision disabilities were most likely to be inconvenienced by e-scooters**. The report also highlights the difficulty to report badly parked vehicles, and consequently to resolve problems related to improperly parked e-scooters for blind or visually impaired people.

Table 20: Survey Response to "Has your experience with e-scooters and their placement on the sidewalk been a source of inconvenience to you?"

	No	Yes, a little	Yes, a lot	No response
No Disability	6%	15%	18%	61%
Any Disability	8%	14%	38%	39%
Vision disability	2%	9%	47%	42%
Hearing disability	10%	15%	43%	32%
Cognitive disability	5%	10%	23%	61%
Ambulatory disability	10%	17%	48%	25%
Self-care or independent living disability	3%	20%	26%	51%
Other	10%	15%	25%	51%
No response	3%	5%	10%	83%
Grand Total	5%	12%	16%	67%

Note: The sample sizes for the subcategories of disability are small (35 to 143 responses) and are overlapping (i.e. people could report having more than one kind of disability).

Figure 7: Impact of shared dockless e-scooters on people with disabilities surveyed in Chicago pilot program's evaluation (Chicago Department of Transportation 2020)

In France, in Lyon, the associations of blind and visually impaired people "Comité Louis Braille" and "UNADEV" also called local authorities to take action (Rogeret 2019; Frénéat 2019) and solve the problem of shared micromobility devices obstructing the way.

In the US, e-scooters have even been deemed to violate disabled citizens' rights. A 2019 report (Mazoch 2019) even argues that e-scooters violate the **Americans with Disabilities Act** of 1990 (ADA), and more precisely ADA's Title II, which states that "*no qualified individual with a disability shall, by reason of such disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of a public entity, or be subjected to discrimination by any such entity*". This act is based on the concept of equity, as defined in the initial part: opportunities and costs should be equally shared across all citizens, and no citizen should be deprived from accessing opportunities that are offered to others. Based on the existing jurisprudence in the United States of America (Barden vs. City of Sacramento and Frame vs. City of Arlington), sidewalks are covered by Title II. Hindering the circulation for people with disabilities on sidewalks is therefore a violation of ADA's Title II. In 2018, Mia Labowitz, who is paraplegic and relies on a wheelchair to get around, decided to sue Bird e-scooter rental company and the cities of Santa Monica, Los Angeles and Beverly Hills for discriminating against disabled people (Courthouse News 2018). To date, this action has not yet resulted in a court decision.

d) Access to shared micromobility services without bank account or smartphones

Shared micromobility services relies on mobile applications, that allow the user to geolocate a vehicle, unlock it and pay for the ride, by connecting his bank account to the app. Today, **not having a smartphone** (or lacking sufficient skills to use it) **and/or a bank account** is in itself a factor of social exclusion. It also represents a barrier to shared mobility service use. Nowadays, even if the majority of the population of developed countries owns a smartphone and a bank account, a significant portion of the population does not have any access to these services. For instance, in France, 12 to 17% (Crédoc 2019; INSEE 2019) of the population lack essential digital skills and can thus be considered to suffer from "**numerical illiteracy**". It should be noted that those facing "numerical illiteracy" are most often elderly and/or low income citizens (Crédoc 2019). To overcome this barrier, solutions might be provided to access the service without a smartphone or a bank account (cash rental access), as explored in section 2.2.

The City of Calgary e-scooter pilot report (City of Calgary 2020) provides data on this issue. Among the 3,531 survey respondents who did not use an e-scooter during the pilot, almost 20% indicates the service was too expensive, **7-8% indicates they did not have sufficient access to technology to use the app** and **3-4% indicates they lacked a credit card** to pay for the service (several possible answers). Even if the lack of smartphone and/or credit card concerns a limited share of non-users (<10%), these two barriers should be considered to ensure equity.

Section 3: Have not used a Shared Electric Scooter

1. Please select all the reasons why you haven't tried a shared electric scooter: (NOTE: Respondents were able to choose more than one answer so percentages add up to more than 100%) (n=3,531)

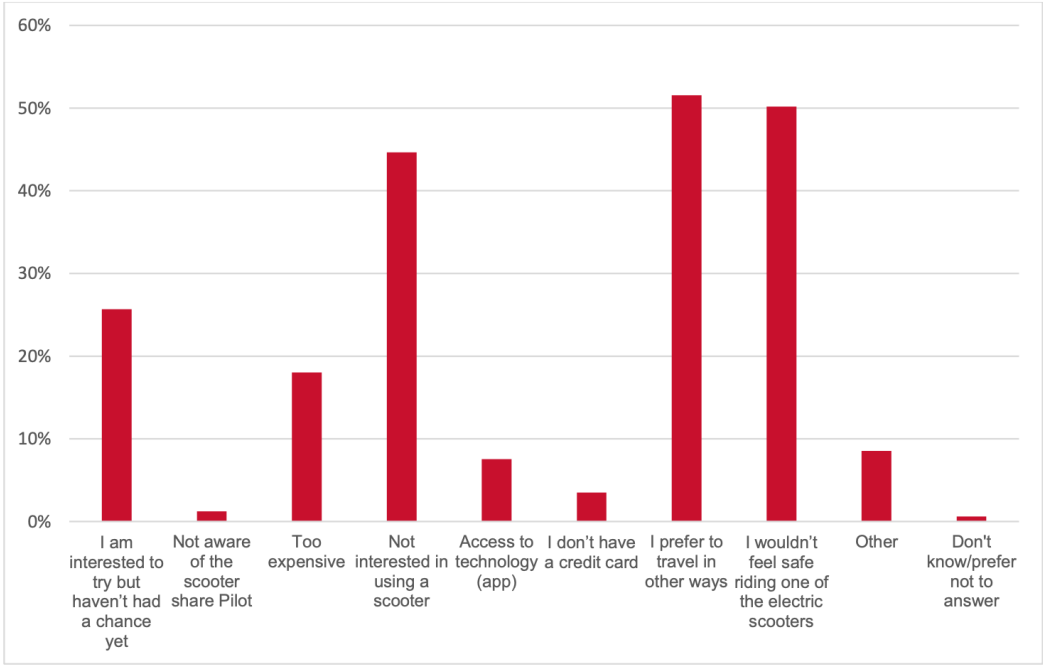


Figure 8 : Reasons why respondents have not used a shared e-scooter during the pilot program in Calgary (City of Calgary 2020)

3.2. Measures to ensure shared micromobility's inclusiveness

To tackle these different issues associated with shared micromobility's inclusiveness, specific measures can be implemented by **local authorities and/or micromobility operators**. The section below provides an overview of the different actions that have been taken, to date, to diversify micromobility user profiles.

Note that many of these initiatives were initially experimented as part of **North American micromobility pilot programs** that required operators to ensure equitable access to their services.

a) Making shared micromobility affordable to all through social pricing

It has been highlighted that shared micromobility users have a very specific 'early adopter' profile. Highly educated people, white collars and executives, as well as people with high incomes are overrepresented amongst them. This can be linked to the cost of shared micromobility services, which may be too high for low-incomes households. As outlined in the first part, cost is not the only factor of exclusion, but it is a primary one that should be given priority. This led certain operators to offer **social pricing**, often as a response to local e-scooter pilot programs established by cities. Indeed, many North American cities include equity requirements in their pilot programs.

London has recently selected three selected companies for its first dockless e-scooter trial. These companies are required to offer social pricing to low-income users, as well as "*to offer discounts to certain groups where appropriate, including key workers playing a vital role in helping London get through the*

pandemic" (TfL 2021b). Transport for London has set up an equality impact assessment, which includes paying special attention to low-income groups. The equality impact assessment (EqIA) form states that "*throughout the trial all operators must offer low income/equitable access customer plans to support the use of rental e-scooters by disadvantaged groups in London*" and that "*plans must be visible, and the pricing structure explained clearly to users*" (TfL 2021a). Plus, it is specified that social pricing options for low income groups may also serve other groups of under-represented users, as "*BAME groups, women, younger people and those from the LGBT communities*" who tend to have lower than average income. As part of the e-scooter trial, Dott offers a 80% discount for low income (and disabled) users, (TfL 2021a). Lime offers a 50% discount for low income riders and specifies that "*discounts are automatically applied in any 'priority areas' set by boroughs*". Tier provides discounted rides from any borough-designated priority area and long term discounts to concessionary riders (that is, the elderly and disabled people).

In the UK, Voi offers discounts for students (Voi 4 Students), low-incomes people (Voi 4 All) and NHS or Emergency workers Voi 4 Heroes)[4]. Users who meet these criteria and want to apply for discounted access have to send their demand on Voi's website by filling in a form and providing proof of eligibility. Note that only Voi 4 All can be considered as social pricing, based on user's income. Indeed, to benefit from Voi 4 All program, users have to hold a valid HC2 certificate (delivered by the NHS and allowing people with low income to get full help with health costs). They can then subscribe to the monthly Voi pass at a discounted price (75%) and also purchase a day pass with a 75% discount.

