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Chapter 12. Shared Micromobility: Policy and Practices in the United States

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INTRODUCTION

Over the last two decades, a variety of social and technological factors have converged contributing to the growth of the sharing economy. The sharing economy is a phenomenon based on renting and borrowing goods and ser- vices, rather than owning them. The sharing economy can improve efficiency, provide cost savings, monetize underused resources, and offer social and environmental benefits. Shared micromobility, the shared use of a bicycle, scooter, or other low-speed transportation mode, is one facet of the sharing economy.

Shared micromobility growth in U.S. cities has been on a relatively steep growth curve, starting in the early 2010s. Micromobility systems offer shared active transportation and low-speed modes for first-and-last mile trips, many-mile trips, or both in an urban environment (Shaheen et al. 2019). Shared micromobility is an innovative transportation strategy that enables users short-term access to a transportation mode on an as-needed basis. Shared micromobility includes various service models and transportation modes that meet diverse traveler needs, such as station-based micromobility (a bicycle or scooter picked up from and returned to any station or kiosk) and dockless micromobility (a bicycle or scooter picked up and returned to any location) (Shaheen and Cohen 2019).

Common modes include bikesharing and scooter sharing. *Bikesharing* provides users with on-demand access to bicycles at a variety of pick-up and drop-off locations for one-way (point-to-point) or roundtrip travel. Bikesharing fleets are commonly deployed in a network within a metropolitan region, city, neighborhood, employment center, and/or university campus. *Scooter sharing* allows individuals to access scooters by joining an organization that maintains a fleet of scooters at various locations. Scooter sharing models can include a variety of motorized and non-motorized scooter types. Scooter usage rates typically include gasoline or electric charge (in the case of motorized scooters), maintenance, and may include parking. Scooter sharing can include different types of scooters, such as moped-style and standing electric scooters. Both bike and scooter sharing can be deployed in one of three service models: (1) station-based systems that enable access to bicycles via unattendedstations; (2) dockless systems that allow users to check out a bicycle and return it to any location within a predefined geographic region; and (3) hybridsystems that enable users to check out a bicycle from a station and end their trip by either returning it to a station or a non-station location (or vice versa).

Shared micromobility has the potential to offer communities an array of individual and community benefits, such as increased mobility, greater environmental awareness, and increased use of active transportation and non-vehicular modes. With careful planning and public policy, micromobilitycan also enhance accessibility and quality of life in cities. This chapter dis- cusses the growth of shared micromobility, its impacts on users and communities, and policy considerations for managing the potential adverse impactsof shared micromobility on curbspace management. This chapter is organized into four sections. The first section discusses the growth and evolution of shared micromobility in the U.S. The next summarizes user demographics andshared micromobility impacts. The third section discusses shared micromobility policies and practices, including two policy case studies from Seattle, Washington and Santa Monica, California. The final section concludes witha discussion of the future of shared micromobility.

GROWTH AND EVOLUTION OF SHARED MICROMOBILITY IN THE U.S.

Recent growth of shared micromobility over the past decade includes four milestone periods described below:

Origins of IT-Based Micromobility and Station-Based Bikesharing (2007 to2012)

North America’s first information technology (IT) enabled bikesharing system,Tulsa Townies, started operating in 2007 in Tulsa, Oklahoma. Tulsa Townies was the first mobile solar-powered, IT station-based system in the world.The service is free of charge, with a credit card refundable deposit. By 2012, IT-enabled station-based bikesharing had grown to 22 operators in the U.S., claiming approximately 884,442 users sharing 7,549 bicycles.

Growth of Peer-to-Peer Bikesharing (2012 to 2014)

Approximately five years after the launch of station-based bikesharing inthe U.S., a variety of dockless technologies began to emerge, enabling new operational and business models such as peer-to-peer (P2P) bikesharing. P2P micromobility services involve the sharing of privately owned micromobility devices where companies broker transactions among micromobility owners and guests by providing the organizational resources needed to make the exchange possible (e.g., locking mechanism, online platform, etc.). In 2012, Spinlister, a smartphone application, launched a P2P bicycle rental market- place where a bike owner could make their bicycle available to others for short time periods, enabling direct exchanges between individuals via the Internet. Spinlister eventually shut down in April 2018, but it relaunched in January 2019 with new features including remote locking and bicycle delivery (a bicycle brought to a user). At the same time that Spinlister was launching in 2013, another company, BitLock, created a keyless bike lock accessible via smartphone technology, enabling another P2P bikesharing option.

