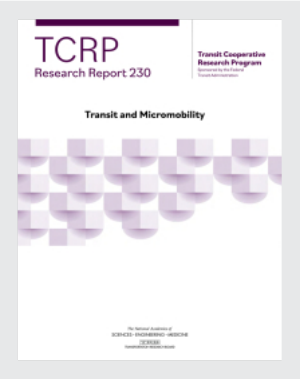

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TRANSIT COOPERATIVE RESEARCH PROGRAM

TCRP RESEARCH REPORT 230

Transit and Micromobility

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2021

TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, adapt appropriate new technologies from other industries, and introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions,* published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), *Transportation 2000,* also recognized the need for local, problem-solving research. TCRP, modeled after the successful National Cooperative Highway Research Program (NCHRP), undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes various transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA; the National Academies of Sciences, Engineering, and Medicine, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Commission.

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TCRP provides a forum where transit agencies can cooperatively address common operational problems. TCRP results support and complement other ongoing transit research and training programs.

TCRP RESEARCH REPORT 230

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- Bird
- Lime
- Lyft
- Spin

The data used in this report are for the sole purposes of this research and cannot be used for any other non-project-related research or products without permission from the jurisdictions and operators.

FOREWORD

By Mariela Garcia-Colberg
Staff Officer
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TCRP Research Report 230: Transit and Micromobility (Project J-11/Task 37) provides an analysis of the full benefits and impacts of micromobility on public transportation systems in transit-rich markets as well as in medium-sized and smaller urban areas. The report includes case studies and lessons learned from different collaborations among cities, transit agencies, and micromobility companies. This report will provide public transit agencies with a reference on the benefits, impacts, and opportunities of micromobility to transit ridership and the built environment. The report was developed for public transit systems of all sizes and their stakeholders, including policymakers, transit board members, and elected officials who are seeking better understanding of the micromobility environment and their options. The report will also be useful to DOT officials who regulate and manage micromobility.

Micromobility refers to small, low-speed vehicles intended for personal use and currently includes station-based bikeshare systems, dockless bikeshare systems, electric-assist bikeshare, and electric scooters. Before the COVID-19 pandemic, micromobility was evolving rapidly, and new types of devices were being introduced to the market every year. Bikeshare companies had indicated an interest in increasing cooperation with transit agencies, and some transit systems were operating their own bikeshare systems. Further, micromobility services like bikeshare and scooter sharing had helped provide first- and last-mile connectivity to transit, further supporting a multimodal lifestyle. This symbiotic relationship meant micromobility had the potential to increase the number of transit trips by expanding the reach of multimodal transportation, but it also could replace transit trips.

This research had four key objectives: identify the impact of micromobility on bus and rail transit ridership, identify the economic impacts of micromobility for the community and the transit agency, identify the impacts on the built environment (e.g., bike lanes and parking spaces) of the implementation of micromobility, and identify ways to strengthen the relationship between micromobility and transit to maximize sustainable trip modes. The report uses survey and trip data to help transit agencies understand their role in the growing micromobility market. The report also presents information and lessons learned from transit collaboration with micromobility companies.

The report is organized into seven chapters; the initial chapters define micromobility and the business models and operational arrangements of the market and provide an overview of the policy and regulatory environment surrounding micromobility. Subsequent chapters describe micromobility users' characteristics, implications for transit agencies, and different partnership approaches. The report concludes with a toolkit that provides action items that a transit agency can follow in order to make decisions on these micromobility partnerships. The appendices provide several valuable resources public transit agencies can use to expand their understanding of digital policy and compliance and make informed decisions on how best to incorporate the available resources into their strategies going forward.

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When docked bikeshare appeared a decade ago, few could have imagined the explosive evolution of small, low-speed mobility into the variety of devices, business models, and operational arrangements that characterize the sector now known as "micromobility." This growth has been accelerated by infusions of private capital, popular enthusiasm for the devices, and economies of scale for the vehicles and technologies that underpin micromobility services.

This report combines survey and trip data with operational lessons from agencies and cities that are working to maximize the public benefit of the expanding micromobility market. This information is intended to fill gaps in understanding of public transit agencies' role with regard to micromobility by helping agencies identify:

- Characteristics of micromobility devices and business models;
- The range of regulatory levers for micromobility (generally at the municipal level), transit agencies' role in regulation, and micromobility's interaction with the built environment;
- Who is using micromobility and how it is used, both on its own and connecting to transit; and
- The impact of micromobility on bus and rail transit ridership, operations, and economics.

This study considers micromobility's interactions with transit in a range of urban environments, agency sizes, economic circumstances, and transportation contexts. The report concludes with a Partnership Toolkit, which, building on the analysis and case studies presented throughout the report, provides a guide for transit agencies that are considering whether and how to collaborate with micromobility providers.

Impacts of COVID-19

This report was written at the height of the COVID-19 pandemic, but most of the data collection and analysis took place earlier. Likewise, operational examples and case studies cited throughout largely cover the pre-COVID period. In 2020 and 2021, micromobility appeared to serve as a mode perceived as providing a lower risk of exposure than riding in shared, closed vehicles like those of transit or ride-hail services. However, as travel overall fell to historic lows, so did micromobility ridership in most places, and usage patterns of the micromobility trips that remained differed from those before the crisis, with longer trips and a shift away from peak-hour and transit-connecting usage (Holder 2021; Heineke et al. 2020). As the pandemic's longer-term impacts on communities, travel choices, and public agencies are still emerging, it is difficult to describe them with confidence. For that reason, this report describes the transportation context as it existed on the eve of COVID-19—acknowledging that massive changes will have taken place by the time the

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pandemic's direct effects subside, but that these outcomes are unknowable while we are still in the middle of the crisis.

Defining Shared Micromobility

The term "micromobility" can encompass a broad variety of small, low-speed vehicles intended for personal transportation in urban areas. In popular usage, it is commonly applied to shared bikes, motorized kick scooters, and other personal transportation devices [National Association of City Transportation Officials (NACTO) 2019a, 5; Chang et al. 2019, 2; National League of Cities (NLC) 2019, 6]. This study will follow the vehicle taxonomy provided by SAE International, which classifies powered micromobility vehicles based both on form factor and on physical characteristics. Expanding on the powered micromobility taxonomy provided by SAE J3194 (SAE International 2019), this study defines "micromobility" as services using vehicles with the following characteristics:

- Designed for human transport on pavement (excluding mobility aids intended for use by people with disabilities and low-speed vehicles like golf carts),
- Top speed of 30 mph or less, with full or partial human power,
- Unloaded weight of less than 500 pounds,
- If motorized, an electric motor rather than an internal combustion engine, and
- Deployed as part of a shared fleet available for use by the general public.

The Micromobility Market

With the introduction of free-floating modes of micromobility, many jurisdictions have shifted to managing the public right-of-way for these services, including regulating how they may operate on sidewalks and roads or in other public spaces. Micromobility adoption has grown rapidly since shared scooters' appearance in 2018. The number of shared micromobility trips in the United States more than doubled between 2017 and 2018 (NACTO 2019b). Shared scooters and bikes operated legally in some 180 U.S. municipalities on the eve of COVID-19 in 2020, which is nearly double the count of the 2018 season (Smart Cities Dive 2020; NACTO 2019b).

Dockless scooter services in U.S. cities are dominated by a few major operators, but many smaller regional operators also offer shared bicycles and scooters, with some specializing in working with smaller jurisdictions or campuses. Large programs, with thousands of vehicles, are in place in large or fast-growing cities, while smaller cities or college towns may have fleet counts in the dozens or hundreds.

Regulatory and Policy Review

Transit agencies generally lack the regulatory powers that state or local governments possess, and they achieve policy goals largely through partnerships with operators and coordination with regulating agencies. Put another way, cities regulate, while transit agencies partner. City departments of transportation (DOTs) use regulation as a tool to manage micromobility; transit agencies partner with private or nonprofit operators and with surrounding jurisdictions. This section surveys the whole of the regulatory environment, starting at the local level and then moving to the transit agency's role.

Key Areas of Local Regulation

Most local enabling statutes and permit requirements for micromobility typically cover some combination of several key regulatory approaches [Shared-Use Mobility Center

(SUMC) and New Urban Mobility Alliance (NUMO) 2020]. (The Micromobility Policy Atlas, which contains several dozen local micromobility regulations from the United States and elsewhere, is available at https://learn.sharedusemobilitycenter.org/atlas/.) These regulatory levers are detailed in the main text of this report, with examples from relevant jurisdictions. The most common areas of local regulation include the following:

- **Vehicle location:** Operation, parking, and geographic limitations.
- **Limiting overall scale and impact:** Fleet caps, utilization targets, and provider counts.
- **Rider and public safety**, which center on
  - Speed limits,
  - Vehicle requirements (international standards, federal consumer regulations, or state standards for bikes or personal e-mobility vehicles),
  - Helmet use,
  - Rider age restrictions/license requirements, and
  - Hours of operation and curfews.
- **Operator responsibilities:** Parking enforcement, rebalancing, maintenance, and communications.
- **Social equity considerations:** Geographic distribution and access for the unbanked or people without smartphones.
- **Data-sharing requirements and standards/specifications.**
- **Risk management,** including insurance coverage and performance bonds**.**

The Transit Agency's Regulatory Role

Most of the regulatory mechanisms described previously sit outside the control of transit agencies. Transit agencies' specific policy areas of interest include:

- Safe station access,
- Managing network demand,
- Risk management,
- Digital policy and data sharing,
- Fare integration, and
- Equitable access.

Partnerships take place in the physical, digital, and policy realms. Transit agencies partner with cities to plan and build *physical* infrastructure to enhance access to transit, increase ridership, and increase customer safety. On the *digital* front, to enable station-area planning and informed decision making, transit agencies coordinate with city regulators to ensure agency access to micromobility data. In the *policy* realm, agencies partner with cities to develop equitable access, contribute financial or in-kind resources for program management, and pursue other policies needed to achieve their vision and goals.

We are still early in understanding the transit agency role in the governance of micromobility systems. Given their ability to regulate, city DOTs are the natural leaders for micromobility governance. The understanding that transit agencies need to become partners and begin their own micromobility policy development has only been realized recently as agencies across the United States begin to interact with micromobility vendors. As more agencies experiment and develop their own micromobility policies and partnerships with cities, best practices will become clearer.

Government subsidization of micromobility is possible today, but a fully validated payment model has not yet been achieved. While publicly subsidized docked bikeshare is common, transit agency subsidies for dockless micromobility are only starting to emerge. To exclusively

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subsidize trips that provide first- and last-mile access, a transit agency would either need a fully integrated payment system (subsidizing only those trips that take place both on transit and via micromobility) or access to trip data (subsidizing trips that definitively start or end within a specified geofenced area of transit service). Alternative models, such as offering free transit with a micromobility receipt or subsidizing trips based on vendor invoicing, are administratively burdensome and leave opportunities for fraud.

Mobility hubs provide a new framework for city and transit agency partnerships at the physical, digital, and policy levels. However, there are few examples of mobility hub implementation, and it is too soon to tell whether hubs further empower transit agencies to achieve their policy priorities. Mobility hub best practices and demonstrated outcomes are a necessary area of further research.

Micromobility and the Built Environment

As major mobility destinations and transfer points, transit stations and stops are natural centers of mobility activity—including those related to personal bikes and other small devices, docked bikeshare, and shared dockless micromobility services. Historically, transit agencies have implemented and managed bicycle parking on their property and coordinated the siting of docked bikeshare and bicycle parking nearby. Agencies saw benefits with this approach; reports have found that over 50% of docked bike users frequently linked bikeshare and transit trips (NACTO 2016).

The appearance of private, dockless micromobility increases the need for coordination between transit agencies and cities. By taking a more active role in the development and management of micromobility systems in collaboration with municipal partners, transit agencies can ensure that these services meet both agency and city goals. There are five key areas in which this built-environment coordination takes place:

- Transit access and parking
- Street management and first/last mile
- Demand management
- Data (and its relationship to the built environment)
- Infrastructure funding

Cities and transit agencies can rely on existing bike parking and station siting guidance around transit but must expand the array of approaches to accommodate dockless micromobility. Transit agencies and local jurisdictions have long managed the access and right-of-way for personally owned bicycles and bikeshare stations to ensure first- and last-mile connectivity and pedestrian access. Dockless micromobility provides new connections to transit and heightens the need to manage access and redesign rights-of-way. The ability to park dockless vehicles anywhere necessitates new design guidance and forms of infrastructure such as mobility hubs, while incentives and enforcement should explicitly support transit access.

Cities and transit agencies must coordinate on data sharing and availability to achieve beneficial outcomes concerning the built environment around transit stations and stops. The growth of dockless micromobility requires policy coordination between local jurisdictions and transit agencies.

When infrastructure supports the use and growth of micromobility, micromobility is a demand-management tool for cities and transit agencies. Because of its atomized presence and permeability throughout a city—with vehicles' ability to reach, but also be abandoned in,

a nearly infinite number of locations—the growth of dockless micromobility heightens regulating agencies' responsibility to manage the vehicles' use in streets, on sidewalks, and in other public rights-of-way. Growth in transportation options has long been understood as a remedy for car reliance and a complement to transit ridership.

Micromobility companies can support the expansion of on- and off-street infrastructure in multiple ways. Cities, transit agencies, and micromobility companies share an interest in the growth of safe, accessible micromobility infrastructure. Permit fees could support limited infrastructure investment, but companies' primary support of infrastructure investment will come through demonstration projects, advocacy campaigns, and community organizing.

Micromobility Users and Utilization

This study used survey and operational trip data to provide a picture of who is using micromobility, as well as the services' impact on transit and docked bikeshare. Using representative survey data from 18 U.S. metro areas, the authors present demographic and travel behavior data for scooter and non-scooter users. While the data include information from metros of a variety of sizes, transit system extents, and urban forms, the research was limited by data availability and operator participation, and for that reason does not include metro areas at the smaller end of the population scale or cities or towns in rural areas.

Overall, almost 10% of survey respondents had ridden a shared scooter. About twice this number had used either a shared bike or scooter (here called "micromobility users"). In general, cities with lower levels of regulation, especially caps on fleet size, had higher scooter adoption rates.

The survey also found the following about the demographic characteristics of micromobility users:

- Scooter and micromobility users are younger than the general population of their metros, with peak use in those under 35 and few users above 55.
- In contrast to micromobility, in which the gender split is fairly even, a slight majority of scooter-only users are female.
- Compared to the general population, more non-white people use scooters and micromobility. Hispanic and Asian people make up the bulk of this difference.
- People of all income levels use scooters and micromobility, with a fairly small variation from the general population across income levels. However, adoption rates do rise with income, especially for micromobility.

The survey also examined how scooter users make use of other modes of transport:

- Scooter users are less likely to commute alone by car and more than twice as likely to commute by transportation network companies (TNCs) across all metro types, but use of transit and carpools varies. In areas with higher transit use, scooter users commute by transit at a lower rate and carpool more than non-adopters, while in low-transit-use areas, the inverse is true.
- Scooter users' households have more cars in general than non-adopters' households, and notably, more scooter users' households have three or more cars. This is consistent with the higher income associated with scooter adoption but may also point to younger people who live in group households with several roommates.

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The survey also examined how and why people use scooters. The responses were weighted by frequency of use:

- Trips on public transit represented 0.5%–10% of trips replaced by scooters. The largest portion of journeys replaced by scooter trips (46%–78%) would have taken place in cars—either alone, with another passenger, or in a ride-hail vehicle. Walking trips were the next most likely to be replaced: 15%–37% of trips, with the most replacement in areas with the least density and transit service.
- Users choose scooters for many trip purposes. The most common trip purposes for scooters were commuting (in denser metros) and socializing (in the less dense metros).
- Asked why they chose a scooter on their most recent trip, "It was just for fun" was the most frequent response in all but the densest metros, where utilitarian considerations like speed, reliability, and parking were dominant. Scooters' competitive prices compared to other modes were also important to a significant minority of users.

Implications for Transit Agencies

This section explores the benefits and impacts of micromobility with an emphasis on outcomes likely to be valuable to transit agencies. It begins by extending the micromobility analysis from the prior section and examines trip patterns in proximity to high-frequency fixed-route transit. The second part of the section examines the broader implications of shared micromobility's impacts on transit agencies, including funding and the financing of public infrastructure; agencies' civil rights obligations under the Americans with Disabilities Act (ADA) and Title VI of the United States Civil Rights Act of 1964; and the rider experience.

Micromobility Usage Patterns and Impacts

Scooter Impacts on Docked Bikeshare

Using daily trip counts, the researchers examined docked bikeshare use before and after the addition of dockless shared vehicles in Oakland, CA, and Arlington County, VA. Both regions saw a decline in dock-based bike trips soon after the introduction of scooters, but it's unclear whether this was a result of the introduction of dockless services or a consequence of seasonality or other factors. And in both cases, docked bikeshare recovered at least its prior level of ridership, and in Oakland reached new heights after scooters' introduction.

Dockless Vehicle Use near Transit Stations

The researchers also examined aggregated micromobility trip data to observe patterns in scooter trips starting or ending near high-capacity transit stations [heavy or commuter rail and bus rapid transit (BRT)] in five urban jurisdictions: Oakland, CA; Arlington County, VA; Cleveland, OH; Indianapolis, IN; and Baltimore, MD.

- In every region, the vast majority of micromobility trips occurred in the urban core and university campus areas.
- Oakland and Arlington County—densely populated jurisdictions in large metro areas—saw most scooter trips clustered along rail corridors, with 56% and 70% of trips, respectively, starting or ending within ¼ mile of a rail stop, and 30% and 42% within ⅛ mile.
- The less dense cities of Indianapolis and Baltimore showed less association between scooter trips and high-capacity transit stops, as did Cleveland's rail transit and light-rail

lines. Cleveland's three BRT lines, with many stops throughout the dense urban core, had much greater association, with 83% of scooter trips starting or ending within ¼ mile of a stop, and 68% within ⅛ mile.
- In every region except Baltimore, over 90% of scooter trips started or ended within 1 mile of a high-capacity transit stop.

Funding/Financing Impacts, Civil Rights, and Other Agency Concerns

Docked bikeshare systems are a strong precedent for publicly subsidized micromobility operations, but at present, dockless operations are largely privately supported. The growth of private micromobility has convinced some agencies that the older model of subsidized micromobility is no longer needed. However, reliance on private services leaves jurisdictions vulnerable to market whims. In this model, some public entities have found it difficult to effectively convince private operators to provide micromobility access across different geographic, income, and racial populations, as well as for people with disabilities, and have in some cases turned to subsidies or other incentives to ensure deployment in support of public goals.

Funding and Financial Implications

Transit agencies weigh the costs and benefits of funding micromobility infrastructure and subsidizing services to encourage their use, and thus possibly increase ridership and revenue for the public transit system. Transit agencies have limited operational funds to invest in new service types, but capital funds (including some FTA formula monies) can be used to support micromobility infrastructure such as dedicated parking and bikeshare docks.

Civil Rights and Social Equity Implications

Transit agencies are federally required to ensure equitable access to their programs but do not have specific guidance from the FTA on what exactly that means for partnerships with micromobility services. Existing guidance focuses on two key questions: which funding programs include micromobility (specifically, bikeshare) as eligible expenses and what requirements apply depending on the funding source used. The ADA applies regardless of funding source, and Title VI applies when federal funding is used. Federal sources of operational funding are limited, and FTA's guidance on what the use of those funds requires in terms of ADA compliance focuses on the use of ride-hailing or other demand–response services, not micromobility. Aside from then-Secretary Foxx's 2016 *Dear Colleague* letter (U.S. DOT 2016), there is little guidance on Title VI requirements for federally funded micromobility services.

Transit Rider Experience Implications

Whether or not it is operated in partnership with transit agencies, micromobility has the potential to improve transit riders' experience by alleviating peak-period crowding on transit (Pucher and Buehler 2009) and rider demand for bringing personal bikes and scooters on board. However, shared micromobility services could also reduce the quality of the rider experience if vehicle parking and use are not well planned at stations and stops. Further, the current multimodal digital experience of trip planning, booking, and payment is scattered and inconsistent.

Agency–Micromobility Partnership Approaches

As the micromobility marketplace continues to take shape, new types of collaboration between cities, transit agencies, and private operators are emerging to align mobility goals, regulate sensibly, and improve transit access. City and transit agency partnership roles depend on market and transit system characteristics. In urban areas with supportive infrastructure and large and willing customer bases, private operators are eager to deploy. In this case, DOTs take a regulatory approach, and transit agency partnerships focus more on coordination with the city.

But in smaller or shrinking cities, vendors may not be clamoring to enter the marketplace like they are in larger or more affluent metros. Public agencies in these areas might still decide that micromobility is worthwhile and seek to attract and actively shape the service in ways that are applicable to their particular needs.

Engagement between public agencies and micromobility providers falls along a spectrum of public/private partnership arrangements, from direct agency operation of micromobility services to more private-sector–dependent collaborations in which agencies have little or no control over the private operator's activities. The following subsections provide summaries of case studies of how transit agencies of various types are working to ensure desired policy outcomes in partnerships throughout this spectrum.

Transit Agency–Led Operation or Integration of Services

Partnerships with the greatest level of agency control employ a vendor's vehicles and technology platform, but operations, including customer support, rebalancing, charging, and other fleet maintenance activities, are the responsibility of the public agency or a closely allied nonprofit. The Greater Dayton Regional Transit Authority (RTA) appears to have gone further than any other U.S. agency in its level of operational involvement, but a number of transit agencies in metros large and small have worked closely with micromobility vendors to create systems that are effectively extensions of the transit system and are clearly marketed as such to the public. Other examples:

- Kansas City Area Transportation Authority: RideKC Bike and Scooter
- Los Angeles County Metropolitan Transportation Authority (LA Metro): Metro Bikeshare
- Austin Capital Metro: MetroBike
- The Central Midlands Regional Transit Authority (COMET; Columbia SC): Blue Bike SC

Subsidizing Specific Ride Types or Creating Connections

Several agencies have sought to take advantage of the popularity of micromobility to subsidize or encourage service at times and places where transit is not available or to create new first-/last-mile options. Examples:

- Sacramento Regional Transit District: free light-rail trips for same-day bikeshare users
- Sonoma–Marin Area Rail Transit: capital support for hybrid e-bikeshare for first-/last-mile connections throughout a rail corridor

City/Transit Agency Policy Collaboration

Another approach is to use policy levers, enforced through local regulatory powers, to encourage desired public outcomes without either direct outlays or subsidies to private operators. City/transit agency partnerships, with formalized communication and shared

goals, enable more effective planning. While this is a well-established approach in other areas of mutual city/transit agency interest, fewer examples of this type of collaboration exist for micromobility.

- **Denver Regional Transportation District (RTD)/City and County of Denver.** An interagency collaboration is using the city micromobility permitting process to build on an existing transit amenity program, promoting vehicle placement at transit stops. This local action is matched by a coordinated transit agency program to designate micromobility parking at transit properties both in the city and in the wider RTD operating area.
- **Mobility Hubs.** Transit agencies can also partner with cities to plan, build, and operate a system of mobility hubs, which colocate micromobility and other shared mobility services, community amenities, and electric mobility charging infrastructure at key transit stations or stops. Examples are:
  - **Move 412 and the Pittsburgh Mobility Collective.** Moving toward modal integration with transit, micromobility, and mobility hubs at the center of a comprehensive consortium-based transportation approach.
  - **Metro Transit, Twin Cities.** Agency-led pilot of placemaking mobility hubs along BRT lines.
  - **LA Metro/Los Angeles Department of Transportation (LADOT).** Integrated mobility hubs in a variety of contexts, focused on expanding access for low-income communities.

Partnership Toolkit

The report concludes with a Partnership Toolkit that distills the findings of this study into a set of concrete action items. For transit agencies that are interested in going further and pursuing more direct engagement with micromobility providers, this toolkit provides a set of steps that will help agencies decide why and how to build micromobility partnerships, define goals, and measure success.

CHAPTER 1

Micromobility Devices and Business Models

When docked bikeshare appeared in North American cities a decade ago, it emerged as a valuable service that offered wider access to clean, low-speed urban transportation and helped extend the reach of public transit networks. Few could have imagined the explosive evolution of small, low-speed mobility into the variety of devices, business models, and operational arrangements that characterize the sector now known as "micromobility." This growth has been accelerated by major infusions of private capital, rising popular enthusiasm for micromobility devices (both personally owned and deployed as shared services), and economies of scale for the devices and technologies that make micromobility possible. Public agencies face a moment of inflection; as the landscape of mobility options evolves, profound impacts for urban transportation may emerge from the shared bikes and scooters found in ever greater numbers in our cities.

To date, much of the discussion about shared bikes and scooters has focused on impacts and regulations at the municipal level, with little consideration of the ways these new services interact with public transit or how transit agencies in particular can leverage the benefits and address the impacts of these new ways of getting around. In investigating these impacts and relationships, this study considers micromobility's interactions with transit in geographies representing a range of urban environments, agency sizes, economic circumstances, policy climates, and existing mobility networks.

Agency responses to micromobility, particularly in its dockless and motorized forms, have varied widely, from free-market pilots to bans. Municipalities were more prepared and knowledgeable than during the largely unregulated appearance of ride hailing, but some cities have clamped down severely, prohibited the services outright, or been very slow to create permit regimes before the services' uptake or impacts could be understood. Transit agencies, more focused on their own operations, facilities, and ridership, have a different set of responses available to them than do municipalities and others with more regulatory roles.

For transit agencies, the question often comes down to how to collaborate with micromobility companies in order to best build partnerships. As public transit agencies consider whether to work with providers, it is essential that they understand the actual benefits, impacts, and risks of various forms of micromobility to their riders and their bottom lines.

Defining Shared Micromobility

The term "micromobility" can encompass a broad variety of small, low-speed vehicles intended for personal transportation in urban areas. In popular usage, it is commonly applied to shared bikes (whether fully or partially human powered), motorized kick scooters, and, at times, personal transportation devices like Segways [National Association of City Transportation

Officials (NACTO) 2019a, 5; Chang et al. 2019, 2; National League of Cities (NLC) 2019, 6]. This definition crosses several modes and does not necessarily accord with statutory definitions of bicycles, electric bicycles, motorized scooters, and other small, low-speed vehicles. In fact, even the definitions of "small" and "low speed" are fuzzy and often vary by jurisdiction or publication. While electric bicycles, or e-bikes, have been described in federal law since 2002 (15 USC § 2085) and a number of state laws since then, electric scooters exist in more of a legal gray area, and both industry and regulators have raced to define them (People for Bikes 2019).

The standards organization SAE International published a flexible descriptive taxonomy of micromobility vehicles. The taxonomy is based both on form factor (e.g., scooter, bicycle) and physical characteristics (e.g., top speed, weight, width, and power source). The framework is limited to vehicles that are at least partially motorized (i.e., excluding bicycles that are fully human powered) and without regard for their deployment characteristics (i.e., whether they are personally owned or part of a shared fleet) (SAE International 2019). This provides a useful way to describe micromobility vehicles that is independent of who owns them and how they are made available for use. It also allows future vehicles to be classified based on their physical qualities.

This study follows the general parameters of the SAE International micromobility vehicle definition, but it will limit itself to those deployed in shared or rental fleets and will also include standard, unpowered bicycles that are part of a bikeshare service. Specifically, this study considers as micromobility those vehicles that:

- Are designed for human transport and use on paved roadways and paths, but excluding mobility aids mainly intended for use by people with disabilities (such as powered wheelchairs and mobility scooters) as well as low-speed vehicles like golf carts,
- Have a top speed of 30 mph or less (regardless of local regulations, which may cap the permitted speed lower), with full or partial human power,
- Have an unloaded (curb) weight of less than 500 pounds (SAE International 2019, 6),
- If motorized, rely on an electric motor rather than an internal combustion engine, and
- Are deployed as part of a shared fleet available for use by the general public.

Beyond e-bikes and powered seated and standing scooters, a variety of other devices fall under a general definition of low-speed, powered personal transportation devices, such as Segways, powered skateboards and skates, and powered self-balancing boards (or hoverboards). Since these are largely intended for the individual consumer market rather than fleet deployment, the types are not detailed here. This study focuses on the micromobility modes outlined by the service and vehicle types described in the following.

Service Types

Bikeshare

Bikeshare is a service that offers short-term rental of fleet bicycles, usually for durations of an hour or less. Usage periods can range from a single ride, to 1 or more days, to unlimited rides over the course of an annual subscription (Feigon and Murphy 2016, 5). Regardless of whether it is docked or dockless, bikeshare may use bikes that are fully human powered or that provide motor assist. For more on the latter, see Electric Bicycles in the Powered Vehicle Types section.

Operating Characteristics. Bikesharing comes in two major service configurations, docked and dockless, with a third, hybrid bikeshare, growing in use.

Docked bikeshare (also called "station-based bikeshare"; see Figure 1) is a station-to-station system in which users unlock bikes from a fixed dock, which generally contains the information technology (IT) hardware through which it processes payments, unlocks bicycles, and

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Credit: SUMC.

Figure 1. Docked bikeshare: Divvy bikes in Chicago.

communicates with the system operator's network about the status and availability of bicycles. The bicycles themselves may contain little or no networked IT hardware. Users can purchase rides or passes via a mobile app or from interactive kiosks located on the docks, and use a key fob or radio-frequency identification (RFID) card, keypad, or app to release bikes from the dock. The location of the technology among the various system components leads to an industry shorthand using the terms "smart" and "dumb": the dominant dock-based systems can be described as "dumb bike/smart dock" since the bulk of the IT hardware is located in the dock, with none located on the bike [Shared-Use Mobility Center (SUMC) 2019; Hernandez et al. 2018].

Docked bikeshare was the service configuration used in the early 2010s in several large U.S. metro areas for the rollout of public bikesharing, including Denver B-Cycle, Citi Bike NYC, Chicago's Divvy, and LA's Metro Bike Share. Due to the larger non-vehicle capital costs and bureaucratic burdens involved in placing dock infrastructure in the public way (and often connecting it to power and communications networks), private operators have been less likely to build docked systems using their own capital, instead generally acting as vendors for public systems (NACTO 2019b). The clear chain of custody for the bikes, along with secure locking at the start and end of rides, seems to result in a lower risk of vandalism and theft than with dockless systems (Hernandez et al. 2018, 13).

Hybrid bikeshare uses a mix of technologies from docked and dockless bikeshare. Early on in the evolution of bikeshare, some bikeshare vendors experimented with a smart-bike/dumb-dock approach, which, although it did not become the dominant paradigm in extensive systems, was useful in smaller areas and in limited deployments and provided a precursor to the technologies underlying dockless micromobility. More recently, some systems have begun to fold smart bikes into dumb-bike fleets as other bikes reached the end of their operational life.

Enabled by dockless technology, these bikes can be parked using both the traditional smart docking hardware and at "virtual docks" (i.e., anywhere the operator designates, whether it is a

dock at all) (SUMC 2019). Hybrid systems are less common than docked systems but appear to be expanding in numbers, while many fully dockless bikeshare operations have contracted or converted entirely to scooters since the height of the dockless bikeshare bubble in 2017 to 2018 (Hirsch et al. 2019).

Most hybrid systems are smaller to midsized public operations, such as Portland's Biketown, Boise GreenBike (Figure 2), Grid Bikeshare in Phoenix, and Relay Bikeshare in Atlanta; there are a number of campus operations as well.

Dockless bikeshare (also called "free-floating bikeshare"; Figure 3) locates IT hardware, including a locking/unlocking mechanism, network communications, and global positioning system (GPS) hardware, directly on each vehicle, making them smart bikes. Users locate and unlock bikes via a mobile app. At the end of a ride, users can leave the bike in any permitted location within an operating area. Locking mechanisms depend on the vehicle. In the simplest design, they contain only a wheel lock. A wheel-locked vehicle cannot be ridden but can still be picked up and moved (or knocked over). Other vehicles provide lock-to equipment—a cable or other device that allows the bike to be locked to a rack or another immovable object. Many jurisdictions require lock-to equipment to help reduce clutter and obstruction of the right-of-way.

Dockless bikeshare is characterized by lower capital costs than docked bikeshare. The lower costs are achieved in large part through the avoidance of costs associated with docking infrastructure, but for some providers (few of which are still in operation), at least partly from lower per-vehicle costs—as low as $200 per bike, which was reflected in their more frequent breakdowns and replacement as compared to the heavy-duty bikes used in docked systems or by most e-bike providers (Nikolewski 2018). As a result, user pricing per trip can be lower than docked systems or transit (Hernandez et al. 2018, 32; Nikolewski 2018).