Voi already experimented these social pricing measures in France, when the company was still operating in Paris and Lyon. Recipients of income-based social benefits or of social pricing offered by the local transport authority (Île-de-France Mobilités) were allowed to ride Voi e-scooters for €50 worth at a discounted price of €10 per month through a program called "Voi4all"[5]. Similarly, when Jump was operating in Paris – before it was purchased by Lime -, economically disadvantaged users were able to ride Jump e-scooters or e-bicycles for €5 per month with the offer "Boost"[6]. Lime, currently operating in Paris, offers a social fare through a program called "Lime Access"[7] (no unlock fee and €0.10 per minute, instead of a €1 unlock fee plus €0.25 per minute for standard users). Eligible users (users who are already eligible to Île-de-France Mobilités' social pricing or to national social benefit programs) have to register on the company's website, and provide documents certifying their eligibility. To date, Lime Access is only available in North America and in Paris.

The variation of the scope of social pricing measures form one operator to another raises the question of the **target profile** and the **criteria** taken into account: who should benefit from discounts? which indicators should be used? where should the threshold be placed?

In **North America**, most shared micromobility pilot programs included **equity requirement** to ensure that micromobility would not constitute a luxury only affordable for the happy few. The mostly common measure consisted in a discounted monthly subscription or a **discounted use price**. For instance, as part of the 2019 San Francisco e-scooter pilot program (San Francisco Municipal Transportation Agency 2019), the company Scoot offered a 50% discount for lower-income users to ensure equitable access to the service.

[4] https://www.kettering.gov.uk/news/article/1582/voi_shared_e-scooters_arrive_in_kettering (accessed on 10/05/2021)
[5] https://www.leparisien.fr/info-paris-ile-de-france-oise/transports/trottinettes-electriques-a-paris-l-operateur-voi-lance-un-forfait-solidaire-a-10-euros-06-11-2019-8187711.php (accessed on 14/05/2021)
[6] https://www.leparisien.fr/info-paris-ile-de-france-oise/transports/paris-les-trottinettes-et-velos-electriques-jump-lancent-un-tarif-solidaire-a-5-euros-par-mois-09-10-2019-8169399.php#:~:text=Uber%20sort%20un%20tarif%20solidaire,(1%20euro%20par%20course). (accessed on 14/05/2021)
[7] https://www.li.me/fr/community-impact (accessed on 10/05/2021)

According to the pilot results report, this social pricing measure did not completely reach its goal: participation was insignificant. This raises a **communication issue**: such incentives should be sufficiently advertised to come to fruition.

Similarly, as part of the Tucson e-scooter pilot program (City of Tucson 2019), companies had to offer discounts to low-income users. Bird offered a $5 monthly subscription with unlimited 30-minute rides, while Razor offered a 50% discount on all trips. The City advertised these measures on its official website and social media, to enhance the participation in this low-income program. The evaluation report indicates that, as of February 2020 (the pilot was launched in September 2019), Bird had 12 users registered in its 'Bird access program', and Razor 18 users registered in its availability program (the total number of unique users of the pilot program is over 37,000). Thus, the impacts of social pricing measures appear very limited. In addition to lack of communication, one may argue that lower fleet densities in lower-income areas, and/or a perceived lack of interest from time- and money-strained users might have played a role.

Figure 9: City of Tucson's communication on e-scooter low-income program (City of Tucson 2019)

In addition to the target profile, operators must deliberate on **the format and the level of discounts** they will offer.

b) Measures to reduce the gender gap in micromobility

Social pricing is the first step for an operator who endeavours to broaden the profile of micromobilty services users. Income being related to education level and socio-professional category (though imperfectly), social pricing can be regarded as a way to broaden the profile of micromobility users as it relates to these three variables. However, it has also been noted that there is a significant gender gap in terms of micromobility. Women do suffer from 'transport poverty' and from limited resources available for their mobility. However, as argued in the first part, this resource depletion is not only economic. It is also a 'time poverty' due to the unequal sharing of household serving tasks. How has this been addressed?

To narrow this gap, operators mostly implement **communication-based strategies**. They endeavour to make **women more visible** on their websites, advertising campaigns and social media. The ambition of these campaigns is to change the representations associated with micromobility, and encourage women to imagine themselves using these mobility solutions (avoiding self-censorship and unconscious bias).

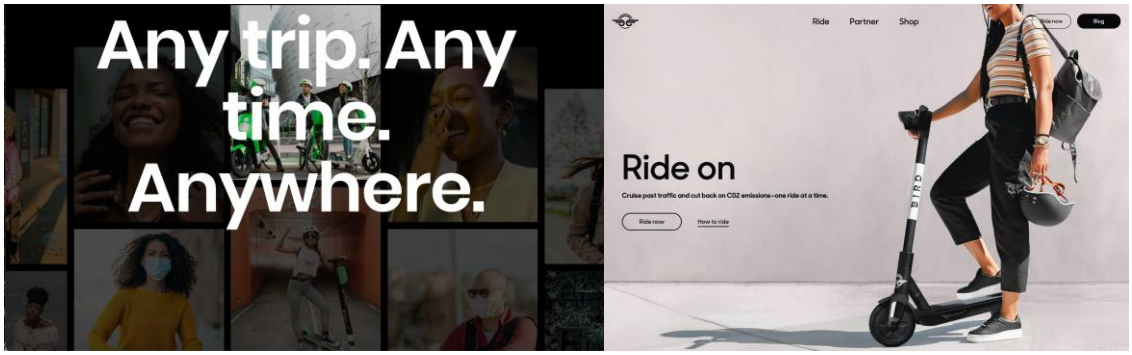


Figure 10: Lime (on the left) and Bird's (on the right) homepages, with visual featuring women (sources: Lime and Bird, 2021)

When communication strategies are adopted, they should be carefully planned to avoid reinforcing gender stereotypes. This has been observed in communications campaigns deployed by other shared mobility services operators in the past. For 2021 International Women's Day, a French company offering shared dockless electric mopeds published interviews with some of its female users, in order to integrate women within the moped imagery. However, the choice of some of the highlighted excerpts appears questionable. On the screenshot below, one can note that if the middle excerpt seems consistent with the goal pursued ("*I ride and work as well as the others, being a woman doesn't change anything*"), the other excerpts nourish clichés and stereotypes associated with women: women as eternal minors under their father's responsibility ("*I called my dad and said: "Dad! I just rode a moped in Paris, alone!*") and driving-related gender stereotypes suggesting women cannot perform complex car manoeuvres ("*I'm much less afraid of parking a Cityscoot than I am of parking a car* "). This example shows that special attention should be paid to the precise choice of messages when designing a female-friendly – and any kind of minority-friendly – communication campaign, in order to **avoid reinforcing detrimental stereotypes**.

Figure 11: Communication campaign highlighting excerpts from interviews with female users (source: Cityscoot, 2021)

If operators' actions towards gender equity are limited to these 'soft measures', this could be interpreted as a form of '**pinkwashing**'. 'Pinkwashing' is a term coined in the 1990s to describe a specific marketing strategy that involved declaring one's company commitment in the battle against breast cancer, with the

mere goal of economic profit. Through the years it has however acquired a broader meaning, and it now denotes all practices that exploit feminist or LGBTQIA+-friendly themes for commercial purposes.

In any case, communication-based strategies tend to be based on the unspoken premise that women would not use e-scooter services because they do not identify to the user base. Past research on gender and mobility has shown that the significant gender gap in the division of household tasks (breadwinner vs. caretaker) impact women's mobility opportunities. These unequally shared household-serving trips imply specific vehicles – adapted to the transport of groceries and relatives, for instance – and skills – e.g. balancing an e-scooter while carrying groceries. There is thus a **higher barrier to entry for women than for men.** Plus, women tend to have **fewer financial** resources, and are thus less likely to spend money on a new transport mode if they found a suitable, affordable arrangement before. According to Eurostat (European Statistical Office), on average, in the European Union, women earn 14% less than men (Eurostat 2021), with gender pay gap ranging from 1.3% in Luxembourg to 21.7% in Estonia. Due to this wage gap, micromobility service – as any service – are relatively higher for women. Social pricing for women could be envisioned in those countries where the wage gap is highest.