Introduction of Dockless and Geo-Fencing Technologies (2014 to 2016)

Shortly after the introduction of P2P bikesharing services, a number of bikesharing startups, including Social Bicycles (known as SoBi, which was acquired by Uber as JUMP in April 2018 and later by Lime in Spring 2020), launched dockless or flexible docked bikesharing systems, featuring "smart bikes" that host the locking mechanism on the bike rather than the dock. Dockless and flexible docking systems enable users to pick up and drop off bicycles anywhere within a geographic area by locking the bicycle to a bike- sharing station, existing bicycle parking, street furniture, or a designated bikesharing rack. Users identify bicycle availability and locations in real time through mobile or Internet applications or via bikesharing kiosk screens. The geographic proximity of bikesharing (docked and dockless systems) can be limited through "geo-fencing." A geo-fence is a virtual perimeter, which limits the range of mobility of an enabled bicycle, by comparing the GPS-satellite coordinates of the bicycle to the allowable geographic area.

Growth of Dockless Bikesharing and Scooter Sharing (2017 to Present)

Beginning around 2017, the number of bikesharing providers began to experience notable growth. In addition to docked or station-based services provided by B-Cycle, Motivate, Zagster, and Social Bicycles, a number of new dockless vendors entered the marketplace including: JUMP (formerly Social Bicycles), Limebike, MoBike, Ofo, Spin, and an array of smaller vendors and service providers. In September 2017, Bird became the first app-based, scooter sharing provider to launch in Santa Monica, California. Several other companies launched shortly after (Linton 2019). The National Association of City Transportation Officials (NACTO) estimates that there were 136 million shared micromobility trips (scooters and bikes) in the U.S. in 2019 (including 86 million trips with standing electric scooter sharing, 10 million dockless electric bikesharing trips, and 40 million station-based bikesharing trips). Between 2010 and 2019, 343 million shared micromobility trips were completed in the U.S. In spite of this growth, enabled by large venture capital investment, a number of cities saw a reduction in dockless shared micromobility fleets in late 2019, with some cities reporting increased use and others decreased use during the COVID-19 pandemic (Wilson 2020; Grogan and Hise 2020). Some cities have implemented slow streets programs intended to support micromobility, outdoor dining, and other outside socially distanced activities in response to the pandemic.

USER DEMOGRAPHICS AND SHARED MICROMOBILITY IMPACTS

While North American studies of dockless micromobility are limited, there is anecdotal evidence that the user demographics of dockless shared micromobility are similar to other shared modes (i.e., carsharing, microtransit, transportation network companies (TNCs), etc.) (Rayle et al. 2016; Cohen and Shaheen 2016; LeVine, Zolfaghari and Polak 2014; Fishman 2015; Kopp, Gerike and Axhausen 2015). A number of studies have documented different demographic profiles across a range of shared modes. Older studies of shared mobility have found that users generally tend to be: (1) well educated (often with a college or postgraduate degree); (2) younger adults (typically between the ages of 21 and 45); (3) childless households; (4) middle- and upper-income households; and (5) living in urban built environments, often with limited vehicle access (e.g., zero or one car households) that use multiple transportation modes, such as public transit, cycling, and walking.

For a variety of reasons, these studies tend to reflect the demographic profiles of early adopters, urban lifestyles, and households without children. First, urban built environments tend to be more walkable, bikeable, and less conducive to private vehicle use (e.g., limited and expensive parking). Additionally, the presence of children in a household is commonly associated with increased vehicle dependency. Finally, active transportation, and cycling in particular, in the U.S. can be associated with a social stigma whereas vehicle ownership can be perceived as a status symbol, associated with freedom, and providing a lifeline to job access for individuals underserved by public transportation or non-vehicular modes.

In contrast, there is some anecdotal evidence that suggests the user base for shared micromobility services could be more diverse than other shared modes since dockless bikesharing and scooter sharing have demonstrated success in reaching underserved areas in some cities. Although studies on dockless shared micromobility impacts are limited, a number have documented the demographics of station-based bikesharing users.

