Title

Shared Micromoblity Policy Toolkit: Docked and Dockless Bike and Scooter Sharing

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SHARED MICROMOBILITY POLICY TOOLKIT

DOCKED AND DOCKLESS BIKE AND SCOOTER SHARING

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SHARED MICROMOBILITY POLICY TOOLKIT

DOCKED AND DOCKLESS BIKE AND SCOOTER SHARING

THIS TOOLKIT OUTLINES POLICIES AND PRACTICES FOR CITIES INTEGRATING SHARED MICROMOBILITY INTO THE BUILT ENVIRONMENT.

OVERVIEW

WHAT IS SHARED MICROMOBILITY AND WHAT ARE ITS IMPACTS?

Shared Micromobility – the shared use of a bicycle, scooter, or other low-speed mode – is an innovative transportation strategy that enables users to have short-term access to a mode of transportation on an as-needed basis. Shared micromobility includes various service models and transportation modes that meet the diverse needs of travelers, such as station-based bikesharing (a bicycle picked-up from and returned to any station or kiosk) and dockless bikesharing and scooter sharing (a bicycle or scooter picked up and returned to any location). Early documented impacts of shared micromobility include increased mobility, reduced greenhouse gas emissions, decreased automobile use, economic development, and health benefits.

WHO USES SHARED MICROMOBILITY?

Some studies suggest that the market potential for micromobility could include between 8 to 15 percent of trips under five miles and grow to $200B to $300B in the U.S. There are limited studies of dockless micromobility, and while early studies suggest that users are often Caucasian, generally younger and upper-to-middle income, some of the cities who provided feedback on this Toolkit have noted evidence that counter those findings. Convenience may be a core motivator for using dockless micromobility.

SHARED MICROMOBILITY POLICIES AND PRACTICES

Curb space management is a term used to describe a transportation design and policy approach that requires curb access to be planned, designed, operated, and maintained to enable safe, convenient, and multimodal access for all transportation users. This section reviews best practices and case studies for curb space management and related policies, including equity programs, enforcement, data sharing, and performance metrics for establishing pilot programs and policies for micromobility.

CONCLUSION

This section concludes with a summary of key findings from this toolkit.

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WHAT IS SHARED MICROMOBILITY AND WHAT ARE ITS IMPACTS?

WHAT IS SHARED MICROMOBILITY?

SHARED MICROMOBILITY - THE SHARED USE OF A BICYCLE, SCOOTER, OR OTHER LOW-SPEED MODE - IS AN INNOVATIVE TRANSPORTATION STRATEGY THAT ENABLES USERS TO HAVE SHORT-TERM ACCESS TO A MODE OF TRANSPORTATION ON AN AS-NEEDED BASIS.

Micromobility includes various service models and transportation modes that meet the diverse needs of travelers, such as station-based bikesharing (a bicycle picked-up from and returned to any station or kiosk) and dockless bikesharing and scooter sharing (a bicycle or scooter picked up and returned to any location).

Common shared micromobility modes include:

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. Bikesharing typically includes one of three common service models:

- **Station-based bikesharing systems** where users access bicycles via unattended stations offering one-way station-based service (i.e., bicycles can be returned to any station) (Figure 1.1 – Upper Left);
- **Dockless bikesharing systems** where users may check out a bicycle and return it to any location within a predefined geographic region. Dockless bikesharing can include business-to-consumer or peer-to-peer systems enabled through third-party hardware and applications (Figure 1.1 – Upper Right); and
- **Hybrid bikesharing systems** where users can check out a bicycle from a station and end their trip either returning it to a station or a non-station location or users can pick up any dockless bicycle and either return it to a station or any non-station location.

Scooter sharing allows individuals access to 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. The scooter service typically provides gasoline or electric charge (in the case of motorized scooters), maintenance, and may include parking as part of the service. Scooter sharing includes two types of services:

- **Standing electric scooter sharing** using shared scooters with a standing design with a handlebar, deck and wheels that is propelled by an electric motor. The most common scooters today are made of aluminum, titanium and steel (Figure 1.1 – Lower Left); and
- **Moped-style scooter sharing** using shared scooters with a seated-design, electric or gas-powered, generally having a less stringent licensing requirement than motorcycles designed to travel on public roads (Figure 1.1 – Lower Right).

FIGURE 1.1 COMMON TYPES OF SHARED MICROMOBILITY SERVICES

Station-based Bikesharing

Dockless Bikesharing

Standing Electric Scooter Sharing

Moped-style Scooter Sharing

SHARED MICROMOBILITY IMPACTS

Although before-and-after studies documenting micromobility impacts are limited, a few North American programs have conducted user surveys to record program outcomes. These studies suggest that a number of social, environmental, and behavioral impacts are attributable to micromobility, and an emerging body of empirical evidence supports many of these relationships–although more research is needed as studies on dockless modes (bikesharing and scooter sharing) are limited. This section reviews key study findings by station-based bikesharing, dockless bikesharing, and dockless standing electric scooters.

STATION-BASED BIKESHARING

By addressing the storage, maintenance, and parking aspects of bicycle ownership, public bikesharing enables cycling among users who might not otherwise use bicycles. Additionally, the availability of a large number of bicycles in multiple dense, nearby locations frequently creates a "network effect," where bicycles in close proximity add value to bikesharing and encourage its use for trip purposes, such as commuting and errands (Cohen & Shaheen, 2016).

A few North American programs have conducted before-and-after studies documenting the impacts of station-based bikesharing. Many of these studies have been completed by the bikesharing operators and represent findings from a single city or region. Only a very limited number of studies have researched the impacts of bikesharing across multiple cities. A much larger body of literature has studied optimization issues associated with equipment balancing and lifecycle analysis to assess the environment impacts of bikesharing associated with the product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling of bikesharing equipment.

Documented user impacts of bikesharing include increased mobility, reduced greenhouse gas emissions, decreased automobile use, economic development, and health benefits. For example, Boston's Bluebikes estimates 267,000 users completed more than 1.7 million trips, traveled 2.1 million miles, and offset 3 million pounds of greenhouse gas (GHG) emissions in 2018 (Bluebikes, 2019). Similarly, in Fort Worth, Texas, the local station-based bikesharing program estimates that approximately 15,000 unique riders completed 59,000 trips covering 266,000 miles offsetting 251,000 pounds of GHG emissions in 2017 (Camareno & Brennan, 2017).

Bikesharing can also help to bridge first-and-last-mile gaps in the transportation network and encourage multimodal trips. Studies indicate that bikesharing can also enhance mobility, reduce congestion and fuel use, lower emissions, and increase environmental awareness. Additionally, bikesharing also has had measurable effects on economic activity, health, helmet use, and safety.

PUBLIC TRANSPORTATION AND AUTO USE

A number of studies have shown that station-based bikesharing can reduce driving and taxi use while increasing cycling in many cities. One study found that half of all bikesharing members report reducing their personal automobile use (Shaheen, Martin, Cohen, & Finson, 2012) (Shaheen, Martin, Chan, Cohen, & Pogodzinski, Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Models, Industry Trends and User Impacts, 2014). Shaheen et al. 2014 conducted an online survey of annual bikesharing members and 30-day subscribers (n=1238) in four metropolitan regions (Montreal, Quebec; Toronto, Ontario; Washington, D.C.; and Minneapolis-Saint Paul, Minnesota) between November 2011 and January 2012.

In Minneapolis-Saint Paul, more people shifted toward rail (15 percent) than away from it (3 percent) in response to bikesharing. For walking, more respondents shifted toward walking (38 percent) than away from it (23 percent) in response to bikesharing. However, the study found a slight decline in bus ridership: 15 percent of respondents increased their use of buses compared to 17 percent that decreased it. In Washington, DC, more people shifted away from rail (47 percent) than to it (7 percent), and more respondents shifted away from walking (31 percent) than to it (17 percent) due to bikesharing. Similar to the Twin Cities, the study also found a decline in bus ridership, with just 5 percent of respondents increasing bus ridership compared to 39 percent that decreased it (Shaheen, Martin, Chan, Cohen, & Pogodzinski, Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Models, Industry Trends and User Impacts, 2014) (Shaheen & Martin, 2015).

A geospatial analysis of this study data involved mapping modal shifts and found that shifts away from public transportation were most prominent in urban environments within high-density urban cores. Shifts toward public transportation in response to bikesharing tended 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 connector 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 transit trips. Additionally, public bikesharing may be more complementary to public transportation in small and medium metropolitan regions and more substitutive in larger metropolitan areas, perhaps providing relief to crowded transit lines during peak periods (Shaheen & Martin, 2015). Another study of bikesharing in New York City found a notable decrease in bus ridership coincident with station-based bikesharing. This study estimates that every thousand bikesharing docks along a bus route is associated with a 1.69 to 2.42 percent reduction in daily unlinked bus trips on routes in Manhattan and Brooklyn (with and without controlling for bicycle infrastructure, respectively) (Campbell & Brakewood, 2017).