Credit: Vanessa Fry.

Figure 2. Boise GreenBike, a hybrid bikeshare system.

Credit: Flickr user waltarrrrrr/Creative Commons.

Figure 3. Wheel-locked dockless bikes in Los Angeles.

However, the operating burden may be greater due to the greater need for rebalancing, as opposed to a system where docks provide an organizing principle. Rebalancing entails moving vehicles from one location to another in order to match demand and to alleviate pileups of vehicles at popular destinations. In the case of scooters and e-bikes, rebalancing is often also combined with charging operations.

A far greater number of dockless services in the United States have been private, for-profit operations than have been public or nonprofit systems. Because of the lower costs, operators can show up in a city and rapidly deploy hundreds or thousands of units, and often disappear just as rapidly. Dockless bikeshare appeared suddenly in many U.S. cities in 2017 and expanded even more widely in 2018, but even before the interruption caused by COVID-19, the mode was largely in retreat, with most providers either shutting down U.S. operations or converting operations entirely to scooters (Hirsch et al. 2019). Only a few fully dockless public systems remained as of mid-2020, including Orlando's Hopr [formerly Juice (Gillespie 2019)] and Tampa's Coast Bikeshare.

Scooter Sharing

Scooter sharing (see Figure 4) is a service similar to dockless bikeshare that uses the same basic technologies to enable the service but relies entirely on motorized scooters (operated either standing or seated—see Powered Vehicle Types section). A version of scooter sharing using larger electric vehicles, more akin to mopeds or Vespa-type scooters, is a growing subset of this market.

Most scooter-sharing services are operated entirely by the private sector. Scooter sharing first appeared in Los Angeles County in late 2017, and over the next year spread to a great number of cities, especially in warmer climates (NACTO 2019b). By 2018, starting from almost zero the year before, scooters saw more trips in the United States than all station-based bikeshare

Credit: SUMC/Creative Commons.

Figure 4. Electric kick scooters parked in a corral.

combined (NACTO 2019b), and more than twice as many in 2019 (86 million scooter trips versus 40 million on docked bikeshare) (NACTO 2020).

Operators use a mix of employee labor and independent subcontractors to accomplish charging and rebalancing. While some vehicles do have batteries that can be quickly swapped (which may present additional safety challenges) (Dickey 2019), most devices still need to be directly plugged in for several hours to recharge. This period is often when operators perform other maintenance and checks on the vehicles.

Powered Vehicle Types

Electric Bicycles

Electric pedal-assist bicycles, or e-bikes (see Figure 5), provide riders with a slight motorized boost that increases speeds and eases hill climbing. While state and federal laws define three classes of e-bikes depending on top speed and whether they provide motor assistance, the type most commonly deployed in bikesharing services is a Class 1 electric bicycle, which provides assistance only when the user is pedaling (as opposed to control via throttle) and has a maximum speed of 20 mph [15 USC §2085 defines a "low-speed electric bicycle" as a "two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 hp), whose maximum speed [is] less than 20 mph." This definition is the core of federal consumer product safety regulations (16 CFR §1512.2) that exclude bicycles and low-speed electric bikes from the definition of motor vehicles. At higher power and speed levels, two- and three-wheeled vehicles fall under Federal Motor Vehicle Safety Standards (49 CFR §571.3), which regulate motorcycles and motor-driven cycles under 5 hp. Several states have adopted laws similar to California's Vehicle Code §312.5 (2016), which defines three classes of e-bikes conforming to the federal definition. Class 1 and Class 2 e-bikes comply with 15 USC §2085, and are distinguished by whether the motor provides assistance only when the rider is pedaling (Class 1) or can be controlled with a throttle (Class 2). Class 3 e-bikes (also called "speed pedelecs") are similar to Class 1, but with a top speed of 28 mph.]

E-bikes offer a number of potential benefits to bikeshare by expanding the distance covered within a given ride time, expanding the reach of the system, making bikeshare viable in areas

Credit: Flickr user Mike Licht/Creative Commons.

Figure 5. A Jump e-bike.

with steeper topography, and allowing people with some disabilities or lower levels of physical fitness to use the services (Hernandez et al. 2018). Users respond to these benefits; when Citi Bike NYC introduced e-bikes into its bikeshare fleet in 2018, the new vehicles saw roughly three times the daily usage (15 rides) of the typical human-powered bike in the fleet (NACTO 2019b).

Electric Scooters

Electric Kick Scooters (e-scooters or Powered Standing Scooters). The first wave of scooter-based micromobility relied almost exclusively on electric kick scooters, or what SAE J3194 calls a "powered standing scooter" (see Figure 6). These one-person electric vehicles have two or three wheels, a platform for the operator to stand on, and are controlled by a throttle, brakes, and handlebars (SAE International 2019, 9–10).

Powered Seated Scooters. A second scooter type, mechanically nearly identical to standing scooters, is intended for seated operation, which makes it more useful for people with physical limitations or on longer trips for which standing would be uncomfortable. At the smaller end, these vehicles look like a standing scooter with a bicycle seat post grafted on (see Figure 7), but larger versions of these vehicles segue into vehicles that are difficult to distinguish from motor scooters or e-bikes without pedals. These vehicles are distinguished from their larger motorized cousins (mopeds and motor-driven cycles/motor scooters) in that they stay below statutory limits on speed and power that require a motorcycle or driver's license.

Motor Scooters/Electric Mopeds. The largest of the vehicles deployed as micromobility are Vespa-like motor scooters, which are being offered for rental in at least a few cities around the United States (see Figure 8). These registered motor vehicles are the only micromobility mode requiring titles and license plates, are heavier and more substantial than e-scooters (though still below the 500-lb curb-weight micromobility limit), generally require a driver's license to operate, and cannot be used in bike lanes or parked on the sidewalk. Despite these somewhat

Credit: Flickr user Tony Webster/Creative Commons.

Figure 6. Several generations of Spin electric kick scooters.

Credit: BikePortland.org/Bryn Dearborn.

Figure 7. A powered seated scooter by Razor.

Credit: Flickr user Phillip Pessar/Creative Commons.

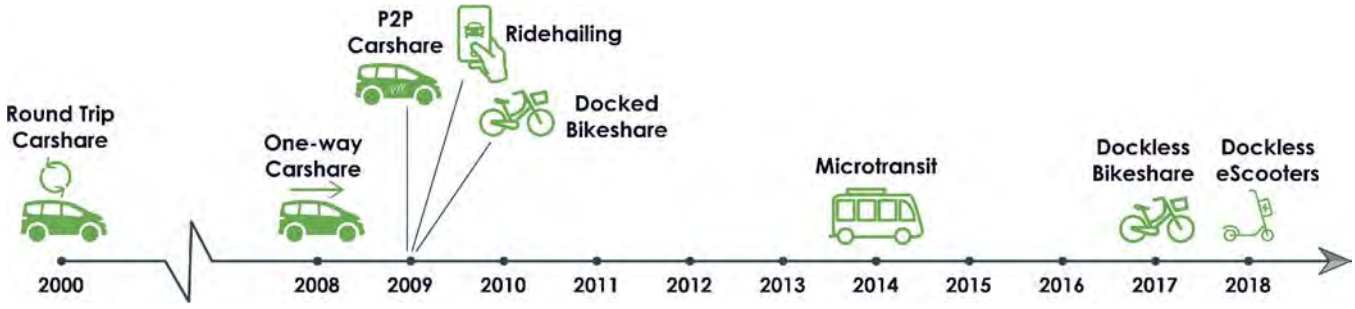
Figure 8. Revel shared mopeds in Miami.

greater user accessibility and regulatory hurdles (and greater vehicle costs), rental rates are in line with other micromobility services (O'Kane 2019). Most operators provide motorcycle helmets as part of the rental (Small 2019).

Business Models and Industry Trends

The Micromobility Market

Shared mobility services have expanded and diversified since the advent of round-trip or station-based carshare in the early 2000s, as illustrated in Figure 9. In the early 2010s, a new wave of shared mobility services led by ride-hailing companies (most notably Uber and Lyft) were increasingly deployed by private companies, with limited regulatory intervention at the outset. Starting in the mid-2010s, more state and local jurisdictions began to regulate shared mobility services' pricing and accessibility, labor and contracting practices, use of public space, and requirements around data sharing. Several key regulatory actions have led to legal challenges from private operators and others that are likely to be working their way through the courts for some time. The regulatory controversy most relevant to this study is the Los Angeles Department of Transportation's (LADOT) requirement for micromobility operators' use of the Mobility Data Specification (MDS), which has attracted privacy lawsuits from Uber/Jump and civil liberties



Source: SUMC. Note: P2P = peer to peer.

Figure 9. Shared mobility services have expanded and diversified since the turn of the 21st century.

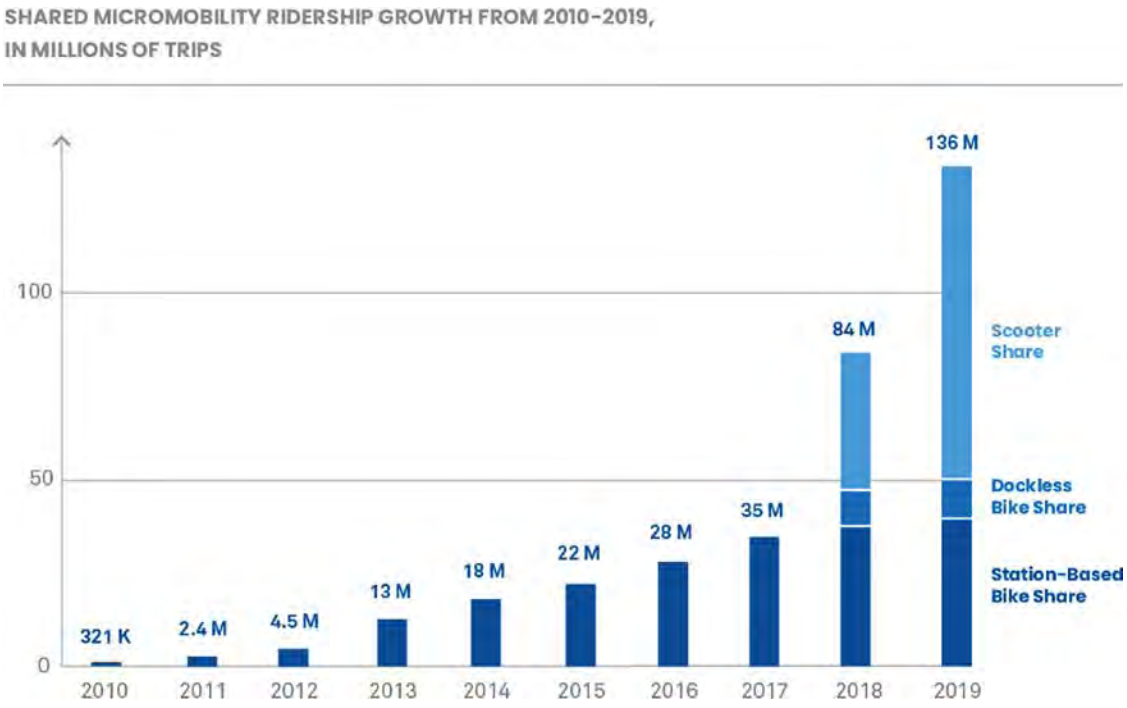
and privacy advocates (Hawkins 2020). The subject of MDS and data policy is explored at greater length later in this report.

Dockless micromobility represents the most recent evolution of shared mobility. With the introduction of new free-floating modes, more jurisdictions have shifted to managing the public right-of-way for these services, including regulating whether they may operate on sidewalks or roads or in other public spaces.

Micromobility adoption has grown rapidly, accelerating since shared scooters' appearance in 2018 (Figure 10). NACTO estimates that the number of shared micromobility trips in the United States more than doubled to 84 million between 2017 and 2018, with the increase almost completely attributable to the introduction of scooters (NACTO 2019b). In 2019, nearly twice as many U.S. micromobility rides took place on scooters (86 million) than on docked and dockless bikeshare of all types (50 million) (NACTO 2020).

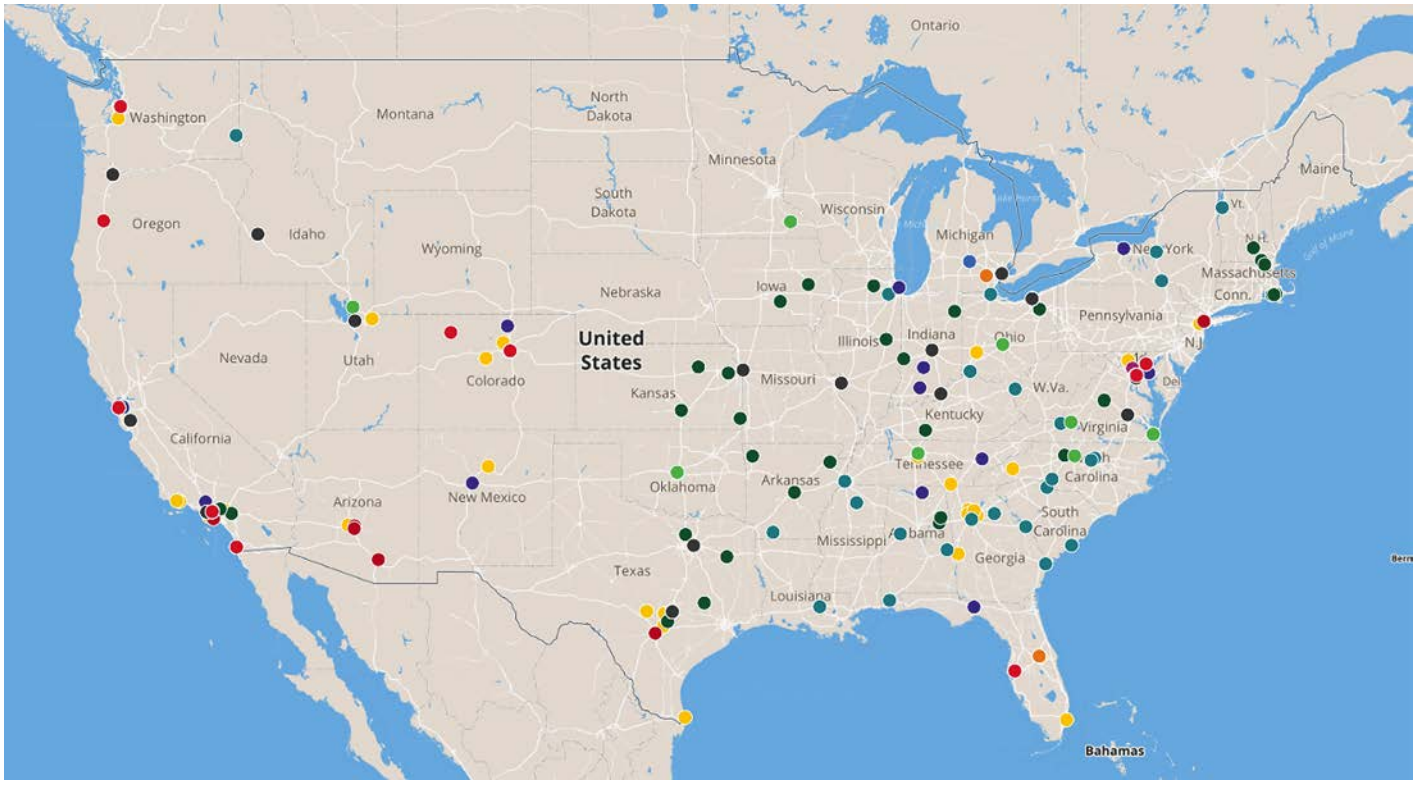
Shared scooters and bikes from 19 companies operated legally in some 180 U.S. cities and municipalities on the eve of COVID-related disruptions in 2020 (Figure 11), nearly double the count for the end of 2018 (Smart Cities Dive 2020; NACTO 2019b). The trend is not limited to the United States: the New Urban Mobility Alliance (NUMO) counted micromobility operations in more than 625 cities and over 50 countries around the world as of mid-2020 (NUMO 2020).

Dockless scooter programs in U.S. cities are currently dominated by a few major operators, but many smaller regional operators also offer shared bicycles and scooters in a few markets, with some specializing in smaller cities or university campuses. Large programs, with thousands or tens of thousands of vehicles, are in place in large or fast-growing cities like Los Angeles, Washington, D.C., and Austin, while smaller cities or college towns may have fleet counts in the dozens or hundreds.



Source: NACTO 2020.

Figure 10. Micromobility adoption—particularly uptake of scooters—is taking place at an accelerating rate.



Source: Smart Cities Dive 2020.

Figure 11. Locations of dockless vehicle operations in the continental United States in early 2020.

Business Models

Transportation researchers have identified a number of ways to classify the business models at work in micromobility. In general, these are based on the public, private, or nonprofit status of the entities that own the service's assets and operate the services from day to day. Most of the work in this area was done with respect to bikesharing, and for the most part, these frameworks continue to hold for micromobility more broadly.

Shaheen et al. (2014) discuss five models: nonprofit; privately owned and operated (the model that applies to most dockless bike and scooter services); publicly owned and operated; publicly owned, contractor operated; and vendor operated. Writing about bikeshare only, Hernandez et al. simplify this classification to three types that cover the vast majority of existing micromobility services in the United States: nonprofit owned and operated, privately owned and operated, and publicly owned and operated by a third party (Hernandez et al. 2018). This classification scheme is applied to the micromobility market in Table 1.

The variety of permitting, franchise, and regulatory arrangements under which micromobility operations take place within these business models will be explored in case studies later in this report.

Table 1. Micromobility business models.

Business Model	Sources of Capitalization and Operating Revenue	Operational Functions and Characteristics	Notes	Example Programs or Operators
Nonprofit owned and operated	• Startup/capital funding often through public grants, private sponsorships, or philanthropic monies • Operations supported by user fees, sponsorships, ad revenue.	• Can access a wide variety of funding sources and operating arrangements • May contract with third-party vendor to operate	• Responsive to public interest and local/regional goals • A dwindling model, with more organizations turning over some or all of operations to a mix of public and private entities	• RideKC Bike and Scooter (Kansas City) • Pacers Bikeshare (Indianapolis)
Privately owned and operated	• Private investors fund startup and often much of operations. • Operation supported through user fees, sponsorship, ad revenue, ongoing investor infusions	• Often the same company both manufactures equipment and operates service. • Rapid startup and expansion of operations • Daily operations activities (rebalancing and charging especially) often rely on independent contractors, with maintenance performed and overall fleet deployment planned and overseen by employees.	• Most common model for dockless micromobility • Often little coordination with local authorities beyond what is required by permit/regulation • Does not require public money for operation, but may increase administrative burden on regulating agencies • Industry marked by ongoing consolidation and vertical integration may present risks for jurisdictions relying excessively on fully market-based solutions	• Most scooter operations: Lime, Bird, Jump, Spin • Spin Dayton (privately owned, operations and maintenance by transit agency)
Publicly owned, third-party operated	• Startup funding often through federal or local grants • Operations funded by public revenues, user fees, sponsorships, and advertising. • Operations may be performed by nonprofit or private vendors.	• Operations provided by a private operator that works closely with the sponsoring public entity on system planning and administration • Operating partners often have revenue guarantee and incentives tied to system performance. • Often have exclusive or preferential access to right-of-way	• Model most closely tied/responsive to local public agency goals	• Divvy (Chicago area) • Capital Bikeshare (D.C. area) • Link Dayton Bikeshare

CHAPTER 2

Regulatory and Policy Review

This chapter examines the policy environment surrounding shared micromobility, including areas of regulation and areas where regulatory approaches are still in flux. Since this report is focused particularly on transit agencies and their interaction with micromobility, a large part of this chapter examines the specific policymaking and regulatory role of public transit agencies. However, public transit agencies generally lack the policymaking or regulatory powers that state or local governments possess, and they achieve their policy goals largely through partnerships with operators and coordination of goals with regulating agencies. Put another way, cities regulate, while transit agencies partner. For that reason, this chapter begins with an examination of the main levers that jurisdictions—of all types—commonly use to regulate micromobility.

The Range of Local Regulatory Approaches

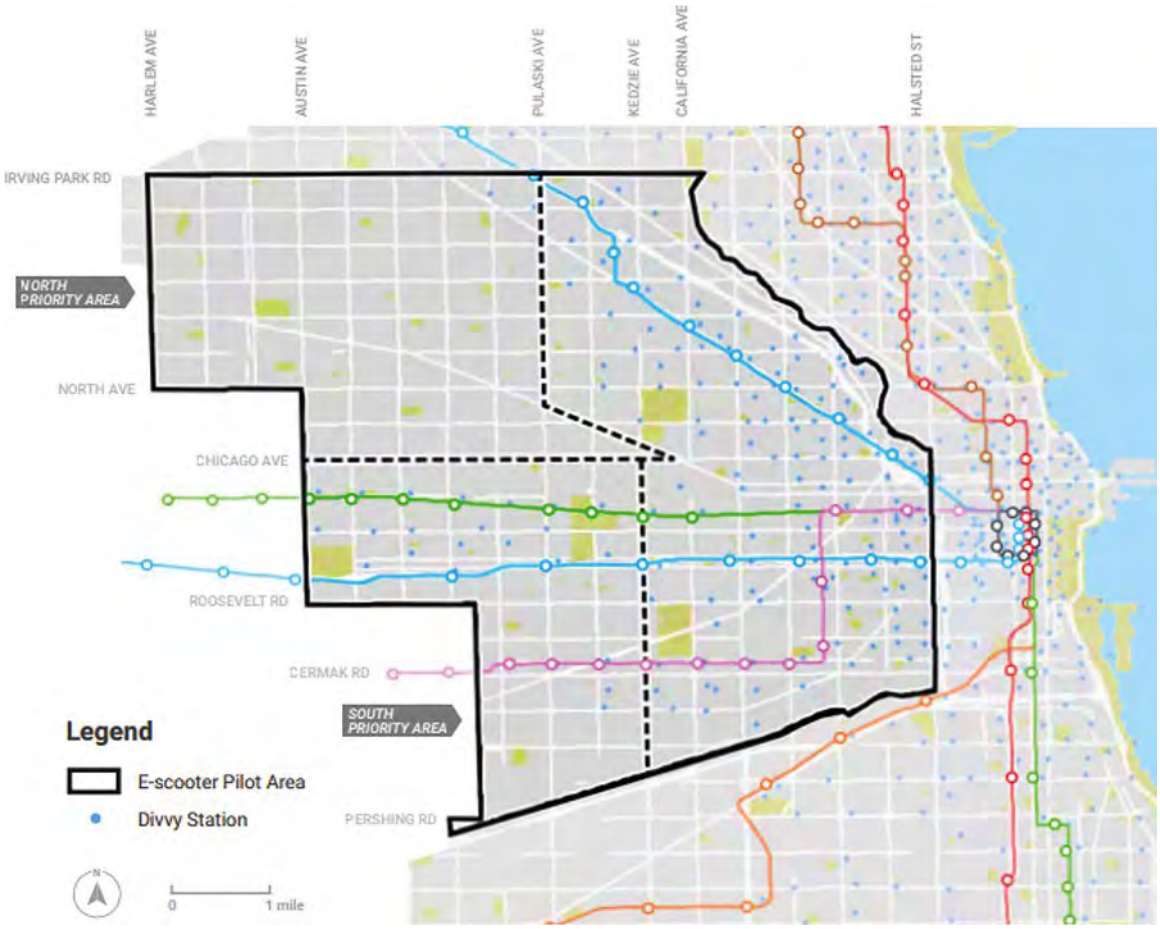
Most local enabling statutes and permit requirements for micromobility typically cover some combination of several key regulatory approaches. The Shared-Use Mobility Center's Micromobility Policy Atlas provides summaries of policies in a number of cities in the United States and worldwide for a common set of regulatory fields, and provided much of the documentary basis for this chapter (SUMC/NUMO 2020).

Vehicle Location: Operation, Parking, and Geographic Limitations

Regulations on vehicle location can govern where in the right-of-way riding is permitted or prohibited (particularly with regard to bike lanes and sidewalks) and where and how vehicles should be parked between rides (including bike rack, corral, and lock-to requirements), and outline broader zones where operation is permitted or prohibited (such as certain paths or geographic areas of a city).

Atlanta's 2018 scooter ordinance, for instance, regulates operation and parking location, with scooter riding prohibited on sidewalks and limited to certain areas of the public way (in city parks, including the Atlanta BeltLine, and in vehicle travel lanes, bike lanes, and shared-use paths throughout the city). Scooters must be parked upright and only at bike racks or against a building or curb, and in a way that provides at least 5 feet of clearance for pedestrians, with a minimum of obstruction. Parking is prohibited in a variety of locations, including at bus stops, at bikeshare stations, or where it obstructs pedestrian or wheelchair access to buildings, public facilities, or accessibility features like ramps and handrails (Atlanta 2018).

In many jurisdictions, operation is further limited to specific geographic areas. During Chicago's 2019 scooter pilot, the city limited operations to a 50-square-mile area on the west and northwest sides of the city (see Figure 12)—about a quarter of the city's geographic



Source: Chicago 2020a.

Figure 12. Operating area for Chicago's initial 2019 scooter pilot, limited to the city's west and northwest sides. The dotted lines delineate the two "priority areas" that were the focus of the program's equity provisions.

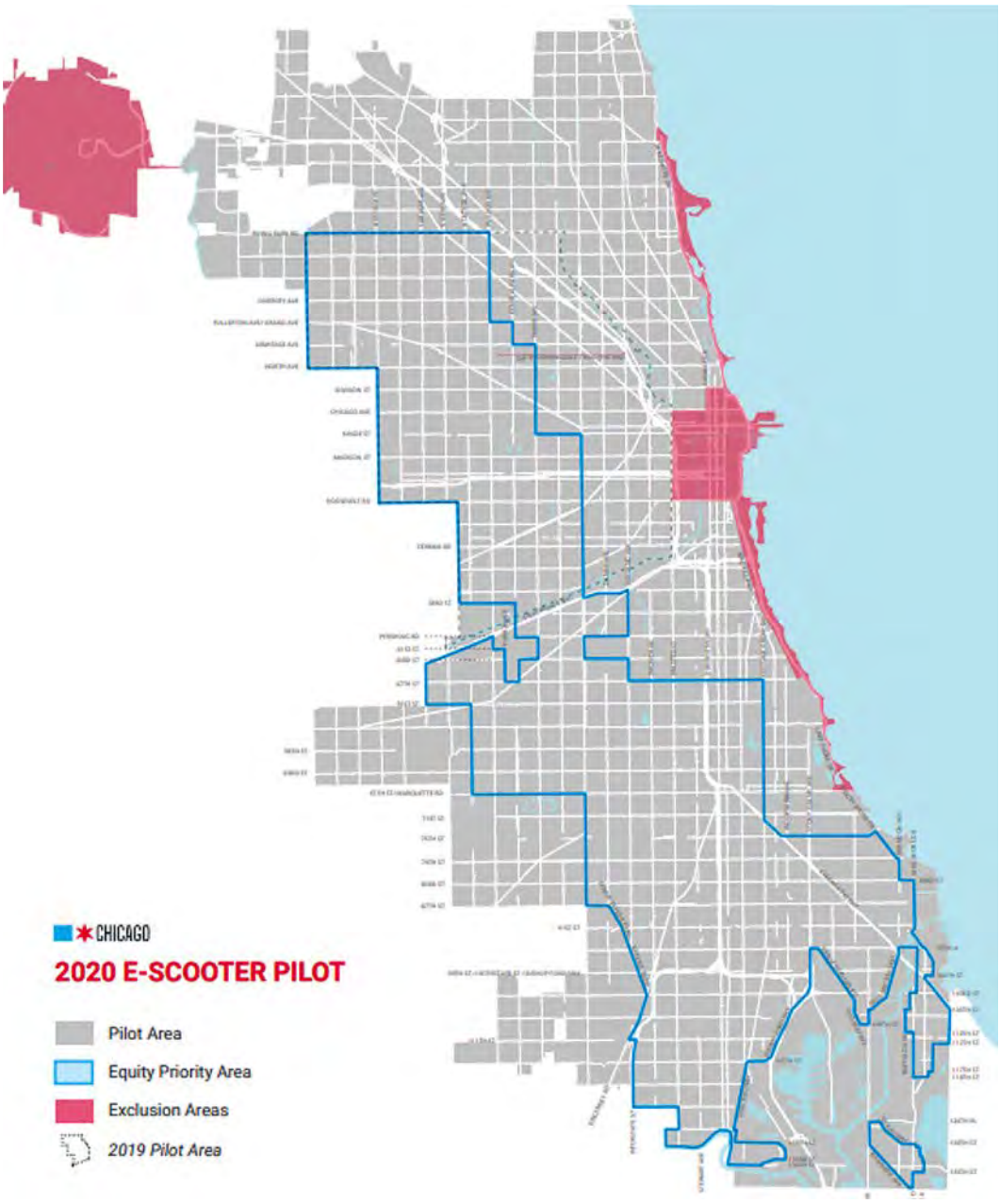
area—excluding downtown business and entertainment districts, heavily populated areas along the lakefront, and several major transit corridors (Chicago 2020a). Two western sections comprising about half of the pilot area were further designated as "priority areas" where the program's equity requirements were focused.

In the city's 2020 pilot (see Figure 13), the area of permitted operation was expanded to the whole of the city except for the core of downtown, two heavily used mixed-use paths, and O'Hare Airport, with the equity priority area expanded to most of the west and south sides (Chicago 2020b).

Operators are generally expected to communicate these geographical limits to riders and, in many cases, to use geofencing to physically disable micromobility vehicles if they enter a prohibited area.

Limiting Overall Scale and Impact: Fleet Caps, Utilization Targets, and Provider Counts

Many jurisdictions seek to limit the impact of micromobility by placing caps on the number of vehicles that can operate and requiring that deployed units see a minimum level of utilization.



Source: Chicago 2020b.

Figure 13. Expanded operating area for Chicago's 2020 scooter pilot, with exclusion areas overlaid in red and the equity priority area outlined in blue.

Fleet caps can appear as a per-operator cap, a citywide fleet cap, a limitation on the number of permitted operators, or some combination of the three approaches. A number of jurisdictions use fleet caps as a central part of a performance-based regulatory approach that aligns operator incentives with public goals. In this approach, operators that meet certain performance requirements (such as hitting vehicle utilization targets, providing vehicles in every part of the city, or demonstrating a commitment to recruiting users or employees from disadvantaged communities) are rewarded with higher fleet caps, lower fees, or other incentives that help them reduce operating costs and boost potential margins.

Utilization targets, usually expressed as an operator's fleet-wide average trips or rides per vehicle per day (rvd), can help ensure that the right number of vehicles are deployed, with jurisdictions ideally adjusting fleet caps to reflect market signals: raising caps as growing utilization demonstrates sufficient demand or reducing them if low utilization suggests that too many vehicles are on the street.

The ideal target range is still being established and likely depends on the specific market characteristics, but a number of jurisdictions seem to have settled on 3 rvd as the threshold for fleet cap increases. For example, the Austin Transportation Department's 2018 Rules for Dockless Units use fleet caps and utilization requirements to address a number of public goals: starting from an initial cap of 500 units per operator, the transportation director can award increases of 250 vehicles for each additional 5-square-mile area (outside of downtown) that an operator services, as long as each additional area maintains a minimum utilization level of 3 rvd (Austin Transportation Department 2018).

An examination by the research team of more than a dozen shared-scooter pilots from 2018 to 2019 found typical actual utilization rates clustered between 2 and 4 rvd. This accords with analysis by NACTO, which found that for scooters, smaller systems tended to have higher utilization than larger systems (4 and 2.6 rvd, respectively, for fleets below and above 2,500 vehicles), while the inverse was true for bikeshare, in which utilization rose from less than 1 to around 3 rvd as fleets grew over 2,500 (NACTO 2020).

Rider and Public Safety

While much of the micromobility regulatory regime touches incidentally on safety, especially those regulations focused on locations of operation, several areas of regulation do so more explicitly. The most clearly safety-focused areas common to local regulations center on:

- Speed limits,
- Vehicle requirements [generally ISO 43.150/4210-1 (ISO 43.150 sec. 4210, 2014), federal consumer regulations (16 CFR §1512.2), or state standards for bikes or personal e-mobility vehicles],
- Helmet use,
- Rider age restrictions/license requirements, and
- Hours of operation and curfews.