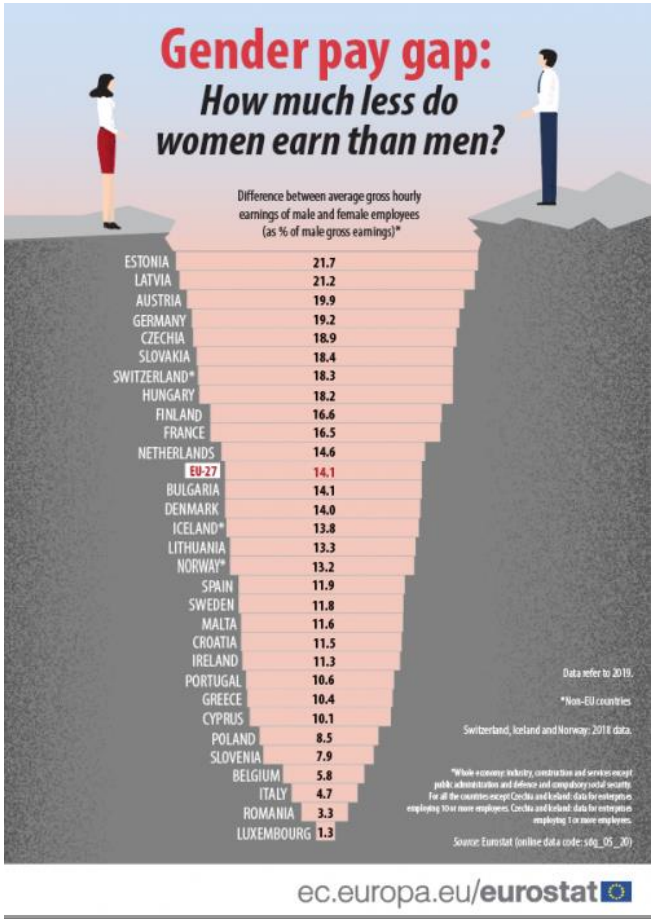


Figure 12: Gender pay gap in Europe (source: Eurostat, 2021)

Finally, to reduce the gender gap, cities and/or micromobility operators can also **team up with associations and organisations who represent women's interests**. Representation of women within the team of the micromobility service operator is also key. In February 2021, Voi joined Women in Transport, a non-profit organisation that supports women working in the transport field (Women in Transport 2021) and explores different ways to improve gender equity. Shared dockless e-scooter company Tier also launched an

initiative called "Women of Tier"[8], which consists of a newsletter, a monthly podcast[9] exploring the role of women in the mobility field, and events.

c) Shared micromobility and disability: adapting responses to the type of disability

Disabled people face greater barriers to access to micromobility services and can even be negatively affected by the presence of micromobility vehicles in the public space, both as users and non-users. Moreover, since there is **a variety of disability types, each with their specificities** (cognitive, motor, hearing- or sight-related), answers should be developed for each type of disability-related negative externality. Two major approaches can be identified to address disability in micromobility: (i) **making e-scooter accessible to people with motor disability** and thus making it easier for them to get around in the city; (ii) **reducing the negative impacts and potential danger associated to e-scooters for those who cannot use them, even with adaptations, or choose not to use them.**

Regarding this first approach, the French start-up Omni[10] created a system called "Globe Trotter" to easily and rapidly **attach a wheelchair to an e-scooter**, turning it into a motorised wheelchair. The system costs €590 and is much more affordable than a traditional motorised wheelchair – according to Omni, it would be five times less expensive. As many people suffering from motor disabilities cannot access a motorised wheelchair due to the high price of such devices, this flexible and relatively affordable solution appears very promising to enhance transport inclusivity.

Figure 13 : Globe Trotter system developed by Omni, and used by its co-founder Charlotte Alaux relying using a wheelchair since the age of four (source: https://www.omni.community/)

Note that the system is not currently compatible with all e-scooters: according to its designers it can match 95% of e-scooters sold on the market, but this does not include shared e-scooters, which are often more robust to resist intensive use. Shared dockless e-scooter providers could work with such stakeholders to provide compatible e-scooters. In that respect, Voi announced a partnership with Austrian company Klaxon Mobility[11] (Voi 2021d). **Klaxon Mobility** has developed a solution named "Klaxon Klick", which offer different models of motorized module to be attached to a wheelchair. Through this partnership, Voi plans to make micromobility solutions accessible for all types of users, including people with motor disabilities. However, it should be specified that these solutions – making micromobility solutions accessible to people facing motor disabilities – raise **complex legal issues**. Indeed, an e-scooter attached to a wheelchair is

[8] https://www.tier.app/fr/women-of-tier/ (accessed on 14/05/2021)
[9] https://open.spotify.com/show/1Y3CzLTLcGeOVjGGTOvhri?si=qks4xLMUSaeqH3odvW-Bag&nd=1 (accessed on 14/05/2021)
[10] https://www.omni.community/ (accessed on 10/05/2021)
[11] https://en.klaxon-klick.com/ (accessed on 10/05/2021)

considered as a specific vehicle, belonging to another category than 'classic' e-scooters, with different legislation and safety standards. It requires specific technical and legal expertise from operators, and it may take a long time to complete the certification process. These issues should be kept in mind when evaluating the pace at which companies deploy these solutions.

Local authorities also have a role to play to improve access for disable citizens: even with solutions such as the Klaxon Klick or the GlobeTrotter, disabled e-scooters users will still need a properly planned public space to be mobile. Reduced or adapted physical barriers (fences, chicanes, portals, etc.) and wide cycle lanes are necessary for them to ride comfortably.

Secondly, for visually impaired people, parked micromobility vehicles represent an obstacle in an already little-adapted urban space. To address the issue of public space and sidewalk clutter, e-scooters companies 'educate' their users, with communication campaigns on their websites or mobile apps to encourage users to park the vehicles without impeding pedestrian access. Plus, operators ask users to take a picture of the vehicle at the end of their trip, to check if it is properly parked. Local authorities also adopt rules to avoid sidewalk clutter, such as banning parking on the sidewalk or creating dedicated parking spots (6t-Bureau de recherche 2019d). These incentive measures mostly rely on users and companies' compliance and can be hard to enforce. Note that, in the UK, Voi redesigned its parking racks[12] in collaboration with the Royal National Institute of Blind People (RNIB). The design includes side panels to better retain the e-scooters and prevent them from falling outside of the rack, and also allows for the structure to be detected with a walking cane. Plus, the colour contrast of the rack has voluntarily been increased, to make the structure more distinctive for visually impaired people.

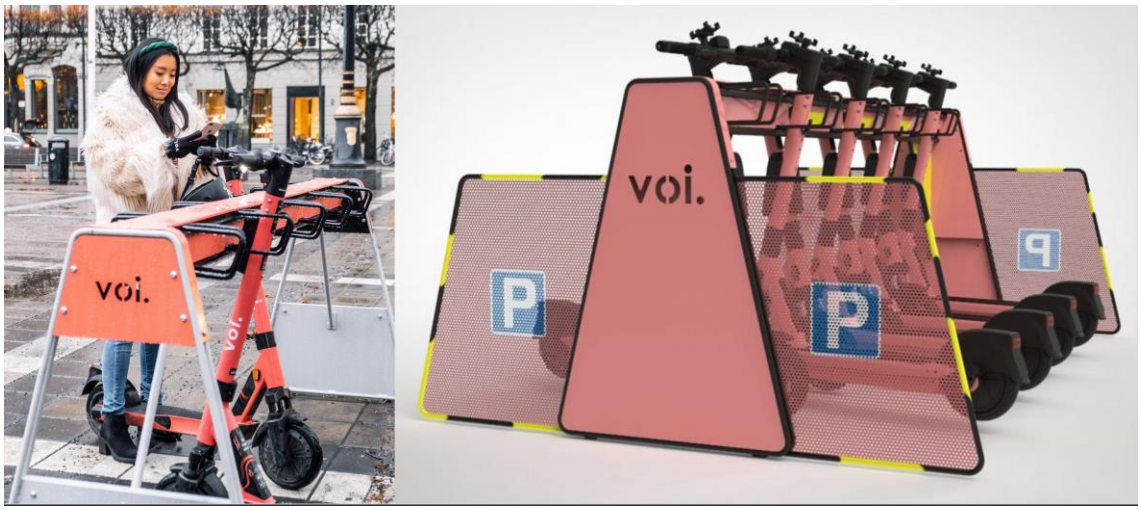


Figure 14: Voi's former parking racks and parking racks redesigned with the Royal National Institute for Blind People (source: Voi)

Remedial actions complement these preventive measures. As part of London's e-scooter trial, boroughs and the City of London will provide parking to avoid street clutter. Operators will also have to ensure proper parking through geo-fencing and to comply with a maximum response time for removing improperly parked devices (TfL 2021b). In France, licenses granted by local authorities to allow shared micromobility companies to launch a fleet of vehicles can include fleet management criteria, with the obligation to **remove broken or unduly parked e-scooters** within a certain time period (6t-Bureau de recherche and Momentum 2020).

[12] https://www.uktech.news/news/to-reduce-street-hazards-voi-introduces-parking-racks-for-e-scooters-in-the-uk-20210520 (accessed on 21/05/2021)

Users or passers-by can signal a vehicle to be removed, the problem being that those who are the most negatively impacted by e-scooters blocking the sidewalk encounter much more difficulties to report improperly parked devices. In this context, to allow **blind and visually impaired people** to signal improperly parked e-scooters blocking the pathway, some companies have developed **Braille or embossed messages on their vehicles** (messages with contact information to signal an e-scooter to be removed by the operator). Nowadays, in the US, e-scooters provided by Lyft, Lime or Voi show this kind of information (Lazo 2019; Manning 2020). Note that this measure is not always clearly understood by the general public and raised questions at first sight, as shown by Reddit forums[13] dedicated to the subject. Communication appears key to ensure the success of such measures, by informing as many people as possible, and especially those for whom these solutions are designed, that they are now able to signal unduly parked vehicles. The fact that this solution allows disabled people to be involved in the process, as well as any other citizen, can be regarded as a kind of empowerment.

Nonetheless, it should be specified that Braille is only used by a minority of blind and visually impaired people. For instance, in France, the share of visually-impaired people able to understand Braille is estimated at 15% (handicap.fr 2018).