ECONOMIC ACTIVITY

Studies on the economic impacts of station-based bikesharing are limited. A study of 1,197 users by Schoner (2012) found that Nice Ride Minnesota users spent an average of $1.25 per week on new economic activity that would likely have not occurred without the bikesharing system; this resulted in approximately $29,000 of new economic activity per season in the Twin Cities. Respondents reported increased spending primarily at food-related destinations, including sit-down restaurants, coffee shops, bars and nightclubs, and grocery stores. The findings suggest that bikesharing stations increase accessibility to station areas, users may alter destinations or make additional trips, and users spend more money in the immediate vicinity around bikesharing kiosks (Schoner, 2012).

HEALTH IMPACTS

In addition to the economic impacts of bikesharing, a number of programs have also documented health impacts. A number of station-based bikesharing programs have attempted to quantify aggregate calories used while cycling. Boston's Bluebikes estimates that its users expended nearly 159 million calories riding on its bicycles in 2018 (Bluebikes, 2019). Similarly, Citi Bike in New York estimates that its users burned 4.5 billion between 2013 and 2018 (Motivate, 2018). Capital Bikeshare in Washington, DC, reported that its users expended 186 million calories over a one-year period in 2013 (Freed, 2014).

A study by Alberts et al. (2012) found that 31.5 percent of Capital Bikeshare users reported reduced stress and about 30 percent indicated they lost weight due to using bikesharing. However, a key limitation of these bikesharing health impact assessment studies is that they do not examine potential negative health impacts associated with ridership, such as the costs associated with increased exposure and risks related to injuries and collisions (Alberts, Palumbo, & Pierce, 2012).

SAFETY

Helmet usage tends to be lower among shared micromobility users, including station-based bikesharing. A study by Buck et al. (2013) found that only 6 percent of short-term Capital Bikeshare users (in the Washington, DC, area) wore helmets, while 37 percent of annual users wore helmets (Buck, et al., Are Bikeshare Users Different from Regular Cyclists? A First Look at ShortTerm Users, Annual Members, and Area Cyclists in the Washington DC Region, 2013). Similarly, Shaheen et al. (2012) found that a high number of respondents in four North American cities never wear helmets (62 percent in Montreal; 50 percent in Minneapolis-Saint Paul; 45 percent in Toronto, and 43 percent in Washington, D.C.) (Shaheen, Martin, Cohen, & Finson, 2012).

Annual crash rates are relatively low among North American station-based bikesharing operators. Although differences in data collection make it difficult to compare bikesharing crash rates among operators, Shaheen et al. (2013) document an average collision rate of 4.33 crashes per year among operators with more than 1,000 bicycles, with rates decreasing among operators with smaller fleets (Shaheen, Martin, Chan, Cohen, & Pogodzinski, Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Models, Industry Trends and User Impacts, 2014). The first documented bikesharing fatality occurred nine years after station-based bikesharing launched in the U.S. in July 2016 (Bauer, 2016).

A study of bikesharing safety in Minneapolis-Saint Paul, the San Francisco Bay Area, and Washington, DC, using data on bicycle and bikesharing activity and bicycle collisions found that the number of bicycle collisions was generally rising in bikesharing regions, but this increase was very likely due to a growth in bicycle activity in all regions (Martin, Cohen, Botha, & Shaheen, 2016). For example, between 2006 and 2013, the estimated number of people commuting to work by bicycle in Washington, DC increased 162 percent, while bicycle collisions increased 121 percent. In San Francisco, the estimated number of bicycle commuters increased 98 percent and collisions increased 40 percent over this same period. Only in Minneapolis-Saint Paul were collisions relatively flat (a 1 percent increase), while bicycle commuters increased an estimated 65 percent (Martin, Cohen, Botha, & Shaheen, 2016).

Identifying comparative safety outcomes are difficult for researchers to determine. If trips were diverted from automobiles, buses, or rail, then the risk to individual bikesharing users as well as overall transportation safety could be expected to increase–based on statistics comparing the per-trip fatality rates of bicycle riding to travel by car, bus, or train (Martin, Cohen, Botha, & Shaheen, 2016). Aside from relatively low helmet usage, experts interviewed as part of this study generally believed that bikesharing bicycles were safer than their road-bike counterparts because the bikes are generally painted bright colors and ride slower than road bikes–both because of the added weight from larger and heavier frames and because the bikes are often engineered with fewer gears, which then limit speeds (Martin, Cohen, Botha, & Shaheen, 2016).

STANDING ELECTRIC SCOOTER SHARING

Studies on standing electric scooter sharing are limited. In Portland, the Bureau of Transportation (PBOT) initiated an e-scooter sharing pilot that ran for 120-days between July 23 and November 20, 2018 with three companies: Bird Rides Inc., Lime, and Skip Transport Inc. Each company started with 100 scooters, which expanded up to 683 scooters per a company through the duration of the pilot (Portland Bureau of Transportation, 2018).

Key goals of Portland's pilot included:

- Reducing vehicular use and congestion;
- Preventing fatalities and serious injuries;
- Expanding access for underserved communities; and
- Reducing pollution and GHG emissions.

During the pilot, PBOT collected quantitative and qualitative data through activity data, accident tracking, user surveys, observational studies, focus groups, and online engagement tools such as: webforms, emails, and polls.

TRAVEL BEHAVIOR IMPACTS OF STANDING ELECTRIC SCOOTER SHARING

Over the course of the four-month pilot in Portland, 700,369 scooter trips were made (averaging approximately 5,885 per day) covering a total of 801,888 miles (averaging 1.15 miles per a trip). Seventy-one percent of survey respondents reported using scooter sharing to get to a destination compared to 29 percent who used them for mostly recreational purposes. As such, the study identified two peak periods of use. The study found a weekday evening commute peak between

3 and 6 p.m. and a recreational weekend peak between 2 and 5 p.m. (Portland Bureau of Transportation, 2018).

The study found that 34 percent of local users would have used a motor vehicle. Nineteen percent said they would have driven a personal vehicle and 15 percent said they would have used a for-hire service, such as a taxi, Uber, or Lyft had scooter sharing not been available. Among visitors, 48 percent said they would have used a motor vehicle (driving or a for-hire service) without the availability of scooter sharing. Additionally, the study found that six percent of local users sold a vehicle and 16 percent considered selling a vehicle because of standing electric scooter sharing (Portland Bureau of Transportation, 2018).

While the study found that a number of respondents replaced motor vehicle travel with scooter sharing, the study also found that scooter sharing replaced some lower emission active transportation trips. Forty-two percent of respondents said they would have either walked (37 percent) or ridden a bicycle (5 percent), if scooter sharing had not been available. Additionally, scooter sharing may have added some vehicular trips to retrieve and redistribute scooters throughout the day; however, overall impact of this behavior was not quantified as part of this study (Portland Bureau of Transportation, 2018).

SAFETY IMPACTS OF STANDING ELECTRIC SCOOTER SHARING

During the Portland pilot, the study attempted to measure the safety impacts of scooter sharing by reviewing reported scooter incidents with the Multnomah County Health Department. However, precise numbers are difficult to quantify because emergency room visits could include a variety of other scooter accidents, such as mopeds and non-motorized standing scooters. During the pilot period, the study identified 176 scooter related emergency room visits compared to 16 during the same period a year earlier (prior to the pilot). On average, emergency room visits increased from less than one a week prior to the pilot to approximately 10 a week during the pilot period. The study also suggests that scooter-related emergency room visits accounted for approximately 5 percent of total traffic crash injury visits during the pilot period. There were no scooter sharing fatalities reported during the pilot period. Although the number of scooter emergency room visits was lower than the number of bicycle-related visits (n=429), the study lacked comparable data on how many trips were taken and distance traveled while bicycling and therefore could not compare injury rates across modes (Portland Bureau of Transportation, 2018).

Of the entire sample of scooter-related emergency visits, 83 percent did not involve another mode compared to 13.6 percent involving a motor vehicle and 2.8 percent involving a pedestrian. Only one collision (0.6%) was reported involving two scooters. Additionally, intoxication was reported in 16 percent of the collisions. Generally, the emergency room reports contained insufficient data on helmet use in the collisions. However, PBOT staff observations suggest that approximately 90% of riders do not wear helmets (Portland Bureau of Transportation, 2018).