Washington, D.C.'s 2020 shared-scooter permit agreement touches on nearly all these points, setting a 10 mph speed limit (less in specific areas) enforced by a speed governor, requiring that vehicles meet applicable international and federal vehicle standards, encouraging provision of free helmets, and requiring operators to inform users of local regulations on age restrictions and hours of operation (addressed elsewhere in local code or user agreements) [District Department of Transportation (DDOT) 2019a]. Santa Monica provides similar rules, and in addition to setting a minimum age of 16 years for shared bikes and scooters, requires scooter users to hold a valid driver's license or learner's permit (Santa Monica 2020).

In a scan of some 30 U.S. policies collected in SUMC's Micromobility Policy Atlas (SUMC/NUMO 2020), operation by riders under the influence of drugs or alcohol appears to be rarely addressed in local regulations, which tend to focus on the providers' responsibilities, although substance-impaired operation and other facets of safety are generally also part of the terms of the private operators' own user agreements (Bird and Lime user agreements 2021). However, a number of cities do list intoxicated operation among the prohibitions in informal guidelines provided to users (Tampa 2020; Chicago 2020c).

Operator Responsibilities: Parking Enforcement, Rebalancing, Maintenance, and Communications

Many jurisdictions place the onus of regulatory enforcement on private operators, outlining regulations dependent on user behavior, such as parking and permitted locations for riding, as well as regulations more centered on fleet operations, such as rebalancing, vehicle maintenance, and outreach to and communications with users.

In the case of user behavior, especially around vehicle parking, operators often pass fines or penalties through to the responsible riders under their user agreements. In order to encourage compliance and create a clearer chain of custody for vehicles that can be easily moved, some jurisdictions and many operators require users to photograph their legally parked, upright vehicle at the end of a ride (Bird, Lime, and Skinny Labs/Spin user agreements 2021; Chicago 2019a).

Parking regulations and transit access. Some local policies recognize that micromobility vehicles will be used for transit access and include provisions that encourage positioning of vehicles near transit stops and also discourage blocking access or pileups of vehicles around transit stops. Denver's collaboration between the city's public works department and the Regional Transportation District (discussed as a case study in Chapter 5: Agency-Micromobility Partnership Approaches) is an example of this kind of policy applied on a regional scale.

Rebalancing constitutes the regular repositioning of vehicles throughout a service area and is a common mechanism for meeting equity goals as well as for placement near transit assets. For instance, in Chicago's scooter pilots, operators were required to deploy at least half of their devices to the south and west side "priority areas" daily (described previously), while many of those vehicles tended to end the day in more centrally located (and more affluent) commercial and entertainment districts (Chicago 2020a; Chicago 2020b). Without rebalancing requirements, those more affluent areas are where the majority of the fleets would likely stay over time.

Rebalancing is also central to fleet operations, providing the opportunity to charge, clean, and inspect vehicles, as well as to pull any that are malfunctioning or due for maintenance. Rebalancing and maintenance provisions may set required intervals for inspection and time limits (usually on the order of hours) for addressing inoperable, abandoned, or improperly located vehicles.

Communications requirements commonly cover:

- Identification and contact information on the vehicles themselves;
- The ways operators notify users of rules, regulations, and other information (e.g., through pre-ride tutorials and in-app notifications);
- Customer support requirements as well as means for receiving and handling complaints from the public;
- Launch, marketing, and outreach plans, often targeting specific communities or populations; and
- Communication (other than data-sharing requirements) with regulators or other agency staff (e.g., activity reporting, coordination meetings).

Social Equity Considerations: Geographic Distribution and Access for the Unbanked or People Without Smartphones

Many agencies incorporate equity requirements in their micromobility regulations, most commonly to ensure geographical distribution of vehicles throughout a jurisdiction (so that they are readily available to people of all income levels and not concentrated only in commercial areas or higher-income districts) and to provide access for users without mobile phones or for those who are unbanked.

Geographical equity approaches may be enforced through a combination of increased fleet caps for better performance and reduced fleet caps or even fines for subpar performance or noncompliance. Each operator is commonly required to submit an equity plan detailing its approach.

Denver's 2018 micromobility pilot set initial fleet caps of 400 dockless bikes and 250 scooters per operator but raised the caps by 100 vehicles if the additional vehicles were located in "opportunity areas" (including a subset of "high priority opportunity areas" where the most vulnerable populations are located) during daily rebalancing (Denver 2018). It also required operators to file equity plans "outlining how their services will be available to those without smartphones or those who are under-banked or un-banked" (Denver 2018), as well as to outline rate structures and discount programs for specific populations.

Most major micromobility providers offer company-wide equity programs, which are often available even in areas where they are not explicitly required, and several have programs that allow unbanked users to load accounts using cash at retail locations or use prepaid debit cards (Chicago 2019b). Access to discount programs is often tied to enrollment in a means-tested public assistance program such as SNAP, Medicaid, or HUD Section 8.

Access for people without smartphones or mobile data plans can generally be accomplished by using short message service (SMS) or voice calls to unlock and lock vehicles and accomplish other account functions. While these allow users without smartphones to use the services, they still generally require a mobile phone of some kind in order to use SMS or call from a verified number at both ends of a ride, thus excluding people with no mobile phone at all.

Data-Sharing Requirements and Standards/Specifications

Public agencies typically seek some level of data reporting from micromobility providers operating in their jurisdictions. These can range from periodic ridership summaries to near–real-time records and GPS traces of individual vehicles, and can also include user surveys and information on other aspects of program participation.

These data may serve a variety of purposes, including identifying trends in transportation and patterns of use of various services, service planning, monitoring operational delivery, accounting and auditing (especially in the case of subsidized services), and regulatory compliance (including establishment and enforcement of geofenced areas) (Gururaja and Faust 2019). Even if most of these data are ultimately drawn from trip- or vehicle-level records, each of these tasks is best accomplished using data with varying levels of granularity, aggregation, timing, and frequency.

Two major data standards have emerged for the collection, management, and distribution of micromobility data. The General Bikeshare Feed Specification (GBFS) and the MDS both provide standard data definitions and methods for data to be shared between providers and jurisdictions.

GBFS is the open-data standard for bikeshare and was originally developed under the leadership of the North American Bikeshare Association (NABSA), along with public, private-sector, and nonprofit bikeshare system operators (NABSA 2019). Derived from the General Transit Feed Specification (GTFS) at the heart of many transit trip-planning tools, GBFS takes real-time service availability data (such as vehicle and dock location and status) from micromobility systems and makes these data publicly available online. GBFS data allow individuals to see the current status of micromobility vehicles, and because of GBFS's similarity to GTFS, it can also easily be adapted to be displayed alongside transit information in a variety of ways, such as through mobile applications, display boards, or websites. It does not include historical

information (although this can be derived from it) nor can it communicate information about paths of travel. Effective use of GBFS can increase the integration between micromobility and public transit, allowing agencies to take advantage of micromobility's transit-supportive qualities. GBFS is a one-way standard, providing a means only for operators to broadcast their service availability but no way for jurisdictions or users to communicate back to operators.

MDS, originally created by LADOT, is a more complex two-way standard with goals to "provide a standardized way for municipalities or other regulatory agencies to ingest, compare, and analyze data from mobility service providers, and to give municipalities the ability to express regulation in machine-readable formats" [Open Mobility Foundation (OMF) 2019a]. MDS was widely adopted and is currently being used by more than 50 cities across the United States to manage micromobility services (OMF 2019b). Unlike GBFS, MDS includes path-of-travel information and enables two-way communication between city and vendor. As such, MDS enables compliance tracking, digital enforcement, and data-driven infrastructure planning. However, its provision of trip-level data to public agencies has also raised privacy concerns, both from vendors and privacy advocates, and by 2020 it was the subject of litigation in Los Angeles and elsewhere (Hawkins 2020). (This is explored in more detail in Appendix B: Digital Policy and Compliance.)

Many local policies specify that data provided to the jurisdiction must use one or both of these standards, while others simply state that micromobility operators must provide an unspecified application programming interface (API) for sharing data or use a data portal or API provided by the city. Several jurisdictions designate third-party services or apps to ingest and process micromobility data, and some require that mobility providers work with the data aggregator, trip planner, or ticketing vendor of their choice as a condition of their operating permit.

Risk Management

Permit programs commonly require operators to carry property damage and personal liability coverage in amounts of $1 million to $2 million or more. Many jurisdictions also require vendors to post performance bonds to ensure payment of fees and regulatory actions.

The Transit Agency's Regulatory Role

DOTs and transit agencies differ in tools available to them: as stated before, cities regulate, while transit agencies partner.

Many of the key policy and regulatory mechanisms described in the previous sections sit outside the control of transit agencies and are instead located with local and, occasionally, state governments. Transit agencies' key policy areas of interest include safe station access, risk management, digital policy and data sharing, fare integration, and equitable access.

This section explores the transit agency's role in the regulatory landscape and examines strategies for aligning local policy with agency priorities.

Defining Transit Agency Interests in Shared Micromobility

City DOTs and transit agencies have different roles, responsibilities, and interests when it comes to shared micromobility operations. Similarly, city DOTs and transit agencies differ in the fundamental tools available to them to achieve their interests. While cities have regulatory authority over micromobility operators, transit agencies primarily influence micromobility operations and outcomes through partnerships with cities, vendors, or other local partners.

Through these partnerships, transit agencies seek to:

- **Enhance transit access and increase ridership –** Transit agencies and cities are both concerned about safe and efficient access to transit stops to foster first- and last- mile micromobility access.
- **Support cities in managing network demand –** Micromobility is one of many demand-management tools that engender mode shift. Micromobility can substitute short trips via driving alone or ride hailing, particularly in medium-to-high-density settings. Shared micromobility pilot evaluations in Santa Monica (Santa Monica 2019a), Portland [Portland Bureau of Transportation (PBOT) 2019], and Chicago (Chicago 2020a) found that between a third and one-half of trips would have otherwise been made by driving, ride hailing, or taxis. This diversion of car trips is also supported by the Populus Groundtruth survey data described later in this report. Likewise, access to shared micromobility can alleviate demand for bringing personal bikes and scooters onto transit vehicles, a strategy that many transit agencies like Caltrain in the Bay Area seek to increase in-vehicle capacity. Shared micromobility's potential to shift peak-period trips, alleviate transit crowding, or reduce delays deserves further research.
- **Make informed service and infrastructure decisions with mobility data –** City DOTs can require that micromobility providers share trip and vehicle status data, can set standards around how those data are structured and shared, and can influence whether the data can be shared with third parties such as transit agency partners. Transit agencies have interests in micromobility data for their ability to help them identify priority locations for micromobility infrastructure, identify transit service gaps, and evaluate whether agency partnerships meet program goals.

Policy Areas and the Role of Transit Agencies

Transit agencies and city DOTs have different roles in achieving their common policy objectives of enhancing transit access and ridership, managing network demand, and making informed service and infrastructure decisions. While city DOTs regulate and permit shared micromobility services, transit agencies' primary role is partnership, marketing services to reinforce first- and last-mile opportunities, and providing real estate to accommodate short-term device storage. Table 2 identifies key policy areas where cities and transit agencies have an interest in micromobility outcomes and identifies each entity's role in ensuring those outcomes.

Micromobility and the Built Environment

As major mobility destinations and transfer points, transit stations and stops are natural centers of micromobility activity, including activity related to personal bikes and other small devices, docked bikeshare, and shared dockless services. Data from docked and dockless systems demonstrate this nexus through the number of trip starts and ends and targeted deployment activity near transit services (Lime 2019; Clewlow 2019a). Historically, transit agencies have implemented and managed bicycle parking on their property and coordinated with other government partners on the siting of station-based bikeshare on their property and bicycle parking nearby. Agencies saw benefits with this approach; studies have found that over 50% of docked bike users frequently link bikeshare and transit trips (NACTO 2016).

The evolution and growth of shared micromobility services into private dockless models increases the need for coordination between transit agencies and cities. What can transit agencies do on their own, and what is the role of their municipal partners in ensuring the safe and seamless experience of transit and micromobility? By taking a more active role in the development and management of micromobility systems in collaboration with their municipal partners,

Table 2. City DOT and transit agency policy roles in key areas of regulatory interest.

Key Policy Areas (Mutual City/Transit Agency Interest)	City DOT Roles	Transit Agency Roles	Transit Agency Interests		
			Enhance Access and Increase Ridership	Support Cities in Managing Network Demand	Inform Service and Infrastructure Decisions and Evaluate Partnerships
Safe access at stations Parking organization and wayside support	• Install bike racks and designated micromobility corrals on city right-of-way • Regulate and ensure compliance through digital policy that micromobility devices cannot be parked in places that block pedestrian right-of-way and transit access (e.g., through geofencing)	• Install bike racks or corrals on transit agency property • Partner with cities to install the infrastructure to facilitate first-/last-mile travel to transit stops and stations, and keep personal micromobility devices off transit vehicles	●	●	
Safe access to stations First-/last-mile infrastructure	• Install protected bike infrastructure • Regulate micromobility vehicle speeds through speed throttling and geofenced zones where devices are not allowed to be ridden, parked, or deployed • Audit vehicle quality and ensure compliance with safety regulations • Partner with vendors on educational campaigns • Implement building of micromobility infrastructure such as bike lanes, racks, and corrals • Use vendor-shared data to inform priority infrastructure investments	• Partner with cities to identify conflict areas with transit for targeting separated bike infrastructure or routing on parallel facilities • Partner with cities and vendors on educational campaigns • Fund and implement micromobility infrastructure on agency property • Maintain wayfinding for users to find designated areas where micromobility devices can be picked up and parked	●	●	

Digital policy and data sharing	• Adopt common data specifications (e.g., GBFS and MDS) • Require the use of data specifications to enable operational restrictions and associated digital compliance and enforcement • Establish data-sharing agreements with transit agencies and vendors • Require geofencing of certain areas to meet safety, saturation, and sensible deployment objectives • Establish and digitally enforce static or dynamic device caps • Set data-sharing requirements in micromobility operating permit • Ensure that contracted or internal data platforms can ingest, store, and protect sensitive mobility data • Ensure that data can be shared with transit agency partners	• Establish data-access agreements with cities • Communicate agency data needs related to micromobility and establish data use agreements • Partner with cities to geofence transit conflict areas and supply transit facilities with enough micromobility devices while minimizing oversaturating • Ensure that cities can share data with agencies for planning purposes and that this is built into any permit program	●	●	●
App/fare integration	• Require or incentivize sharing real-time vehicle availability in mobility as a service or other multimodal trip-planning applications • Require or incentivize integrated fare payments in coordination with vendors	• Work with cities and providers toward API integration for multimodal trip planning • Work toward digital fare integration in partnership with vendors	●	●	

(continued on next page)

Table 2. (Continued).

Key Policy Areas (Mutual City/Transit Agency Interest)	City DOT Roles	Transit Agency Roles	Transit Agency Interests		
			Enhance Access and Increase Ridership	Support Cities in Managing Network Demand	Inform Service and Infrastructure Decisions and Evaluate Partnerships
Enforcement and compliance	• Establish compliance thresholds and enforcement actions for noncompliance (e.g., reductions in fleet size, fines, permit suspension, or revocation) • Set incentives or penalties for vendor compliance and market entry • Track and respond to improper parking complaints • Audit vendors for compliance with deployment, distribution, customer service/311 responsiveness, and parking requirements	• Coordinate with cities to establish parking and deployment standards at or near transit agency property • Partner with cities to audit and enforce standards • Partner with cities to ensure regulatory penalties for improper micromobility parking or riding at stations and stops	●		
Risk management and insurance	• Require a certain level of insurance from private operators before allowing legal operations	• Partner with cities to ensure that safety risks on transit property are accounted for within city regulations Note: Establishing separate transit-specific insurance requirements for vendors will limit partnership opportunities.	●		

Market incentives	• Set incentives (e.g., fleet cap increases, service area expansion, fee reductions) for meeting or exceeding policy goals • Ensure that regulations are not so onerous that they generate disinterest in a market	• Partner with vendors on station-area operations and policy goals on transit access/connection • With future digital fare integration, there is potential to provide user subsidies for micromobility services as an extension of the transit system	●	●	
Equity	• Ensure equitable distribution of micromobility devices through permit requirements • Require operators to develop low-income and accessible device programs to increase equitable access and reduce cost burden • Partner with operators or community organizations to provide equitable access and educational programs	• Ensure that equitable access programs consider access to and from transit, enhance multimodal connections, and prioritize areas with service gaps • Combine reduced-fare programs with micromobility low-income programs to establish integrated mobility programs	●		
Program funding and revenue	• Set permit fees and fines to cover program administration, system management, enforcement administration, staffing needs, and other needs that meet the fee nexus	• Possibly contribute financial or in-kind resources to cities to better operate and manage micromobility programs	●		
Customer service	• Require a certain level of vendor responsiveness to customer service complaints (e.g., address sidewalk obstructions within 2 hours of customer complaint) • Require 311 integration to automatically route customer service requests to vendors	• Rely on station agents to file complaints for vendor noncompliance on transit property	●	●	

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transit agencies can ensure that these services meet agency and city goals. There are five key areas in which this built-environment coordination takes place:

- Transit access and parking
- Street management and first/last mile
- Demand management
- Data (and its relationship to the built environment)
- Infrastructure funding

The relationship between micromobility and the built environment is changing as the adoption of both docked and dockless micromobility services grows. This section explores the extent to which new micromobility services have increased the need for new infrastructure as well as the different roles for cities and transit agencies in managing the built environment.

This section synthesizes key themes from existing city and transit-agency policy frameworks, pilots, and permitting programs that are contending with the challenges presented for the built environment given the growth of micromobility services. The section is organized around five key areas in which micromobility impacts on the built environment can be seen and is supported with case studies from around the United States, as well as primary sources that include existing bikeshare station siting guidance applicable to dockless micromobility infrastructure design and publicly available information regarding transit agency involvement in micromobility planning and regulation.

Additionally, important insights are sourced from the 2019 Dockless Mobility Summit, which took place in Santa Monica, CA, in October 2019. The summit brought together representatives from 17 cities and institutions across the United States. (The summit included representatives from the following jurisdictions and institutions: Anaheim, CA; Atlanta, GA; Beverly Hills, CA; Culver City, CA; Denver, CO; Detroit, MI; Long Beach, CA; Los Angeles, CA; Minneapolis, MN; Oakland, CA; Portland, OR; San Francisco, CA; San Jose, CA; Santa Monica, CA; Seattle, WA; University of California, Los Angeles; and Washington, D.C.) The summit was convened with the goal of helping cities think through the big questions about dockless mobility and venture-backed mobility models and had a strong focus on experiences and insights from municipal regulatory and right-of-way management efforts.

Built Environment Challenges

The tools to manage the interface between transit and micromobility are in flux. As managers of public rights-of-way, cities are the entities primarily leading the development of pilots and permitting programs for dockless micromobility. Cities have quickly progressed in their approaches in the several years since the major expansion of these services across the United States, but even they are still in a cycle of experiment-evaluate-iterate.

On the other hand, transit agencies are primarily concerned with the operation and management of the transit network and, as such, have been less actively involved in partnering with micromobility companies and have had a limited role in their regulation. This section outlines some of the key challenges that emerge specifically for transit agencies given the state of practice today.

Transit Access and Parking

Transit agencies and cities seek to balance safe and convenient micromobility parking locations without impeding safe and efficient pedestrian movement. Micromobility device parking is also important because transit vehicles have capacity constraints for bicycles and micromobility devices carried inside buses/trains or on vehicle-mounted racks, limiting the

maneuverability of these devices within a transit system and increasing the need for adequate device parking at stops and stations.

Street/Sidewalk Management and First/Last Mile

Transit agencies and local governments are concerned about the design and management of streets and sidewalks given the rise in use of micromobility devices. Cities and transit agencies alike share this concern for ensuring safe rights-of-way for all street users and for people of all abilities. Cities' regulations address specific challenges around sidewalk access management, especially for people with disabilities. Transit agencies also have concerns for ensuring Americans with Disabilities Act (ADA) compliance and safe pedestrian access within stations and stops and along streets feeding into stations, but they may have limited ability to address these concerns on property they do not directly control. Additionally, micromobility devices have the potential to provide first-/last-mile access for individuals using the public transportation system. Agencies can also incentivize and encourage the use of these devices by pursuing policies and partnerships that make the built environment around stations safe and comfortable access points.

Demand Management

Micromobility is a potential demand-management tool in congested areas and a complementary mode for transit systems. For example, some cities' early evaluation reports suggested that shared micromobility was supporting shifts away from car travel (Santa Monica 2019a; PBOT 2019). However, the full potential of shared micromobility to manage demand has not yet been realized due, in part, to existing built-environment factors and a lack of integrated operations.

Data Relationship to the Built Environment

In most cases, cities regulate dockless micromobility services. Cities determine whether to require these services to share data, how the data are structured and shared, and whether the data can be shared with third parties such as their transit agency partners. In order to make informed decisions about micromobility infrastructure and the expansion of equitable access, transit agency staff need data at a fine geographic level on transit customers' use of and reliance on micromobility services.

Infrastructure Funding

The private and public sectors have shared interests in the provision of safe and accessible on- and off-street infrastructure. While some hope the private sector can, on its own, provide a funding source for micromobility network investments or parking provisions, there is a lack of evidence that this approach is feasible or sustainable. Some cities are testing new revenue mechanisms—such as fees per trip, fees per daily vehicle mileage, or varying rates depending on location—but they are aware that private operators need to operate these services profitably in order for them to be sustained, so a balance must be struck (Santa Monica 2019b). However, micromobility companies can support infrastructure investment in other ways besides directly providing financial resources, such as by activating constituencies to advocate for micromobility infrastructure or by organizing pilots and demonstration projects.

Emerging Responses and Findings

Transit Access and Parking

With the increase of micromobility vehicles in and around transit stations and stops, agencies are reacting to specific infrastructure needs such as for parking, locking, and charging. But

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transit agencies and cities are also proactive in coordinating and organizing around designated parking areas and mobility hubs. Agencies have leveraged physical and digital tools to manage the capacity, parking, and infrastructure demands of these services. These tools include:

- Mobility hubs,
- Formal and designated micromobility parking corrals,
- Geofencing technology (i.e., using the mobile app to disallow micromobility operation or parking in specified areas), and
- Fleet and operations management partnerships.

Mobility Hubs. As an organizing concept for all mobility services in a marketplace, mobility hubs provide a natural framework for coordination between cities and transit agencies looking to organize micromobility parking and transit access.

The mobility hub concept is a relatively new framework for mobility coordination at the physical level. For the purposes of this document, a mobility hub is the intentional colocation of two or more publicly accessible travel modes within a public space or facility and complemented by information/services such as wayfinding and placemaking elements to make these options broadly useful and accessible. It can also include digital integration of those travel modes and may feature safe bike and scooter parking and curb space dedicated to shared-ride providers (Feigon et al. 2018). More evaluation is needed to understand the effectiveness of mobility hubs at achieving various goals, which could include mode shift, greenhouse gas reduction, economic and community development, and an improved customer experience.

Mobility hubs have been built at neighborhood to regionally oriented scales in several European cities, including cities in Germany, Austria, Switzerland, and Italy (Feigon et al. 2018). Though the mobility hub concept is still in the early stages in the United States, one international example illustrates the potential effectiveness of the intentional colocation of mobility services: Bremen, Germany's Mobil.Punkt mobility hubs. In 2003, the city started expanding its multimodal coordination strategy and set specific objectives for its mobility hub program, including to remove 6,000 cars from its streets by 2020, to enroll 20,000 people in various carsharing programs, and to reclaim 30 linear kilometers of curbside road space from parking (Hurley 2014). The most important achievement of the program was a reduction in private car ownership. Estimates from the European Union were that the carshare component of the mobility hub program had reduced demand for on-street parking by about 5,000 private vehicles (Team Red 2018). For more recently implemented examples in U.S. cities, including Minneapolis and Los Angeles, outcome data are not yet available, particularly related to transit agencies' interest in micromobility.

The infrastructure needs of micromobility services—and the elements provided by a mobility hub—differ depending on the transit context (e.g., bus stops, light-rail stations, and regional/commuter rail hubs). These parking and access infrastructure needs include:

- Demarcated parking areas or corrals located close to transit services but out of the way of the flow of pedestrian traffic,
- Electric scooter and bike charging facilities (particularly to support hybrid docked/dockless models), and
- Traditional bike racks and other lock-to infrastructure.

Transit agencies have the authority to site and provide this infrastructure on their property, and they work in partnership with cities on access infrastructure around their stations, whether as part of a formal mobility hub or not. As such, transit agencies can play a direct role in determining the seamlessness of the mobility experience and the protection of right-of-way for other transit customers.

Santa Monica's experience demonstrates an example of designated micromobility parking areas in locations across the city, including several near transit. The city designated 107 micromobility parking areas at on- and off-street locations during its dockless mobility pilot. They were intended to provide locations for riders to park micromobility devices without obstructing sidewalks, ADA access, and pedestrian access to transit stations and stops. Additionally, micromobility operators were required to encourage riders to end trips in these designated parking spaces through incentives, such as discounted pricing and monthly raffles for free rides. However, the city's 2019 evaluation found that only 0.08% of rides ended in these designated areas. Santa Monica took the lessons learned from its 2019 pilot to increase the efficacy of designated parking areas with better education, in-app signals, parking incentives/disincentives, and more designated parking spaces (Santa Monica 2019a, 30).

Transit agencies can also form partnerships with jurisdictions to plan, build, and operate a system of mobility hubs. Mobility hubs colocate micromobility and other shared mobility services, community amenities, and electric mobility charging infrastructure, among other features, at rail stations and high-frequency bus stops. In Minneapolis, Metro Transit has collaborated with the city of Minneapolis, Hennepin County, mobility service providers, and neighborhood organizations to pilot a mobility hub program. These mobility hubs are intended to not only enhance first- and last-mile connections, but also to serve as centers of placemaking for residents to gather and learn about new ways to travel in the city (Gray 2019).

Transit Agencies' Shifting Role in Managing Personal and Shared Micromobility Is Supported by Existing Siting Guidance. Transit agencies have actively managed docked bikeshare and personally owned micromobility (e.g., bike lockers, racks, and corrals) storage for decades because of the natural use of these modes for transit access. In cities with high transit ridership, 50% of docked bikeshare users linked their bike and transit trips (NACTO 2016). This study's data explore the linkages between transit and micromobility trips (see Chapter 3), and this has been established by a number of other studies as well. Among dockless systems, the proportion of trips that start or end at transit stations varies, but data suggest a similar linkage. Santa Monica found that 4% of all trips were used to access its Expo Line Downtown station (Santa Monica 2019b), and Denver found that 56% of scooter riders used the scooters to access transit at least occasionally (Denver 2019a). According to Lime's *2018 Year-End Report*, 20% of Lime riders in major urban markets worldwide reported traveling to or from public transit during their most recent trip (Lime 2019).

Given the natural relationship between micromobility (docked, dockless, shared, or personally owned) and transit, much of the existing guidance on how to design physical, designated micromobility parking or docking areas within transit stations still applies. The *NACTO Bike Share Station Siting Guide* (NACTO 2016) collects the best practices from around the United States concerning the siting of bikesharing stations and discusses the different street typologies for siting, such as curbside, parking lanes, sidewalks, and open spaces. According to NACTO's research, bikesharing and transit are linked, and it suggests practitioners site stations as close to transit stations as possible (NACTO 2016). However, high-ridership transit stations and stops are also locations with high volumes of pedestrians, and practitioners should make sure pedestrian access to transit is not degraded.

The Bay Area Rapid Transit (BART) board in the San Francisco Bay area played an active role in the siting of Bay Wheels bikeshare stations at BART stations during a system expansion in 2018. This example illuminates the impact of community input on siting decisions and applies to the management and siting of docked and dockless systems. In meetings, the board balanced input from local community and bicycle advocacy groups about the specific locations of stations. Some community groups view bikesharing as a symbol of gentrification. At its 24th and Mission station, for example, the BART board directed staff to locate a bikeshare station

at a nearby library instead of directly in a plaza due to gentrification concerns raised by local advocates (Rudick 2019).

The guidance for the siting of station-based bikeshare discussed in the *NACTO Bike Share Station Siting Guide* can also be applicable when thinking about both protecting and enhancing pedestrian right-of-way for the siting of designated areas for dockless micromobility devices. Best practice when placing a bikeshare station on a sidewalk is to leave at least 6 feet of clearance for the pedestrian right-of-way, with more recommended at locations with high pedestrian volumes. The same clearance rules should apply to designated dockless device parking areas; when 6 feet of clearance isn't possible, on-street configurations should be considered. Bikeshare station siting can also help enhance the pedestrian realm by operating as traffic calming tools and increasing pedestrian visibility at intersections (NACTO 2016). However, designated dockless micromobility parking areas usually do not have the same large, fixed elements (e.g., advertisement boards, information and payment kiosks) as bikeshare stations, so additional permanent and highly visible elements could be considered to help those areas reach the same traffic calming potential. In fact, in some cities, such as Austin (Bliss 2019a); Washington, D.C. (Lazo 2019); Arlington, VA (Bliss 2019a); Tampa (De Jesus 2019); and Ann Arbor (Afana 2019), micromobility docking stations for otherwise dockless services are already being tested.

Cities and Transit Agencies Are Starting to Coordinate on Access and Parking Policies Unique to Dockless Models. Instead of developing their own permitting programs and policies, transit agencies can partner with local jurisdictions and co-develop mutually beneficial permit conditions that incentivize rebalancing (the regular redistribution of vehicles to areas preferred by the agency) and operational excellence in exchange for vendor bonuses.

Important vendor incentives include performance-based fleet cap increases and relaxed permit fees. The regulating jurisdiction or agency initially sets a cap on the number of vehicles a vendor can operate, but that cap can increase if the vendor exhibits desired behavior such as distributing vehicles in underserved communities or providing parking locations.

For example, Oklahoma City's EMBARK (formerly Metro Transit) partnered with the city of Oklahoma City (Oklahoma City 2018); both were seeking to increase first- and last-mile connections to transit by offering micromobility operators incentives related to fleet size and agency property parking space. Operators can apply for higher fleet caps if they work with the transit agency to provide vehicle parking locations (including some form of physical parking zone or digital geofence restricting parking to specific areas) and ensure that pedestrian and bicycle access to stations is not impeded. Increases in fleet size are approved jointly by the city and the transit agency (Brus 2019).

Los Angeles County Metropolitan Transportation Authority (LA Metro) plans to go one step further in its micromobility vehicles pilot program for vehicles parked or operated on its property. In July 2019, LA Metro adopted a 2-year micromobility vehicle pilot program, with the goals of ensuring safe access for transit patrons in and around stations, developing an organized micromobility parking system, and providing equitable access to micromobility vehicles. Through the program's license agreements, LA Metro requires that participating micromobility operators be approved to operate in the local jurisdiction where a given LA Metro property is located and pay a fee per parking space on agency property prior to any deployments or vehicle storage on LA Metro property, parking facilities, or right-of-way. Vehicles must be parked upright in designated parking zones, and any incorrectly parked vehicles must be addressed within 2 hours. ADA violations (parking in ADA spaces or blocking access to them) are strictly prohibited (LA Metro 2019a). Though it was adopted by the board in July 2019, as of spring 2020 the program had yet to be launched; it is unclear whether micromobility operators will participate in the program to gain a competitive advantage or if customer parking and operator deployment will spill over onto city right-of-way.

Some agencies are going beyond regulatory approaches and directly partnering with micromobility operators. The Greater Dayton Regional Transit Authority (RTA) partnered with e-scooter sharing operator Spin to provide service in the city, building on an earlier docked bikeshare partnership with similar parameters. This partnership and the process leading to it are described at greater length later in the report.

A partnership negotiated between Big Blue Bus, the city of Santa Monica, and Lyft includes geofencing prohibited areas (i.e., using the app to disallow micromobility vehicle parking in certain areas) and targeted rebalancing around transit stations. Lyft offers a dollar discount to users who park in a designated "Transit Zone" (Lyft 2018).

Transit agencies are wary of crowding and liability associated with bringing micromobility devices on board transit vehicles. Shared micromobility, which is regulated and permitted by transit agencies' municipal partners, can alleviate some of that pressure. While transit agencies such as BART and Caltrain promote shared dockless micromobility as an enhancement to first- and last-mile connectivity, the vehicles themselves are for the most part forbidden from platforms and trains (Skinny Labs/Spin 2020). Personal bikes and (folded) scooters are allowed on Caltrain cars in limited numbers; BART allows access at all times except for in the first car, but peak-hour trips often do not have capacity for micromobility devices on trains (Caltrain 2019a; BART 2019).