While multi-city bikesharing studies in North America are more limited, a few focused-on station-based bikesharing indicate that users are often Caucasian, generally younger, have an upper to middle income, and are more highly educated (Shaheen et al. 2012; Shaheen et al. 2014). Although there are some variations by city, key demographic ranges include: (1) *Race/Ethnicity:* 74% to 92% of surveyed users are Caucasian, compared to 1% to 5% that are Hispanic or Latino and 1% to 2% that identify as African American; (2) *Household Income:* 29% to 39% have household incomes greater than US $100,000 a year, compared to 9% to 26% that earn less than US $35,000 annually; (3) *Educational Attainment:* 55% to 89% of surveyed users have a minimum of a four-year college degree; and (4) *Age*: 37% to 54% of surveyed users are under the age of 35, and 36% to 51% are between the ages of 35 and 54. Other studies of station-based bikesharing tend to echo these findings (Hoe 2015; Bachand-Marleau, Lee, and El-Geneidy 2012; Smith, Oh, and Lei 2015; Kille 2015; McNeil et al. 2017; Ursaki and Aultman-Hall 2016). In addition to documenting user demographics, a number of North American studies have documented station-based bikesharing impacts, while studies of dockless bikesharing and shared scooter sharing are emerging. Studies of shared micromobility have documented impacts in four key areas:

- **Environment:** Several studies indicate that shared micromobility reduces greenhouse gas (GHG) emissions by replacing personal vehicle trips (Shaheen and Cohen 2019). Additional environmental considerations include lifecycle impacts associated with support staff using vehicles to rebalance the devices, along with manufacturing, recycling, and battery replacement impacts (Fishman 2015).
- **Mode Substitution:** The impacts of shared micromobility on private vehicle and public transit use appear to vary by service model (i.e., station-based and dockless); device (i.e., bicycle or scooter); and study location (Shaheen et al. 2012; Shaheen et al. 2014; McNeil et al. 2017; Fishman 2015). Some studies suggest that shared micromobility may be an effective first- and last-mile strategy connecting users to public transportation, while others indicate that micromobility may result in shifts away from public transit (e.g., more direct micromobility trips replacing public transit transfers and/or long headways between buses or trains) (Shaheen et al. 2014). Some of these studies have shown that shifts toward public transportation due to bikesharing tend to be more prevalent in lower-density regions on the urban periphery, suggesting that station-based bikesharing may serve as a first- and last-mile connection in smaller metropolitan regions with lower densities and less robust public transit networks. The findings also suggest that in larger metropolitan regions with higher densities and more robust public transit networks, station-based bikesharing may offer faster, cheaper, and more direct

connections compared to short-distance public transit trips. Additionally, public bikesharing may be more complementary to public transit in small and medium metropolitan regions and more substitutive in larger metropolitan areas, perhaps providing relief to crowded public transit lines during peak periods (Shaheen and Martin 2015). Additional studies are needed to clarify impacts on mode choice, particularly related to dockless service models.

- **Public Health:** Shared micromobility may increase the use of active modes. A study of station-based bikesharing indicated an increase in physical activity among users. Some studies have found that micromobility users reported reduced stress and weight loss due to bikesharing. However, a key limitation of these health impact assessment studies is that they do not examine negative health impacts associated with ridership, such as the costs linked to increased exposure and risks related to injuries and collisions (Alberts, Palumbo, and Pierce 2012). One study of standing electric scooter sharing found that it attracted new people to active transportation (such as walking and biking) (Portland Bureau of Transportation 2018).
- **Safety:** Studies indicate that shared micromobility users often do not wear helmets, but additional research is needed to determine if these modes are more dangerous than other transportation modes. One retrospective study of scooter sharing safety in Los Angeles, California between September 2017 and August 2018 found that scooter-related injuries are common with varying levels of severity, low rates of adherence to rider age requirements, and low rates of helmet use (Trivedi et al. 2019). Although studies have documented a high number of scooter-related injuries and hospitalizations, more research should be conducted to understand risky riding behavior, safe speeds, and riding locations that contribute to injuries of scooter sharing users (Shaheen and Cohen 2019).

Although *before-and-after* studies documenting the impacts of dockless shared micromobility are limited, a few North American programs have conducted user surveys to document outcomes. These studies suggest that a number of social, environmental, and behavioral impacts are attributable to dockless shared micromobility – although more research is needed.

SHARED MICROMOBILITY POLICIES AND PRACTICES

While shared micromobility can offer communities an array of potential individual and community benefits, the growth of bikesharing and scooter sharing has caused urban curbs to become increasingly congested as a variety of modes to compete for docking stations, parking corrals and racks, parking spaces, and pick-up and drop-off locations. Dedicating curbspace for micro- mobility is an important policy area confronting public agencies. Key elements of micromobility curbspace management include the design, maintenance, enforcement, and policy approach applied to curb access. Common aspects ofmicromobility curbspace management policy include: (1) the policy process, (2) device caps, (3) service area limitations, (4) designated parking areas, (5) fees, (6) equipment and operational requirements, and (7) enforcement. Each of these is described in greater detail below. Next, two case studies focused on curbspace management practices from Seattle and Santa Monica are presented.