In addition to the Portland pilot, a retrospective study of scooter sharing safety in Los Angeles has been published. This study collected data on emergency department visits at two University of California Los Angeles medical facilities. This study queried electronic medical records for clinician notes for the terms "scooter," "bird," or "lime." The retrieved records were then reviewed by researchers to confirm relevance and inclusion into the data set. Records that included other scooter accidents (e.g., mopeds and non-motorized scooters) may have been included, and records that did not include the above search terms may have been omitted from the study (Trivedi, et al., 2019).

The study found that over a one-year period between September 2017 and August 2018, 249 patients sought medical treatment at two medical center emergency rooms. The mean age of patients was 33.7 and 58 percent of patients were male. Ninety-two percent were injured as riders compared to 8 percent injured as nonriders. Approximately 11 percent of patients were under 18 years of age and less than 5 percent reported wearing a helmet. Additionally, 5 percent were intoxicated at the time of their medical treatment. Of the emergency room visits, only 6 percent (15 reports) were admitted patients and only two cases (less than 1 percent) were admitted to the intensive care unit. The study suggests that scooter related injuries are common with varying severity, low rates of adherence to rider age requirements, and low rates of helmet use (Trivedi, et al., 2019).

IMPACTS OF STANDING ELECTRIC SCOOTER SHARING ON CURB SPACE MANAGEMENT

A few studies have also attempted to document the impacts of standing electric scooter sharing on curb space management. For example, during the Portland pilot, PBOT received over 1,600 complaints of illegal sidewalk riding, representing approximately 27 percent of public comments. These complaints generally indicated that sidewalk usage made pedestrians and people with disabilities feel unsafe or uncomfortable. Additionally, survey respondents also indicated a strong preference for protected bicycle and/or scooter infrastructure. PBOT observations during the pilot period suggest that the greater presence of protected infrastructure and lower speed limits on the streets reduces illegal sidewalk use (Portland Bureau of Transportation, 2018).

Another study by the Mineta Transportation Institute attempted to better understand how users park scooters using observational data in San Jose, California. In Summer 2018, researchers observed and photographed 530 parked scooters and categorized key attributes about where and how they were parked and whether or not they likely impeded pedestrian flow (Fang, Weinstein Agrawal, Steele, Hunter, & Hooper, 2018). The researchers defined "well parked" scooters meeting three key criteria:

- Standing upright;
- Placed on the periphery of pedestrian paths or in areas that are already obstructed, such as by street furniture; and
- Not blocking pedestrian access.

Based on the study's observations, 97 percent of scooters were parked upright. Seventy-two percent of scooters were parked within a foot of some other vertical object, such as a wall or street furniture, avoiding parking scooters in the middle of open spaces. Less than 2 percent of scooters were parked in automobile parking spaces; and only 3 percent of scooters were parked on unpaved surfaces, such as vegetation or dirt. The researchers note that although these scooters did not block pedestrian flow, these parking practices could raise concerns about aesthetics and the impact on landscaping. The study concluded that fewer than 2 percent of scooters blocked access for people with disabilities and 90 percent were parked out of the way of pedestrian traffic, either on the edge of sidewalks or in already obstructed street furniture zones (Fang, Weinstein Agrawal, Steele, Hunter, & Hooper, 2018). The study concluded with three key findings:

- Given that most scooters are parked on the sidewalk, scooter parking is a curbspace management issue;
- Scooter parking regulations may not need to be stringent, if they are not blocking access for people with disabilities or pedestrians; and
- Cities could consider adopting policies that encourage or require scooter parking on private property (similar to zoning requirements requiring property owners to provide automobile and bicycle parking).

The study notes that more research is needed to understand the impacts of scooters on different types of neighborhoods, such as communities with narrower sidewalks and higher pedestrian flow; as well as the impacts on aesthetics and maintenance activities (e.g., sidewalk power-washing) (Fang, Weinstein Agrawal, Steele, Hunter, & Hooper, 2018).

In summary the impacts of standing electric scooter sharing are limited. More research is needed to understand the impacts on travel behavior, infrastructure, environment, and safety.

SUMMARY

Micromobility – the shared use of a bicycle, scooter, or other low-speed mode – enables users to have short-term access on an as-needed basis. Micromobility includes various service models and transportation modes that meet the diverse needs of travelers, such as station-based bikesharing (a bicycle picked-up from and returned to any station or kiosk) and dockless bikesharing and scooter sharing (a bicycle or scooter picked up and returned to any location).

Impact studies on micromobility are limited. However, early documented impacts of micromobility suggest that bikesharing and scooter sharing may contribute to increased mobility, reduced GHG, decreased automobile use, economic development, and health benefits.

2

WHO USES SHARED MICROMOBILITY?

THE GROWTH OF SHARED MICROMOBILITY

In recent years, micromobility has gained prominence due to developments in equipment, technology, and batteries enabling a variety of shared bicycle and light-electric transportation services. North America's first information technology (IT) enabled bikesharing system, Tulsa Townies, started operating in 2007 in Tulsa, Oklahoma. By 2012, bikesharing began expanding into peer-to-peer and dockless models with the emergence of new technological and equipment applications in the U.S. In 2012, Spinlister, a smartphone application, launched a peer-to-peer bicycle rental marketplace where a bike owner can make their bicycle available to others for short time periods, enabling direct exchanges between individuals via the Internet. Spinlister eventually closed in April 2018 but relaunched in January 2019 with new features including remote locking and bicycle delivery (a bicycle brought to a user) (Reid, 2019). At the same time that Spinlister was launching, in 2013 another company BitLock created a keyless bike lock accessed via smartphone enabling another peer-to-peer bikesharing option (BitLock, 2019).

Also in the mid-2010s, a number of bikesharing startups, including Social Bicycles (known as SoBi and later acquired by Uber as JUMP) launched dockless or flexible docking bikesharing systems, featuring "smart-bikes" hosting 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 bikesharing station, existing bicycle parking, street furniture, or a designated bikesharing rack (Shaheen, Martin, Chan, Cohen, & Pogodzinski, Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Models, Industry Trends and User Impacts, 2014).

Around 2017, the number of bikesharing providers began to grow notably. In addition to dock-based services provided by B-Cycle, Motivate, Zagster, and Social Bicycles, a number of new dockless vendors began to enter the marketplace including JUMP (formerly Social Bicycles), Limebike, MoBike, Ofo, and Spin and an array of smaller vendors and service providers (National Association of City Transportation Officials (NACTO), 2018).

The National Association of City Transportation Officials (NACTO) estimates that dockless bikesharing accounted for approximately 44% of the fleets and 4% of the trips and station-based bikesharing accounted for approximately 56% of the fleets and 96% of the trips in the U.S. as of December 2017 (National Association of City Transportation Officials (NACTO), 2018). Between 2010 to 2017, 123 million bikesharing trips have been completed in the U.S., with 35 million trips completed in 2017 alone (National Association of City Transportation Officials (NACTO), 2018). As of May 2018, the U.S. had 261 bikesharing operators (station-based and dockless) with more than 48,000 bicycles (Russell Meddin, unpublished data). Roland Berger estimates that the global market size of bikesharing will increase from €6B Euros in 2019 to €7-8B Euros by 2021 (Schönberg, Dyskin, & Ewer, 2018).

A study by Shaheen et al. (2019) estimates that there were an estimated 24,492 standing electric scooters being shared across ten U.S. cities (Austin, Columbus, Dallas, Denver, Detroit, Kansas City, Portland, San Antonio, San Francisco, and South Bend) (Shaheen, Cohen, Dowd, & Davis, 2019).

MARKET POTENTIAL FOR MICROMOBILITY

The market potential for micromobility could include all passenger trips less than 5 miles (8 kilometers) (Heineke, Kloss, Scurtu, & Weig, 2019). According to Heineke et al. (2019), this accounts for as much as 50 to 60 percent of passenger miles traveled in China, the European Union, and the U.S. However, Heineke et al. (2019) more conservatively estimate that micromobility can capture between 8 to 15 percent of trips under 5 miles due to a number of constraints, such as limited space when going shopping, weather, age, fitness ability, customer adoption, and availability in exurban and rural areas. Heineke et al. (2019) conclude that there is an estimated market potential of $200B to $300B in the U.S., $100 to $150B in Europe, and $30 to $50B in China.

WHO USES SHARED MICROMOBILITY?