Figure 15: Lyft, Voi and Lime e-scooters with Braille message (sources: The Washington Post and Reddit)

Another issue for visually impaired people lies in the fact that these electric vehicles are almost silent and can be hard to detect. To prevent accidents involving e-scooter users and people with visual deficiency, operators consider **adding a light noise to e-scooters** while ridden by users. E-scooters sound alert is part of the measures studied in this context. For instance, Voi recently partnered with the University of Warwick to investigate the benefits of e-scooter sound for blind and visually impaired people (Voi 2021a).

Finally, micromobility operators adopt solutions to **improve their website's accessibility**, making it easier for everyone to use it. Bird and Voi include a button on their website that allows web users to select a type of disability ('seizure safe profile', 'vision impaired profile', 'cognitive disability profile', 'ADHD friendly profile', 'blind users (screen-reader)', 'keyboard navigator (motor)'. For instance, the 'seizure safe profile' "eliminates flashes and reduces colors", while the 'vision impaired profile' increases the size of characters. The 'cognitive disability profile' highlights clickable areas on the screen and the 'ADHD friendly profile'

[13] For instance: https://www.reddit.com/r/Blind/comments/cuycdu/braille_on_escooters_to_report_tripping_hazards/, https://www.reddit.com/r/SeattleWA/comments/jeo6qn/why_do_lime_scooters_have_braille_on_them/, https://www.reddit.com/r/ThornTree/comments/jn1701/why_do_electric_scooters_have_braille_messages_on/ (accessed on 10/05/2021)

creates a lighted banner to help readers concentrate on a specific area of the screen. The figure below illustrates the 'cognitive disability profile' and the 'ADHD friendly profile'.

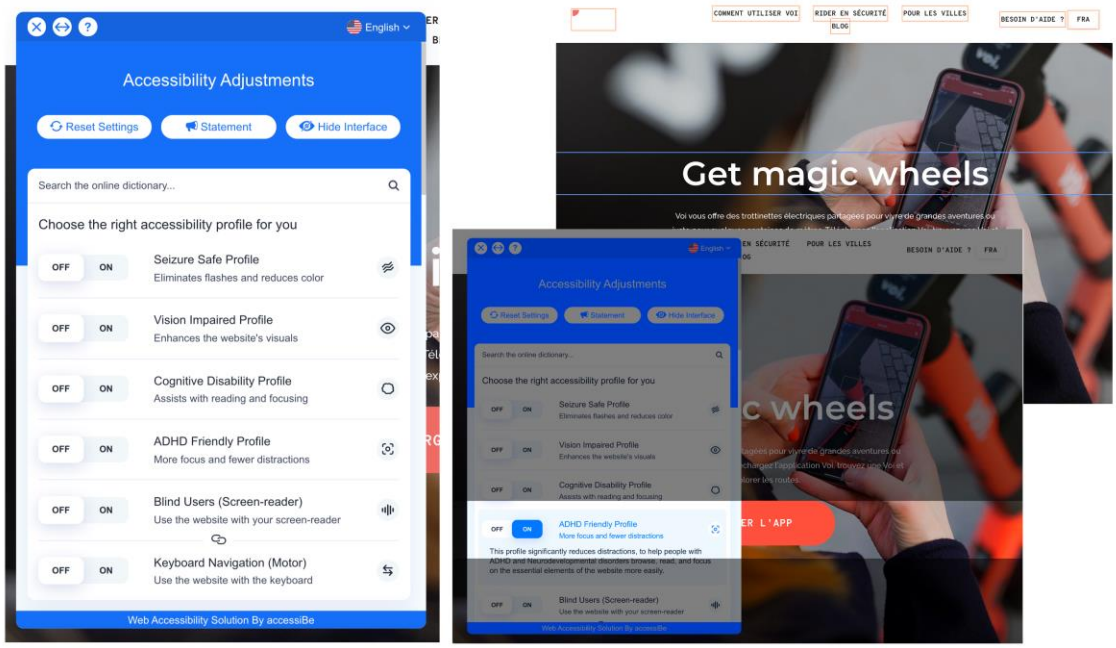


Figure 16: Accessibility options on Voi's website and examples with the "cognitive disability profile" and the "ADHD friendly profile" (source: Voi, 2021)

Evaluations of accessibility options have been conducted in the past, but those mostly focus on blind users (Rodriguez-Sanchez et al. 2014; Sultan et al. 2015; Meddaugh 2011; Aizpurua, Harper, and Vigo 2016). However, the **evaluation protocols and methods** employed are detailed and provide interesting material. Similar methods could be employed to assess disabled people's UX experience and the accessibility options of micromobility services' websites.

By asking the targeted audience to indicate their perceived ease of use – choice between options such as "*got it quickly*", "*got it eventually*" and "*needed help*" (Sultan et al. 2015) – regarding different features (such as selecting an option from the menu, making a call or reading a message), these evaluations can identify what is functioning well and what the main needs for improvement are.

Plus, a study conducted with eleven blind participants (Aizpurua, Harper, and Vigo 2016), asked to assess the accessibility of websites, highlights that perceived accessibility is not only associated with task-oriented aspects but is also related to subjective and hedonic aspects. Two instruments (not specifically designed for disabled people) were used to explore disabled users' experience. First, the **AttracDiff 2** self-administered questionnaire (Hassenzahl 2004) was used. It contains 21 7-point items with bipolar verbal anchors to measure (1) the perceived pragmatic quality, (2) the perceived hedonic quality-stimulation and (3) the perceived hedonic quality-identification and (4) beauty and goodness attributes. Secondly, the "**emotion word prompt list**" (Petrie and Precious 2010) was also used. This instrument consists in a list of emotion words people produced during a think aloud session, each being considered positive or negative (for instance, the word "annoyed" is considered negative, while the word "creative" is considered positive). This method can help users elicit emotional reactions to a website.

Finally, micromobility operators can work with organizations specialised on the issue of inclusion for disabled people to deeply understand the needs of this population and design more inclusive solutions. For

instance, Voi is currently working with the Royal National Institute of Blind People in the U.K. and the University of Warwick to better understand how e-scooter can better integrate in public space without negatively affecting the experience of visually-impaired people (Voi 2021a). Plus, Voi partners with Open Inclusion (Voi 2021c), a consultancy which aim is to increase access for all types of disabled people. Inclusive design workshops with disabled people have been organised, to collect their feedback and experience. Participants were asked to brainstorm on how micromobility solutions could better fit their needs.

d) Allowing access for smartphone non-owners or unbanked people

As part as their micromobility pilot programs, several US cities included requirements regarding access for the unbanked, such as Chicago, Seattle, San Francisco, Saint Louis, Washington D.C. or Oakland, by including **cash-payment options**. For instance, in **Chicago** or in **Portland** (Chicago Department of Transportation 2020; Portland Bureau of Transportation 2021a), operators engaged in the city's pilot program have to offer solutions to enable people with no bank account to access the service. Different solutions were offered: some companies used **pre-paid debit or gift cards** (Bird, Grüv, Lyft and Sherpa) as it is also possible as part as Portland's pilot program, while other companies proposed **benefit programs for unbanked users** (Bolt, Lime, Spin, VeoRide, Wheels). The results appear difficult to interpret, and Chicago's evaluation report indicates that less than 0.5% of all e-scooter trips were made by unbanked people (Chicago Department of Transportation 2020). To this regard, it is worth noting that there is no indication of the share of unbanked people in the general population: thus, it is not possible to estimate if this 0.5% figure accounts for a significant share of unbanked people or not. As part as its e-scooter pilot program, San Francisco also required companies to provide cash options to access e-scooter rental, but here again with very limited results (San Francisco Municipal Transportation Agency 2019).

It should also be mentioned that **cash-payment options often rely on the smartphone application associated with the service**. The user has to select the option in the application and add cash with the help of a local partner (a local business or service). In San Francisco, where unbanked e-scooter users can pay cash credits at pharmacies or 7-Eleven (Lekach 2019), they nonetheless have to open the app to select an "add cash option" and present the barcode to the cashier, as illustrated below.