The Policy Process: Shared micromobility curb space management is typically allocated through a combination of formal and quasi-formal processes.Some cities establish formal policies that may be written, codified by local ordinances, or allocated through an application process, whereas others usequasi-formal, including pilot programs and case-by-case approvals from administrative staff.

Device Caps: Caps are employed to limit the number of bicycles, scooters, or other devices that can be used for shared micromobility. Public agencies may limit the number of devices in a category (e.g., dockless bikesharing, standing electric scooter sharing, etc.) or the number of devices per operator. Establishing device caps can be difficult for public agencies and operators because the number of devices needed to create an adequate network varies based on a number of factors such as: service area, built environment, density,and usage frequency. Caps could also have unintended consequences for con-straining demand or the size of service areas.

Service Area Limitations: Some cities, such as Austin and San Francisco, have geographic access zones where operators can deploy devices. Access limitations can include permissible and prohibited operational areas, which may be enforced through virtual geographic boundaries (commonly referred to as a geofence) employing GPS, RFID, or other technology.

Designated Parking Areas: A number of cities have created designated parking areas for shared micromobility. This can include where to park a device on the curb, a requirement to lock or attach a device to a bicycle rackor other piece of street furniture, or a condition to return a device to a designated station or corral (a painted or barricaded parking location for shared micromobility devices).

Fees: A number of U.S. cities charge operators a variety of fees for allowingthe placement of shared micromobility devices in the public rights-of-way. These fees can include per trip taxes, application fees, and annual fees based on the number of devices placed in public rights-of-way. Portland, for example, charges a US $0.25 tax per scooter ride. The funds are placed in “New Mobility Account” to pay for program administration, enforcement, infrastructure improvements, and access enhancements for underserved communities. Some cities, such as Chicago and St. Louis, charge an application fee (typically US $250 to US $500) per operator. Other cities have established permits and permit review fees (e.g., Seattle). Others may charge an annual fee per device (typically US $10 to US $50) per bicycle or scooter (e.g., Reno and Chicago). Other cities have established variable fees for a block of devices. For example, Aurora, Colorado charges US $2,500 for the first 500 bicycles, US $5,000 for the first 1,000 bicycles, US $7,500 for the first 2,000 bicycles, or US $10,000 for fleets with more than 2,000 bicycles. Other fees that cities have assessed shared micromobility operators on include: (1) fees per docking station, (2) performance bonds (to protect the public entity if the micromobility company goes out of business or fails to meet certain terms under a contractual agreement), or (3) escrow payments per device (or a block of devices).

Equipment and Operational Requirements: A number of cities have established equipment requirements (such as maximum allowable operating speeds) and permissible areas of operation, such as prohibitions from operating devices on sidewalks, bicycle lanes, pedestrian malls, etc. In Massachusetts, for example, all scooters are required to have brake lights and turn signals. Proposed legislation would remove turn signal and brake light requirements and add requirements for insurance and a US $0.20 per ride tax.

Enforcement: Enforcement is important to ensure that shared micromobility devices are parked properly and are equitably and safely dispersed throughout a community and do not impede pedestrians or Americans with Disabilities Act access. To keep fleets from becoming stagnant (not used because they are parked in low-traffic areas) and imbalanced (too many devices located in a particular area), some cities have developed policies requiring service providers to rebalance their fleets on a particular schedule and to correct parking violations within a specific time frame. Failure to comply with these requirements can often result in fines, device impounding, or the eventual loss of operating permission in a jurisdiction. Chapter 14, *A Spatiotemporal Approach to Micromobility*, explores the spatial and temporal dimensions of micromobility activity and travel patterns that occur within the city. Understanding spatial and temporal patterns can be important for a variety of policy purposes, such as enforcing curb space management policies.

SEATTLE'S CURBSPACE MANAGEMENT APPROACH

In Seattle, Washington, the city's department of transportation (SDOT) has established curb space design and management guidelines to manage the curb for a variety of functions and users. SDOT has classified sidewalk frontage into three zones (shown in Figure 12.1).