While North American studies of dockless micromobility are very limited, there is anecdotal evidence from some cities participating in the Toolkit that counters findings that demographics of dockless micromobility are similar to other shared modes. A number of older studies have documented different demographic profiles across different shared modes (Shaheen, Martin, Chan, Cohen, & Pogodzinski, 2014) (Rayle, Dai, Chan, Cervero, & Shaheen, 2016) (LeVine, Zolfaghari, & Polak, 2014) (Fishman, 2015) (Kopp , Gerike , & Axhausen , 2015). These older studies of shared mobility have found that users generally tend to be:

- Well-educated (often with a college or post-graduate degree);
- Younger adults (typically between the ages of 21 and 45);

- Childless households;
- Middle and upper-income households; and
- Living in urban built environments, often with limited vehicle access (e.g., zero or one car households) that use multiple modes of transportation, such as public transit, cycling, and walking.

There is anecdotal evidence from some of the cities involved in the Toolkit project that indicates the user base is more diverse than other shared mobility modes, as the dockless bikes and scooters have had greater success reaching underserved areas of the cities. Although studies on the impacts of dockless micromobility are limited, a number of studies have documented the demographics of station-based bikesharing users.

WHO USES BIKESHARING?

While multi-city studies of bikesharing in North America are limited, a few studies of station-based bikesharing indicate that the users were often Caucasian, generally younger and upper-to-middle income, with higher levels of educational attainment (Shaheen, Martin, Chan, Cohen, & Pogodzinski, 2014) (Shaheen, Martin, Cohen, & Finson, 2012). Although there were some variations by city, key demographic ranges from these studies found:

- *Race/Ethnicity:* 74 to 92 percent of respondents were Caucasian, compared to 1 to 5 percent that were Hispanic or Latino and 1 to 2 percent that identified as African American;
- *Household Income:* 29 to 39 percent had household incomes greater than $100,000 a year, compared to 9 to 26 percent that earned less than $35,000 annually;
- *Educational Attainment:* 55 to 89 percent of respondents had a minimum of a four-year college degree; and
- *Age:* 37 to 54 percent of respondents were under the age of 35 and 36 to 51 percent were between the ages of 35 and 54.

Other studies of station-based bikesharing tend to echo these findings. In another study, 88 percent of London bikesharing users identified as Caucasian compared to 55 percent of the city's residents. In Washington D.C., only 3 percent of Capital Bikeshare users identify as African American even though they account for approximately 50% of the city's residents (Kille, 2015). While older studies of station-based bikesharing show a more Caucasian user base, the advent of dockless bikes may be reaching a more diverse user base in cities based upon anecdotal information from the cities engaged in the Toolkit project.

McNeil et al. (2017) note that station siting could account for racial and socio-economic differences in bikesharing use (McNeil, Dill, MacArthur, & Broach, 2017). A multi-city study from Ursaki and Aultman-Hall (2015) reported notably lower African American bikesharing usage in six out of the seven U.S. cities studied (Ursaki & Aultman-Hall , 2015). A study of 42 U.S. bikesharing systems found that the 60 percent of census tracts with greatest economic hardship contained less than 25 percent of bikesharing kiosks (Smith, Oh, & Lei, 2015). However, results can vary by city as Ursaki and Aultman-Hall (2015) found that the share of residents earning less than $20,000 per year was notably higher near bikesharing stations in three of the seven cities studied. However, the study also found that the share of users earning more than $100,000 was also notably higher near stations in three of the cities studied.

Similarly, other studies have found that bikesharing participation tends to be higher among younger, more educated populations (Bachand-Marleau, Lee, & El-Geneidy, 2012) (Hoe, 2015) (Buck, et al., 2013) (Fuller, et al., 2011) (Daddio, 2012). For example, in Washington D.C., Buck et al. (2013) found that 60 percent of users were under 45 years of age. In another study of bikesharing users by Daddio (2012) in Montreal found that 45 percent of users were under 45 years old and 66 percent had a college or university degree.

In summary, early studies of station-based bikesharing tend suggest that in many cases users tend to be Caucasian, generally younger and upper-to-middle income, with higher levels of educational attainment. However, additional factors such as access to credit/debit cards, the internet and smartphones may also contribute to variations in study results. Finally, some social and cultural perceptions could also pose barriers to riding a bicycle for lower-income populations and minority communities.

PERCEPTIONS OF MICROMOBILITY

By addressing the storage, maintenance, and parking aspects of bicycle and scooter ownership, micromobility enables cycling and scooter use among users who might not otherwise use these modes. A 2008 study found that 89 percent of Vélib' users reported that station-based bikesharing made it easier to travel through Paris (Vélib', 2012). Among Nice Ride Minnesota users, 59 percent said that they most liked the "convenience factor" of their program (Shaheen, Cohen, & Martin, 2013).

During the Portland pilot, PBOT asked community members how their perceptions of standing electric scooters had changed over the course of the pilot (first impression versus current impression). Over the pilot period, positive impressions declined from 73 percent to 57 percent among adults 55 years of age and older. Positive impressions also declined 9 percentage points among residents with incomes of $30,000 per year or less (Portland Bureau of Transportation, 2018). However, the study also found that impressions of standing electric scooters were most positive among minority communities, younger adults, and low-income households. The study also found that younger adults (under 35 years of age) were most concerned about dangerous and illegally parked scooters (56 percent), and older adults (55 years of age and older) were most concerned about sidewalk riding enforcement (Portland Bureau of Transportation, 2018).

Another study of 11 U.S. cities found that 70% of respondents support micromobility, viewing standing electric scooter sharing as a convenient form of mobility without the hassle of owning a car (Populus, 2018). However, details on the questions asked, methodology, and respondent demographics are not disclosed in this report (Populus, 2018).

SUMMARY

Some studies suggest that the market potential for micromobility could include between 8 to 15 percent of trips under 5 miles and grow to $200B to $300B in the U.S. While studies of station-based bikesharing suggest that users tend to be Caucasian, upper-income, younger, and with higher levels of educational attainment, more research is needed to understand the user demographics of dockless bikesharing and scooter sharing users (both standing electric and moped-style scooters). Additionally, studies on the public perceptions of micromobility (from users and non-users) are quite limited. Naturally, more research is needed to understand the users and perceptions of micromobility.

3

SHARED MICROMOBILITY POLICIES AND PRACTICES

SHARED MICROMOBILITY POLICIES AND PRACTICES

Micromobility has the potential to offer communities an array of potential 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, it also has the potential to enhance accessibility and quality of life in cities. This section reviews the most common micromobility policies and practices at the municipal level, including curb space management, equitable service standards and equity programs, enforcement, data standards and open data, performance metrics for micromobility policy analysis, and information on establishing pilot programs and policies for micromobility.

CURB SPACE MANAGEMENT FOR SHARED MICROMOBILITY

City curbs are becoming increasingly crowded as micromobility, carsharing, for-hire services (e.g., Lyft, Uber, and taxis), and delivery services increasingly compete for parking space and pick-up and drop-off locations. Curb space management is a term used to describe a transportation design and policy approach that requires curb access to be planned, designed, operated, and maintained to enable safe, convenient, and multimodal access for all transportation users.

The provision of curb space for dedicated to micromobility is an important policy area confronting public agencies. Key elements of micromobility curb space policies often include:

Policy Process – 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 use quasi-formal processes including pilot programs and case-by-case approvals from administrative staff.

Device Caps – Caps that limit the number of bicycles, scooters, or other devices that can be used for micromobility. Public agencies may limit the number 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 the: service area, built environment, density, and frequency of use. Caps could also have unintended consequences of constraining demand or the size of service areas.

Service Area Limitation – 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) using GPS, RFID, or another technology.

Designated Parking Areas – A number of cities have created designated parking areas for micromobility. This can include where to park a device on the curb, a requirement to lock or attach a device to bicycle rack or 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 micromobility devices).

Fees – Many cities charge operators a variety of fees for allowing the placement of 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 the public rights-of-way. Portland, for example, charges a $0.25 tax per a scooter ride. The funds are placed in a "New Mobility Account" to pay for program administration, enforcement, infrastructure improvements, and access enhancements for underserved communities (City of Portland, 2019). Some cities, such as Chicago and St. Louis, charge an application (typically $250 to $500) per operator. Other cities have established permits and permit review fees (e.g., Seattle). Others may charge an annual fee per device (typically $10 to $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 $2,500 for the first 500 bicycles, $5,000 for the first 1,000 bicycles, $7,500 for the first 2,000 bicycles, or $10,000 for fleets with more than 2,000 bicycles). Other fees that cities have assessed micromobility operators include fees per docking station and either performance bonds (protect the public entity if the micromobility company goes out of business or fails to meet certain terms under a contractual agreement) or escrow payments per device (or a block of devices).