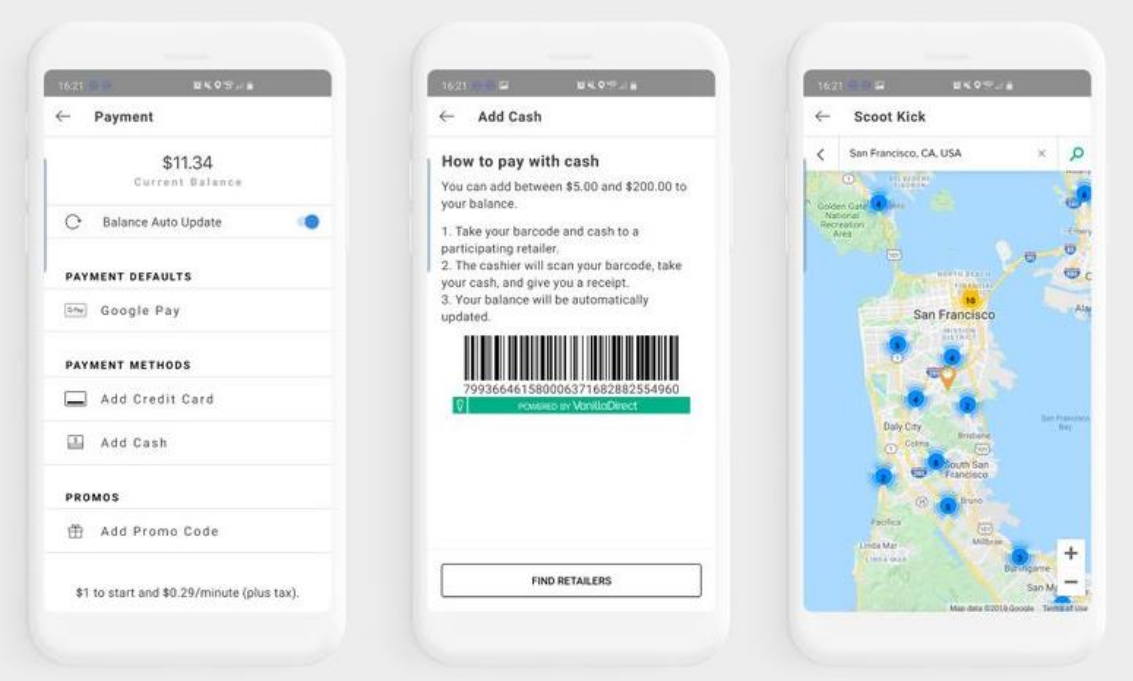


Figure 17: Scoot app cash-payment option in San Francisco (source: Scoot)

As for non-smartphone options to access shared dockless micromobility services, some operators offer **SMS/text messaging options** to rent one of their vehicles. Note that this solution requires a phone, though not a smartphone. In Portland, to unlock a scooter (users can directly spot the scooter on the street or call a special number to obtain the precise location of the nearest vehicle), users who want to access e-scooter rental without a smartphone have to text "unclok" to a specific phone number and indicate the number of the vehicle (Portland Bureau of Transportation 2021b). Similarly, at to end their ride, they have to text "lock". Note that Lime "app-less" riding option (Lime 2021) still requires a smartphone. The user does not have to download the app but has to scan the QR Code and pay through Apple's App Clips or Android's Instant App Features. To date, non-smartphone options to rent a shared dockless e-scooter remains limited.

Cash-payment and non-smartphone options can be complex to adopt for users. Thus, **training sessions** to help unbanked users or those who do not own a smartphone could help them to understand how the service works. To our knowledge, no company or local authority has offered such training sessions (only security training sessions, to learn how to ride safely).

e) Multi-lingual communication

Language can also represent a barrier to access any information or service. People who are not very familiar with one country's official language can have difficulties renting a shared micromobility device, or to understand safety rules, which represents a critical point. In particular, in economically and socially disadvantaged neighborhoods, a significant proportion of people do not master the language of the country. To meet this challenge, shared micromobility operators can **translate the information** mentioned on their websites or mobile applications in different languages. Local authorities can even require operators to provide information in multiple languages. For instance, King County's Scooter Share Pilot Program Contract specifies that "*Permittee should make its software application program available to user in multiple languages, including, but not limited to, English and Spanish, and shall make information available to users on its software application program regarding applicable law and user code of conduct and safety*

criteria" (King County 2020). As part as its e-scooter pilot program, the City of Portland distributed education material (to ensure proper riding and parking in) in five languages (Portland Bureau of Transportation 2019).

Figure 18: Multilingual users' riding guidelines for shared dockless e-scooters in San Francisco (source: VeoRide, 2019)

f) Territorial equity: providing shared micromobility vehicles in every neighbourhood

The above-presented measures address equity and inclusiveness through users' profile. In addition, **spatial distribution** of micromobility devices can be a lever for equity and inclusiveness, provided that operators make their service available in all kinds of neighbourhoods, and do not restrict it to the most socio-economically advantaged areas. In less favoured neighbourhoods, operators can fear their service won't find its public (because it is too expensive compared to local average incomes, unless social pricing measures are implemented). Then, operators can be encouraged, or even required, to ensure territorial equity by local authorities.

In France, after letting shared micromobilty companies deploy their fleet, cities have launched **calls for tender** to select a limited number of operators (6t-Bureau de recherche 2019d). These calls for tender contain operating rules and best practices requirement and specifies the selection criteria for the applicants. In addition to fleet caps, security and sustainability criteria, most of these calls for tender include a **spatial equity criterion**. Marseille's call for tender specify that the city takes into account the "*spatial distribution of vehicles and the operators' capacity to cover areas with low public transport offer*". It should also be noted that these spatial equity requirements are also designed to avoid public space saturation and street clutter.

Similarly, shared e-scooters or shared bicycles pilot programs experimented in several North American cities include equity requirements in relation with spatial distribution, to ensure devices are available outside of the downtown area, in less privileged neighbourhoods, as is the case in Baltimore, Washington D.C., Chicago, Portland or Saint Louis (City of Alexandria 2019). The city is divided in different areas and **minimum vehicle requirements are defined for each area**. The e-scooter company ensures that its vehicles are correctly distributed all over the city by rebalancing vehicles. A few examples can be mentioned:

- In **Saint Louis**, e-scooter companies have to display at least 20% of their fleet in specific areas.
- In **Washington D.C.**, "Equity Emphasis Areas" are defined as areas concentrating low-income and non-white populations, where operators have to deploy a minimum of 20 vehicles (in each area).

- In **San Francisco** (San Francisco Municipal Transportation Agency 2019), companies engaged in the 2019 pilot program had to maintain at least 20% of their fleet in "Communities of concern" defined in the pilot program.

- In **Chicago**, the pilot program (Chicago Department of Transportation 2020) distinguish between two sub-areas (northern and southern priority areas, defined as "underserved community areas"), where companies have to distribute half of their fleet each morning. The results report reveals that "*compliance with this requirement varied*", with "*none of the 10 companies consistently meeting the 25% requirement in each area*". However, even if the goal set by local authorities has not been reached, it seemed to increase the availability of devices in disadvantaged neighborhoods.

- In **Portland**, the City requires operators participating in its 2019 pilot program to deploy each day a minimum of 100 e-scooters in East Portland, a socially and economically disadvantaged neighborhood. Plus, to encourage the deployment of e-scooters in disadvantaged neighborhoods, Portland Bureau of Transportation **adjusts the fee** according to the area where each vehicle is located (Portland Bureau of Transportation 2020): the daily fee is $0.20 for each scooter located in the Central City, $0.10 for each scooter located in the Inner Neighborhoods and $0.05 for each scooter located in the Eastern Neighborhood. This example shows how local authorities can use a financial lever to encourage socio-spatial equity.

- In **Tucson** (City of Tucson 2019), during the e-scooter pilot program, fleet caps have been implemented but companies were allowed to launch an additional 250 e-scooters in "Opportunity areas", defined after census survey data, including four components: socioeconomic status, household composition, minority status and language and housing and transportation.

- In **Baltimore**, e-scooter companies have to display daily 25% of their fleet in 15 "equity zones", specific areas with low average income levels (Baltimore City 2019). The results report indicates that the rate reached in "equity zones" is 21% (below the requirement of 25%, but it should be specified that the count has been made at 6 am and may not include vehicles deployed after 6 am). Results also highlight that "*vendors often deployed on the borders of the zones, not throughout the entire zone*", circumventing the rule. Plus, the report specifies that equity zones count for 17.4% of trips' origins and, between 7 and 9 pm, equity zones count for 28% of trips' destinations, which indicates that e-scooters were used by low-income areas' residents to commute and can thus facilitate equity and job accessibility.

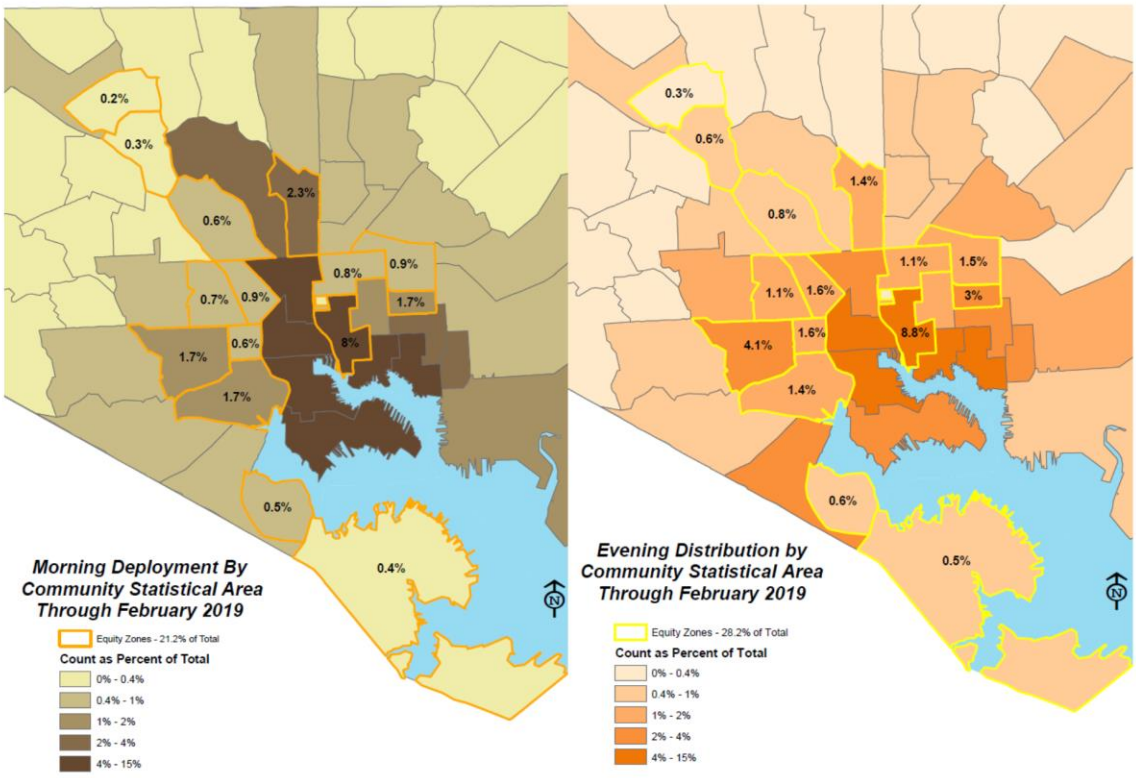


Figure 19: Morning and evening spatial distribution of shared dockless e-scooters in Baltimore during its pilot program (Baltimore City 2019)