Street/Sidewalk Management and the First/Last Mile

Transit agencies, which have traditionally focused on providing reliable bus and rail services, are increasingly positioning themselves as mobility agencies. Agencies' newfound focus on bridging travel needs with mobility choices resulted in a vested interest in supporting and encouraging multimodal access to stations and stops. In fulfilling this role, transit agencies need to coordinate with their city partners on built-environment investments outside agency property.

Together, cities and transit agencies are responsible for the safe, convenient, and comfortable multimodal movement of people. The rapid growth of dockless micromobility services, coupled with the new ways these services interact with the built environment, heighten the need for city/transit agency coordination. Transit agencies concerned with how riders access transit have had to react to an increase in infrastructure needs related to micromobility services (such as more bike lanes and protected infrastructure). Similarly, agencies are grappling with conflicts between transit vehicles, boarding and alighting passengers, and parked/in use micromobility vehicles.

Cities' Requirements for the Equitable Distribution of Micromobility Devices Illuminate Gaps in Protected On-Street Infrastructure and Cities' Overall Accessibility. Transit Agencies Can Be Partners in Addressing These Inequalities. Though it does not identify specific cases of cities investing new or expanded protected bike lanes resulting from the growth of shared micromobility services, Transportation for America's *Shared Micromobility Playbook* recommends the following (Transportation for America 2019):

> Cities should be clear with companies and users about where these vehicles should be operated. As most active transportation and micromobility riders are vulnerable road users, it will be important to designate safe spaces for their operations. Cities will also need to check that their choices aren't in conflict with their state's law governing these vehicle types.
>
> The rapid popularity and proliferation of micromobility services offers cities an opportunity to dedicate greater lane space and create protected spaces for micromobility and active transportation users. Cities should strive to open as many spaces as reasonably possible to micromobility and create a consistent culture for where and how these vehicles may be operated.

Cities are regulating shared dockless scooters and bicycles to advance racial and social equity outcomes, but those efforts are not always coordinated with infrastructure planning and

implementation. Washington, D.C., requires every company to deploy at least 400 dockless vehicles (approximately 52% of the total fleet) in "Equity Emphasis Areas" (DDOT 2019a and 2019b; Metropolitan Washington Council of Governments 2019). Similarly, Chicago's 2019 shared-scooter pilot required that half of each operator's fleet be deployed daily across two "Equity Priority Areas" on the city's historically disinvested West Side (Chicago 2019a). However, compliance with these policies has underscored the lack of safe on-street infrastructure such as bike lanes in these areas. D.C.'s Wards 7 and 8 lack designated bicycle lanes due to historic disinvestment, and protected infrastructure on Chicago's West Side mainly provides access between the area and downtown rather than strong connections between neighborhoods within it. An expansion of safe infrastructure to accompany these new services is vital because expansion of shared micromobility services in these areas will inevitably lead to more clashes on sidewalks with pedestrians or on streets with motor vehicles if there is a lack of safe infrastructure dedicated to bikes and micromobility (Su and Wang 2019).

Transit agencies' interests in first-/last-mile connectivity make them cities' natural partners in finding opportunities to increase the provision of on-street micromobility infrastructure. Transit agencies can support equitable access by facilitating micromobility access around stations and stops in underserved communities. However, there are other barriers to equitable access to micromobility beyond just geographic distribution and infrastructure. Seattle's 2018 bikeshare evaluation report identified barriers such as technological access, banking, affordability, knowledge of micromobility services and their potential benefits, and helmet access [Seattle Department of Transportation (SDOT) 2018].

Demand Management

Micromobility has the potential to help cities and transit agencies manage demand if the built environment supports its safe and convenient operation. Cities and transit agencies alike have a responsibility to manage demand across the mobility system to advance environmental, economic, and equity outcomes. Jurisdictions and agencies generally agree that dockless micromobility has the potential to meet climate-change goals by reducing greenhouse gas emissions, extending the reach of transit and providing first- and last-mile connections, mitigating transit congestion and core capacity issues, and reducing car reliance in low-density areas or late at night when many agencies provide limited or no service.

Dockless Micromobility Can Extend the Reach of Transit. Some transit agencies see micromobility services as part of their mandate to enhance local and regional mobility. To that end, transit agencies are developing and managing micromobility programs or directly partnering with private micromobility operators to achieve transit access and coverage objectives.

In partnership with the Sonoma County Transportation Authority (SCTA) and the Transportation Authority of Marin (TAM), Marin County's Sonoma–Marin Area Rail Transit (SMART) plans to become the focal point of a new bikeshare system. An $800,000 pilot received funding through the regional metropolitan planning organization (MPO), the Metropolitan Transportation Commission (MTC). In February 2020, SCTA and TAM approved a multiyear pilot with Gotcha Mobility to provide a hybrid (docked/dockless) shared e-bike system. Riders will also be able to link their bikeshare accounts to the Bay Area's Clipper Card system, which SMART uses for fare collection (Fixler 2020). The system will provide bicycles at SMART train stations and key destinations along the rail corridor. The goals are "to increase access to transit, promote active transportation and provide a direct first and last mile to SMART, and give people another option for travel in Marin County" (Prado 2018). As a pilot, the program will be evaluated for the possibility of future expansion (Fixler 2019).

Caltrain, also in the San Francisco Bay Area, was, at the time of writing, planning for micromobility and considering how it could be leveraged for first-/last-mile transit access. Caltrain

is one of the leading carriers of bicycles on board trains in the United States, and its onboard carrying capacity is filled almost daily. In 2019, Caltrain began work on the "Caltrain Bike Parking and Micromobility Analysis and Implementation Plan" (Caltrain 2019b). The plan includes:

- A comprehensive policy about the quantity and type of bicycle parking and shared micromobility options to provide at stations over time;
- Station-specific designs and implementation plans for additional secure bicycle parking at stations; and
- Analysis, coordination, and recommendations for the rollout of bikeshare and potentially other shared micromobility devices along the Caltrain corridor.

This plan will provide crucial direction for an investment of $3.5 million in micromobility infrastructure in advance of Caltrain's electrified train service in 2022, which is expected to generate significant new ridership. It will also set the framework for additional capital investments and grant funding in first-/last-mile infrastructure in the future (Caltrain 2019b).

Dockless Micromobility Reduces Car Reliance and Alleviates Core Capacity Issues. Nearly every dockless micromobility pilot has found that shared electric scooters and bikes reduced car use. In 2019, Santa Monica found that 49% of dockless micromobility trips replaced drive-alone/other car (e.g., taxi or ride-hail) trips (Santa Monica 2019b). Portland reported in 2018 that 34% of Portland residents, and 48% of visitors, used a shared e-scooter instead of driving a personal car or using a taxi or ride-hailing service (PBOT 2019), and a 2019 Denver survey found that 32% of e-scooter trips replaced some kind of automobile trip (Denver 2019a). This is true among docked systems as well: one study found that about half of all (docked) bikesharing members reduced their auto and taxi reliance (Shaheen and Cohen 2019).

Dockless micromobility also has the potential to alleviate crowding on some of the most congested parts of a transit system and at certain high-use times of day. Santa Monica found that 4% of users shifted away from transit trips to scooter trips (Santa Monica 2019b), although the data are not detailed enough to demonstrate from which routes or times of day people switched. It is clear that dockless micromobility displaces automobile trips to some degree whenever it is made available, and the development of these services can be encouraged to achieve the greenhouse-gas or congestion-reduction goals of cities and transit agencies.

Data and the Built Environment

At a time where mobility data are increasingly managed as a core infrastructure asset, cities and transit agencies are increasing their role in data collection, management, and distribution. Two widely used mobility data standards, the GBFS and the MDS, provide standardized data definitions and methods for sharing data between cities, vendors, and transit agencies. These standards were described in the Data-Sharing Requirements and Standards/Specifications section earlier in this chapter and are further explored in Appendix B: Digital Policy and Compliance.

Data Partnerships Enable Cities and Transit Agencies to Manage Micromobility Parking and Access at and near Transit. Shared dockless micromobility has the same basic opportunities and constraints of docked and personal micromobility access at transit stations. However, what has changed is the scale and speed of growth of these services, which creates an urgent challenge for cities and transit agencies. If managed, these systems could support access and parking investments at transit stations and stops.

Transit agencies' management of dockless micromobility must be firmly rooted in access planning best practices [as exemplified by planning/design guidelines such as the BART *Multimodal Access Design Guidelines* (BART 2017) and *Denver Moves: Transit* (Denver 2019b), both discussed in the Infrastructure Funding section that follows] and supported by new digital

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management tools that empower cities and transit agencies to better understand their riders' movement across the system, control where companies deploy micromobility devices, and manage where riders park them. These digital management objectives are enabled by the development of the MDS, which was pioneered by LADOT and is now managed by the OMF. MDS defines a set of connections between computers (APIs) that standardize two-way communication between cities, transit agencies, and private companies. This allows mobility providers and mobility managers to share operational and digital policy information.

Some cities analyze, visualize, and report shared micromobility trip and operation data from MDS feeds using in-house tools, while others contract this work out to third parties that specialize in ingesting, auditing, processing, and securing mobility data. However, in both cases the capacity to collect, analyze, and interpret the large amount of data produced by dockless micromobility systems varies among jurisdictions and is dependent on the data-sharing requirements imposed on the private operators (Santa Monica 2019b).

LADOT has also developed a geofenced "Special Operating Zone" in the Venice neighborhood to solve problems related to deployment oversaturation, conflicts with pedestrians on the Venice Boardwalk, and user parking issues. The Special Operating Zone factors in new digital tools, such as no-ride and exclusion zones, throttle zones (vehicles entering an excluded area are automatically slowed to a stop), and enhanced compliance and enforcement auditing. Other cities, like Santa Monica and San Antonio, established similar geofencing tools for non-transit use cases. In each of these cases, the cities use trip and operations data to track provider performance and compliance at geofenced locations (Sharp 2019).

Trip-level data provided to permitting entities can also be used to identify specific routes with high-volume micromobility use. Third-party data tools, such as Populus' Mobility Manager (https://www.populus.ai/solutions/mobility-manager), Remix's Shared Mobility platform (https://www.remix.com/solutions/streets-shared-mobility), and Ride Report's data tools (https://www.ridereport.com/), can be used to aggregate and visualize path-of-travel data for shared micromobility services (Clewlow 2019b). When compared with other information such as that from a high-injury network or key transit access corridors, these path-of-travel data can help identify near-term capital investments, such as for protected bike lanes, bike racks, and dockless parking areas.

Shared Micromobility Data Illuminate Inequitable Distribution of Resources and Inform Infrastructure Investment Priorities. Use of shared micromobility data can help identify areas that are underserved or oversaturated. Agencies and cities can use these data to not only ensure equitable deployment but also to develop future micromobility infrastructure in the areas of most need. This is particularly important because, without intervention, dockless systems potentially exacerbate existing mobility and access inequalities. For example, the city of Detroit found that micromobility operators concentrated their services in affluent areas, leaving traditionally underserved communities with service gaps in the new services (Santa Monica 2019b).

At the time of writing, LA Metro was developing an equity platform for micromobility policies and was planning to use data to develop recommendations for the improvement of disadvantaged communities' access to micromobility vehicles. Staff planned to monitor metro stations in disadvantaged communities to determine if they were underserved by shared micromobility operators (LA Metro 2019a).

SDOT also used micromobility data to understand the equity implications of its dockless bikeshare program. Its initial pilot in 2018 required that at least 20% of the areas in which dockless bikeshare operated be Tier 1 equity areas, which were defined as places with low access to opportunity and high risk for displacement. In its 2018 bikeshare evaluation, SDOT used data provided by operators to monitor operations, finding that while ridership was highest in

the center city, the entire city was covered by bikeshare supply. However, the city's most disadvantaged neighborhoods saw low ridership, suggesting that providing an option does equate to access, nor does it overcome barriers to use in underserved neighborhoods (SDOT 2018; Cohen 2018).

Infrastructure Funding

The Public and Private Sectors Both Have an Interest in Supporting Infrastructure Needs. The basic tenets of bicycle infrastructure design—that the infrastructure should provide safe and comfortable places to bike—also apply in a world with expanded access to dockless bicycles, scooters, and other micromobility services. With the growing popularity of these services, cities seek to expand the number of bike lane miles, the width of bike lanes, and lane-adjacent spaces for parking and pedestrian throughways.

According to responses from the Santa Monica Dockless Mobility Summit (Santa Monica 2019b), some jurisdictions are contending with an increase in demand for micromobility infrastructure such as bicycle or micromobility lanes, bicycle racks, and parking areas to accommodate scooters. Guidance and plans established before the proliferation of dockless micromobility models, such as BART's *Multimodal Access Design Guidelines* (BART 2017) and Denver's *Denver Moves: Transit* (Denver 2019b), acknowledge that transit agencies share an interest in improving access to stations and stops through new infrastructure investments.

Micromobility companies' growth and sustainability also rely on the provision of safe, comfortable, and ubiquitous on- and off-street infrastructure. However, despite some of the companies' early attempts to fund protected lane expansion, their business models do not support the funding of major infrastructure investments (Schmitt 2019). While the primary funding source for parking and on-street infrastructure is the public sector, mobility service providers can support expansion through:

- Advocacy, community organizing, and promotion of customers' stories and demand for better infrastructure;
- Public messaging campaigns;
- Demonstration projects and tactical bikeway and parking installations; and
- Limited funding to support the introduction and management of the new service model.

CHAPTER 3

Micromobility Users and Utilization

This chapter discusses a variety of characteristics of micromobility users, as well as the nature of micromobility's use in a variety of urban environments (including large and small metro areas), with an emphasis on understanding micromobility's interaction with public transit systems. The analysis utilizes two datasets gathered by Populus Technologies, Inc. (one of the author organizations).

First, to understand user characteristics and contrast them with those of non-users, this analysis incorporates Populus Groundtruth data collected through regional surveys. Conducted in 2019 in 18 metropolitan areas with representative sampling, these surveys assess transportation choices. Akin to regional travel surveys typically conducted once a decade, this opt-in data-gathering effort captures basic demographic data, household characteristics, vehicle ownership, and key transportation decisions, including the adoption and use of new mobility services. Here, the focus is on a subset of the data related to micromobility adoption, comparing micromobility users and non-users.

Second, to illuminate patterns of micromobility usage in space and time, Populus has also leveraged relationships with cities and operators to use select micromobility vehicle and trip data from docked and dockless systems, both to observe how the introduction of dockless micromobility may have changed docked system use and to evaluate dockless micromobility use around transit stops. More information on the methodology behind these two data sources is provided in Appendix A. The research team acquired permission from several cities and operators to share the data included in this report.

Grouping of Metro Areas by Density and Transit Use

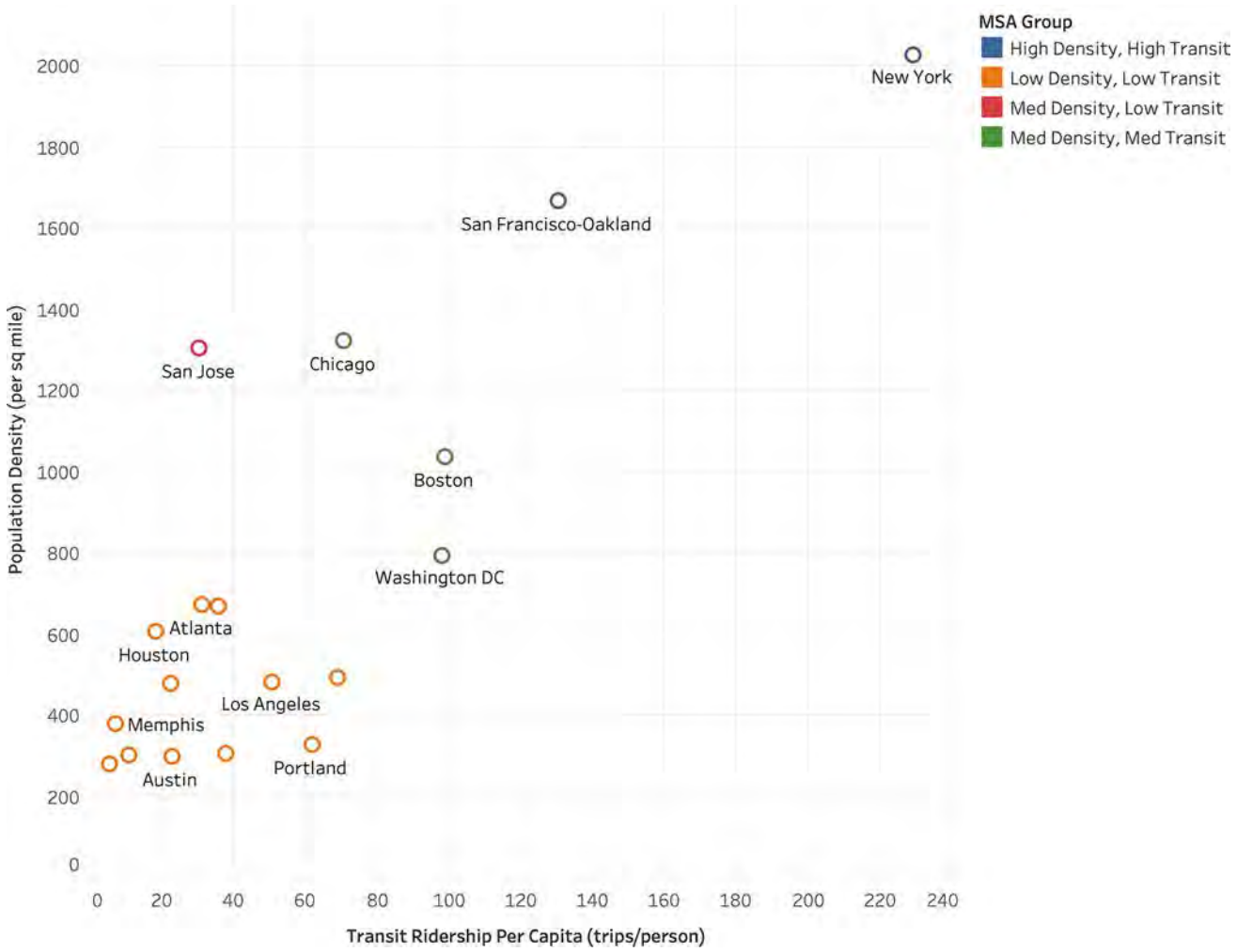
Populus' 2019 Groundtruth survey resulted in over 15,000 responses across 18 metro areas. To identify common patterns across different metro area types, the researchers grouped the regions into subsets with common population and transit characteristics, using population, population density, housing unit density, gross domestic product (GDP) per capita, and transit ridership per capita. Survey responses are presented according to these groupings throughout this study.

Figure 14 displays the metro groupings in terms of population density (persons per square mile) and transit use (unlinked passenger trips per capita).

User Characteristics

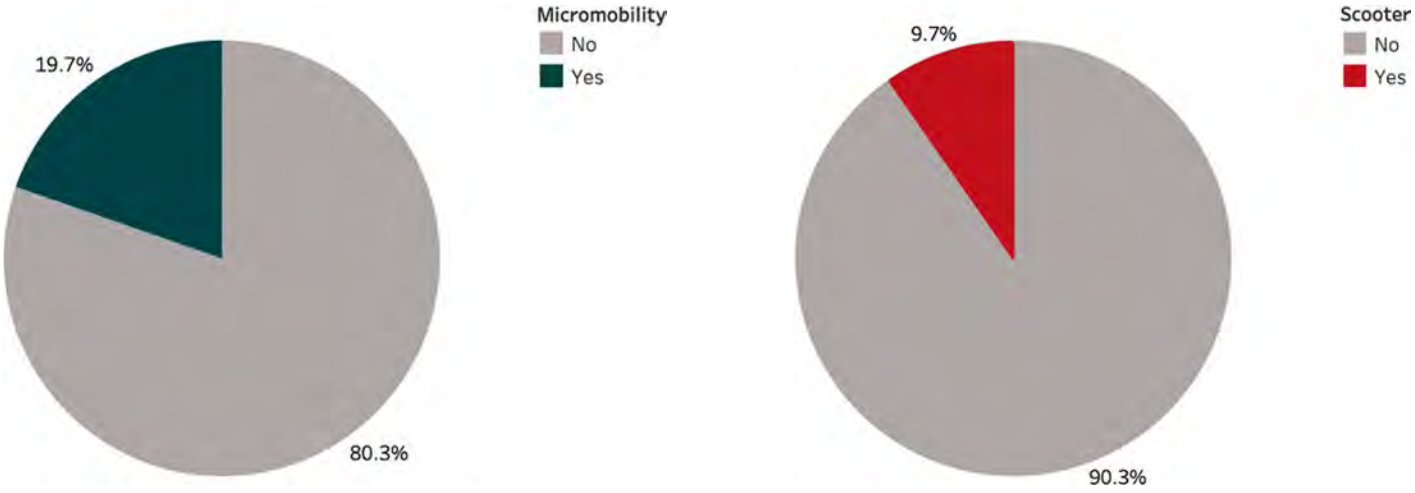
Micromobility Adoption Rates

Among survey respondents, nearly 20% had some experience using a shared bike or scooter (together considered "micromobility adoption"), as shown in Figure 15. About half as many had used a shared scooter alone.



Notes: Only two of five factors used in the clustering are shown in the figure. MSA = metropolitan statistical area.

Figure 14. Result of metro grouping analysis (top) and location map (bottom).



Source: Populus Groundtruth survey 2019.

Figure 15. Micromobility (shared bikes and scooters) adoption (left); adoption of scooters alone (right). Note: "Yes" indicates the respondent had ridden a shared bike or scooter before.

Higher Scooter Adoption Rates Are Associated with Lower Levels of Regulation

Among the cities where scooters were available at the time of the survey, most had scooter adoption percentages near the 10% range, with San Jose, San Diego, and Austin having significantly higher rates (Figure 16). This is likely explained in part by the lightly regulated nature of scooters in those cities. While many cities restrict the number of vehicles that can be deployed, the cities with significantly higher adoption rates had higher fleet caps (or none at all) at the time of the survey.

This pattern is also visible in micromobility users as a whole (Figure 16a). The New York City, Chicago, Boston (except Brookline), Seattle, and Houston metros did not permit, or severely restricted, shared scooters at the time of surveying, but several of them had docked bikeshare systems. This is reflected in the much lower scooter adoption rates in these metros compared with their micromobility adoption overall (with the scooter figures in those cities likely reflecting experience with shared scooters in other markets).

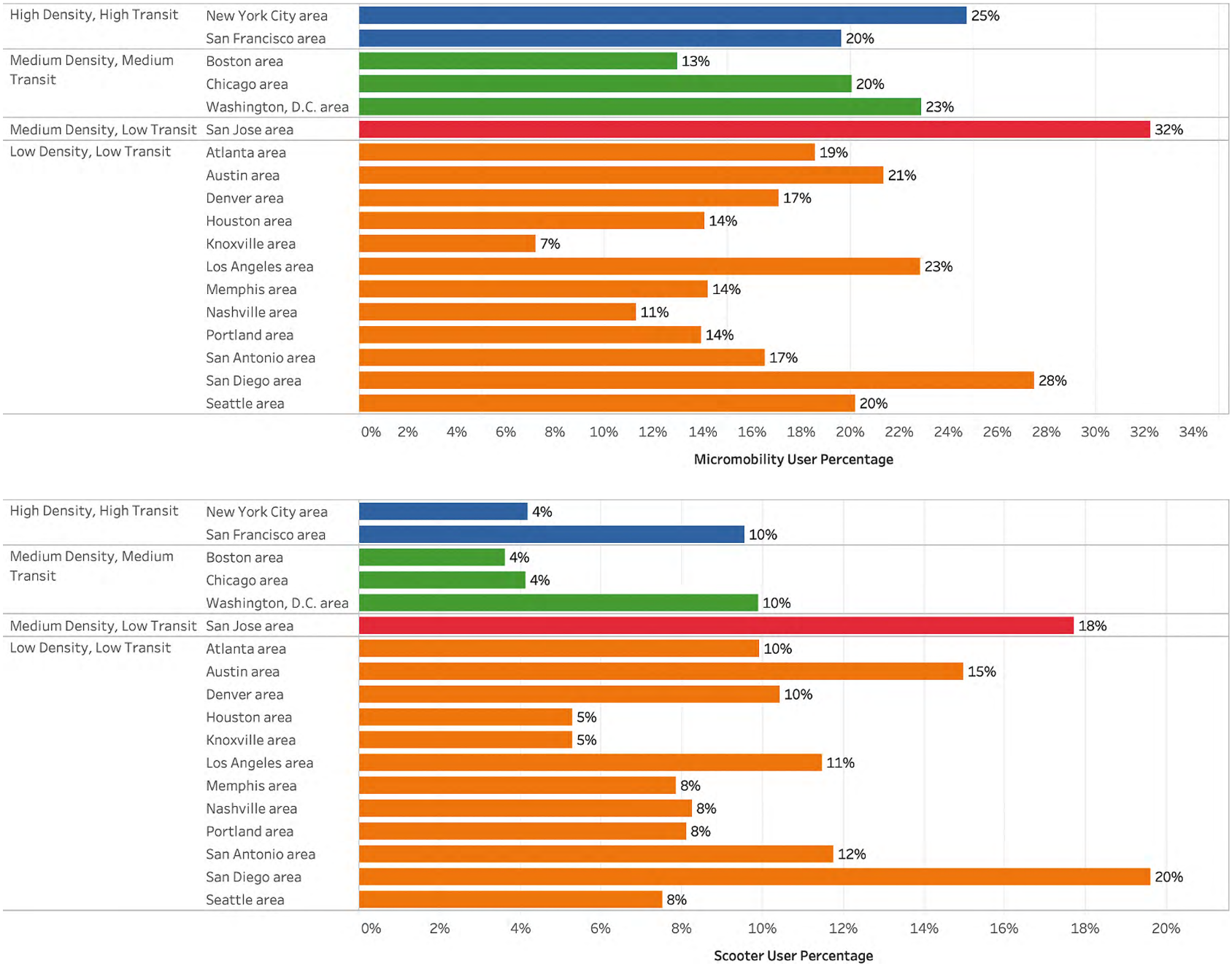
Demographics

Age

Scooter Adopters Tend to Be Younger Than the Typical Residents of Their Metros, with Peak Use in Those Under 35 and Few Users Above Age 55. The average respondent age was 43, while the average age of scooter adopters was 31 years old. Figure 17 shows the age distribution of respondents. In general, scooter users and micromobility users tended to be younger than non-users. The greatest micromobility use was among people under 35, with usage tapering off in older cohorts. Only a few users of scooters or micromobility generally were age 55 or older.

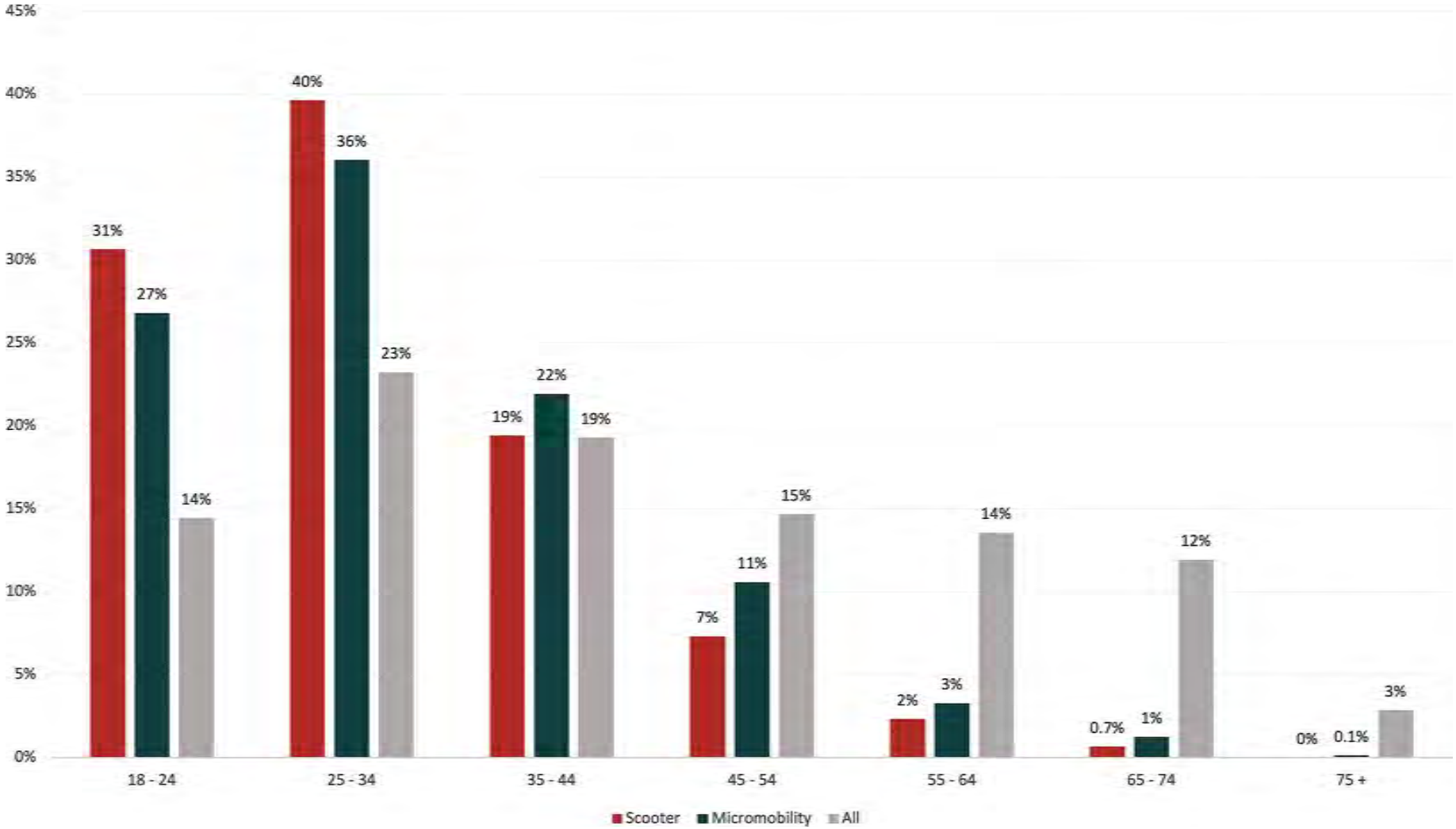
Gender

Micromobility Users Were Split About Evenly Between Males and Females, in Contrast to Scooters Alone, in Which Females Were Overrepresented. Similar to previous studies (Clewlow 2019a), the survey shows a gender gap between how people have adopted micromobility



Source: Populus Groundtruth survey 2019. Note: Some bar lengths vary from percentages due to rounding.

Figure 16. Micromobility adoption by metro area (a, top); scooter-only adoption by metro area (b, bottom).



Source: Populus Groundtruth survey 2019. Note: Some bar lengths vary from percentages due to rounding.

Figure 17. Age distribution for scooter-only users (red), all micromobility users (green), and all respondents (gray) across all metro areas.