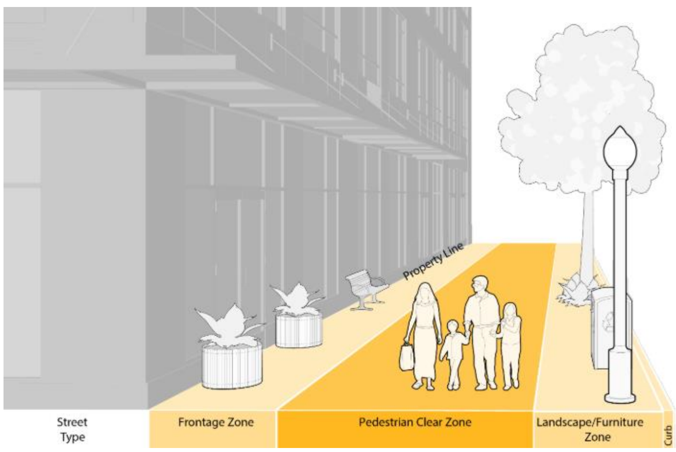
Equipment and Operational Requirements – A number of cities have established equipment requirements (such as maximum allowable operational speeds) and permissible areas of operation, such as prohibitions from operating devices on sidewalks, bicycle lanes, pedestrian malls, etc. In Massachusetts, for 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 $0.20 per ride tax (Borchers, 2019).

Cities may establish additional policies specific to enforcement, data sharing, and equity; each are described in greater detail in the sections that follow.

SEATTLE'S CURB SPACE MANAGEMENT AND DOCKLESS BIKESHARING PARKING GUIDELINES

In Seattle, the city's department of transportation (SDOT) has established curb space design and management guidelines intended to facilitate walking as a safe, attractive, and viable travel mode and allow pedestrians to access their destinations including shared modes and micromobility, public transit stops, work places, recreation facilities, schools, and residences. Recognizing the need to manage the curb for a variety of users, SDOT has classified sidewalk frontage into three zones:

SEATTLE'S SIDEWALK ZONES



Source: Seattle Department of Transportation

- **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 2 feet 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, as well as temporary signs and other items should not protrude into the pedestrian clear 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 appropriate location 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 areas of public transit, this zone may be used for public transit shelters, stops, and platforms; boarding; lighting; trash cans, etc.

These zones form the foundation for Seattle's dockless bikesharing 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;
- Lock devices to a bicycle rack (as long as they do not block pedestrian access); or
- Park bicycles in designated parking zones (sometimes referred to as corrals, these are painted areas approximately the size of a vehicle parking space designated for micromobility parking).

Additionally, SDOT instructs users to leave a clearance of at least six feet 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.

A CASE STUDY OF DALLAS: FROM LAISSEZ-FAIRE TO REGULATORY OVERSIGHT

In Summer 2017, several dockless bikeshaing companies simultaneously launched in Dallas, Texas. By early 2018, the total number of bicycles exceeded 20,000 units (nearly twice the size of North America's next largest public bikesharing system in New York City) (McFarland, 2018). Due to the large number of devices and relatively short timeframe the equipment was deployed, the city began to receive an increasing number of complaints about devices that were parked incorrectly, vandalized, or blocked the public rights-of-way.

EXAMPLES OF COMPLAINTS ABOUT MICROMOBILITY DEVICE PARKING

Source: CNN Business

Source: CNN Business

In response, the city approved an ordinance in June 2018 requiring operators to:

- Provide devices to accommodate a wide range of users;
- Maintain 24-hour customer service number and a staffed operations center;
- Rebalance and relocate improperly parked equipment within two hours of receiving notification on weekdays between 6:00 a.m. and 6:00 p.m. (excluding holidays) and within 12 hours of receiving notice at all other times; and
- Educate customers about proper operation, riding, and parking requirements.

The ordinance also requires:

- The prohibition of third-party advertising on devices;
- Each device includes an identification tag and an active GPS monitoring system;
- Reimbursement of city expenses incurred to address or abate any ordinance violations;
- Helmet usage for all minors;
- Maintain a minimum width of 48-inches in parking sidewalk clearance, which does not impede vehicle or pedestrian access;
- Prohibition of parking devices on private property (without permission of the owner) and in areas without sidewalks or where sidewalks are less than 96 inches in width; and
- Ban of parking devices within five feet of a crosswalk or curb ramp and in ways that impede or interfere with other modes, building entryways, and Americans with Disabilities Act (ADA) access.

Additionally, the city allows the use of dockless devices on sidewalks outside of the central business district as long as the user yields the rights-of-way to pedestrians. The ordinance also allows the city to establish parking zones for dockless devices with paint or decals (Dallas Ordinance No. 30936, 2018).

Within approximately a month of implementing the ordinance, all but two dockless bikesharing companies have left Dallas with an estimated total of 3,500 bicycles (Reigs Tad, 2018). During this same timeframe, one standing electric scooter sharing company entered the market and one dockless bikesharing company began transitioning its fleet to scooters.

A CASE STUDY OF SANTA MONICA: 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 micromobility parking corrals to accommodate approximately 8 to 14 bicycles or standing electric scooters. These corrals can be installed both on the curb or in the footprint of one automobile parking space. The corrals can also include a variety of markers and barriers to increase visibility and protect equipment.

ON-STREET MICROMOBILITY CORRAL

Source: Rick Cole

SIDEWALK MICROMOBILITY CORRAL

Source: Gary Kavanagh

EQUITABLE SERVICE STANDARDS AND EQUITY PROGRAMS

Micromobility can raise a number of potential equity concerns. Generally, many of these equity concerns can be summarized into four common areas of concern:

- **Un- and Under-Banked Households** – Many micromobility services require debit/credit cards for payment and, in some cases, collateral (e.g., a debit or credit card hold) while the equipment is in-use. This can be a barrier for consumers who are under banked or unbanked. Providing alternative fare payment options (e.g., payment via pre-paid cards and public transit fare cards) can help overcome this challenge. For example, Washington D.C. requires dockless bikesharing and scooter sharing programs to offer a cash payment option (District Department of Transportation, n.d.).
- **Low-Income Affordability** - Pay-as-you-go (e.g., per-minute) pricing can be expensive (and sometimes costlier in comparison to walking, private cycling, and public transportation). Discounted and subsidized programs for eligible low-income households can help overcome affordability challenges.
- **Digital Impoverishment** – Micromobility services may require a smartphone and high-speed data packages to access services. This can be a barrier to low-income and rural households who may not be able to afford or may lack data coverage to access micromobility services. Alternatives such as digital kiosks, telephone/text services, and non-tech access (e.g., coin-deposit access) can help overcome these challenges. For example, Washington D.C. requires dockless bikesharing and scooter sharing programs to offer equipment that can be accessed without a smartphone (District Department of Transportation, n.d.).
- **Neighborhood Service Availability** – The lack of service availability in a particular neighborhood can also be an equity concern. Including minority and low-income neighborhoods in service areas and actively re-balancing equipment to ensure service availability can help overcome service availability concerns. For example, as part of the standing electric scooter sharing pilot program in Portland Oregon, the city required a minimum of 100 scooters or 20 percent of an operator's fleet (whichever is less) to serve the city's disadvantaged east neighborhoods (City of Portland, 2018).

- **Education and Outreach –** Community outreach can play an important role expanding access and use of shared micromobility services. For example, Austin BCycle, a station-based bikesharing program, works to overcome safety, comfort, and cost barriers through a bilingual outreach and education campaign paired with subsidized membership and cash payment options. In Washington D.C., the District Department of Transportation (DDOT) has developed an array of outreach materials including a: training curriculum, multilingual demonstration video on how to use bikesharing, new member kits, and ambassador networking facilitate community partnerships (Corbin, 2015).
- **Access for People with Disabilities –** Micromobility can affect people with disabilities in a few different ways. The availability of adaptive devices, such as tricycles, hand-pedaled cycles, recumbent cycles and others, have the opportunity to enhance access for individuals with disabilities who otherwise rely on cars or paratransit for most of their transportation needs (Transportation 4 America, 2019). Public agencies may be able to expand access for people with disabilities by requiring a percentage of a fleet includes adaptive devices and establishing incentives for the addition of adaptive devices into micromobility fleets. For example, in Seattle, SDOT is using permit fees to partner with operators to increase the availability of adaptive bicycles. Additionally, operators that deploy adaptive bicycles as part of their fleets could be eligible for up to an additional 1,000 micromobility device permits. In addition to increasing accessibility through adaptive devices, the placement of micromobility equipment in the public rights-of-way can present notable challenges for people with disabilities when bicycles or scooters block curb or ramp access. Prudent curb space management policy (e.g., designated parking areas, lock-to requirements) coupled with education, outreach, and proactive enforcement is key to protecting ADA access.