g) Supporting socially beneficial activities

Shared micromobility companies can also support socially beneficial activities, an indirect way to address the issue of transport equity, or equity through transport. In the context of the pandemic, several e-scooter companies offered free rides to medical staff, including Voi. In Norway, Voi supports the project "Vennehjelpen" (which can be translated as "friendly support") developed by the Norwegian home service platform Luado (Voi 2020): volunteers helping vulnerable people with everyday tasks can use Voi e-scooters for free. Voi is also engaged on the issue of inclusivity and diversity in the workplace by participating to the employability workshop organised by Key4Life (Voi 2021b), a crime prevention and rehabilitation charity which aims at reintegrating young men who have been in jail by offering advice and support to master skills such as CV writing and interviewing.

h) The key importance of communication

All in all, it is worth keeping in mind that for inclusiveness initiatives to work, beneficiaries need to be aware of them. Information and communication are thus key, and should be part of any inclusiveness strategy. Relying on community ambassadors is a way to communicate about inclusiveness programs while engaging with grassroots associations. This measure has been used in New York by the Citi Bike equity team (Better Bike Share Partnership 2021) : ambassadors receive training from the equity team, and then attend community events and inform their neighbours of the different programs available to them.

Not only can community ambassadors inform, they can also play a key role in capabilities-based approaches: in London, TfL has hired community ambassadors to train mobility impaired passengers to circulate safely and confidently on the network (TfL 2018). Working with ambassadors is thus a way to

ensure that measures effectively reach their intended beneficiaries, and that these beneficiaries are supported by a peer in taking advantage of them.

3.3. Conclusion: using shared dockless micromobility services to increase transport equity

To conclude, shared dockless micromobility services raise **multiple issues related to equity and inclusiveness**. To this regard, users' profile, spatial equity, access for disabled people and for people who do not own a smartphone or a bank account concerns can be distinguished. As an additional and flexible mobility option, which can complement public transportation in areas where the offer is low, shared micromobility can contribute to transport equity. It is then critical to implement appropriate actions to address each of these issues. To date, several **solutions** have been adopted or are experienced to ensure or increase the inclusiveness and equity of micromobility services.

These different solutions are summarised under the three steps identified from the literature review:

- Step 1 – Ensuring access to all

Social pricing measures aim at ensuring (financial) access to all types of users, especially those with low income. While **social pricing** is an interesting way to make micromobility services affordable to all, its impact of this measure has not been rigorously evaluated in the past. Evidence from US pilot programs suggests that **communication is key** to boost the impact of this kind of measures. In the different countries and cities where it operates and where it has operated, Voi offers social pricing.

As for spatial equity, **minimal fleet-density requirements can be used to ensure the equitable spatial distribution** of services. Associated with social pricing, these measures can ensure universal access to shared micromobility, regardless of the neighbourhood.

Note that the goal of "improving access to opportunities" is not addressed in itself by shared micromobility companies or programs, and can be considered as indirectly addressed through spatial equity measures.

Following insights from capabilities approach, one could argue that good communication is a necessary step towards the "appropriation" of these services: to use them, one needs to be aware of where they are located, and at which conditions they can be accessed. The prospective user also needs to see a potential for the service to fit his or her daily routine, and to identify with the user image as displayed in advertisement. However, if **communication and imagery** can provide a 'soft' way to diffuse the idea that micromobility could suit all types of users, special attention must be paid to communication design so as to **avoid any kind of 'social washing'**.

- Step 2 – Tailoring the service to under-represented users

If socially-priced, spatially-equitable micromobility services are tailored to suit most people, they do not take into account the **specific needs** of some users, who tend to be under-represented. Measures to tackle this issue include **multi-lingual** communication, as well as **non-smartphone** or **cash-payment** options. The latter are still scarce and often fastidious to use ; a phone, if not fast, is often still required.

Women are also an under-represented public with specific needs related to the unequal sharing of domestic and care work, combined with lower wages and important time constraints. Understanding the way these constraints operate in action, throughout women's daily trips, is key to designing a service that would answer their needs. This has, so far, not been addressed by most operators. The needs of women

are best addressed when women are themselves represented among the staff working for operators. It is thus worth underlining that **Voi has recently joined Women in Transport**, an association that promotes the involvement of women in the transport and mobility industry.

As for **disabled people**, in addition to allowing blind and visually impaired non-users to signal improperly parked vehicles obstructing the way, **interesting solutions have been developed to motorise wheelchairs through the use of e-scooters.** These solutions have, nowadays, not been operationally deployed by shared micromobility operators. These solutions raise both technical and legal issues as a motorised wheelchairs are entirely different vehicle than e-scooters. Voi is currently working on a solution with its partner, Klaxon Mobility.

Finally, **website accessibility** options and bright design features to make e-scooters noticeable to blind and visually impaired people are necessary. Both have been implemented by Voi.

- Step 3 – Getting under-represented users meaningfully involved

This third step of is the most ambitious and appears to be the least addressed by micromobility companies. Note that Voi is already engaged to get under-represented users involved: its partnership with the Royal National Institute for Blind People, Women in Transport, or the multiple round-table meetings being held for disabled users and facilitated by Open Inclusion, are examples of such measures. Plus, Voi support grassroots associations, such as Key4Life in the UK or Luado in Norway. This effort should be sustained and enhanced by developing, for instance, an evaluation committee who would be able to monitor the performance of services overtime.

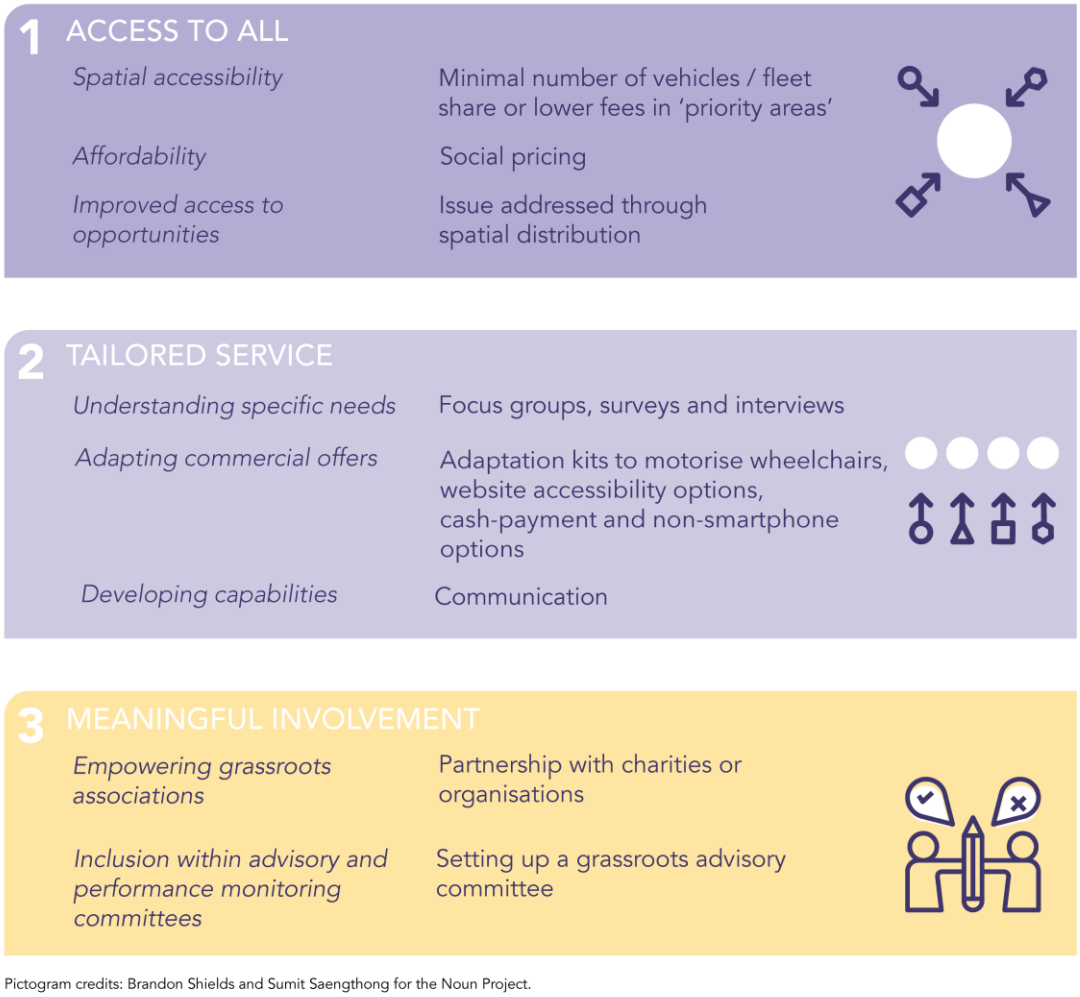


Figure 20: Equity and inclusiveness issues raised by shared micromobility services and solutions associated