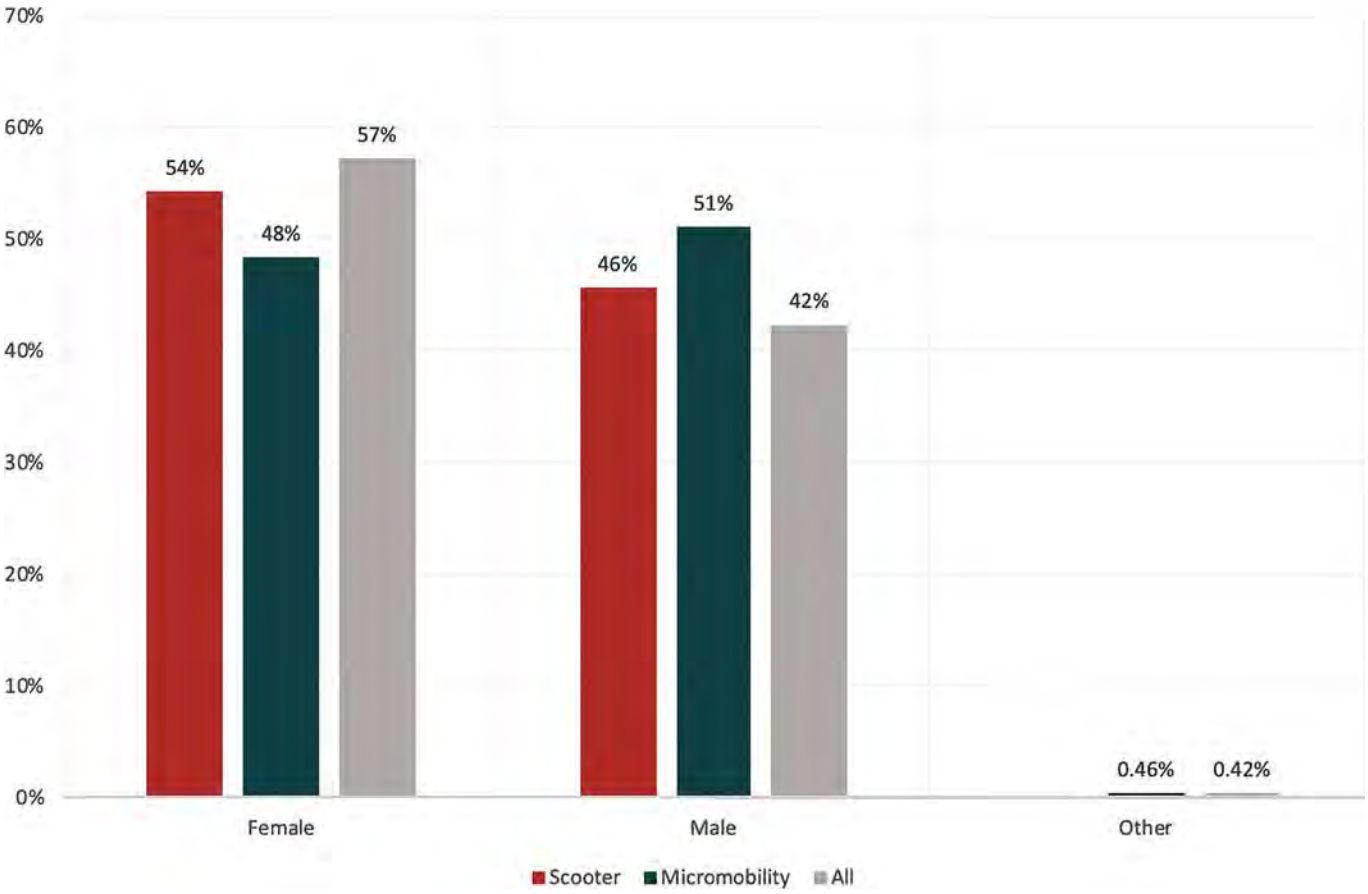
generally versus scooters alone (Figure 18). Combining bikeshare and scooter services, 48% of users identify as female versus 51% as male. The gender gap for scooter-only adoption is the inverse, favoring women, and slightly larger, with 54% of users identifying as female and 46% as male.

Race and Ethnicity

More Non-White People Were Users of Micromobility and Scooters. The rates of micromobility and scooter use by race and ethnicity differed from those for the overall population of respondents (Figure 19). A smaller proportion of both groups was white (42% to 43% versus 52% among all respondents), with Hispanic and Asian people seeing greater representation among both micromobility generally and scooter-only users. The data do not suggest a significant difference in micromobility or scooter adoption by Black people.

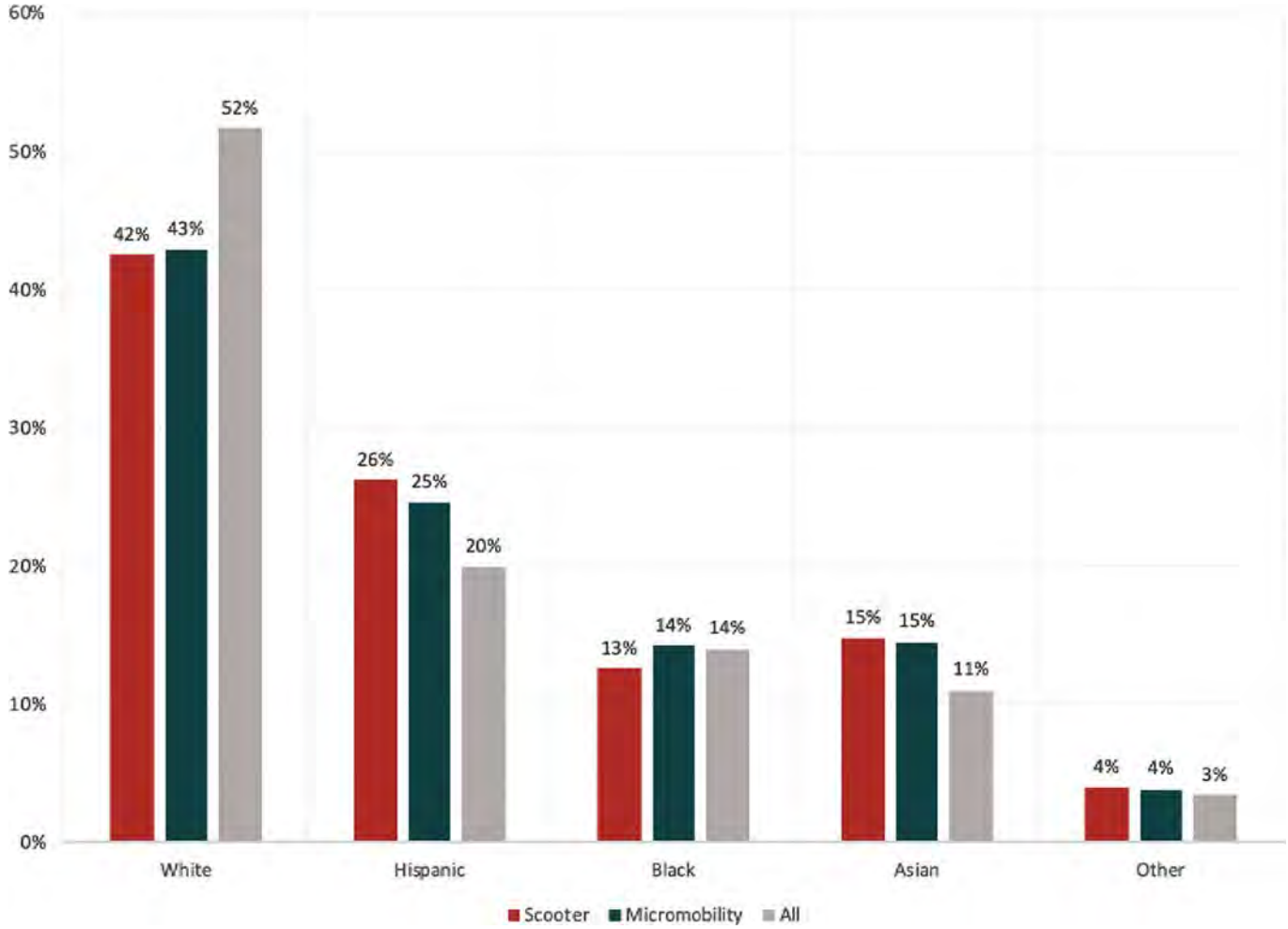
Income

People of all Income Levels Used Scooters and Micromobility, with Only a Small Variation from the General Population Across Income Levels. Adoption rates did rise with income to some degree, with the highest income brackets somewhat overrepresented among scooter and micromobility users (Figure 20). Compared to micromobility generally, in which higher income brackets contained somewhat more users, scooter use appears to be more equitably distributed. For all groups, the most users came from households in the middle of the income spectrum



Source: Populus Groundtruth survey 2019.

Figure 18. Gender distribution for scooter-only users (red), all micromobility users (green), and all respondents (gray) across all metro areas.



Source: Populus Groundtruth survey 2019. Note: Some bar lengths vary from percentages due to rounding.

Figure 19. Race and ethnicity distribution for scooter-only users (red), all micromobility users (green), and all respondents (gray) across all metro areas.

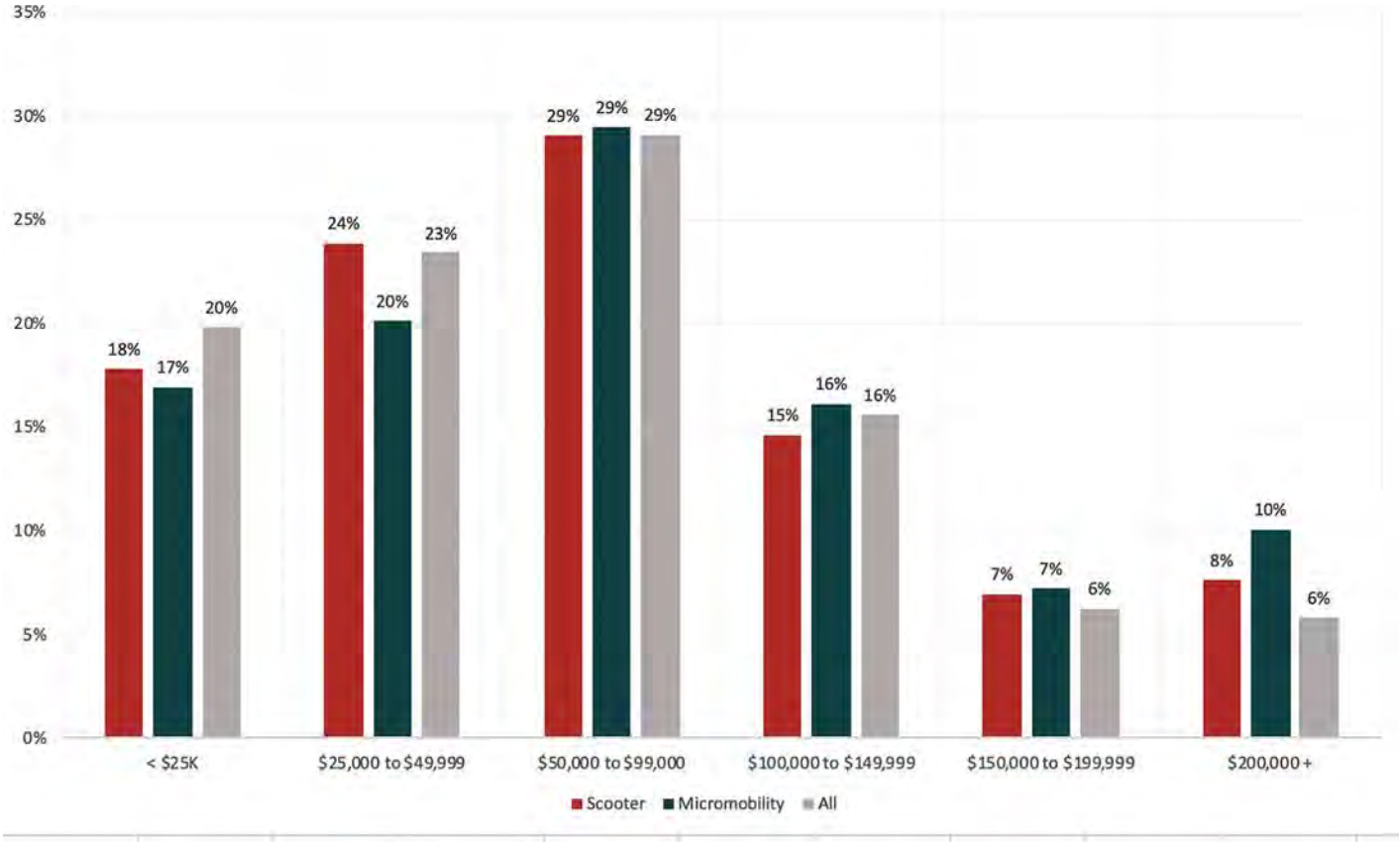
($50,000 to $99,000). Some 42% of scooter users had an annual household income under $50,000, about the same as the general population, compared to 37% for micromobility generally.

Use of Other Transportation

To better understand how shared mobility options fit into broader travel decisions, Populus' regional travel surveys gather data on traditional transportation behavior, including commute mode, vehicle ownership, and mode shift. This section presents analysis based on data gathered in 2019, with a focus on assessing how scooter adoption fits into broader travel decisions.

Commute Mode

Scooter Users Were Less Likely to Have Solo Car Commutes and More Likely to Use Ride Hailing, but Use of Transit and Carpools Varied by Region. Scooter users made different commute choices than the general population, with slightly lower rates of solo driving and notably higher rates of ride-hail commuting (double or more) across all metro types, suggesting



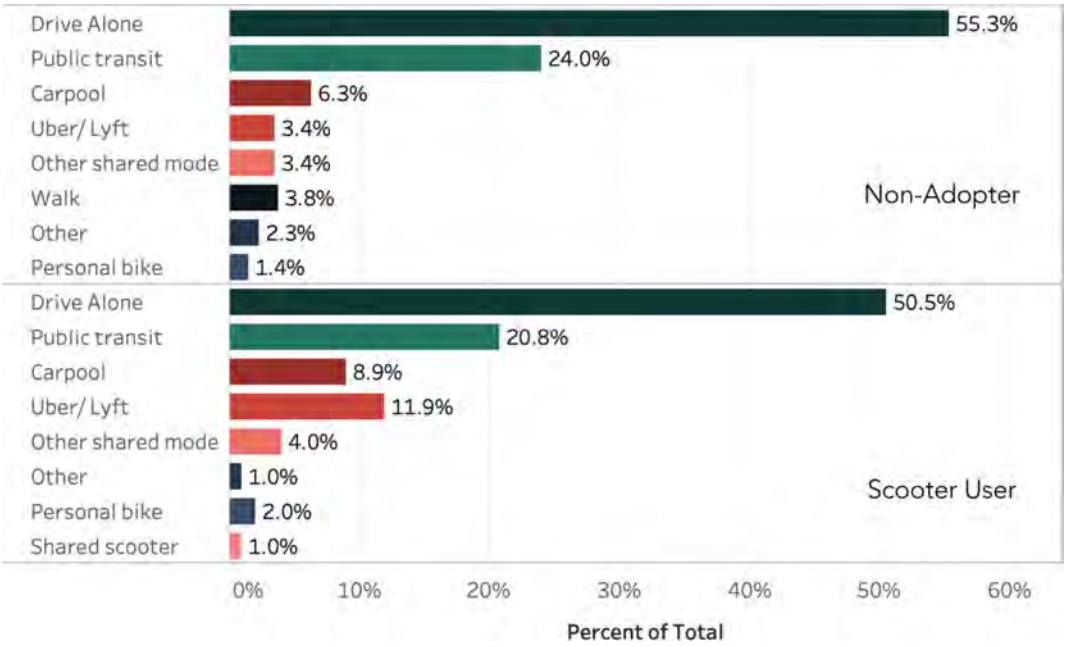
Source: Populus Groundtruth 2019. Note: Some bar lengths vary from percentages due to rounding.

Figure 20. Household income distribution of scooter users (red), all micromobility users, (green) and all respondents (gray).

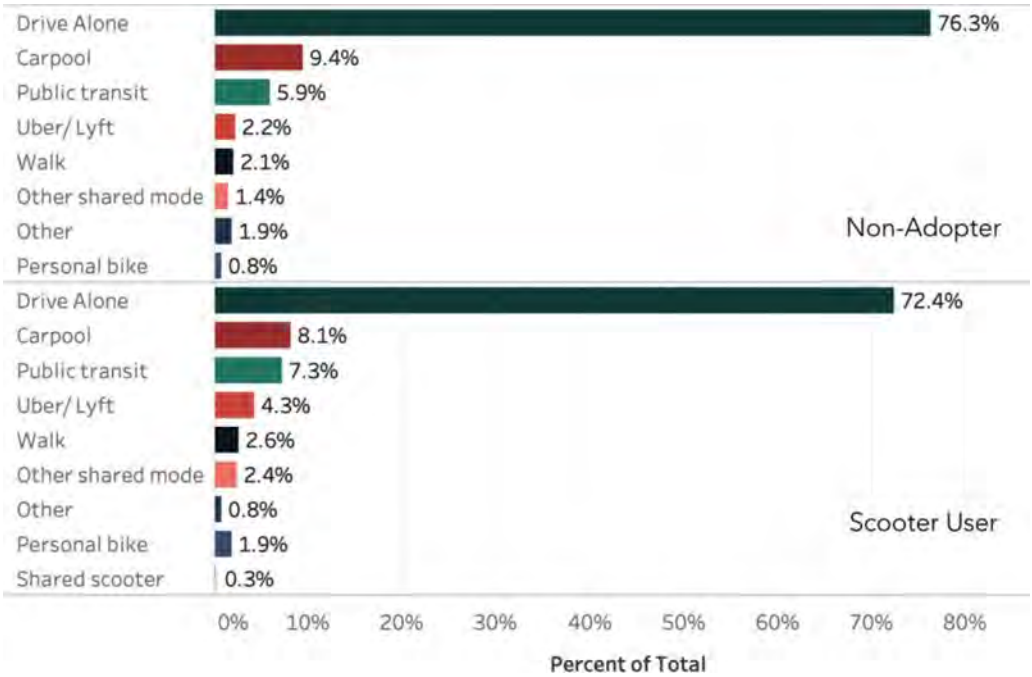
that they are people who are already comfortable with using shared mobility. In the high-transit-use metros (Figure 21a), scooter users commuted by transit at lower rates, and carpooled at higher rates, than the general population. The inverse was true of the low-transit-use metros (Figure 21b): scooter users were somewhat more likely to be transit commuters, and less likely to carpool.

Given that the average scooter trip is approximately 1 mile, commutes by scooter (assessed only among scooter adopters) represent only a fraction of respondents' primary commute mode. That being said, this figure reached 1% in the high-transit-use metro areas (Figure 21a), which is surprisingly large given that scooters are a new entrant to the transportation mix and that commuting by bike even in higher-use cities is below 3%. Given that a substantial proportion of frequent scooter users said that their last scooter trip was for commuting, a number of first-/last-mile trips may not be being picked up by a question focused on a single commute mode.

Commuting patterns more generally appear to be mostly driven by urban context. Survey respondents in the medium- and high-transit-use metro areas had the highest share of public transit use for commuting (15% and 24%, respectively) and the lowest shares of driving alone (64% and 55%), regardless of scooter use. Both low-transit-use metro groups were dominated by solo driving as the primary commute mode (74% to 76%), with only 6% of the population relying on public transit. (Note that medium-density, medium-transit and medium-density, low-transit metros are not shown in the figure.)



(a). Commute mode for high-density, high-transit-use metro areas for all respondents (top) and scooter users (bottom).



(b). Commute mode for low-density, low-transit-use metro areas for all respondents (top) and scooter users (bottom).

Source: Populus Groundtruth survey 2019.

Figure 21. Respondent commute modes.

Note that these figures simply describe the differences in the commuting habits of scooter adopters compared with non-adopters across metro types; they do not represent causal relationships or tell us anything about non-commute trips.

Household Vehicle Ownership

Scooter Users Live in Households with More Cars Than Non-Adopters Do. Across all user groups and metro types, respondents were consistently most likely to live in one- or two-vehicle households (Figure 22). But scooter users had a larger share of households with three or more vehicles than the general population—consistent with scooter users tending to have higher incomes, but also possibly pointing to younger people living in group households with several roommates. Given that many scooter users have multiple household vehicles, there may be greater opportunity for personal vehicle shedding due to increased micromobility options.

How and Why People Use Scooters

The Populus Groundtruth survey also asked scooter users how frequently they rode shared scooters, as well as safety-related questions and how scooters fit into their overall transportation mix. This section highlights several key findings based on those questions; the findings are broken out by the metro clusters described previously. Results are weighted by frequency of scooter use; the weighting method is described in Appendix A.

Trip Purpose: People Use Scooters for a Variety of Reasons

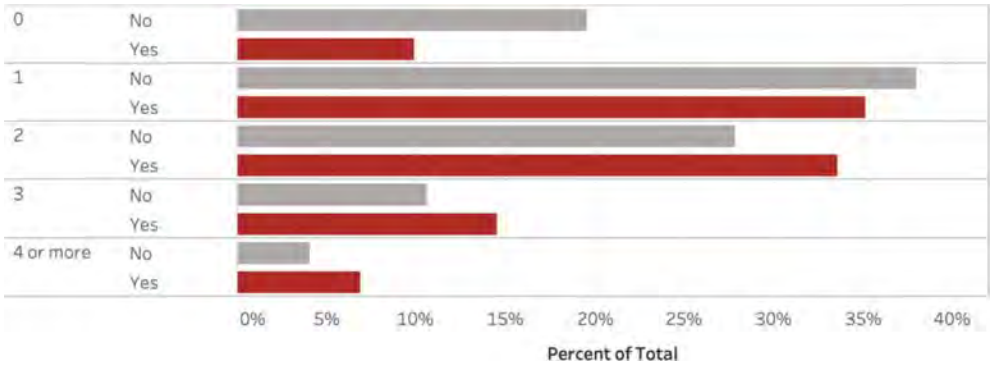
Commuting in the More-Dense Places, Socializing in the Less Dense. There was high variability in the reasons that people use scooters across metropolitan areas, as shown in Figure 23. In higher-density regions with greater transit service and usage, shared-scooter use was primarily associated with commutes to/from work (38% in the medium- and high-transit metros). This contrasts with low-density, low-transit regions, where less than 14% of trips were for commuting and the majority of trips were for social activity (51%). Since less than 1% of respondents said that scooters were their primary commute mode (see previous section), many of the commute trips here may represent first-/last-mile trips connecting to other modes.

Although they are not shown here, the unweighted results find social activities as the most common trip purposes across all metro types. But since the frequency-weighted results place commutes in the top position in denser metros, this suggests that repeat users are those who find ways to incorporate scooters into their travel in more utilitarian ways.

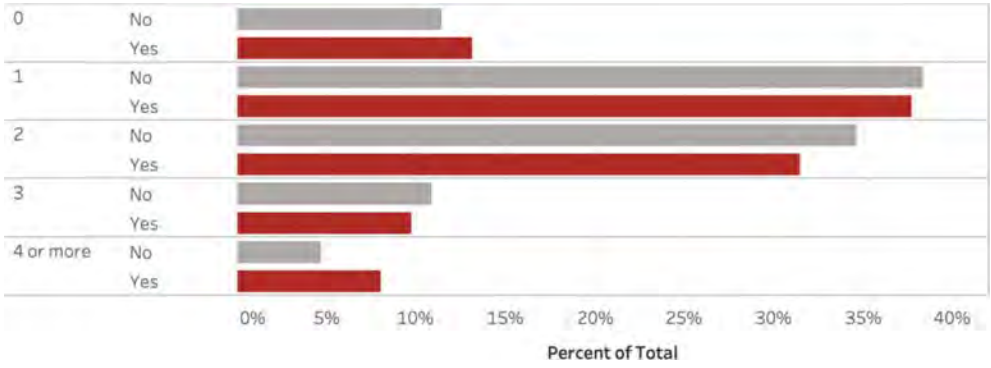
Reasons for Choosing Scooters

Fun Is Key Almost Everywhere, but Utility Is Central in the Densest Metros. Competitive Prices Are Also Important. Mirroring the results for trip purpose, the reasons that people chose scooters over other transportation options also varied significantly by metro type (Figure 24). In higher-density, high-transit regions, scooters were chosen over other alternatives for utilitarian reasons the majority of the time, especially because they are the fastest and most reliable option (33%) and because of the difficulty of parking at their destination (22%).

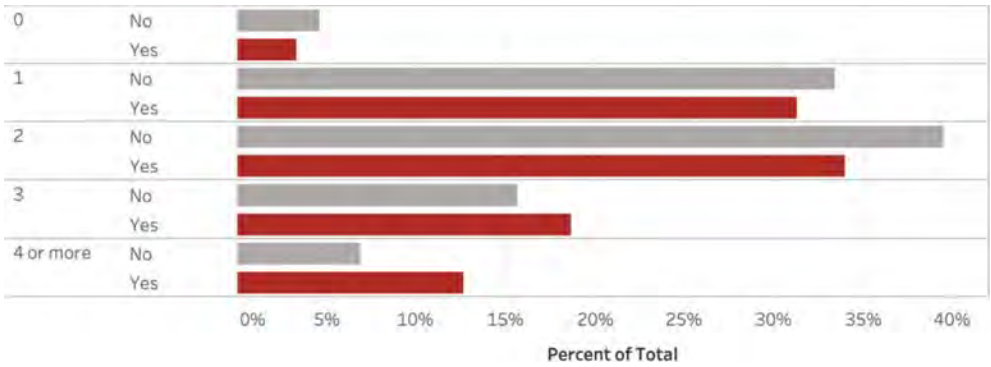
In medium-density and low-density metropolitan areas, scooters were chosen as a mode "just for fun" more than a third of the time, likely including "joyrides" and trips made to get to or from social activities. While it was nowhere the top reason, scooters' low price compared to other modes was a key rationale 11% to 15% of the time in every metro type.



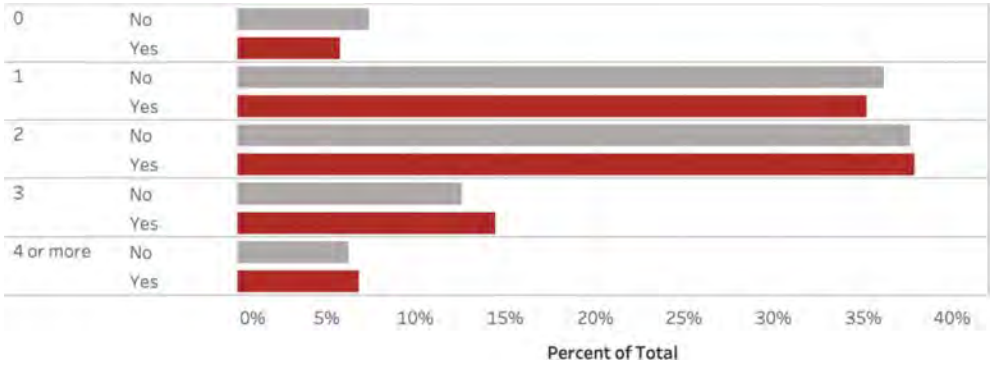
(a). Number of household vehicles, high-density, high-transit use.



(b). Number of household vehicles, medium-density, medium-transit use.



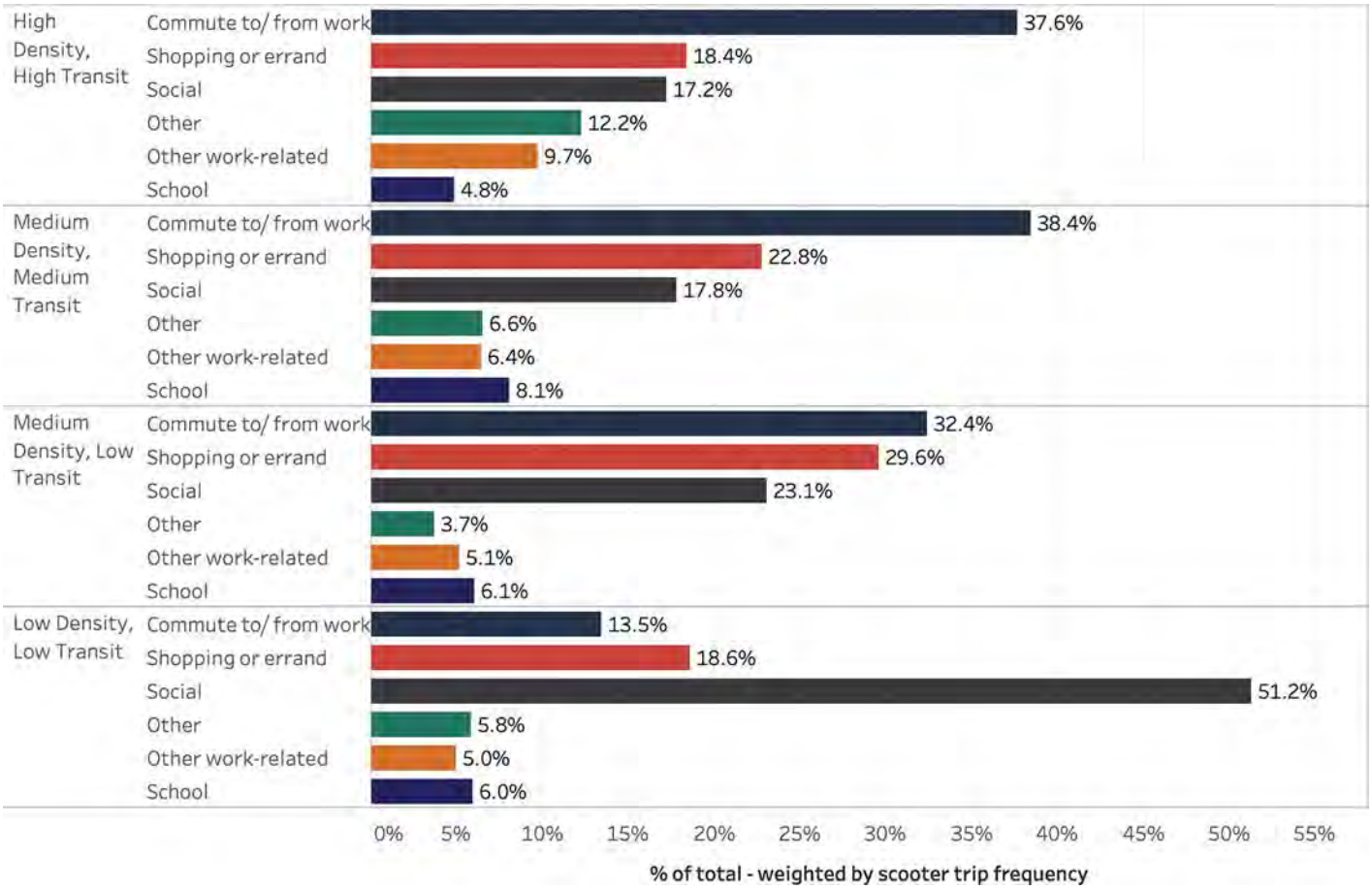
(c). Number of household vehicles, medium-density, low-transit use.



(d). Number of household vehicles, low-density, low-transit use.

Source: Populus Groundtruth survey 2019.
Notes: "Yes" (red) bars represent scooter use; left axis is vehicles per household.

Figure 22. Number of household vehicles owned, by metro type.



Source: Populus Groundtruth survey 2019.

Figure 23. Trip purpose for last scooter trip, weighted by trip frequency.

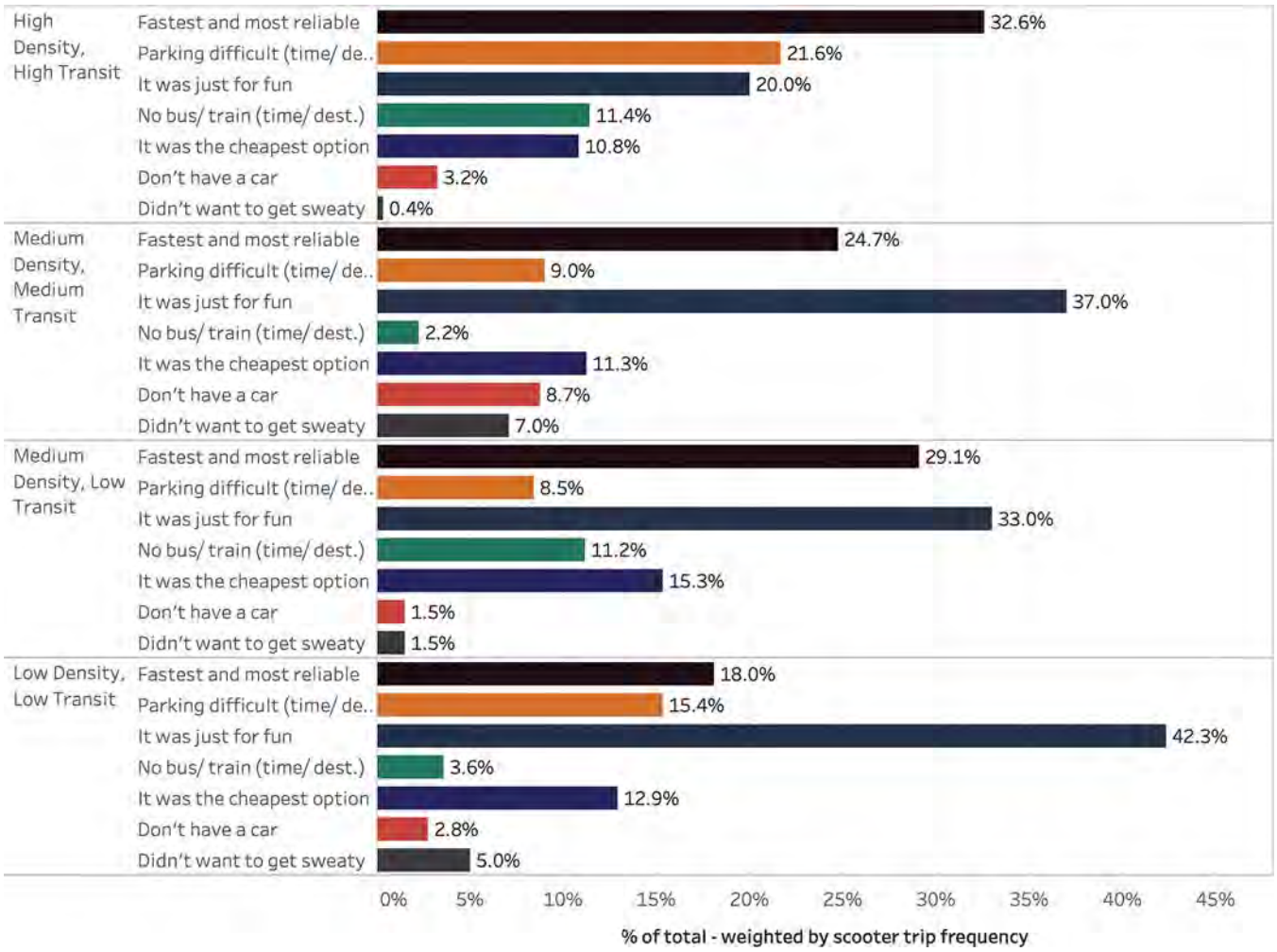
Together, the trip purpose and reasoning results suggest that shared scooters were more likely to be used for utilitarian purposes in high-density, transit-oriented areas, as compared with lower-density regions where they were used less frequently and primarily for social trips. Scooters' low prices also appear to remain an important selling point for a significant minority of users.