AN EXAMPLE OF MICROMOBILITY BLOCKING ADA ACCESS

Source: Emily Shryock

ENFORCEMENT

Enforcement is important to ensure that micromobility devices are parked properly, equitably, and safely disbursed throughout a community, and not impeding pedestrian or ADA access. Additionally, enforcement can help ensure that micromobility is equitably serving the entire community and people with special needs.

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. Common enforcement policies can include:

- **Rights-of-Way Access Preservation:** Requiring service providers to relocate devices blocking the rights-of-way within a set timeframe. For example, Santa Monica requires that devices parked improperly must be relocated within one hour after receiving notice of the violation between 7AM and 10PM daily. Other cities offer a two-hour window to correct the problem, generally between 6AM and 6PM during weekdays with a larger timeframe to correct violations during the evenings and weekends.

- **Protecting Private Property:** Mandating service providers to remove equipment that was parked on private property without permission.
- **Fleet Rebalancing:** Requiring service providers to rebalance devices on a set cadence or as necessary to achieve proper equipment densities and/or service equity.
- **Stagnant Device Rebalancing:** Mandating service providers to move "stagnant" devices that have not been used for a given amount of time. Durham, for example, requires bikesharing operators to move bicycles that have been parked in the same location for more than one week.
- **Removal of Unsafe or Inoperable Devices:** Requiring service providers to remove inoperable or unsafe equipment from service. For example, a number of cities have established policies requiring the removal of broken and unsafe equipment. Durham requires the removal of unsafe and inoperable devices within 24-hours of notification.

When equipment is parked correctly and violations are not abated quickly, cities can:

- **Issue a Cease and Desist Notice:** A cease-and-desist letter (commonly known as a demand letter) is a document sent by a public agency to a service provider demanding that they correct an alleged violation of law. Generally, these letters warn that if the parties do not stop the alleged unlawful activity, the regulatory agency may take certain administrative actions or sue the infringing party.
- **Issue a Fine:** A city may require an operator pay a fee for improperly parked equipment.
- **Impound Equipment:** Impounding equipment involves the public agency seizing and taking legal custody over micromobility equipment. The equipment is typically returned to the service provider for an impound and citation fee. For example, Arizona State University charges $100 per scooter for their return to service providers.
- **Revoke Operating Permits:** A city may revoke an individual bicycle or scooter permit for failure to correct parking or other equipment violations. More serious violations may result in the reduction of fleet sizes or the complete revocation of an operator's ability to provide micromobility services in a jurisdiction.

Public education and outreach programs on ADA awareness and proper micromobility parking can help mitigate the administrative burdens of enforcement. Cities should provide operators and the public clear and concise guidance on expectations for micromobility use.

DATA STANDARDS AND OPEN DATA

Data sharing is another requirement that public agencies may require as a condition for operating in the public rights-of-way. Standardized and open data allows public agencies to understand micromobility impacts (and other transportation services); identify gaps in the transportation network; monitor equitable service standards; and offer multimodal, real-time transportation information through smartphone apps, websites, and other platforms. Beginning in 2015, the North American Bike Share Association (NABSA) adopted an open data standard, known as the General Bike Share Feed Specification (GBFS) makes real-time bikesharing operational data feeds publicly available in a standardized format. GBFS does not include historical usage data or other personally identifiable information.

More recently, Los Angeles has led the development of the Mobility Data Specification (MDS) in conjunction with data scientists from other cities to supply operators with a single, open-source application programming interfaces (API) they can use to share required real-time data about their services. San Francisco, Seattle, and Austin are also contributing to the development of the data standard. MDS is a data and API standard that allows the city to gather, analyze, and compare real-time and historical data from shared mobility service providers. The specification also serves as a measurement tool that helps enable enforcement of local regulations. MDS also allows service providers and public agencies to communicate with each other about their services because it consists of two APIs: a service provider API and a public agency API (Bailey, 2018). MDS includes data such as: mobility trips (and routes); location and status of equipment (e.g., available, in-use, and out-of-service); and service provider coverage areas. As of December 2018, ten U.S. cities (Austin, Detroit, Kansas City, Miami, Minneapolis, Portland, Seattle, San Francisco, Santa Ana, and Santa Monica) require operators to provide data using MDS. Denver is considering requiring operators to use MDS and has worked with operators to identify a data format. In Fall 2018, Detroit announced a partnership with NACTO and SharedStreets, a nonprofit developer of tools for transport data, to pilot a new standard for real-time dockless mobility data using data from Lime and Bird (NACTO, 2018).

These efforts are helping to support research, public policy development, and contribute to public agency enforcement, operational management, and transportation planning. Additionally, the development of back-end and end-user multimodal applications and improve transparency and public access to micromobility data. Some guiding principles for public agencies interested in adopting data standards and open data requirements as part of their micromobility policies include:

- **Data Standards** – Determining the type, format, and standards for publishing data sets that are consistent with industry standards, other public entities, and address interoperability issues. Requiring the inclusion of metadata with methodological information on how the data were collected and geocoding for location-based data mapping can enhance the value and usability of the data.
- **Data Accessibility** – Ensuring data are made available in an open format that can be downloaded, indexed, searchable, and machine-readable to allow automated processing.
- **Open License** – Ensuring data are available for public use.
- **Data Quality and Timeliness** – Ensuring that data are: 1) high quality and processed for plug-and-play end use by developers without requiring extensive effort to make datasets usable; and 2) made available as quickly as possible and frequently enough to remain current and usable.

In addition to establishing data standards and open data policies, public agency data exchanges can serve as a repository for micromobility data. A number of cities, such as Los Angeles, New York, and Washington D.C., have open data platforms to share a variety of transportation and other data sets with the public. A few guiding principles for the establishment of data exchanges include establishing:

- **Conditions for Use** – Requiring micromobility and other transportation service providers to share data as a condition for offering services within a jurisdiction and requiring that data providers filter and scrub their data, according to set standards, prior to uploading a data exchange.
- **Data Management Policies** – Developing user agreements and standard procedures to protect consumer privacy and proprietary data. Shared micromobility operators typically track several important data points: the origin and destination, travel time, and trip duration. These types of data may reveal the daily routines or residence of a user. It is important to remember that when public agencies handle transportation data, there could be a number of external compliance standards for data sharing; transmission; and storage (e.g., Payment Card Industry Data Security Standard (PCI-DSS) regulating the compliance of financial data). A data breach could expose a public agency to civil liability. Public and private sector collaboration can help protect sensitive data, manage risk, and ensure compliance with third-party standards.
- **Data Dashboards** – Establishing an data dashboard to monitor the impacts of micromobility services (e.g., travel behavior, equity, and environmental impacts, etc.) and aid in enforcement actions. For example, Ride Report uses a variety of data sharing and public APIs to create a dashboard depicting the location of bicycles and scooters in real time (Ride Report, No date). Translating micromobility data feeds into data dashboards can provide public agencies and the public access to curated data on shared services.

State sunshine laws may impact data sharing policies and agreements between the public and private sectors. Additionally, the storage and collection of data may trigger additional compliance requirements with regulatory agencies with respect to privacy protection and data management. For more information on data standards and open data for shared and micro- mobility, please see Shaheen et al. 2016.

PERFORMANCE METRICS FOR MICROMOBILITY POLICY ANALYSIS

A general set of performance metrics could be useful for public agencies to assess the impacts of micromobility deployments on users and non-users. The hypotheses and metrics below are suggestions and public agencies should consider the types of metrics that are appropriate for assessing their policy goals.

SAMPLE MICROMOBILITY PERFORMANCE METRICS

Safety: Hypothesis/Research Question(s)

- Have scooter crashes declined?
- Have bicycle crashes declined?
- Have pedestrian crashes declined?
- Have scooter injuries and fatalities declined?
- Have bicycle injuries and fatalities declined?
- Have pedestrian injuries and fatalities declined?

Safety: Performance Metrics

Crashes…

- per million VMT
- per 1,000 cyclists
- per 1,000 pedestrians

Injuries/fatalities…

- per million VMT
- per 100,000 cyclists
- per 100,000 pedestrians

Congestion: Hypothesis/Research Question(s)

- Is congestion getting worse?
- Are fewer people driving to work alone?
- Are people driving less?