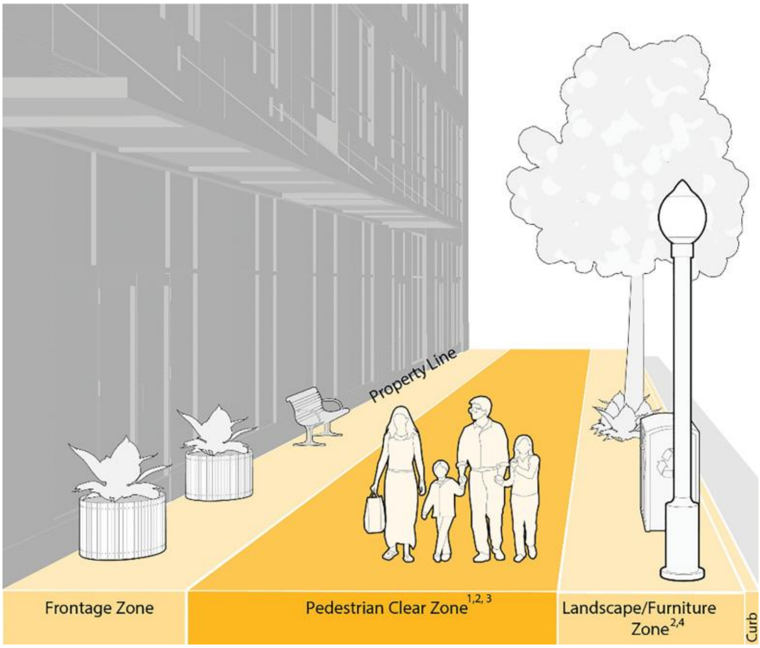
The *Frontage Zone* is the area between the property line and pedestrian clear zone. Depending on the size of the frontage zone, this area may be able to accommodate sidewalk cafes, store entrances, retail display, landscaping, public transit stop amenities, or other features that activate and enhance the pedestrian environment. Wider frontage zones provide more room for future tenants and residents to activate the public rights-of-way in a manner compatible with street trees and other required features between the frontage zone and curb. A minimum of two feet (.61 meters) is recommended for the frontage zone to allow for sufficient distance from fixed objects.

The *Pedestrian Clear Zone* is the area of the sidewalk corridor that is specifically reserved for pedestrian travel. Street furniture, street trees, planters, and other vertical elements, such as poles, fire hydrants, and street furniture, aswell as temporary signs and other items should not protrude into the pedestrianclear zone.

The *Landscape/Furniture Zone* (including the curb) is defined as the area between the roadway curb face and the front edge of the pedestrian clear zone.This zone buffers pedestrians from the adjacent roadway and is the appropriatelocation for street furniture, art, street trees, and vegetation. The landscape/ furniture zone is also the preferred location for other elements such as: signage, pedestrian lighting, hydrants, and above and below grade utilities. In areasof public transit, this zone may be used for public transit shelters, stops, and platforms; boarding and unloading; trash cans; etc.

These zones form the foundation of Seattle’s micromobility parking policy. Seattle’s guidelines for dockless bikesharing parking instruct users to:

- Park a bicycle in any landscaping/furniture zone of the sidewalk that is more than three feet wide (approximately 0.91 meters);
- Lock devices to a bicycle rack (as long as they do not block pedestrian access);
- Park bicycles in designated parking zones (sometimes referred to as corrals, these are painted areas approximately the size of a vehicle parkingspace designated for micromobility parking); and
- Leave a clearance of at least six feet (approximately 1.8 meters) for pedestrians to pass and park equipment upright. SDOT does not allow operators/ users to park equipment in a way that blocks corners, driveways, curb ramps, buildings, benches, parking pay stations, bus stops, or fire hydrants.



Source: City of Seattle (2017).

Figure 12.1 Seattle's sidewalk zones

Seattle requires dockless bikesharing companies to move improperly parked bicycles and to correct parking violations within two hours of a problem report during normal business hours. In September 2020, Seattle invited Lime, Wheels, and LINK to participate in a scooter sharing pilot program (Olsen 2020). Seattle is starting to permit up to 500 scooters for each companyinitially, with the option to expand fleets up to 2,000 scooters per operator pending city approval (Seattle Department of Transportation 2020). The pilot also requires that scooter sharing service providers limit the speed of devices to eight miles per hour (mph) on a user's first ride and a speed limit of 15 mphbeginning on a user's second ride.