Modes Replaced by Scooters

Similar to other recent reports, this national, statistically based sample of data suggests that scooter trips replaced a significant number of automobile trips, although mode substitution also varies by region (Figure 25).

Most Scooter Trips Replaced Trips in a Car, and Many Replaced Walk Trips. While in most regions, a larger portion of scooter trips replaced car trips as compared to walking, biking, or transit trips (Figure 25), an analysis across different types of U.S. metros suggests that urban context—population density, the built environment, and existing transit services—influences shared scooters' potential to provide substantial positive impacts as opposed to simply replacing existing sustainable transportation options.

In high-density, transit-oriented regions, 55% of scooter trips replaced trips that would have otherwise been made by a car—either alone, with another passenger, or via a ride-hail service like Uber or Lyft. This number increased to 78% of trips in medium-density, low-transit areas, suggesting that there is potentially an even greater opportunity for shared electric scooters to



Source: Populus Groundtruth survey 2019.

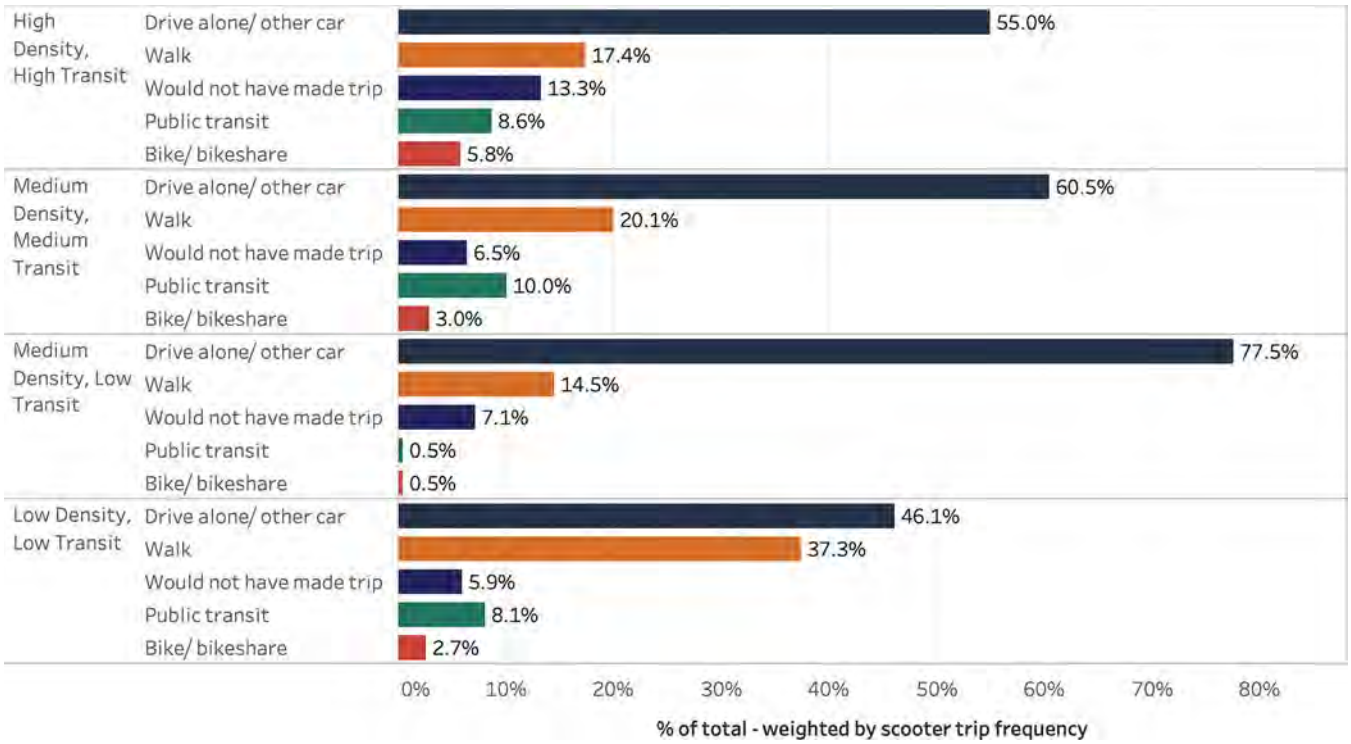
Figure 24. Reason for using a scooter on last scooter trip, weighted by trip frequency.

influence mode shift to more sustainable modes in these auto-dependent regions. However, in the lowest-density regions, scooter trips were likely to have replaced a car trip less than half the time (46%).

Across all regions, walking was the second most common mode replaced, with results ranging from 15% of replaced trips in medium-density, low-transit metros, to as high as 37% of replaced trips in low-density, low-transit metros (the group that also had the lowest level of car trip replacement). Trips on public transit represented 0.5% to 10% of those replaced, and private bikes and bikeshare were an even smaller proportion, ranging from 0.5% to 6%. Scooters appear to create some trips that would not have taken place otherwise, between 6% to 13% of the time (likely representing many of the "joyride" trips just for fun noted in the previous section).

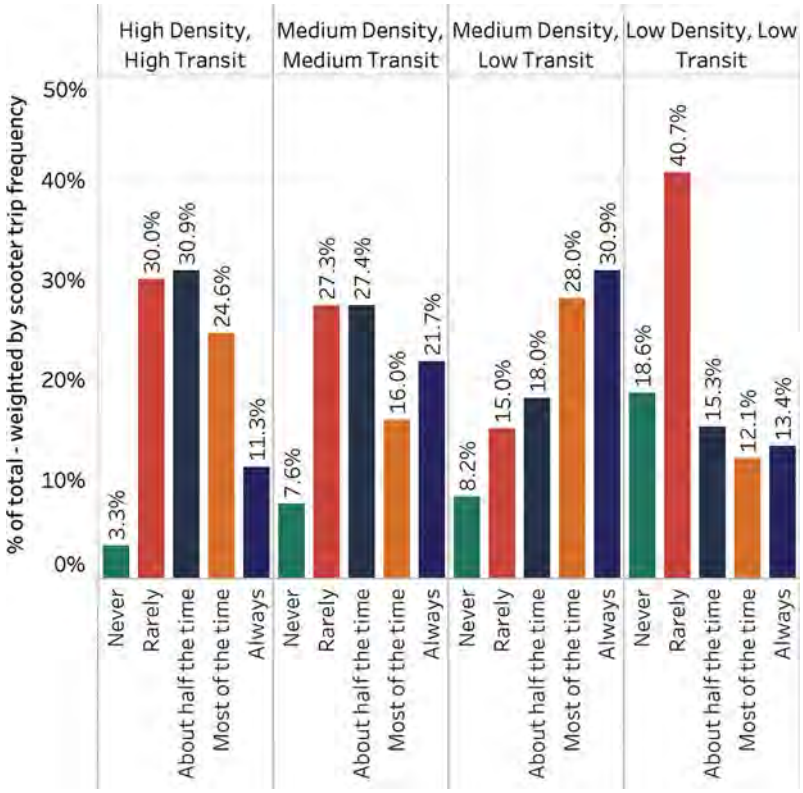
Scooting to and from Transit

Populus Groundtruth survey data were also used to better understand whether and to what degree scooter adopters used scooters for first-/last-mile connections to/from public transit. Scooter users were asked how often they used a shared scooter to get to or from public transit (Figure 26). Similar to the analysis of scooter trip purposes, reasons for mode choice, and mode substitution analysis, these results are weighted by frequency of scooter use.



Source: Populus Groundtruth survey 2019.

Figure 25. Modes replaced by scooters, weighted by trip frequency.



Source: Populus Groundtruth survey 2019.

Figure 26. How often scooters were used to get to/from public transit, weighted by trip frequency.

Where Transit Is More Available, More Scooter Trips Are to or from Transit

In the high-density, high-transit-use metro areas, slightly more trips were "sometimes" or "always" made to or from transit (36%) as opposed to "never" or "rarely" (33%). In lower-density, low-transit metros, the majority of trips "never" or "rarely" (nearly 60%) were made to or from transit, which largely reflects the lack of transit availability in these metropolitan areas. However, even in areas with low transit and low density, scooters were used to connect to transit more than a quarter of the time, and the most frequent occurrence of this purpose was in the medium-density metros, suggesting a connection with the longer distances and diminished walkability of these areas.

CHAPTER 4

Implications for Transit Agencies

This chapter explores the benefits and impacts of micromobility with an emphasis on outcomes likely to be valuable to transit agencies. It begins by extending the micromobility use analysis from the prior chapter, specifically examining trip patterns in proximity to high-frequency fixed-route transit. The second half of this chapter examines the broader implications of shared micromobility's impacts on transit agencies, including on funding and the financing of public infrastructure, interaction with agencies' civil rights obligations under ADA and Title VI of the United States Civil Rights Act of 1964, and implications for the rider experience.

Micromobility Usage Patterns and Impacts

The impact of dockless shared micromobility on other forms of transportation, particularly public transit and docked bikeshare, is a key question in this report. To supplement the user-focused survey data in the previous chapter, this chapter uses publicly available docked bikeshare data to observe total trips before and after the addition of dockless shared vehicles. For dockless vehicles, which can start or end a trip at any location, aggregated trip data also were used to observe the use of the vehicles near transit stops. There is some overlap between the cities here and the metro areas surveyed in the previous chapter, but the data in this section were dependent on established relationships with cities and operators and their willingness to provide aggregated data for this study.

The question of data availability also affects the cross-section of metro types examined, especially on the less-populated end of the scale: although the research team strived to represent smaller cities and less-populated regions, the places available for analysis were limited to Populus partner cities where all parties to the data consented to data sharing.

The Populus research team collaborated with cities, counties, and scooter operators to use aggregated shared-scooter data to show scooter use around transit stations. Four major scooter operators, Bird, Lime, Lyft, and Spin, consented to use of their data in these aggregated forms. Note that in many of these cities, smaller scooter companies also operate but were not included in the analysis. The five regions were chosen from Populus' existing partner cities and were selected based on a few additional criteria in order to create a range of cities in terms of density and access to transit. Figure 27 shows the jurisdictions: Arlington County, VA; Baltimore, MD; Cleveland, OH; Indianapolis, IN; and Oakland, CA.

Arlington County and Oakland were selected to represent dense, urban environments with more access to transit. Cleveland and Indianapolis were selected to represent more car-centric cities. However, Cleveland is also distinct from Indianapolis in that Cleveland provides numerous transit options as well as a vehicle rebalancing requirement whereby operators are asked to leave scooters in locations that are often near transit stations. Finally, Baltimore has a popular scooter

Source: Populus.

Figure 27. Cities or counties where scooter use data were approved for use in this study.

program and is a relatively dense city, but public transit is less accessible across the city. The regions are shown in Table 3 along with the major transit services used in the analysis.

Scooter Impacts on Docked Bikeshare

To examine the trend in bikeshare trips in relation to the introduction of shared scooters, this report shows weekly or monthly trip docked bike volumes in Arlington County (for Capital Bikeshare, which operates across the D.C. region) and Oakland (Bay Wheels, which operates around the Bay Area; until June 2019 the system was known as Ford GoBike).

Figure 28a shows weekly trip volumes for Oakland's docked bikeshare system from July 2017 to October 2019. In Oakland, dockless shared scooters were introduced in September 2018 (indicated by the vertical dashed line). As shown in the figure, trip volumes for the docked bikeshare system declined from October to December 2018, around the time of the introduction of scooters, but also coinciding with likely seasonal variation. Then the docked trip volume increased again starting in January 2019, and despite considerable fluctuation, the overall trend was growth in the use of docked bikeshare.

Arlington County shows clearer seasonal fluctuation in docked bike use (with large drop-offs in winter) than is visible in the Oakland example. Figure 28b shows weekly trip volumes from January 2017 through November 2019. Shared e-scooters were launched in early October 2018,

Table 3. Study regions and their major transit services.

City/County	Population (2018 est.)	Dockless Micromobility Service Area	Major Transit Services Used for Location Analysis
Arlington County, VA	238,000	County limits with some restricted areas (i.e., the Pentagon)	Metro
Baltimore, MD	602,000	City limits with equity zone distribution requirements	Light RailLink, Metro SubwayLink, MARC
Cleveland, OH	384,000	City limits with rebalancing locations focused in certain parts of the city	Rapid Transit (Red Line), Light Rail (Green, Blue, Waterfront), Bus Rapid Transit
Indianapolis, IN	867,000	City limits with access zone and high utilization distribution requirements	IndyGo Bus Rapid Transit (Red Line)
Oakland, CA	429,000	City limits	BART

as indicated by the vertical dashed line. Docked bikeshare trips appeared to decline slightly overall from 2017 to 2019, but it is unclear if that is linked to the availability of scooters.

In both regions, it is unclear whether a decline in dock-based bike trips soon after the introduction of scooters was a result of the introduction of a dockless system or a consequence of seasonality or other operational factors. In both cases, docked bikeshare recovered at least its prior level of ridership, and in Oakland reached new heights after scooters' introduction.

Dockless Vehicle Use near Transit Stations

To better understand dockless vehicle use in relation to transit stations in the five regions, the researchers used trip origin and destination counts within the jurisdictions. Overlaid with the trip starts and ends are the locations of major transit stations. For the regions explored, stops for basic local bus service were not included because of their ubiquity throughout the cities; stops more typically within walking distance to one's home makes the analysis difficult to meaningfully parse. However, bus rapid transit (BRT) was used in Indianapolis and Cleveland, which in both cases have fewer stops, more frequent service, faster boarding, and more direct routes through the downtown core.

Using the data from the four major scooter operators where they are active, trip origin and destination counts were aggregated over the service areas in each of the regions. Figure 29 visualizes scooter use across the regions, with the darker-shaded areas experiencing more trip starts and ends. Data represent one month of trips in October 2019.

In general, in all the cities, more trips occurred in the urban core and in university campus areas. What varied between the cities was the type and location of available transit. It is difficult to link trips starting and ending to connections to transit, but understanding use patterns of shared scooters is a first step.

The densely populated suburban jurisdictions of Oakland and Arlington County (Figures 29a and 29b, respectively) show more trip starts and ends in the vicinity of major transit stops, both regional heavy-rail lines. In Cleveland and Indianapolis, both the center cities of smaller metropolitan markets (Figures 29c and 29d, respectively), there was some correlation with BRT lines, but in Cleveland there was less alignment with heavy- and light-rail line stations outside the urban core. In Baltimore (Figure 29e) the areas with the most trip starts and ends did not line up with the locations of the major transit stops as was the case in Oakland and Arlington.

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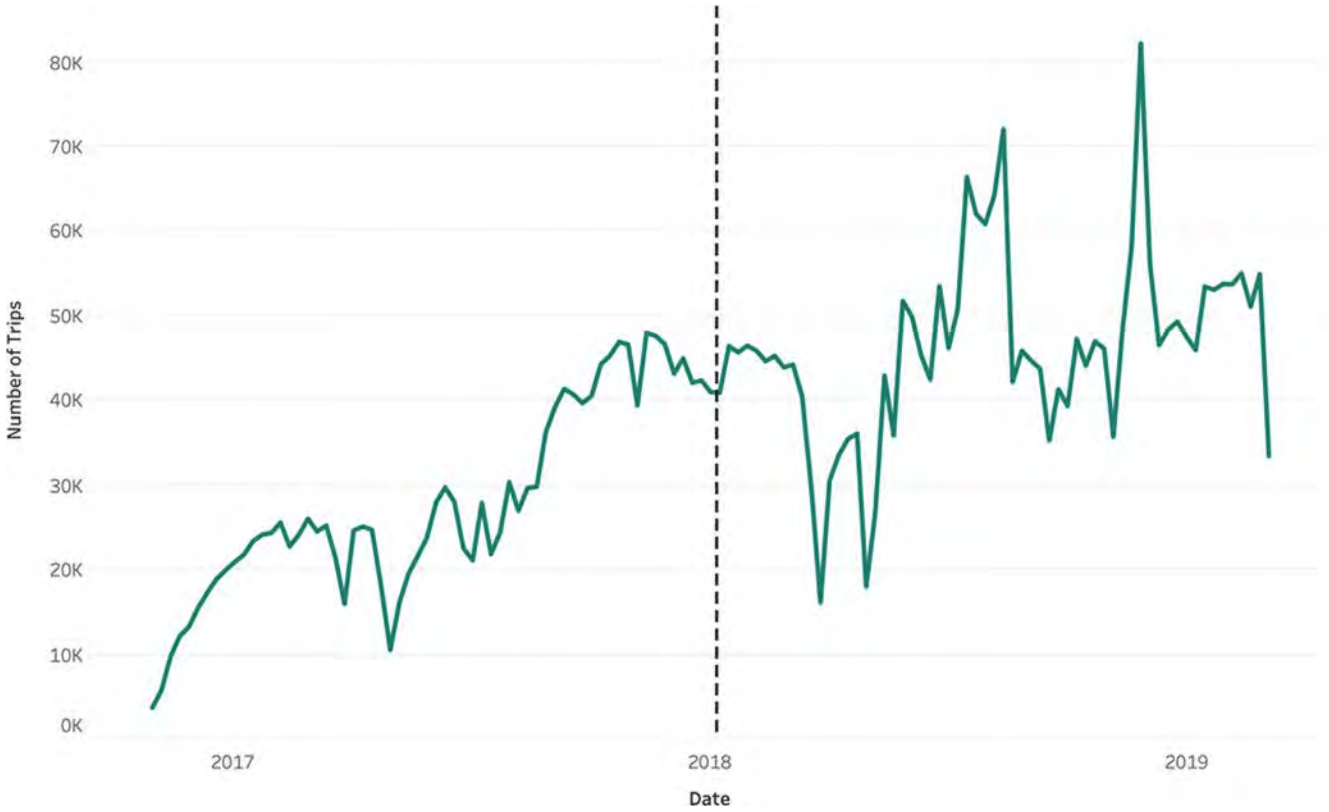
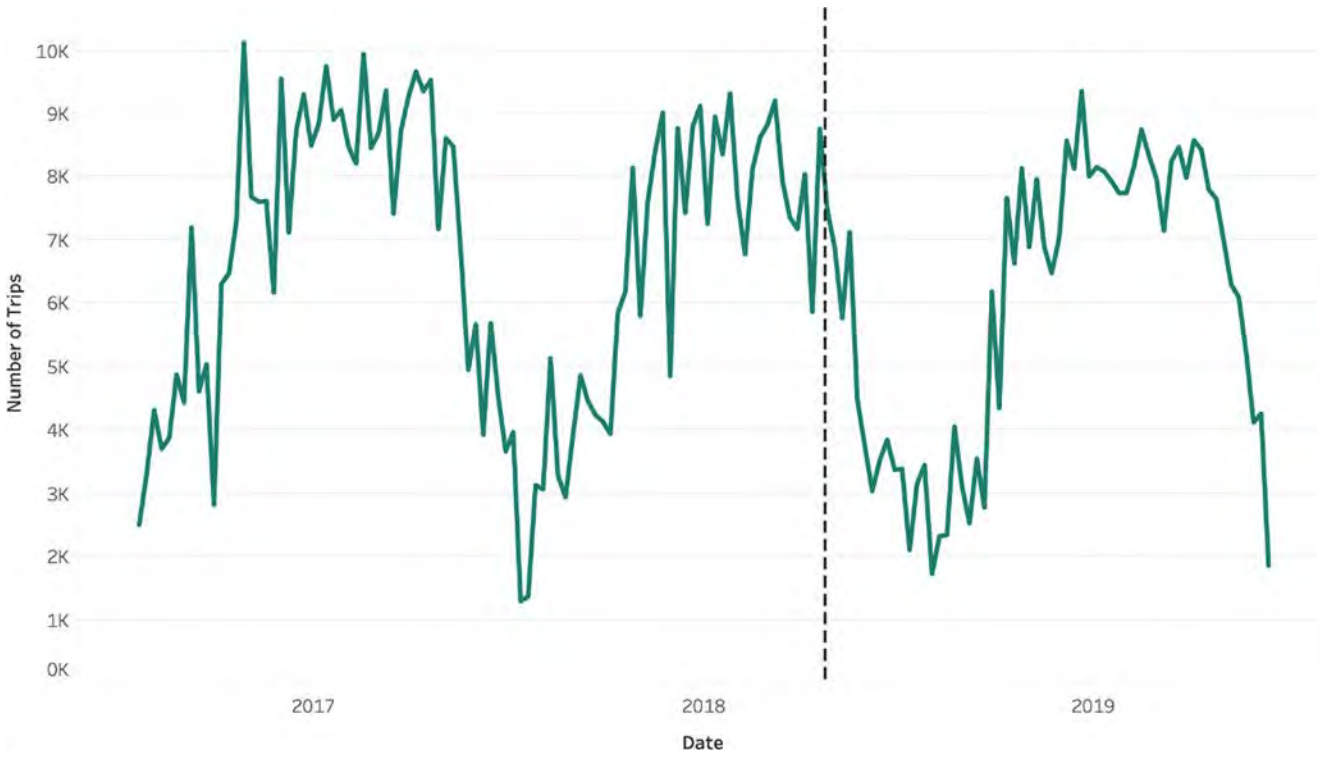


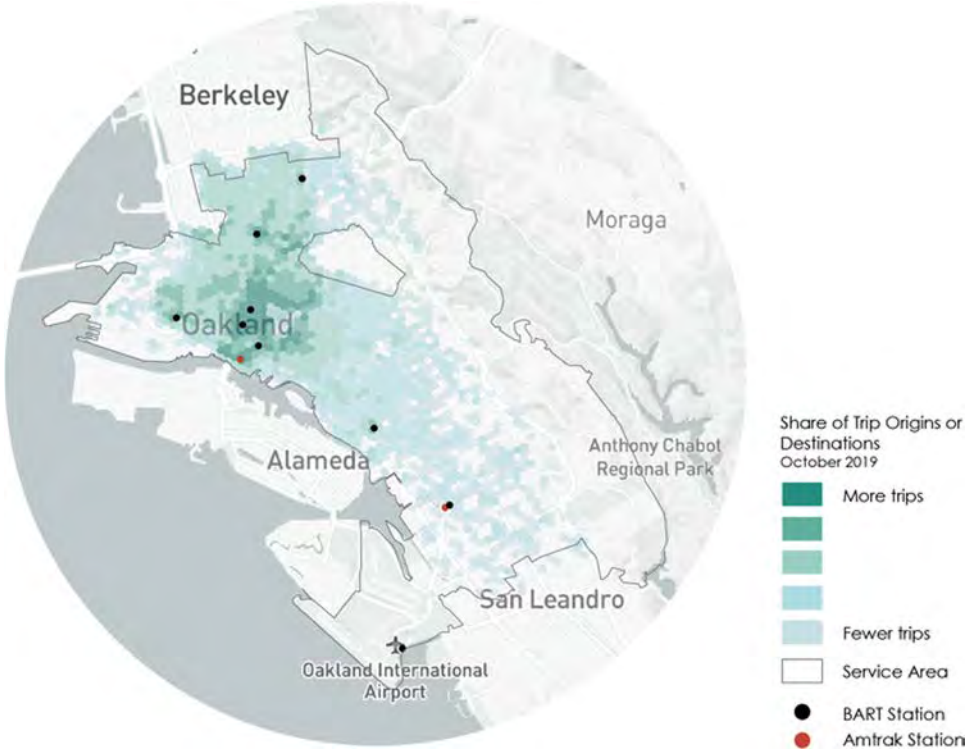
(a). Oakland GoBike/Bay Wheels docked system weekly ridership, June 2017–October 2019. Dockless scooters were introduced in early September 2018.



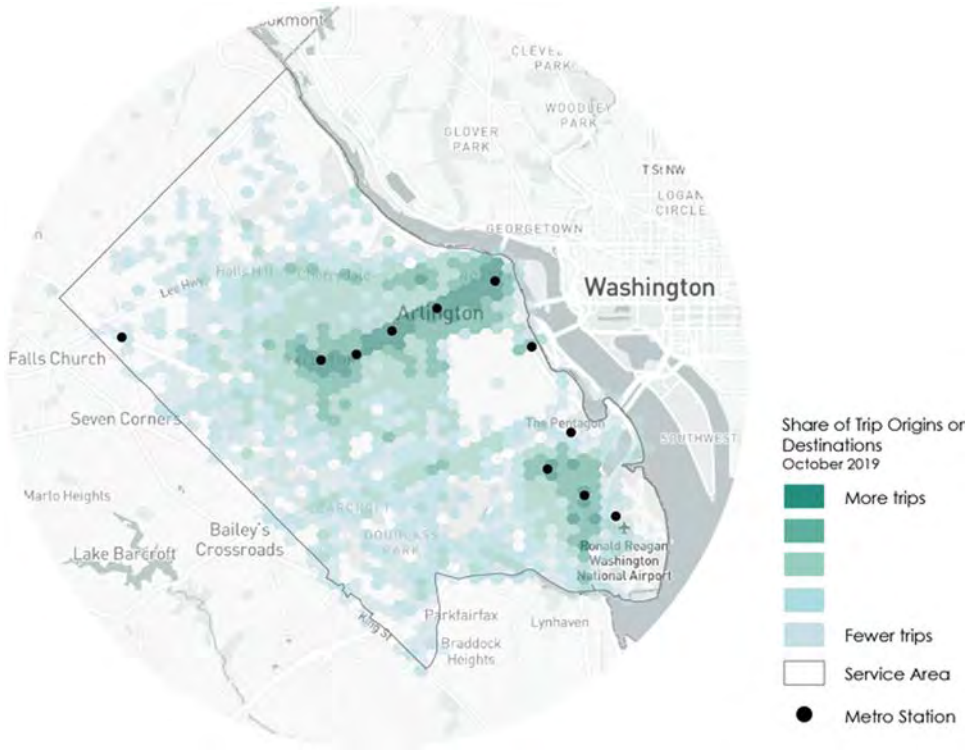
(b). Arlington Capital Bikeshare docked system weekly ridership, January 2017–November 2019. Dockless scooters were introduced in early October 2018.

Note: The vertical dashed lines indicate the introduction of dockless shared scooters.

Figure 28. Docked bikeshare trip volumes.



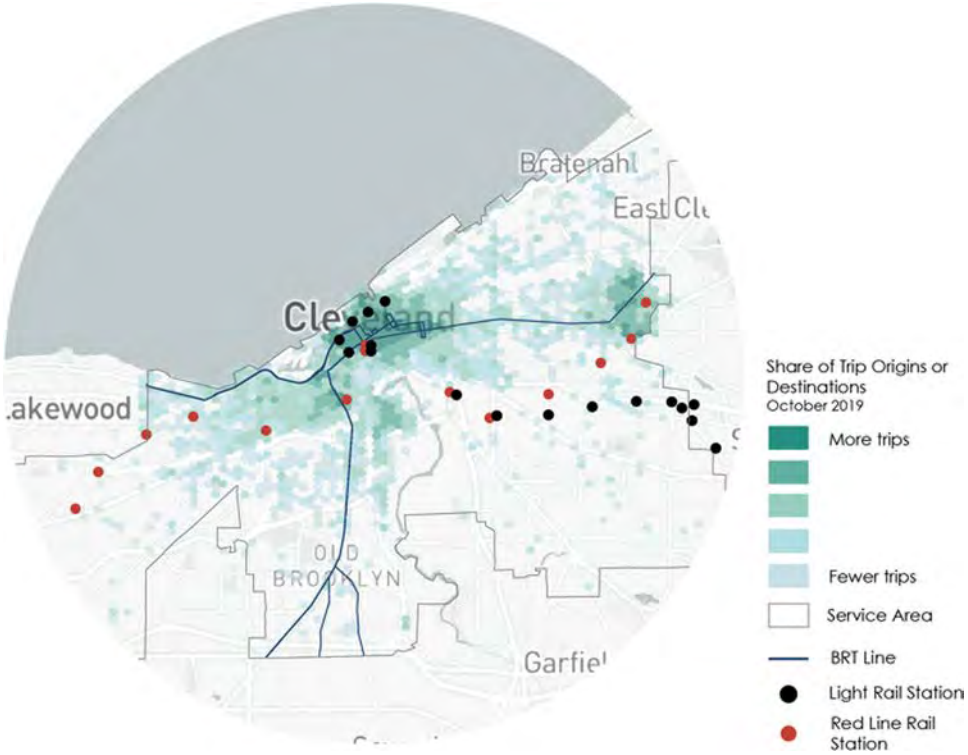
(a). Oakland, CA.



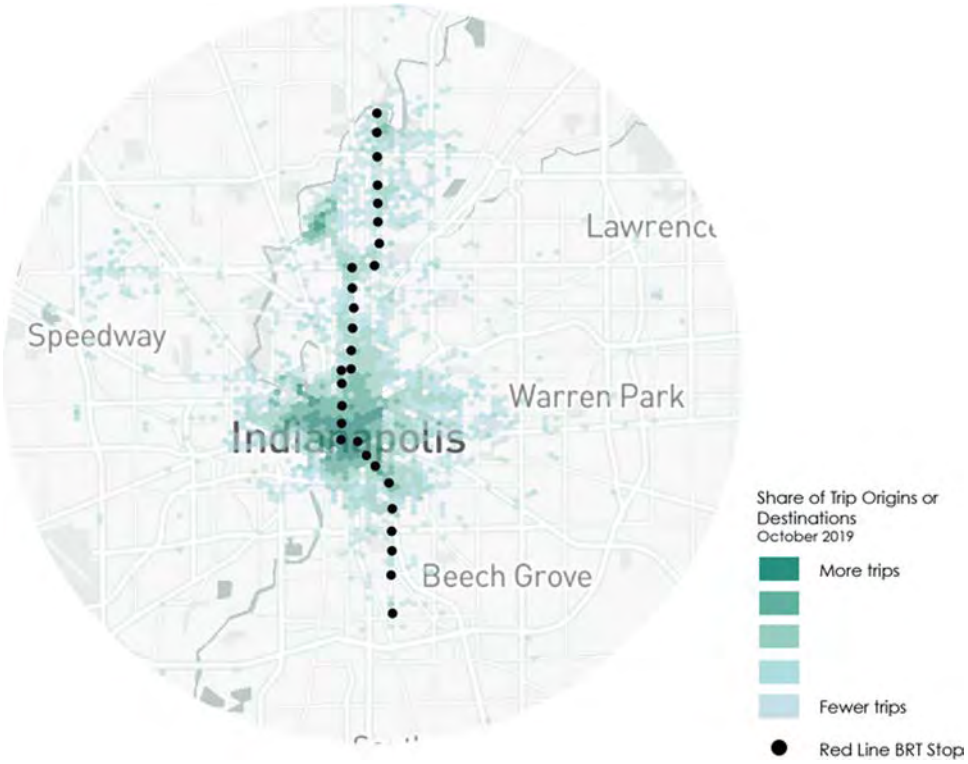
(b). Arlington County, VA.