Congestion: Performance Metrics

- Non-vehicle mode share
- Travel time to work (minutes)
- Daily/Annual VMT per capita

Equity: Hypothesis/Research Question(s)

- Is micromobility serving the community equitably?

Equity: Performance Metrics

- User demographics (by income, age, gender, ability, etc.)
- Average distance to the nearest micromobility device/service area
- Percentage of the population/geography served by micromobility
- Increase in users of equitable access programs

Environmental: Hypothesis/Research Question(s)

- Is the city/region achieving optimal energy efficiency from micromobility?

Environmental: Performance Metrics

- Carbon dioxide (CO_2) footprint of the vehicles
- Vehicle/battery life span

ESTABLISHING PILOT PROGRAMS AND POLICIES FOR MICROMOBILITY

As micromobility has grown, the need to develop and manage public policy for these transportation services has also expanded. In recent years, the growing number of multimodal demands for public rights-of-way have increased the need for public policy guidance. When considering the development of pilot programs and local policies, policymakers may consider service characteristics, procedures for allocating and valuing rights-of-way, and management of competition.

The best approach for establishing pilot programs and policies for micromobility may depend on a number of factors such as staff resources, community interest, and how micromobility may or may not fit into existing transportation system or plan, direction from elected officials, existing local ordinances and state statutes, and the private sector's desire to operate in the community. Below is a summary of common considerations for the development of micromobility pilots and policies.

COMMON CONSIDERATIONS FOR THE DEVELOPMENT OF MICROMOBILITY PILOTS AND POLICIES

Shared micromobility pilots and policies requires the operational coordination of multiple transportation providers and institutional coordination among the agencies and entities responsible for rights-of-way management (e.g., city and county governments, public transit agencies, etc.). When shared micromobility is managed by more than one transportation agency, coordinated and integrated policies are optimal. With a comprehensive shared micromobility policy, public agencies manage the rights-of-way and operations as a multimodal system rather taking a more traditional policy approach of managing an individual operator or mode.

Prudent shared micromobility policy can aid public agencies in leveraging positive impacts and taming negative impacts to achieve key public policy goals such as: reducing driving and parking congestion; lowering vehicle miles traveled and single occupant vehicle auto dependency; improving air quality; achieving climate action targets; and providing mobility access to underserved populations.

Approaches to Regulation

- Pilot Programs (e.g., temporary regulations that will be updated at the conclusion of the program)
- Requests for Proposals (RFPs) (e.g., a procurement method to solicit firms that have experience and qualifications)

- Open Participation (e.g., any number of qualifying operators may provide service)
- Ordinances (e.g., permanent policies with operating requirements)
- Service Prohibition (e.g., prohibiting commercial micromobility services from the public rights-of-way)
- Allowing Operation without Regulation (e.g., allowing micromobility to operate without any regulation)

Service Characteristics
- Mode (e.g., bikesharing, standing electric scooter sharing, moped-style scooter sharing, etc.)
- Operational characteristics (e.g., station-based, dockless, etc.)
- Business characteristics (e.g., for-profit, public-private partnership, etc.)

Procedures for Allocating Rights-of-Way
- Jurisdiction (e.g., city staff, city council, staff department)
- Process (e.g., application, permit request, request for proposals, etc.)
- Methodology for determining fees (e.g., cost recovery of program administration, permits, revenue generation, etc.)
- Fleet size (e.g., fixed caps on the number of devices or dynamic caps on the number of devices a company can have at any one time while at the same time allowing flexibility for companies to increase fleet size with demonstrated demand)
- Device management procedures (e.g., setting time limits for each company to relocate misplaced devices)

Management of Competition
- Methods for managing competition between operators (e.g., multiple operators seeking to roll-out large fleets of devices)
- Methods for managing competition between modes (e.g., managing curb access for public transit, for-hire services, goods delivery, carsharing, etc.)
- Methods for dispute resolution (e.g., administration hearings/appeals, mediation, arbitration, litigation)

Equity
- Policies that expand micromobility access to people with disabilities, under-banked households, and other communities with special needs
- Policies that require micromobility to be equally distributed in the rights-of-way into economically disadvantaged areas
- Discounts or subsidies for low-income users based on income qualifications

Enforcement Procedures
- Methods for enforcement procedures (e.g., cease and desist notices, fines, equipment impounding, and other administrative actions)

Data Sharing
- Public agencies may consider requiring real-time anonymized trip data; parking compliance data; survey data; maintenance data; and/or safety data
- Encouraging a minimum level of publicly available data on shared micromobility

BEST PRACTICES AND KEY TAKEAWAYS

Curb space management is an important policy issue confronting public agencies. Key elements of micromobility curb space policies often include:

- Formal and informal policy processes;
- Device caps;
- Service area limitations;
- Designated parking areas;
- Fees; and
- Equipment and operational requirements.

Additionally, micromobility can raise a number of potential equity concerns related to access for un- and under- banked households, low-income affordability, accessibility for users without a smartphone, geographic availability, people with disabilities.

In addition to the availability of adaptive devices, the placement of micromobility equipment in the public rights-of-way can present notable challenges for people with disabilities when bicycles or scooters block curb or ramp access.

Enforcement can be key to ensuring that micromobility devices are parked properly, equitably, and safely disbursed throughout a community, and not impeding pedestrian or ADA access. Additionally, enforcement can help prevent fleets from becoming stagnant (not used because they are parked in low-traffic areas) and imbalanced (too many devices located in a particular area).

Data standards and sharing can aid local governments in enforcement and help proactively mitigate potential issues. Recently, a number of cities and private operators have adopted the Mobility Data Specification (MDS) with a single, open-source application programming interfaces (API) they can use to share required real-time data about their services.

While the best approach for establishing pilot programs and policies for micromobility may depend on a number of factors, public agencies should consider seven core issues:

- The general approach to regulation (e.g., establishing a pilot program, issuing a RFP, etc.);
- Key service characteristics, such as mode and operational model;
- Procedures for allocating curb space and rights-of-way;
- Policies for managing competing modes, operators, and stakeholder interests;

- Equity policies;
- Enforcement procedures; and
- Data sharing guidelines.

4

CONCLUSION

WHAT IS SHARED MICROMOBILITY AND WHAT ARE ITS IMPACTS?

Shared micromobility – the shared use of bicycle, scooter, or other low-speed mode – is an innovative transportation strategy that enables users to have short-term access to a transportation mode on an as-needed basis.

Micromobility includes a number of transportation modes and service models that meet the diverse needs of travelers, such as station-based bikesharing (a bicycle picked-up from and returned to any station or kiosk) and dockless bikesharing and scooter sharing (a bicycle or scooter picked up and returned to any location).

Common shared micromobility modes include: bikesharing (station-based, dockless, and hybrid systems) and scooter sharing (standing electric scooters and moped-style scooters.

By addressing the storage, maintenance, and parking aspects of bicycle and scooter ownership, micromobility enables shared active transportation among users who might not otherwise use low-speed modes. Additionally, the availability of a large number of devices in multiple dense, nearby locations frequently creates a "network effect," where bicycles and scooters in close proximity add value to micromobility and encourage its use for trip purposes, such as commuting and errands.

Although before-and-after studies documenting the impacts of micromobility are limited, a few North American programs have conducted user surveys to document program outcomes. These studies suggest that a number of social, environmental, and behavioral impacts are attributable to micromobility — although more research is needed, particularly as studies on dockless bikesharing and scooter sharing are limited.

Documented user impacts of station-based bikesharing include increased mobility, reduced greenhouse gas emissions, decreased automobile use, economic development, and health benefits.

While studies on standing electric scooter sharing are limited, one early study found that one-third of users would have used a motor vehicle, if scooter sharing had not been available (including driving a personal vehicle or dispatching a for-hire service, such as a taxi, Uber, or Lyft). Although studies on the safety of micromobility are limited, one study suggests that scooter-related injuries are common with varying severity, low rates of adherence to rider age requirements, and low rates of helmet use.

WHO USES SHARED MICROMOBILITY?

In recent years, the number of micromobility providers have grown notably. The National Association of City Transportation Officials (NACTO) estimates that between 2010 to 2017, 123 million bikesharing trips have been completed in the U.S., with 35 million trips completed in 2017 alone. As of May 2018, the U.S. had 261 bikesharing operators (station-based and dockless) with more than 48,000 bicycles (Russell Meddin, unpublished data). Roland Berger estimates that the global market size of bikesharing will increase from €6B Euros in 2019 to €7 to 8B Euros by 2021 (Schönberg, Dyskin, & Ewer, 2018). A study by Shaheen et al. (2019) estimates that there were an estimated 24,492 standing electric scooters being shared across ten U.S. cities (Austin, Columbus, Dallas, Denver, Detroit, Kansas City, Portland, San Antonio, San Francisco, and South Bend) (Shaheen, Cohen, Dowd, & Davis, 2019). Some studies suggest that the market potential for micromobility could include between 8 to 15 percent of trips under 5 miles and grow to $200B to $300B in the U.S.