Voi has already implemented several actions that can be placed into these different steps. The figure below evaluates these actions, using the following scale:

- Absent: no measure has been taken
- Incipient: first steps have been taken, but the answer is only partial
- Satisfactory: a satisfactory set of measures have been implemented
- Advanced: the strategy used goes beyond the satisfactory level and encompasses ambitious measures

As shown in the figure below, Voi has already achieved a satisfactory level on all three dimensions. The roadmap will plan for ways to (1) monitor the effective impact of the actions taken; (2) plan for additional actions to reach the "advanced" level.

Figure 21: Voi's actions regarding the three steps towards accessibility

Section 2
A roadmap towards inclusive micromobility

1. Key guiding principles

The previous literature review has allowed to identify three steps towards inclusive micromobilities. These steps are based on conceptual discussions regarding equity, inclusiveness and justice, and have been confronted to the actions already taken by actors of the sector, including Voi. This part uses these findings from the literature to define a **roadmap towards inclusive micromobility**. In this roadmap, steps are broken down into sub-objectives. To each objective are associated measures for Voi to take, as well as methods to evaluate the success of these measures. Indeed, transport justice should be understood "*not as a state of affairs, but in terms of an* ***ongoing process****, power relations and struggles over praxis, meanings and values that are actively shaped by the places and spatial configurations as part of which they unfold*" (Verlinghieri and Schwanen 2020, 3). Monitoring the evolution of performances is thus key to evaluate the efficiency of the measures taken, but also to redefine them over time if that proves necessary.

We recommend that Voi uses this roadmap following Karner and Marcantonio's (2018, 107) three-step model:

- The needs and priorities of underserved residents should be identified and understood through a "*community-led approach and appropriately resourced decision-making process*";
- A near-term revenue stream should be defined to address these needs;
- Progress should be monitored through appropriate indicators.

Finally, it is worth keeping in mind that the following part presents a roadmap that would apply across all of Voi's cities and countries of operations. It includes several data collection (survey and focus groups) and participatory measures that should be applied at the level of each city/country of operation. Once this new data will be produced and analysed, Voi will be able to adapt the roadmap to the local context in a "local inclusiveness plan". We would recommend presenting the plan to a local grassroots inclusiveness monitoring committee, and having grassroots representatives vote on its adoption.

2. The roadmap

The roadmap is structured following the three steps identified in the literature. These steps should not be understood as unfolding in a chronological order. Rather, they represent different levels of ambition, and different approaches to the issue. Progress on all dimensions can thus be achieved at the same time.

It is worth noting step 1 actions are those easiest to implement quickly. Step 2 actions imply focus group discussions and the identification of external partners to adapt vehicles, and step 3 actions imply setting up a performance monitoring committee made of representatives from underrepresented groups. These latter two steps thus require longer time and effort.

Voi has already adopted some of these measures. For instance, several focus groups have already been organised. The goal of this framework is to standardise that process, organise its monitoring, and make sure results from such measures directly influence service design.

The following framework has been developed to be very exhaustive and complete. It is worth underlining that not every single measure has to be performed, and that Voi may decide to prioritise some key indicators. For instance, cash-payment and non-digital options, as well as app or website accessibility features, are not very advanced yet. As a result, little is known about the impact of these features on inclusiveness, and it appears very difficult to evaluate them thoroughly and effectively. On the contrary, measures such as social pricing, territorial equity or grassroots committees for equity performance monitoring are much more advanced and there is sufficient material and hindsight to evaluate them accurately and conclude that they have proven their worth. We therefore recommend focussing on these measures first when implementing the roadmap, although it is up to Voi to determine which measures should be prioritised to offer inclusive micromobility.

Broad objective	Detailed objective	Measures to take	Monitoring indicators	Monitoring method and temporality
Step 1 – Access to all	Affordability	Offering social pricing	• Share of users with revenue beyond a certain threshold • Number and share of users on a social pricing subscription • Number of trips taken by users benefiting from social pricing	Data analysis using : • Independent user survey (online questionnaire) • Voi's own data Cadence: Once per year
	Availability of vehicles	Ensuring that e-scooters adequately serve all neighbourhoods within a city, and especially those that lack public transport options	• Spatial distribution of the fleet within a city, compared to the share of low-income users and users in high categories socio-economic categories (in the UK, National Statistics Socio-economic classification, or NS-Sec) living in each area • Average access/egress time from an e-scooter (target: should never be above 5 minutes) per neighbourhood (heat map) • New indicator: MIL (Micromobility Inclusivity Level, based on the PTAL). Ratio of the average access time to an e-scooter in the neighbourhood with the highest share of low-income residents, and this same average access time in the neighbourhood with the lowest share of low-income residents. The closer it is to one, the more inclusive the service.	GIS data analysis using: • Voi's use data • Census data Cadence: analysis 6 months after service launch and after each increase in fleet sizes.
	Accessibility to opportunities through the service	Measuring improvements in access to key jobs and services; adjusting pricing, deployment and outreach accordingly	• Average number of jobs/shops/public services reached within 30 minutes using e-scooters	GIS analysis using: • Voi's use data

			(unimodal/intermodal) and comparison with the number reached without e-scooters. • Evolution of isochrons with/without e-scooters	• Publicly available data on jobs (provided it is available) • Census data Cadence: analysis at the time-of-service launch, and when fleet sizes evolve.
Step 2 – Tailored services	Understanding the needs of disabled users	Organising focus groups discussions with disabled users	Number of focus groups organised	Focus group organised independently Cadence: • At least once per country to shape service in all cities
	Understanding the needs of women	Organising focus group discussions with women	Number of focus groups organised	
	Understanding the needs of socioeconomically disadvantaged users	Organising focus group discussions with socio-economically disadvantaged users	Number of focus groups organised	
	App accessibility	App modes compatible with: • Multiple languages • Blind or sight-impaired users • Learning impaired users • Neurodiverse users App has the capability to save and store specific in-app user features to the users account	• Number of users who use these features • Share of these users who approve of accessibility features (Likert scales to rate different features, such as "searching and booking an e-scooter", "accessing to one's profile page and personal data", etc.)	Independent user survey (online questionnaire) Voi's own reporting Cadence : • Yearly survey
	Vehicle accessibility	Development and deployment of technological and non-technological solutions to make vehicles accessible to a variety of disabled users Ride-along interviews with disabled users to test adaptive devices	• Presence of a solution for disabled users (e.g. Klaxon Klick) • Cost of the solution to users compared to the cost of the solution for a non-disabled users • Number of beneficiaries	• Voi's reporting • Independent user survey • Ride-along interviews

			• Disabled users' appraisal of the different solution's features (ease of use, practicality) • Number of ride-along interviews organised	Cadence: 6 months after launching the device.
	Riding skills	Training prospective users to use e-scooters confidently and safely Employing representative ambassadors to provide this training	Number of users who attended training Number of training session offered Share of users who state they are confident riding an e-scooter (before/after for those who attended the training session)	• Voi's reporting • Independent user survey (online questionnaire) Cadence: training sessions all throughout the year, evaluation of riding confidence once per year.
	Digital capabilities	Training prospective users to feel comfortable with the app Ensuring those who cannot use the app have another option (non-digital option) Ensuring unbanked citizens can also use the app	Number of digital training sessions organised Share of users who state they are comfortable using the app (before/after for those who attended the training session) Presence of a non-digital option Number/share of users who use the non-digital option Users' appraisal of the non-digital option (ease of use, practicality) Presence of an option for unbanked users Number/share of users who use the cash-payment option Users' appraisal of cash-payment option (ease of use, practicality)	• Voi's reporting • Independent user survey Cadence: • Digital training sessions offered on-demand all throughout the year • Appraisal of options: pop-up on the app one week after first using these options + question in the independent survey once a year