Figure 29. Relative numbers of dockless shared-scooter trips in Oakland, CA, Arlington, VA, Cleveland, OH, Indianapolis, IN, and Baltimore, MD.

(continued on next page)

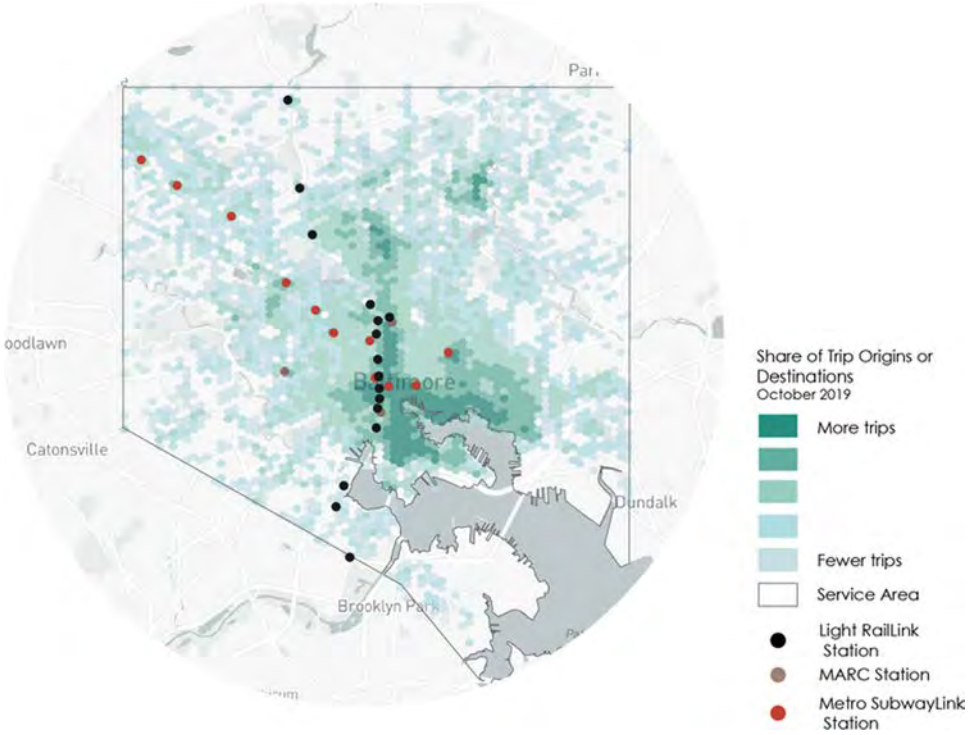


(c). Cleveland, OH.



(d). Indianapolis, IN.

Figure 29. (Continued).



(e). Baltimore, MD.
Source: Populus analysis of scooter company data.

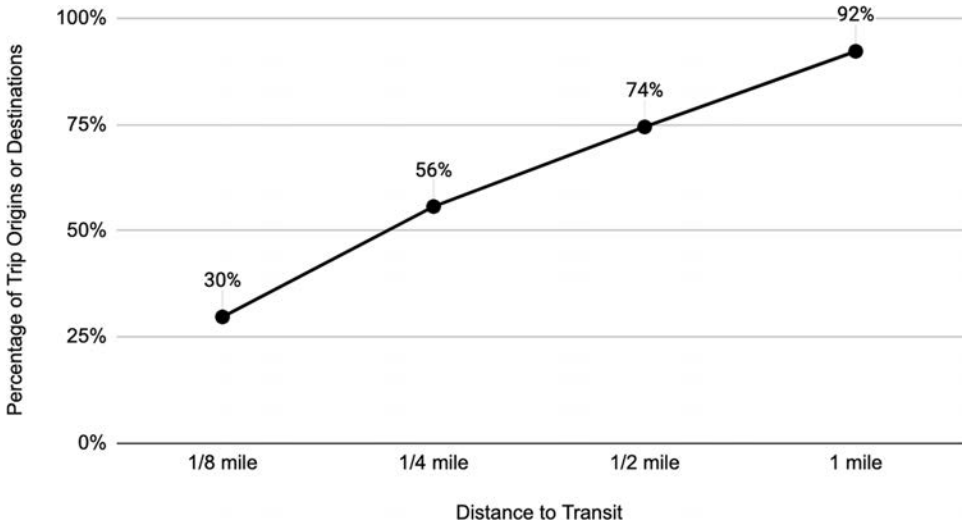
Figure 29. (Continued).

Trip Proportions near Major Transit Stops

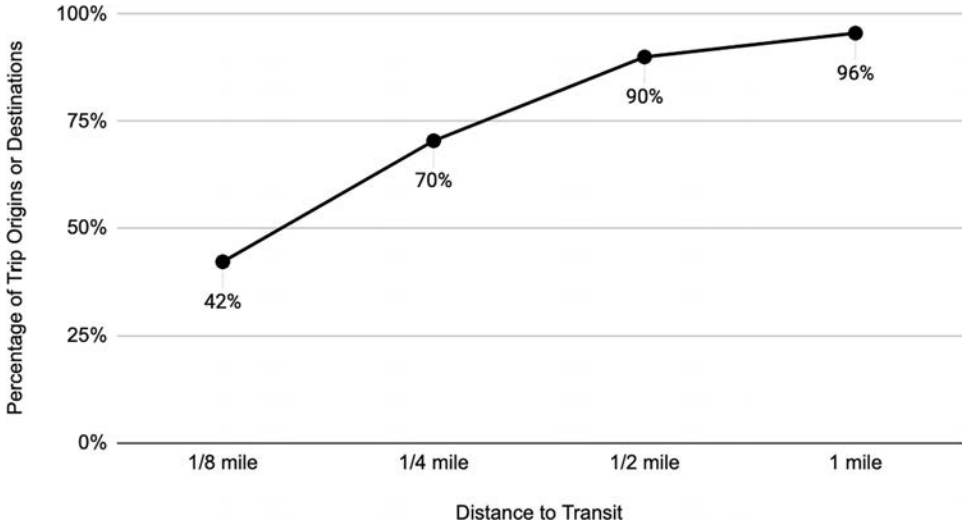
Operator-provided data cannot definitively prove which scooter trips were being used as first- or last-mile connections to transit, which would require trip-chaining data or continuous observation of the same individuals to confirm. However, the data can be used to observe where shared-scooter trips were starting or ending in proximity to transit (as in the previous section and illustrated in Figure 29). To pair with the maps, the five charts in Figure 30 show the percentage of trip origins or destinations (aggregated to the zones visualized in the hex areas in Figure 29) that were within a specified distance of a major transit station: ⅛ mile, ¼ mile, ½ mile, and 1 mile. The buffer assumes the stations are points, which may not accurately describe larger metro stations with multiple entrances and exits, but larger metro stations should be captured with the smallest (⅛ mile) buffer.

In general, Arlington, Cleveland, Indianapolis, and Oakland appear to show some correlation between the location of trip starts and ends and major transit stops. This is also true in the cities without any distribution requirements as there could be other confounding factors, such as proximity to restaurants, work, and other popular destinations, that are common to the urban core areas.

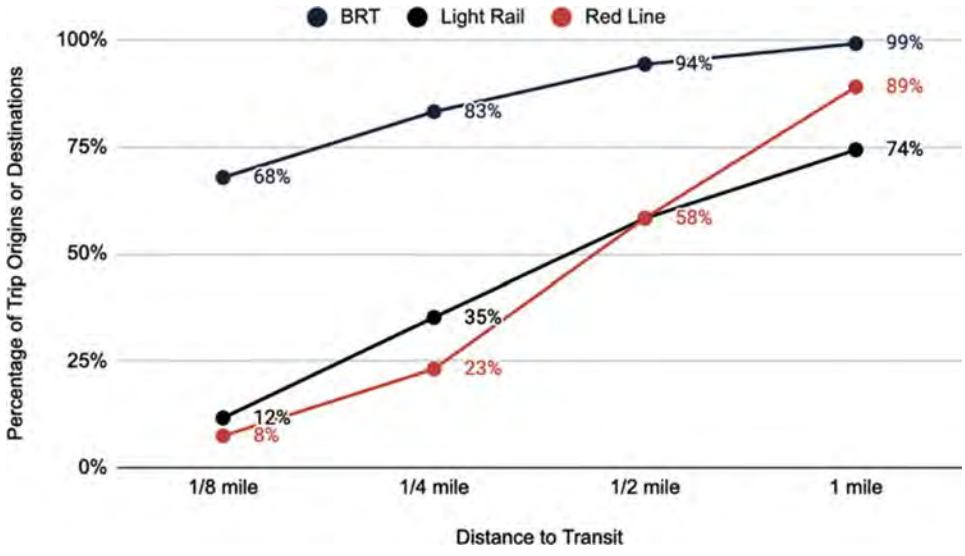
Oakland and Arlington County (Figures 30a and 30b, respectively) both primarily have metro stations in their dense downtowns, with rail lines connecting to the primary urban cores of their regions. In Arlington County, 42% of trip origins or destinations fell within ⅛ mile of a metro station, and in Oakland 30% did. At lower levels of association, the rapid transit and light rail in Cleveland and BRT in Indianapolis (Figures 30c and 30d, respectively) saw less than 20% of scooter trips starting or ending within ⅛ mile. In all these cities, three-quarters or more of scooter trips (and as high as 99%) started or ended within 1 mile of major public transit services.



(a). Oakland, CA.

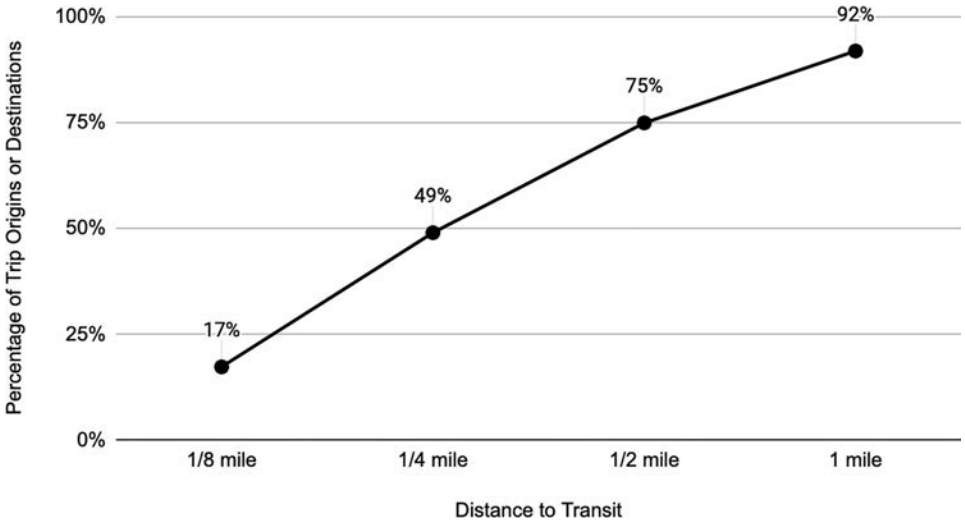


(b). Arlington County, VA.

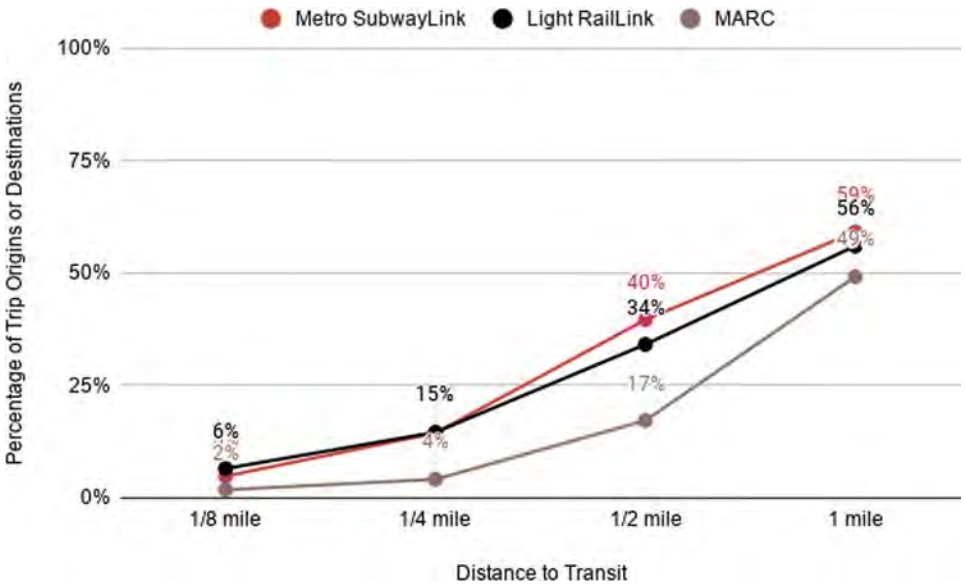


(c). Cleveland, OH. (Note: BRT is the top line.)

Figure 30. Number of trips within ⅛, ¼, ½, and 1 mile of major transit stations.



(d). Indianapolis, IN.



(e). Baltimore, MD.

Source: Populus analysis of dockless shared-scooter trip data.

Figure 30. (Continued).

Standing out among these transit systems is the BRT in Cleveland, which includes three routes throughout the city with over 100 stops, and had 68% of scooter trips within ⅛ mile. Like a more traditional bus route, Cleveland's BRT has frequent stops, particularly in the dense, well-connected areas that typically support more scooter activity. It is unclear whether the high proportion of nearby scooter trips was actually being used to connect to transit; however, given the moderate levels of scooter activity near Cleveland's other transit stops, it seems unlikely that the BRT is unique in attracting an extraordinary number of riders. More likely the data are just showing trips that are in the same destination-dense corridors but not necessarily connecting. Also possibly confounding the analysis is Cleveland's policy requiring that scooters be rebalanced to locations within commercial districts and near transit stations, bus stops, recreation centers, libraries, and parks. It is difficult to disentangle the distribution requirements to transit stations from what is observed with the origins and destinations location data.

In Baltimore, the pattern of usage appears to differ from the other cities. Referring to Figure 30e, areas of high scooter use do not appear to line up with the location of Metro, light rail, or MARC stations. In terms of proximity to transit, the curve of the distance to transit lines is more gradual and rises to lower peaks (less than 60%) than in the other regions, indicating a smaller proportion of trips even at some remove from transit but still potentially connecting to it. In fact, only 2% to 6% of trips started or ended within ⅛ mile of any of the transit stations, and this range only rises to 4% to 15% within ¼ mile of a station. The areas experiencing more trip starts and ends are located around the Inner Harbor, along main north–south corridors, and around some of the universities in the city. These locations do not line up with where non-bus transit is located. Baltimore does have one of the more popular scooter programs observed, but acting as a first- or last-mile solution may not be one of the main use cases for shared scooter users there.

Changes in Use of Transit and Other Modes

Since the researchers cannot say strictly from the analysis illustrated in the previous section whether the addition of shared scooters changed transit use, survey data can help inform the understanding of scooter user behavior. The metro area survey specifically asked users how their use of transit and other modes had changed since they started using shared scooters. Across metro areas (and again using frequency-weighted measures), the largest percentage of scooter users said they saw either no change, more use, or significantly more use of transit since they began using shared scooters (see Figure 31).

However, approximately 20% to 30% of scooter users indicated they were using transit less or significantly less often than before. Given these responses, it is reasonable to say that for some

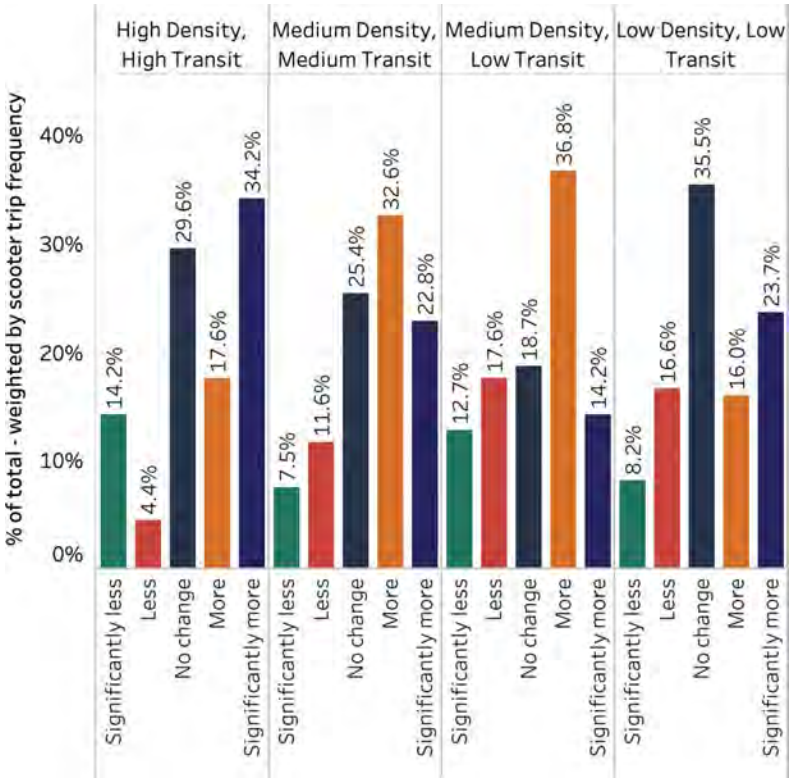


Figure 31. Scooter user response to how their transit use behavior changed since they started using shared scooters.

people, scooters have replaced or reduced public transit trips (as also suggested in Figure 25). For others, the addition of scooters may have increased public transit use because it enables them to more quickly and easily access transit.

Funding/Financing Impacts, Civil Rights, and Other Agency Concerns

Transit agencies may struggle to understand the potential risks and benefits of leveraging, partnering, and actively managing shared micromobility services. Transit agencies need more information on the experiences of their peers and the potential funding, civil rights, and service quality implications of a growing micromobility market. This section summarizes three of the key risk areas for transit agencies. This analysis is not comprehensive but investigates key implications for transit agencies in greater detail.

- **Funding and financial implications** – Transit agencies weigh the costs and benefits of funding micromobility infrastructure and subsidizing services to encourage their use, and thus possibly increasing ridership and revenue for the public transit system. Transit agencies have limited operational funds to invest in new service types, but capital funds can be used to support micromobility infrastructure.
- **Civil rights and social equity implications** – Transit agencies are federally required to ensure equitable access to their programs but lack specific guidance from the FTA on how that applies to agency partnerships with micromobility services. Transit agencies seeking mobility-manager status must consider ways to help transform micromobility services from a private, permitted amenity that is available to those who can access and pay for it to a public mobility option that breaks down systemic barriers to mobility and access.
- **Transit rider experience implications** – Whether or not they are operated in partnership with transit agencies, shared micromobility services have the potential to benefit transit riders' experience by alleviating peak-period crowding on transit (Pucher and Buehler 2009) and rider demand for bringing devices on board. However, shared micromobility services could also reduce the quality of the rider experience if device parking and use are not well planned in and around stations and stops. Further, the current digital experience of trip planning, booking, and payment is disaggregated.

As the global micromobility industry evolves, its full effects on transit agencies and the services they provide are not yet known. This section uses current research or evaluation outcomes (where available) to demonstrate the range of possible micromobility impacts on transit agency operations and customer experience.

Funding and Financing Implications

Micromobility has positive and negative effects on transit agency funding and financing. Micromobility has potential as a first-/last-mile transit access mode, particularly in major urban areas (Lime 2019). The first-/last-mile use case supports transit ridership and can increase the frequency of transit use, thus increasing an agency's fare-box revenue. However, micromobility may also replace shorter transit trips, such as in cases where taking a bike or e-scooter for short distances is more convenient and time efficient than taking a bus or train. Santa Monica's 2019 shared mobility survey found that 4% of e-scooter trips would have otherwise been made by transit (Santa Monica 2019a). Similarly, the Populus Groundtruth survey data provided in Chapter 3 show the proportion of scooter trips that displace public transit at between 0.5% and 10%, depending on the market.

Public Subsidies for Micromobility Operations. Some cities are contemplating publicly subsidizing shared micromobility services to reduce rider trip costs (particularly for riders

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with low incomes), to create a market for micromobility in underserved and disadvantaged areas, and to support the long-term financial sustainability of these services. Many dock-based bikeshare systems have received public support, and cities and transit agencies could further extend this level of subsidization so that newer micromobility systems—such as dockless bike and e-scooter share systems—can scale and provide more options when and where people need them and at potentially lower prices in some circumstances. Subsidies could be used to encourage broader use of active transportation and public transit, and ultimately, a long-term mode shift.

Some cities initially aimed to have bikeshare systems be self-sustaining and funded through revenue, but due to the expense of operations, subsidies remained necessary, especially to expand services into underserved areas. Private interest in operating bikeshare systems without government subsidy has increased and accelerated with the introduction of free-floating micromobility technology. However, a city takes on inherent risks when it shifts from a publicly owned and operated mobility model to a privately owned one. As with any other contracted service, if the privately owned micromobility operator goes out of business or simply leaves a market, a jurisdiction can be left without any micromobility service. The risk of operator exit could be greater without an operating contract or subsidy.

Limited Operational Funding Sources. Operational funding for micromobility systems is harder to come by for cities and transit agencies. For the purposes of federal funding, the FTA does not consider bikeshare a form of public transportation, and it does not define micromobility specifically (FTA 2020d). Certain capital costs associated with bikesharing, such as the cost of installing docking stations and infrastructure, though not of the bikes themselves, can be covered by FTA funding programs when functionally related to public transportation. The Central Midlands Regional Transit Authority (COMET) in Columbia, SC, provides an example of a transit agency using FTA formula funds to support the expansion of bikeshare as a first-/last-mile amenity for its riders. The agency's approach is described in Chapter 5.

The FTA provides some guidance on capital or operational funding eligibility for e-scooters and other micromobility services (FTA 2020a; FTA 2020b). Given the potential for shared micromobility services beyond bikeshare to support public transportation, as docked bikeshare does, transit agencies may benefit from further guidance and new sources of operational funding if they are to financially support micromobility services.

Funding Examples. Many docked and privately operated bikeshare systems, such as Bay Wheels (San Francisco Bay Area) and Citi Bike (New York City), rely on advertising revenue for operational funding. Capital Bikeshare in Washington, D.C., and Divvy Bikeshare in Chicago were initially operated or capitalized with public funding, including local and federal funds. Capital Bikeshare still operates with a public subsidy, but in 2019, Divvy shifted to private ownership with Lyft through a 9-year contract. Lyft is investing $50 million in Divvy and is additionally required to make annual payments to the city, starting at $6 million and increasing by 4% each year. The city of Chicago and Lyft share revenue (Buckley 2019).

A number of examples exist of micromobility systems subsidized through transit agency partnerships. Micromobility partnerships that are underway could provide guidance on how transit agencies could subsidize micromobility in the future, especially in markets where operators would have trouble operating profitably. For example, in the Greater Dayton RTA's partnership with e-scooter operator Spin, RTA provides staff time (device pickup, charging, and drop-off), while Spin provides the vehicles themselves and operates the digital platform. The staff time provided by RTA offsets Spin's overall operating costs, enabling it to operate in Dayton, which it would have been unable to do otherwise. Another example is Kansas City Area Transportation Authority's (KCATA) funding of bike and scooter share through a contract and partnership with a local nonprofit (RideKC Bike 2020). Los Angeles's docked Metro Bike

Share system is funded by LA Metro (through the region's Measure R sales tax revenue) and is explicitly part of its transit system (LA Metro 2020a). Metro's bikeshare subsidy is about $8 per ride (LA Metro 2019b). The COMET, in Columbia, SC, uses FTA formula funds to buy stations and support transit rider use of docked bikeshare. These partnerships are described in greater detail in Chapter 5.

These examples do not cover direct-to-consumer subsidies, which is a model being used to support first-/last-mile connections by ride-hailing companies. In those examples, such as the Sacramento Regional Transit District's (SacRT) 2016 pilot to alleviate parking demand at its Golden 1 sports arena, and Solano Transportation Authority's (STA) ongoing pilot to connect county employees with regional rail, the transit agency directly subsidizes each eligible customer fare. Customers typically use a ride code within the app to access the subsidy; at the end of the month, the ride-hailing company invoices the transit agency for all eligible trips in the subsidized program (Curtis et al. 2019).

This subsidy model could be used for a micromobility system. However, because a transit agency cannot digitally verify the trips, this approach requires a high level of trust between the private operators and the governing agency. An invoice-based subsidy system therefore requires a considerable amount of staff time to verify. The only way for transit agencies to scale such a program is to use a data-sharing protocol, such as the MDS, to link known micromobility trips to known transit trips in the data architecture. From the customer perspective, this could mean booking and paying both for transit and micromobility trips within the same application. Only those micromobility trips that truly serve the purpose of the program (e.g., first-/last-mile connectivity) would be subsidized.

Infrastructure Funding

The public and private sectors have an interest in developing micromobility infrastructure such as parking corrals and protected bike lanes. Guidance published by local municipalities and the FTA established before the growth of dockless micromobility models remains relevant and should be referenced. Pioneering cities like Long Beach, Los Angeles, and Seattle have experimented with micromobility infrastructure to achieve better outcomes in public-space management.

Private companies have yet to show the capacity to fund public micromobility infrastructure at scale (and likely will never do so), so transit agencies and local jurisdictions should partner to improve infrastructure. With improved infrastructure, transit agencies can reap the benefits of more seamless connections between transit and micromobility services. If micromobility users are supported with safe routes to destinations with dedicated lanes and easy-to-locate parking locations, transit agencies could see ridership and revenue increase as well as improved customer satisfaction.

Case Studies. Examples of private-sector infrastructure funding are limited, and the private sector's approach has changed over the last few years. In 2018, Bird created its own voluntary program to pay cities $1 per scooter per day to contribute to local micromobility infrastructure investments (Schmitt 2019). However, by early 2019, Bird ended the voluntary program (Schmitt 2019). Through their permit programs, some cities now require a similar fee to support micromobility infrastructure funding. And while the per-scooter-per-day voluntary payment from scooter companies did not last, at least one company is now piloting the use of its own charging stations, which controls its operational costs by reducing rebalancing needs and supports cities' goals to organize micromobility devices and keep sidewalks clear.

Portland. PBOT collects a per-scooter-trip surcharge. Revenue collected from the surcharge, fees, and penalties funds the city's New Mobility Account, which covers costs related

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to program administration and enforcement, safe travel infrastructure, and expanded and affordable access (PBOT 2020a, 2020b).

Phoenix and San Francisco. Scooter company Spin installed "Spin Hubs" in Phoenix—docking stations that also charge scooters. Spin was the only operational scooter company in the city's yearlong pilot, which ran through September 2020. The hubs were operational in two other pilots on private property in Ann Arbor, MI, and Washington, D.C. (Stone 2020; Teale 2020). In spring of 2020, the company announced an extension of the concept to a larger transit-adjacent mobility hub concept, located alongside private bike parking at the Caltrain SF Bike Hub, operated by Tranzito, in San Francisco (Skinny Labs/Spin 2020).

Civil Rights and Social Equity Implications

Shared micromobility services have the potential to increase access and mobility. However, this outcome is not guaranteed for all segments of the population or in all geographies or times of day, and left unmanaged, micromobility has the potential to exacerbate historical inequalities. While bike- and scooter-sharing companies have made voluntary investments to broaden the reach of their services, local incentives or requirements are often required to ensure access in neighborhoods with few transportation options, to ensure reservation and payment options for people without smartphones, and to ensure options for people with disabilities. Research into scooter-share perceptions and use indicated that public support for micromobility was higher among low-income groups (Clewlow 2019a), but several cities' pilot evaluations since then have indicated difficulty in reaching this population through low-income fare programs (see PBOT 2019 and Santa Monica 2019a, for example). There are implications for transit agencies considering partnerships with micromobility services because they have federal requirements to ensure access for people with disabilities and to all regardless of race, color, or national origin, and because communities of color are disproportionately low income.

Background on FTA Guidance

While the FTA provides broad guidance on the relevance of bikesharing for transit agencies, this guidance is limited to general information and the cases where FTA funding can be used for bikesharing capital costs. As of early summer 2021, FTA had not issued guidance concerning any other micromobility modes. In an interview with the research team, representatives from FTA's legal and innovation groups indicated that they had not received any inbound requests from transit agencies seeking clarified guidance on transit agencies' roles and responsibilities as related to partnerships with other micromobility modes (FTA 2020e).

The FTA does not interpret micromobility—including public bikeshare systems—as public transportation.

> The statutory definition (49 U.S.C. § 5302) of public transportation is "regular, continuing shared-ride surface transportation services that are open to the general public or a segment of the general public defined by age, disability, or low-income" (FTA 2020a).

Public transportation is considered "shared ride," in the sense that multiple customers use the same vehicle concurrently. Bikeshare and other micromobility modes are considered "shared use" because individuals do not share the same ride on micromobility devices but instead access a shared fleet of vehicles at different times. There are no plans to adjust or reinterpret the statutory definition of public transportation. Any changes to the wording of the statutory definition of public transportation would require an act of Congress. Under this definition and current guidance, there is also no requirement (nor means) for micromobility rides to be included in National Transit Database (NTD) reporting, even if provided on services subsidized or directly operated by a transit agency.

However, the FTA considers bicycle facilities and improvements to be "functionally related" to transit when they are located within a 3-mile radius of a transit station or bus stop and, therefore, considers them eligible capital investments for some FTA funding programs (49 USC 5302).

The ADA and Expanding Micromobility to People with Disabilities

The ADA applies to transit agency services regardless of whether transit services are supported with federal funding. The Micromobility and the Built Environment section of Chapter 2 discusses possible access conflicts when micromobility devices block wheelchair and pedestrian access to transit stations and stops. Public transit agencies clearly understand their responsibility under the ADA to maintain access to their services; however, transit agencies lack guidance regarding the eligibility of federal capital funds for micromobility infrastructure (beyond bikeshare). Further, the ADA applies to transit agency actions regardless of whether federal funding is used. Therefore, when engaged as a micromobility funding or operational partner, transit agencies could benefit from explicit guidance regarding adaptive micromobility requirements.

Though transit agencies lack specific guidance, some cities have experimented with programs that include accessible micromobility devices. Adaptive micromobility vehicles include hand cycles for individuals with no or limited leg movement; three- and four-wheel cycles for those who need more stability or support; hand-and-foot–powered cycles, tandem cycles, and cycles of smaller sizes. Additionally, the private sector's introduction of e-bikes and e-scooters into the micromobility market has also increased the accessibility of micromobility for people with certain types of disabilities. Individuals who find it difficult to power traditional bicycles unassisted may have an easier time using e-bikes and e-scooters (SDOT 2019a).

Case Studies

Seattle DOT's Adaptive Cycles Program. SDOT found that it had difficulty incentivizing private micromobility operators to provide adaptive micromobility vehicles during its initial free-floating bikeshare permit program in 2018 (SDOT 2018). In the following permit period, SDOT partnered with the nonprofit Outdoors for All to provide adaptive cycles for Seattle residents. Though offered at limited times and locations, Outdoors for All provided free rentals of adaptive cycles throughout the summer of 2019 and brought adaptive cycles to multiple events in Seattle (SDOT 2019b).

Oakland Adaptive Cycles and Scooters Programs. The city of Oakland launched a similar program with a partnership between the Bay Area Outreach & Recreation Program (BORP), an adaptive sports nonprofit, and Bay Wheels (Lyft) to provide access to adaptive cycles. Two days a week during the summer of 2019, adaptive bikes were available to any person with disabilities with Lyft's Bay Wheels app. Additionally, Oakland made adaptive options a requirement for its e-scooter permit program in 2019. Lime has provided e-scooters with a seat, intended for riders unable to use standing e-scooters (Rudick 2020).

The private market provides accessible micromobility vehicles, beyond e-bikes and e-scooters, in limited markets. Cities struggle to find the best way to operationalize a shared, adaptive micromobility service that supports the general transportation needs of people with disabilities. However, the Oakland example demonstrates that with the growth of e-scooters, we may see more adaptive e-scooter devices enter the market, particularly in major urban markets. Transit agencies that partner with micromobility operators or operate their own micromobility systems will benefit from cities' experiences piloting adaptive devices.

Title VI and Other Racial and Social Equity Concerns

Title VI of the United States Civil Rights Act of 1964 protects people from discrimination based on race, color, and national origin in programs and activities receiving federal financial

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assistance. For transit agencies, this covers any activities funded by the FTA (although there are limited FTA operational funding programs).