While older studies of station-based bikesharing suggest that users tend to be Caucasian, upper-income, younger, and with higher levels of educational attainment, more research is needed to understand the user demographics of dockless bikesharing and scooter sharing users (both standing electric-style and moped-style scooters). Anecdotal evidence from the cities indicates that dockless bikesharing and scooter sharing is reaching a more diverse set of users from underserved portions of the cities. Additionally, studies on the public perceptions of micromobility (from users and non-users) are quite limited. Naturally, more research is needed to understand the users and perceptions of micromobility.

SHARED MICROMOBILITY POLICIES AND PRACTICES

Given that most shared micromobility devices are parked on the sidewalk, micromobility parking is a curb space management issue. Additionally, micromobility can raise a number of potential equity concerns related to access for un- and under- banked households, low-income affordability, accessibility for users without a smartphone, geographic availability, and people with disabilities. Additionally, the placement of micromobility devices in the public rights-of-way can present notable challenges for people with disabilities when bicycles or scooters block the curb or ramp access.

Enforcement can be key to ensuring that micromobility devices disbursed throughout a community do not impede pedestrian or ADA access. Enforcement can also help prevent fleets from becoming stagnant and imbalanced.

Data sharing can help local governments actively enforce policies and help prevent potential issues. A number of cities and private operators have adopted the Mobility Data Specification (MDS) that provides a single, open-source application programming interfaces (API) that can be used to share required real-time data about their services.

While the best approach for establishing pilot programs and policies for micromobility may depend on a number of factors, public agencies should consider seven key areas:

- General approach to regulation (e.g., establishing a pilot program, issuing a RFP, etc.);
- Key service characteristics, such as mode and operational model;
- Procedures for allocating curb space and rights-of-way;
- Policies for managing competing modes, operators, and stakeholder interests;
- Equity policies;
- Enforcement procedures; and
- Data sharing guidelines.

CONCLUDING THOUGHTS

Over the past decade, shared micromobility has continued to grow and evolve around the world with the advent of innovative modes and technologies. How cities manage curb space will remain a topic of conversation. Over the past decade, a trend that has emerged is the growing need for curb access by an increasing number of users and services. Cities will have to develop policies that fairly manage the demand for curb space (e.g., micromobility, public transit, goods delivery, loading zones, etc.). What is also clear is that urban transportation is on the verge of rapid transformation. The growing number of electric and electric-assist low-speed modes will continue to transform how people travel, goods are delivered, streets are designed, and cities evolve. What is clear is that these innovative technologies will likely have a disruptive impact on traditional notions of curb space planning and design. Thoughtful planning, continued research, and an understanding of micromobility's impacts will be important to balance public goals with commercial interests and to harness and maximize the social and environmental benefits of these innovative transportation modes.

RECOMMENDED READING

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THE SHARING ECONOMY, SHARED MOBILITY, AND MILLENNIALS

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ONLINE RESOURCES

ACADEMIC AND NON-GOVERNMENTAL ORGANIZATIONS

Eno Center for Transportation - www.enotrans.org - The Eno Center for Transportation is a neutral, nonpartisan think tank promoting policy innovation and providing professional development opportunities to transportation professionals.

Frontier Group - www.frontiergroup.org - Frontier Group provides research and analyses to help citizens address a range of issues including: fracking, solar energy, global warming, transportation, and clean water.

Innovative Mobility Research - http://innovativemobility.org - Innovative Mobility Research conducts research on technology applications, behavioral response, and public policies that seek to expand and enhance transportation choices, better manage demand for transportation services, and improve the environment. The Shared Mobility Resources page provides a quick guide to recent reports and publications at: http://innovativemobility.org/?page_id=2762

Institute for Transportation and Development Policy - www.itdp.org - The Institute for Transportation and Development Policy works with cities worldwide to develop transport solutions that cut greenhouse gas emissions, reduce poverty, and improve the quality of urban life. It has offices in Argentina, Brazil, China, India, Indonesia, Mexico, and the United States.

Living Cities - www.livingcities.org - Living Cities is a member organization of foundations and financial institutions that works with leaders in cities across the United States to improve the economic well being of low-income people.

Mineta Transportation Institute - http://transweb.sjsu.edu - The Mineta Transportation Institute conducts research, develops education programs, and facilitates information and technology transfer focusing on multimodal surface transportation policy and management issues.

Mobility Lab - http://mobilitylab.org - The Mobility Lab conducts research and provides best practices guidance to advocates related to the development of healthy, efficient, and sustainable transportation options. One of its primary goals is to measure the impacts of transportation demand management services in Arlington County, Virginia.

National Association of City Transportation Officials (NACTO) - http://www.nacto.org/ - The National Association of City Transportation Officials is an association of 63 major North American cities and ten public transit agencies formed to exchange transportation ideas, insights, and practices and cooperatively approach national transportation issues. NACTO's mission is to build cities as places for people with safe, sustainable, accessible, and equitable transportation choices that support a strong economy and vibrant quality of life.

National Center for Mobility Management - http://nationalcenterformobilitymanagement.org - The National Center for Mobility Management helps communities adopt transportation strategies that increase mobility options and promote health, economic development, and self-sufficiency. An initiative of the United We Ride program, the center is supported through a cooperative agreement with the Federal Transit Administration and operates through a consortium between the American Public Transportation Association, the Community Transportation Association of America, and the Easter Seals Transportation Group.

Natural Resources Defense Council - www.nrdc.org - The Natural Resources Defense Council is an international environmental advocacy organization with a staff of over 500 lawyers, scientists, and other policy experts and more than two million members and online activists around the world working to ensure the rights of all people to air, water, and the wild.

PeopleForBikes - www.peopleforbikes.org - PeopleForBikes is a membership organization made up of individual riders, businesses, community leaders, and elected officials that works to promote bicycling.

Shared-Use Mobility Center - http://sharedusemobilitycenter.org - The Shared-Use Mobility Center is a public-interest partnership working to foster collaboration around shared mobility and helping to connect the growing industry with public transit agencies, cities, and communities across the country.

Transportation for America – http://www.t4america.org - Transportation for America is an alliance of elected, business, and civic leaders from communities across the country who are united to ensure that states and the federal government step up to invest in smart, homegrown, locally-driven transportation solutions.

Transportation Research Board - www.trb.org - The Transportation Research Board promotes transportation innovation and progress through research activities involving engineers, scientists, researchers, and practitioners from the public and private sectors and academia. It is one of seven major programs of the National Research Council, which is the principal operating agency of the National Academies and is jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Transportation Sustainability Research Center - http://tsrc.berkeley.edu - The Transportation Sustainability Research Center conducts analyses and evaluation to develop findings and recommendations for key transportation issues of interest to industry leaders and policy makers to aid in decision making. It is part of the Institute of Transportation Studies at the University of California, Berkeley. It is also home to the Innovative Mobility Research group (see above).

University of California Center on Economic Competiveness in Transportation - http://ucconnect.berkeley.edu - The University of California Center on Economic Competiveness in Transportation serves as the University Transportation Center for federal Region 9, supporting the faculty of its consortium of five University of California campuses (Berkeley, Irvine, Los Angeles, Riverside, and Santa Barbara) and its affiliate, Cal Poly, Pomona. It pursues research aligned the broad theme of promoting economic competitiveness by enhancing multimodal transport for California and the region.

United States Public Interest Research Group - www.uspirg.org - The United States Public Interest Research Group is a consumer group focused on consumer health and safety, financial security, and public participation.

INDUSTRY ASSOCIATIONS

North American Bikeshare Association - http://nabsa.net - The North American Bikeshare Association is a member association of micromobility system owners, managers, operators, and service vendors. It facilitates collaboration, sharing of experiences and best practices, enhanced communication, and guidance on the new and fast-growing micromobility industry.

OTHER ONLINE RESOURCES

Bike Share Map - http://bikes.oobrien.com - The Bike Share Map shows the locations of docking stations in bicycle sharing systems in over 150 cities around the world.

Shareable - www.shareable.net - Shareable is a nonprofit news, action, and connection hub for sharing-related movements and activities including: the maker movement, collaborative consumption, and the solidarity economy.

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