	Language capabilities	Making all information (terms and conditions, safety guidelines) easily understandable for all users, regardless of their language skills	Number of languages offered	• Voi's reporting Cadence: revise the figure after each addition of a new language
	Targeted communication campaigns to ensure awareness	Making sure under-represented users are aware of the options developed to serve them. Relying on representative ambassadors and communications campaigns in partnership with local associations.	Share of under-represented citizens who are aware of tailored options within a pilot city Number of representative ambassadors hired	• Quick social media survey 1 month after the launch of a communication campaign
	Tailored pricing options	Exploring whether different social pricing options would be needed to answer the needs of various disadvantaged groups	(*If results from focus groups and surveys suggest various social pricing options would be valuable*) Presence of a variety of pricing options to answer various needs Number and share of users on each social pricing option	• Voi's reporting Cadence: • Monitor once per year
	Creating new transport opportunities for under-represented users	Monitoring that measures taken to serve under-represented users do encourage them to use the service	(*Depending on the city/country*) Share of disabled users Share of users with a lower education level Share of unbanked users only if there is available data to compare it to the share of unbanked users within the population Share of users with no smartphone only if there is available data to compare it to the share of users with no smartphone within the population Share of users considered to be "in need of transport", that is, living more than a 15-min walk away from public transport New trips allowed by the service for users "in need of transport" Share of women users	• Independent user survey (online questionnaire) Cadence: • Once per year

			Diversity of ethnic profiles Diversity of ages	
	Adapting products and services to under-represented users	Soliciting users' input on services and products and empowering grassroots organisations to explore these issues	Number of design workshops conducted Number of grassroots associations empowered Number of association's members involved	• Voi's reporting and qualitative appraisal Cadence: • Once per year
Step 3 – Meaningful involvement	Being accountable to under-represented users	Assembling diverse local committees for equity performance monitoring	Presence/absence of a grassroots committee for performance monitoring Number of sessions held	• Voi's reporting and qualitative appraisal Cadence: • Once per year
	Engaging with city officials for systems change	Reporting to city officials on data and learnings Helping cities identify infrastructure needs to support riding for all ages and abilities **Reporting back on areas identified by the city in any pre-trial assessments such as an IIA or EqIA in the UK.**	Number of synthesis and analysis reports shared with the city	• Voi's reporting on the above metrics as well as on infrastructure needs in the city Cadence: • Twice per year

The figure below summarises the roadmap, with its different steps, objectives and measures.

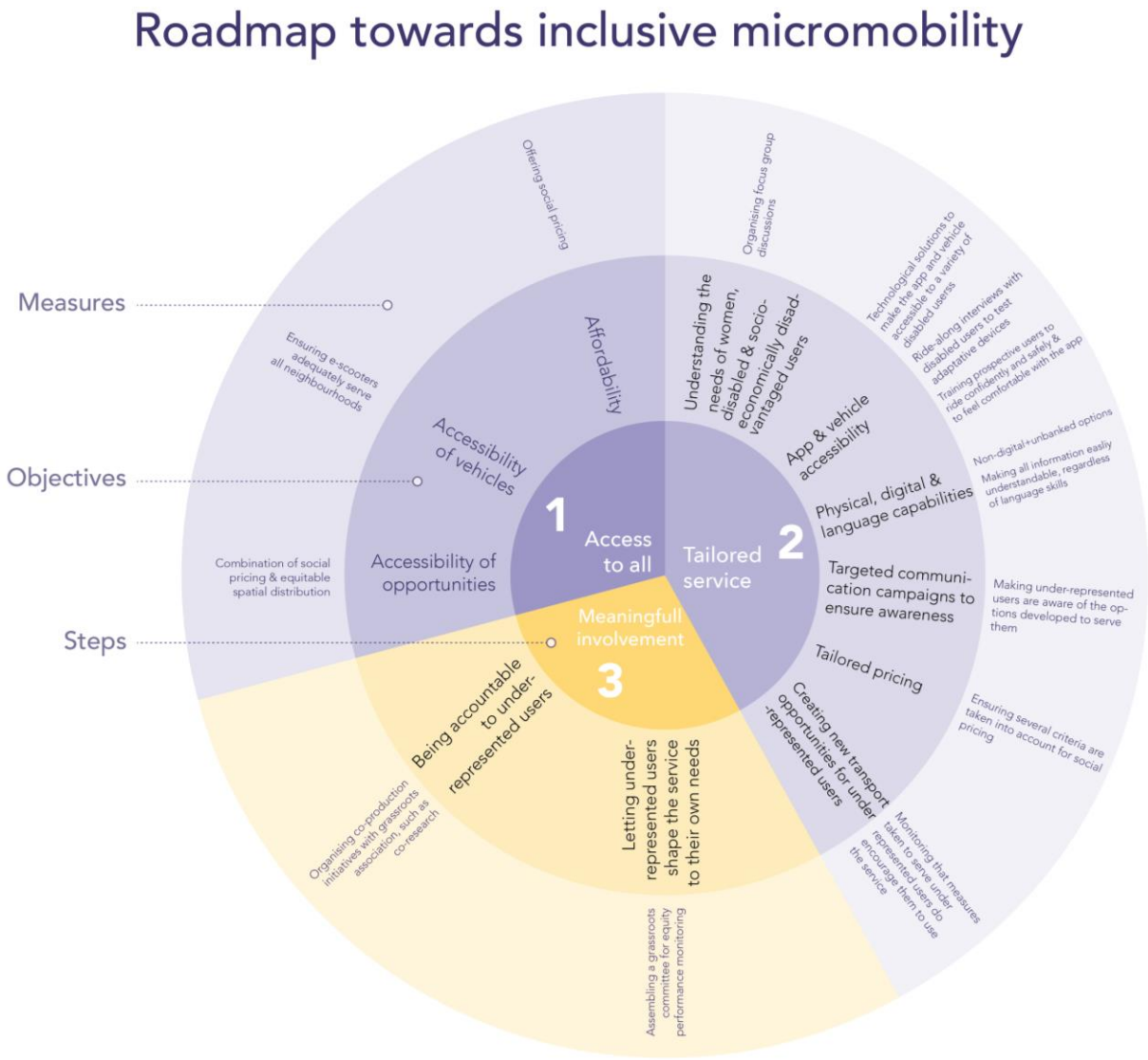


Figure 22: Roadmap towards inclusive micromobility

Glossary

Accessibility: Accessibility is based on the idea that equitable transport planning should allow all citizens to benefit from the same level of access to opportunities, whatever their living area or sociodemographic profile. Three key types of indicators are generally used to assess accessibility: proximity to transport services, daily travel behaviour and access to opportunities.

Capabilities: Capabilities have been developed from the work of the economist Amartya Sen and the philosopher Martha Nussbaum and refer to individual's capacity to convert the resource available (e.g., a mobility service) into opportunities (e.g., access to jobs). This takes into account the multiple factors that may limit one's mobility, in addition to physical and financial barriers.

Early adopter: The expression 'early adopter' is derived from Everett Rogers' diffusion of innovation model, establishing a five-category typology of consumers following a normal distribution. When available on the market, an innovation diffuses progressively within the population and 'early adopters' are among the first to adopt a new product or service. Research has shown that, whatever the product or service considered, they tend to be more frequently men, wealthy, highly educated, full-time working as white collars and to live in large urban areas.

Inclusiveness: Inclusiveness can be considered as equal access to opportunities and resources, whatever the living area and socioeconomic characteristic conditions of an individual. Thus, a service can be regarded as inclusive if it offers such equal access.

MIL: MIL stands for Micromobility Inclusiveness Level. It is a new indicator developed by 6t, based on PTAL, to assess the level of inclusiveness and accessibility offered a micromobility service. MIL is the ratio of the average access time to an e-scooter in the neighbourhood with the highest share of low-income residents in a given city, and this same average access time in the neighbourhood with the lowest share of low-income residents.

Mobility equity: The term 'equity' is used to refer to the equal and fair distribution of the benefits and costs associated with a certain project. Applied to transportation, it refers to the fact that all inhabitants of a city, whatever their living area and socioeconomic status should equally benefit from transport services, and the negative externalities of these transport services (e.g., noise, pollution) should not be overwhelmingly born by disadvantaged citizens.

Mobility justice: The term 'mobility justice' implies that justice goes beyond the equal distribution of benefits and costs and also involves the inclusion of under-represented citizens in the decision-making process. When it comes to transportation, it implies participatory planning and the understanding of the different needs and constraints of different groups: not only should resources be equally shared, but some citizens may need different resources to seize mobility opportunities.

Motility capital: In line with capability approaches, motility is a term coined by the sociologist Vincent Kaufman and co-authors to refer to individual's capacity to be mobile. Motility is determined by three components: (1) accessibility, that is the material conditions of mobility (physical access and financial affordability); (2) skills, that is physical and cognitive competences to be mobile (e.g., driving a car, riding a bicycle, using an app) and (3) appropriation, that is preferences, representations, norms and values.

PTAL: PTAL stands for Public Transport Accessibility Level, an indicator developed by Transport for London to measure the level of access to the public transport network. For any given point in London, this indicator combines walking time to the nearest public transport stop to service frequency at that stop. PTAL can range from 0 to 6b, 6b indicating an excellent access to public transport.

Transport poverty: The concept of transport poverty refers to the link between transport disadvantage and social disadvantage. Indeed, in most countries, the poorest socioeconomic groups also tend to be the least mobile. Transport-poor people tend to suffer from a limited access to mobility options and a limited capacity to seize these mobility options. The concept thus brings together distributive justice and capabilities.

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