SANTA MONICA'S MICROMOBILITY CORRALS

Beginning in 2011, Santa Monica, California began planning bicycle corrals as part of the city's Bicycle Action Plan. In recent years, the concept has been expanded to include scooters, and the city has installed shared micromobility parking corrals to accommodate approximately eight to 14 bicycles or standingelectric scooters. These corrals can be installed on the curb or in the footprint of one automobile parking space. The corrals also can include a variety of markers and barriers to increase visibility and protect equipment (Shaheen and Cohen 2019).

In August 2018, the city began installing corrals (Figure 12.2) for a 16-month shared micromobility pilot that launched in mid-September 2018 (City of Santa Monica 2018). In May 2020, Santa Monica approved an extension of the pilot program due to the COVID-19 pandemic. In 2020, the city hadapproximately 100 shared micromobility corrals: approximately two-thirds arelocated on sidewalks and one-third along the street edge. For the most part, Santa Monica has installed the street edge corrals in red painted curb areasto avoid removing on-street parking. The city estimates that each corral cost US $200 to US $800 to install, depending on the design and type of supplies required (i.e., paint or bollards) (Linton 2018).

Source: Linton (2018).

Figure 12.2 Santa Monica's micromobility corrals

While lessons learned from the pilot program and corral deployments arestill emerging, the city reports corral usage has been mixed with a number of users continuing to park scooters elsewhere. Nevertheless, operators return e-bikes and scooters to the corrals after they have been picked up for charging.Geofencing (i.e., app-based virtual geographic boundaries) and user incentives may be required to encourage or enforce corral use (Linton 2018).

Developing curbspace management policies for shared micromobility can be key to providing policy support for non-vehicular modes, managing curb- space congestion, and helping to ensure safe, convenient, and multimodal access for all travelers.

THE FUTURE OF SHARED MICROMOBILITY

Improvements in battery technology (i.e., range, weight, etc.) are likely to support the continued growth and development of an array of short-range electric devices and/or new "form factors," such as motorized quadricycles, light electric vehicles (EVs), and neighborhood EVs that are typically built to carrytwo to four passengers and operate at speeds up to 25 miles (40.2 kilometers) per hour.

Four trends related to automation, safety, data privacy, and public policy could impact shared micromobility in the future. First, automation (shared micromobility devices and vehicles) could have transformative impacts. Automating shared micromobility devices could help to simplify curbspace management and charging by allowing devices to be delivered to a person's door and returned automatically at the conclusion of a trip. While the automation of shared micromobility devices creates potential opportunities, vehicle automation could pose a number of risks. Shared automated vehicles could compete with micromobility for short urban trips, particularly if the per tripor per mile/kilometer costs are more competitive. Second, vehicle automation could reinforce historic infrastructure funding and design biases that prioritize motorized vehicles over micromobility and active transportation.

In addition to automation, safety could impact public perception and potential growth of shared micromobility. While shared micromobility safety records can be challenging to access/assess due to imprecise incident coding (e.g., motorcycles) and the relatively small number of bike and scooter sharingusers, several improvements could enhance safety and encourage ridership including: (1) improved device design (e.g., larger wheels to reduce theimpacts of potholes); (2) infrastructure enhancements (e.g., better pavement quality, dedicated facilities for shared micromobility use, and curbspace management); and (3) education and outreach with users (e.g., public awareness and share the road campaigns).

Data privacy may also impact community acceptance of shared micromobility. Shared micromobility operators typically track several important data elements related to use, such as trip origin and destination, travel time, and trip duration. However, these data may reveal the daily routines or the residences/ workplaces of users. Implementing industry-wide data protection and compliance standards could be key to protecting sensitive data, managing risk, and building consumer confidence in shared micromobility (e.g., the Mobility Data Specification (or MDS), which has been adopted in the U.S. and several othernations).

In the future, the growth and success of shared micromobility could be largely dependent on regulatory and policy environments. Prioritizing parkingand visibility for bikes and scooters; enhancing infrastructure (e.g., slow lanes, multi-use trails, etc.); and incorporating bikesharing and scooter sharing into multimodal trip planners could aid shared micromobility effectiveness. By enhancing the visibility and convenience of shared micromobility and reducing rider stress, communities have the opportunity to encourage its use for shorterdistance travel and to connect with public transit. Since the global pandemic, micromobility has become an integral strategy for cities across the globe to encourage safe, active transportation, while accommodating the need for socialdistancing. Many cities have expanded street space for active transportation (often called slow or healthy streets) to reduce traffic volume and speeds and to expand space for pedestrians, cyclists, scooter riders, and outdoor recreation (National Association of City Transportation Officials 2020).

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