While the FTA provides guidance on how to apply Title VI generally to all transit agency programs, available guidance is not explicit on requirements related to micromobility operations. In a 2016 "Dear Colleague" letter that serves as key federal guidance on transit agencies' civil rights responsibilities regarding shared mobility, then U.S. DOT Secretary Anthony Foxx wrote:

> Given that communities of color are disproportionally low-income, each public transit agency has an obligation under Title VI to ensure that alternative methods of both payment and reservations are available. Most TNCs [transportation network companies] currently lack accessible vehicles for persons with disabilities, including those who use wheelchairs. When your agency enters into a covered partnership with a TNC, however, you must ensure that your service is accessible to and usable by persons along the full spectrum of disabilities, including both physical and intellectual disabilities (U.S. DOT 2016).

The letter references "service operated under contract or other arrangement or relationship with private entities," but does not name bikeshare, scooter share, or micromobility specifically. Similarly, most of FTA's shared mobility guidance focuses on the ADA and Title VI implications of agency partnerships with ride-hailing and microtransit services. Given the different nature of micromobility as compared to ride-hail or demand-responsive transit options, transit agencies could benefit from more specific guidance regarding micromobility.

However, regarding the applicability of Title VI to public transit and shared mobility in ways beyond what is specifically discussed in its guidance, the FTA does state (emphasis added):

> The Civil Rights Restoration Act of 1987 clarified the broad, institution-wide application of Title VI. Title VI covers all of the operations of covered entities without regard to whether specific portions of the covered program or activity are federally funded. The term "program or activity" means all of the operations of a department, agency, special purpose district, or government; or the entity of such State or local government that distributes such assistance and each such department or agency to which the assistance is extended, in the case of assistance to a State or local government.
>
> Therefore, compliance with this Circular does not relieve a recipient from the requirements and responsibilities of the DOT Title VI regulation at 49 CFR part 21, or any other requirements under other Federal agencies' Title VI regulations, as applicable. This Circular only provides guidance on the transit-related aspects of an entity's activities. Recipients are responsible for ensuring that all of their activities are in compliance with Title VI. **In other words, a recipient may engage in activities not described in the Circular, such as ridesharing programs, roadway incident response programs, or other programs not funded by FTA, and those programs must also be administered in a nondiscriminatory manner** (FTA 2020c).

Beyond Title VI, cities and transit agencies recognize their role in ensuring racial and social equity. As such, jurisdictions regulating or operating micromobility systems have built permit requirements and incentives to expand access beyond owners of smartphones and to low-income communities. Many cities require or provide cash payment options, materials in different languages, non-smartphone access, low-income discount programs, and geographic distribution to underserved areas. Cities are still experimenting with different policy levers to achieve racial and social equity goals, and most recognize that there is a gap in how their regulations translate to outcomes (Santa Monica 2019b).

Rider Experience Implications

Some of the impacts of micromobility on transit rider experience are not yet well understood. The impact of newer micromobility services on transit operations is not well studied, but guidance on designing for bike/transit integration is well established. In 2018, APTA published

"Bicycle Transit Integration: A Practical Transit Agency Guide to Bicycle Integration and Equitable Mobility," which states (emphasis added):

> Business access and transit (BAT) lanes function as on-street ROW for transit buses. These dedicated bus lanes are intended to bypass automobile traffic and allow transit vehicles to run faster and maintain schedules during peak travel periods. On high traffic streets without bike lanes, cyclists may gravitate to BAT lanes for relative safety. While these lower traffic volume lanes (compared with open traffic lanes) may be attractive for cyclists, **the presence of bicycles may interfere with on-time performance and bus operations. On-street separation of bicycles from BAT lanes is generally recommended but sharing BAT lanes may be appropriate in some instances, such as short connections with other bike routes, lower-frequency routes or other unique instances** (APTA 2018)**.**

Shared micromobility services also have the potential to alleviate demand for personal micromobility devices on buses and trains. For example, Caltrain in the Bay Area is studying this potential as it anticipates significant ridership growth over the next 20 years and already has limited capacity for onboard devices. APTA encourages transit agencies to partner with bikeshare operators to produce consistent educational materials on the proper way to integrate bikeshare with transit (APTA 2018), but the specific effect of shared micromobility availability on rider demand for onboard personal devices has not been studied.

Digital Experience

Part of the rider experience comes from the set of digital tools individuals use to navigate a multimodal system. These tools include trip planning, booking, and payment. Often referred to as "mobility as a service," or MaaS, this integration of the digital experience of multiple transportation modes has been posited as a strategy to generate transit ridership, use other sustainable modes, and improve the overall experience of the mobility system. The theory is that "by providing tailored solutions to individual users according to their needs and those of the system as a whole, MaaS enables not only more efficient usage of transport infrastructure, but also a better customer experience" (Veerapanane et al. 2018, quoted in Smith et al. 2020, 163). To date, implementation of MaaS has been limited to a few European pilots, such as Whim in Helsinki and UbiGo in Sweden, but these pilots show promise for MaaS, at least partially due to the integrated digital experience.

Case Studies

UbiGo – Sweden. Implemented in Gothenburg as a 6-month pilot between November 2013 and April 2014, UbiGo created a booking, payment, subscription, and incentive platform for transit, bikeshare, carshare, car rental, and taxis. UbiGo offered a monthly subscription for mobility service packages and rewarded customers with points that could be redeemed for goods and services. A study of the UbiGo pilot found that 44% of participants used private cars less often, and 46% used buses more often. Further, it showed a 50% decrease in private car usage alongside increased use of all other modes except walking (Karlsson et al. 2017).

Whim – Finland. Operational in Helsinki, Whim is a MaaS platform that combines taxis, rental cars, bikeshare, and public transit and the ability to plan, book, and pay for trips. The program offers several mobility subscription packages at different price points. A study of customers' mode choice in 2018 found that program participants were much more likely to use transit than the general population (73% versus 48%), but that participants were much less likely to walk or bike than the general population (29% versus 44%). The study also examined the link between bikeshare and transit and found evidence of multimodal trip-chaining. For example, 12% of bike trips were taken within 30 minutes before a public transit trip, and 30% of bike trips were taken within 90 minutes after a public transit trip (Ramboll 2019).

CHAPTER 5

Agency–Micromobility Partnership Approaches

Transit agencies engage with micromobility providers in a variety of ways, ranging from direct subsidy of operation to informal relationships in which agencies and private operators collaborate without any exchange of funds or risk. As the micromobility marketplace continues to take shape, new types of collaboration between cities, transit agencies, and private operators are emerging to align mobility goals, sensibly regulate, and more effectively provide transit access.

City and transit agency partnership roles may depend on market characteristics such as regional population, demographics, and transit ridership, as well as transit characteristics such as mode or system size. In urban areas with bike- and scooter-supportive infrastructure and large and willing customer bases, private operators are eager to deploy. In this case, city DOTs take a regulatory approach, and transit agency partnerships focus on coordination with the city to ensure station-area parking organization and rebalancing. In smaller markets, where the demand for shared micromobility is lower, either cities or transit agencies might lead with a partnership approach aimed at incentivizing private operators to launch in their region.

But in some markets, especially in areas with static or declining population, private vendors may not be clamoring to enter the marketplace as they are in larger or more affluent metro areas. Still, cities and transit agencies in these areas might decide that micromobility has worthwhile public potential and seek to attract and actively shape the service in ways that are useful for their particular needs. Dayton, OH, Kansas City, MO, and Pittsburgh, PA, described in the following, provide examples of smaller-market agencies partnering with or funding private operators to drive the creation of micromobility systems with strong ties to transit service.

Engagement between public agencies and micromobility providers falls along a spectrum of public/private partnership arrangements, from direct agency operation of micromobility services to more laissez-faire/private-sector–dependent collaborations in which agencies have little or no control over the private operator's activities. This chapter provides summaries of how transit agencies of various types are working to ensure desired policy outcomes in partnerships throughout this spectrum.

Transit Agency–Led Operation or Integration of Services

Some transit agencies have taken the lead by creating their own market incentives or integrating micromobility operations into their transit systems. Partnerships with the greatest level of agency control employ a vendor's vehicles and technology platform, but almost all aspects of ongoing operations, including customer support, rebalancing, charging, and other fleet maintenance activities, remain the responsibility of the public agency or a closely allied nonprofit.

RTA seems to have gone further than any other U.S. agency in its level of operational involvement, but a number of transit agencies in cities large and small have worked closely with micromobility vendors to create systems that are effectively extensions of the transit system and are clearly marketed as such to the public.

RTA – Dayton, OH

In 2019, RTA partnered with e-scooter sharing operator Spin to provide service in the city of Dayton. The unique partnership involves Spin providing the e-scooters and digital platform, while RTA is responsible for the daily pickups, charging, and drop-offs of the scooters. This allows for the agency to be fully responsive to any issues concerning e-scooter parking or access to transit stops (Metro Magazine 2019).

The arrangement evolved from an earlier bikeshare partnership in which the agency was similarly heavily involved. In 2014, seeking to foster an integrated multimodal network complementing fixed-route transit, RTA partnered with the local nonprofit Bike Miami Valley to bring Link Dayton Bikeshare to the region. While operating partnerships between public agencies and local nonprofits are fairly common in bikesharing, the Dayton arrangement was unique in that the transit agency was the owner *and* operator of the service. RTA procured the bikes and dock equipment and provided day-to-day maintenance, while Bike Miami Valley focused on customer service, marketing, and business management. On top of maintaining the fleet, the RTA also provided bike repair services to the public out of a storefront in the agency's downtown headquarters. In 2020, the system was to transition to a dockless, lock-to system and would add 100 e-bikes (increasing the fleet size by 50%). In addition to the roughly 2.5 full-time employees it employs to handle maintenance and the bike shop, the agency provided an annual subsidy to the bikeshare system of about $250,000 (APTA 2020).

When dockless scooters swept through the country in 2019, RTA applied the same agency-operated-and-maintained model to a partnership with the scooter provider Spin (Skinny Labs/Spin 2019b)—a model that appears to be unique among transit agencies in the United States. When the city of Dayton was working on authorizing legislation for scooters, RTA worked closely with it to require that any provider permitted to operate in the city must provide a public API and integrate with the city's chosen mobility app provider (Dayton, Department of Public Works Division of Civil Engineering 2019).

KCATA – Kansas City

In 2019, KCATA approved an agreement with the local nonprofit BikeWalkKC to operate the city's hybrid docked/dockless bike and scooter sharing, as well as to brand all devices with RideKC, the transit system's branding (BikeWalkKC 2019). In addition to the growth of the system with 150 new bikes, the partnership allowed BikeWalkKC to provide combination bike and bus passes that allow unlimited 60-minute bike and local bus rides each month (KCATA 2019).

In an example of services marketed as "powered by" a technology provider, RideKC electric devices are marketed with the branding of platform/vehicle vendor Drop Mobility alongside the transit agency's branding on vehicles, stations, and marketing materials (RideKC Bike 2020).

The COMET/Blue Bike SC – Columbia, SC

Columbia, SC, a city of about 130,000 residents at the core of a region of less than a million, launched docked bikeshare in fall 2018, with 135 bikes (a mix of conventional and electric) and

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18 stations for the program's first phase. The system was equipped and operated by the Canadian vendor Bewegen Technologies, and BlueCross BlueShield of South Carolina was the system's title sponsor (Trainor 2018). Soon after launch, the region's transit agency, the COMET (Central Midlands Transit), a bus-only system that provides about 2.5 million trips per year, entered into a joint partnership with the operator and the city to provide first-/last-mile access to its customers via the bikeshare system (Trainor 2019).

Under the partnership, which began operating in late 2019, COMET riders get unlimited 45-minute bikeshare rides on days when they pay a bus fare. After initially linking their transit fare card with the bikeshare system, users unlock bikes electronically via an app or by tapping a card bearing a daily, multiday, or multi-ride transit pass. Alternatively, riders who pay with cash can ask bus drivers for a unique code, akin to a paper transfer, that will unlock bikes for the day (COMET 2020). Despite the lack of chain of custody for bikes checked out by cash riders with a code, the system has not experienced any equipment loss, according to COMET's executive director (Andoh 2021).

The agency used a portion of its FTA 5307 Urbanized Area Formula Grant funds to support the purchase of bikeshare stations and support transit rider access, activities permitted as "associated transit improvements" under the grant. The agency will dedicate up to $250,000 for the purchase of 10 stations in the system and will pay an annual $70,000 for transit rider access (Trainor 2019). Under the joint agreement, the city and COMET co-manage the system and together make management decisions on station siting and overall operations. The city holds the master contract and handles procurement and right-of-way decisions and permitting, while COMET oversees the transit integration; day-to-day operations and maintenance are Bewegen's responsibility (Andoh 2021). COMET-sponsored stations and kiosks prominently feature the agency's branding, with additional advertising and marketing materials on buses, stops, and at the system's main transfer station.

Other Agency-Affiliated Operational Arrangements: Metro Bikeshare (LA) and MetroBike (Austin)

Several agencies contract with a third-party vendor, separate from the equipment provider, for fleet operations, rather than using their own employees. LA's Metro Bikeshare, administered by the transit agency, is operated by Bicycle Transit Systems using BCycle equipment (Metro Bike Share 2020). The system has stations and bikes in the city of Los Angeles, North Hollywood, Santa Monica, and other LA County cities. From its start, the system was envisioned as a regional service closely identified with the LA County transit agency rather than with a particular municipality (Freemark 2015; LA Metro 2015).

In July 2020, Austin's Capital Metro entered into an agreement to take over co-management of the city's existing 500-bike docked bikeshare system under a partnership with the city of Austin and the system's operator, Bike Share of Austin (Capital Metropolitan Transportation Authority 2020). With support from the agency of up to $2.25 million over 7 years, the system will be administratively folded into the transit agency, rebranded as MetroBike, and incorporated into the transit agency's app (along with bundled pricing in future phases) as part of a broader technological update to the system; there will also be an addition of 200 e-bikes to the fleet (Gates 2020; Thornton 2020a). Bike Share of Austin will continue to handle daily operations, while the transit agency will take over branding, planning, and programming of the system. The system's physical assets, which were originally purchased using Congestion Mitigation and Air Quality (CMAQ) funds, will be owned by the city, which will also manage right-of-way as it relates to the system (Ballentine 2020; Thornton 2020b).

Subsidizing Specific Ride Types or Creating Connections

Several agencies have sought to take advantage of the popularity of micromobility to subsidize or provide services at times and places where transit is not available or to create new first-/last-mile options in their operational areas.

Sacramento RT – Sacramento, CA

As an incentive for passengers to link micromobility with transit, SacRT offered fare-free light-rail trips in December 2019 for anyone who completed a JUMP (shared e-bike) trip within the SacRT service area on the same day. During the program, riders could provide their JUMP receipt to a light-rail fare inspector in lieu of payment. Additionally, the SacRT had nine JUMP charging stations at light-rail stations. This incentive was only in place for a short time, but it provides a model for a market incentive policy to enhance first-/last-mile connectivity with micromobility and could potentially be expanded more broadly (SacRT 2019).

SMART – Sonoma and Marin Counties, CA

In partnership with SCTA and TAM, Marin County's SMART is planning to integrate a new dockless bikeshare system into its rail transit system (Fixler 2020; Prado 2018). This $800,000 pilot received funding through the regional MPO, the MTC. The MTC grant does not cover the ongoing operating costs of the system, so SMART sought a sponsor and partner to help defray operator costs. In February 2020, SCTA and TAM approved a multiyear pilot with Gotcha Mobility to provide a hybrid docked/dockless shared pedal-assist e-bike system. The program will offer a fleet of 300 e-bikes near SMART stations along the 45-mile line. Additional pickup/drop-off locations are planned for popular locations along the rail corridor. Riders will also be able to link their bikeshare accounts to the Bay Area's Clipper card system, which SMART uses to collect fares. The system will provide bicycles at SMART train stations and key destinations along the rail corridor. The goals are "to increase access to transit, promote active transportation and provide a direct first and last mile to SMART, and to give people another option for travel in Marin County" (Prado 2018).

City–Transit Agency Policy Collaboration

Another approach is to use policy levers, enforced through local governments' permitting and regulatory powers, to encourage multiple entities' desired public outcomes without direct outlay or subsidy of private operators by public agencies. City/transit agency partnerships, with formalized, regular means of communication and shared goals, enable more effective planning. While this is a well-established approach in other areas of mutual city/transit agency interest, fewer examples of this type of collaboration exist in relation to micromobility.

Regional Transportation District – Denver

In its strategic plan "Denver Moves: Transit," the City and County of Denver notes that transit agencies share interests with cities concerning micromobility infrastructure and policy (Denver 2019b). The city collaborated with the Regional Transportation District (RTD) to put these shared interests into action in a 2018 micromobility pilot.

Denver's 2018 dockless mobility pilot (covering scooters and e-bikes) built on an existing "transit amenity program" to promote vehicle placement at transit stops and had the explicit

goal of encouraging transit use (Denver 2018). The permit states "vehicles are to be readily available at transit and bus stops in the public right-of-way" (i.e., within 25 feet of the stop/station sign, if a designated parking area is not provided) (Denver 2018). Operators were required to rebalance vehicles back to transit and bus stops throughout the day and to reset vehicles to the same locations no later than 7 a.m. daily (NACTO 2018). At the same time, micromobility vehicles must not impede pedestrian access or boarding/departure of transit users. The city's program was matched by a separate license program by the RTD that provided for painting designated micromobility parking at transit properties in Denver and also at RTD-owned locations elsewhere in its operating area (Figure 32) (Denver 2018; Skilling 2018).

Mobility Hubs

Transit agencies can also partner with cities to plan, build, and operate a system of mobility hubs. Mobility hubs colocate micromobility and other shared mobility services, community amenities, and electric mobility charging infrastructure (among other features) at rail stations and high-frequency bus stops.

Metro Transit – Minneapolis

In Minneapolis, Metro Transit is collaborating with the city of Minneapolis, Hennepin County, mobility service providers, and neighborhood organizations to pilot a mobility hub program. The mobility hubs are intended not only to enhance first- and last-mile connections, but also to serve as centers of placemaking for residents to gather and learn about new ways to travel in the city (Gray 2019). More recently, Met Council (the Twin Cities' metropolitan planning organization and Metro Transit's governing body) issued a request for proposals (RFP) for mobility hub implementation planning across the Metro Transit operating area, with the goal of aligning the Minneapolis mobility hub efforts with separate approaches in St. Paul and elsewhere in the region.

LADOT and LA Metro – Los Angeles

LADOT and LA Metro have developed in-depth concepts for mobility hubs throughout the Los Angeles Region (Urban Design Studio 2019). At writing of this report, Metro and LADOT had released an RFP for their Integrated Mobility Hubs project. The project seeks to provide individuals with mobility choices to accommodate seamless trips to and from origins and destinations through mobility hubs at existing Metro rail stations. There is also a focus on

Source: RTD Denver.

Figure 32. A designated micromobility parking area at an RTD station in Denver.

increasing mobility access for low-income individuals and the recipients of government assistance. The infrastructure and service components of each mobility hub will vary and be context specific, but partnership between LADOT, Metro, and other transit agencies will be essential for the success of the project (LA Metro 2019c).

Toward Full Modal Integration

Move 412 and the Pittsburgh Mobility Collective: Micromobility and Mobility Hubs Within a Comprehensive Consortium-Based Approach

Pittsburgh placed mobility hubs at the heart of a larger consortium-based approach to providing a multimodal suite of public and private mobility services in a pilot branded Move 412. Led by the Department of Mobility and Infrastructure (DOMI) in collaboration with the Port Authority of Allegheny County (PAAC, the transit agency), Healthy Ride bikeshare, and the city's parking authority, the program brings together a group of private mobility and IT service providers called the Pittsburgh Mobility Collective (PMC). The PMC, which came together in 2019 in response to a competitive process run by DOMI (Skinny Labs/Spin 2019a), comprises the following private providers and services:

- Spin (shared scooters and e-bikes)
- Swiftmile (mobility hubs with charging, colocated with transit stops and other mobility services)
- Zipcar (station-based carshare)
- Waze Carpool (ad-hoc carpooling)
- Transit app (integrated multimodal trip planning and payment)
- Masabi (transit fare payment)
- Ford Mobility (data analytics backend) (Skinny Labs/Spin 2019a; Move 412 2020)

A network of 50 mobility hubs will be sited to extend service coverage of the existing transit and docked bikeshare networks. In bringing together a variety of services, along with multimodal trip planning and payment and physical infrastructure, Move 412 is getting close to a complete MaaS approach. The model creates something of a walled garden, with micromobility operations in the city to be permitted only under this program. Along with Dayton, this provides an example of a public agency–led, intentional path for bringing micromobility into a market that private operators may have been slower to reach on their own (Bliss 2019b). The program is an expression of DOMI's guiding principles, which state that all the department's work should be in service of five core aspirations: (1) zero road deaths or serious injuries, (2) access to fresh food within 20 minutes of every home and without the need for a car, (3) short trips are easily and enjoyably achieved without a motor vehicle, (4) all streets and intersections are capable of being intuitively navigated by an adolescent, and (5) the cost of housing plus transportation should not exceed 45% of household income (Move 412 2020).

CHAPTER 6

Suggestions for Further Research

To inform transit agency actions on micromobility, conducting further research on a number of questions related to micromobility, transit, and various strategies for improving their integration could be considered.

- The transit rider experience impacts of shared micromobility have not been widely studied. As with personal micromobility devices, transit agencies have operational interests related to onboard devices, customer circulation around parked devices, micromobility use in the same right-of-way as transit operations, and the digital experience of riders. These subjects could be explored in future research. Specific areas of inquiry include:
  - The interaction of micromobility use with transit operations as the modes and markets mature;
  - The effect of shared micromobility on customer demand for bringing personal bikes or scooters on board transit vehicles; and
  - The transit ridership benefits of multimodal integrated trip planning, booking, and payment.
- A growing body of evidence, including the survey data in this study, suggests that scooters are attracting a different cohort of riders than more bicycle-centered micromobility has done thus far, with younger riders, women, people from lower-income households, and non-white people appearing to favor scooters over micromobility generally. Further research could use data on these nontraditional users' ongoing ridership (as opposed to adoption rates) and usage as the modes mature.
- In the regions where scooter trips were observed for this study, it was possible to say that trips were starting and ending *near* transit, but the data limited the ability to make stronger conclusions about the links between modes. Future studies could examine trip chaining and mode shift to provide a clearer picture of these connections.
- As the COVID-19 pandemic subsides and its longer-term impacts on transportation become clearer, the public understanding would benefit from an analysis of micromobility's role during the crisis—especially during lockdown periods and when widespread working from home began.
- Other areas of research interest are:
  - Outcomes from explicit transit agency–micromobility integrations, especially in smaller markets;
  - The effectiveness of city, transit agency, and vendor attempts to increase access for people with disabilities, people with low incomes, and other disadvantaged groups through micromobility regulation and partnerships;
  - The adequacy of permit fees and fines to support enhancements to micromobility infrastructure;
  - Outcomes from U.S. experiments with mobility hubs since most research to date comes from European implementations but an increasing number of jurisdictions have begun working on their own interpretations.

CHAPTER 7

Partnership Toolkit

As this study has established, transit agencies and cities have differing roles and interests when it comes to interacting with private micromobility operators. In short, cities regulate, while transit agencies partner. In most cases, the overall parameters regarding whether and how micromobility operates in a jurisdiction will be out of a transit agency's hands, so the agency must work closely with municipal departments to ensure that transit agency interests are considered as part of micromobility's regulation.

For public transit agencies that are interested in going further and pursuing more direct engagement with micromobility providers, this Partnership Toolkit proposes a set of concrete steps that will help agencies decide on why and how to build micromobility partnerships, define goals, and measure success. (In addition to distilling the findings of the main body of this study, the Partnership Toolkit draws on partnership frameworks and recommendations outlined in several TCRP and SUMC publications: Curtis et al. 2019; Gururaja and Faust 2019; Peterson 2019; Murphy et al. 2019; and Yanocha et al. 2018.)

In addition to suggested steps and decision-support tools for establishing a micromobility partnership, this chapter also includes a concise list of the case studies and pilot examples in the report as well as links to key partnership and procurement documents, agreements, administrative rules and regulations, and statutes that are available.

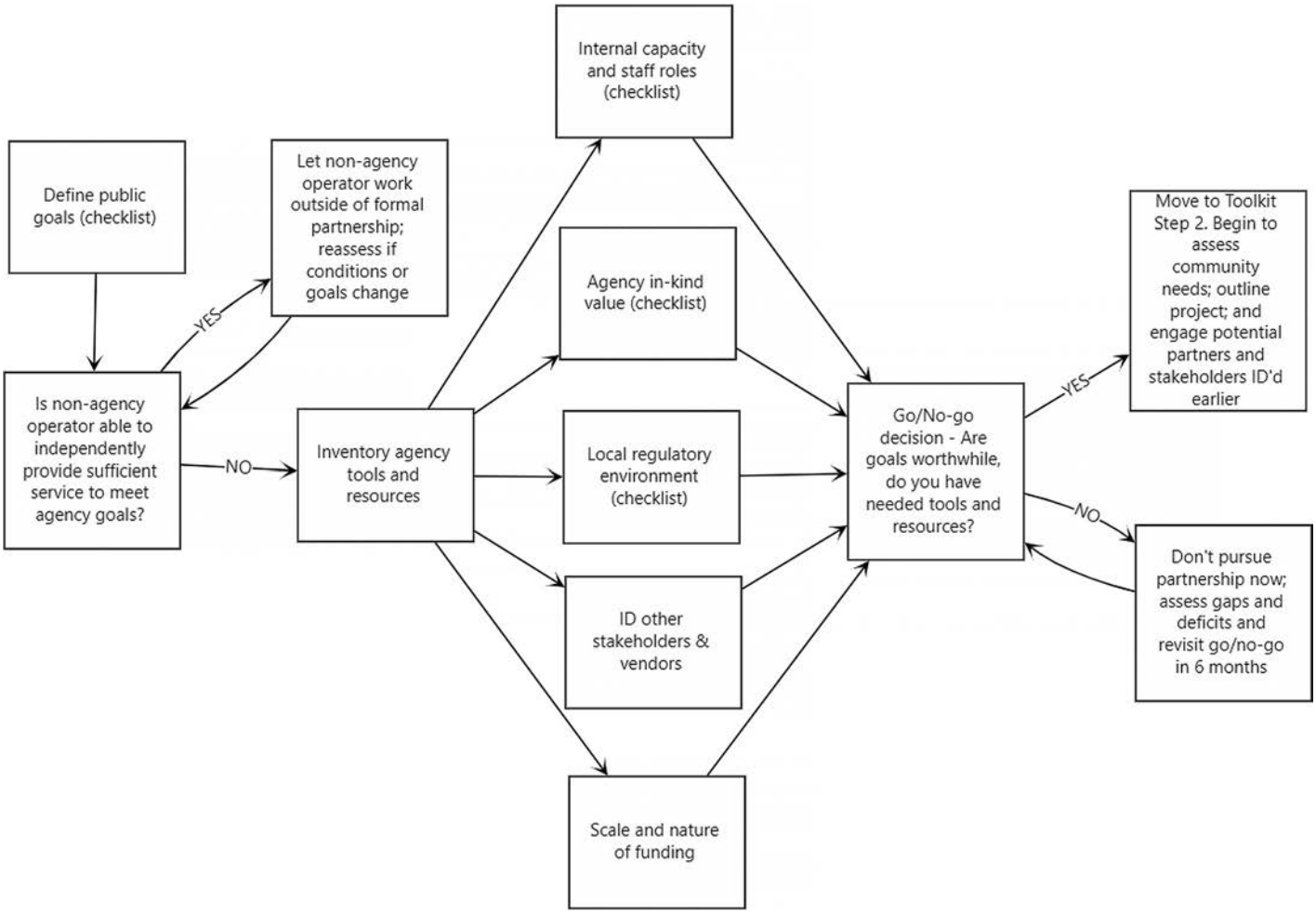
Toolkit

1. Prepare for Partnership

Decision Tree: Whether to Pursue a Partnership

Figure 33 provides a suggested means for assembling the information and making the initial decision on whether a micromobility partnership is something that makes sense to pursue. Each of the nodes is described later in this step, and boxes marked "checklist" refer to supporting checklists and explanations on the following pages of the toolkit. If a "go" decision is indicated, the checklists will provide key information needed to support decisions in later steps.

Define the public goals or policy objectives a micromobility project would help reach or the agency challenge it will help address. (A fuller treatment of these goals and policy objectives can be found in Chapter 2: Regulatory and Policy Review, particularly in the Transit Agency's Regulatory Role section; examples of individual agencies' goals can be found in Chapter 5: Agency–Micromobility Partnership Approaches. Key studies and pilot examples cited in the text are listed at the end of this toolkit.) Whether an agency is considering soliciting proposals or has been approached by a vendor, it should be able to articulate the problem a micromobility partnership would solve. Ideally, these goals should connect to larger transportation



Note: Boxes marked "checklist" refer to supporting checklists and explanations on the following pages of the toolkit.

Figure 33. Decision tree: whether to pursue a partnership.

strategies, plans, or processes in the region, such as comprehensive planning, bike and pedestrian master plans, and multimodal access plans.

Checklist: Define Public Goals (See Table 4)
Choose from among the common agency goals in Table 4 for micromobility partnerships, or add others. If applicable, list the strategy documents, plans, or authorities that provide the goals.

Decision: Assess whether micromobility providers/non-agency operators are likely to independently achieve the agency's identified goals or whether agency involvement is needed to make things happen.

If the activity toward achieving those goals is already taking place, or you otherwise have reason to believe greater public involvement is unlikely to be needed at present, pause the process of pursuing a partnership for now and revisit if goals or conditions change.

Otherwise, begin to inventory tools and resources at your disposal for pursuing a partnership: **Inventory the tools and resources at your agency's disposal, as well as what is outside of its control.**

Checklist: Internal Capacity and Staff Roles (See Table 5)
Take stock of internal capacity to manage a collaboration and engage with partners; this process can also help identify areas where additional staffing or organizational changes may be needed

Table 4. Checklist to define public goals.

✓	Goal	Plan or Authority
	Increase the accessibility of the transportation system	
	Equitably distribute mobility choices	
	Reduce automobile dependency; create safer and easier travel for people outside of cars	
	Improve local/regional mobility, reducing congestion	
	Expand the area readily accessible by transit	
	Fill transit service gaps/provide alternatives	
	Relieve peak-hour crowding on transit vehicles	
	Reduce car parking pressure near stations	
	Reach new customers	
	Expand service offerings for existing customers	
	Reduce demand for personal bike/scooter storage/transport	
	Organize micromobility parking near stations	
	Add non-auto options for station access	
	Other (list)	

to move a partnership forward. Depending on the size of the agency and potential partnership, several of these functions may be combined in a single office or for a single staff member.

Understand the scale and nature of available funding sources, including limitations on their application. Especially in markets where micromobility providers have not already arrived, some level of subsidy may be necessary, and for capital-intensive docked or hybrid systems, it almost certainly will be. Beyond government monies, sponsorship and advertising are common components of the micromobility funding picture.

Checklist: Agency In-Kind Value (See Table 6)
Beyond funding, understand what other value the agency can offer that is beneficial to private operators or their riders (especially if it is possible to offer/award it in a way that provides exclusive or preferential access to a smaller number of vendors). Some typical examples are to:

- Think through the stations, parking lots, storage/maintenance facilities, and other agency assets that may be relevant to a project.

Table 5. Internal capacity and staff roles checklist.

Role	Team Member/Department
Project management	
Capital and infrastructure planning	
Operations planning	
Procurement and contracting	
Legal/legislative	
Data handling and analysis	
Labor relations	
Construction	
Marketing and communications	
Community outreach	
Other	

Table 6. Agency in-kind value checklist.

✓	Value or Benefit to Operators	Possible to Offer Preferential/Exclusive?
	Access to key locations on public way	
	Access to key locations off public way (on agency property, parking lots, etc.)	
	Dedicated parking at transit stops	
	Trip planning/payment integration with agency app	
	Marketing support/tie-ins	
	Advertising locations on transit vehicles/stops	
	Direct communications with potential customers	
	Association with trusted local brand	
	Other	

- Identify other stakeholders: existing mobility providers (especially incumbent bikeshare systems) and trip-planning, ticketing, and data aggregation vendors; community organizations and advocates; local institutions, key businesses, and potential sponsors; and the community itself.

Checklist: Local Regulatory Environment (See Table 7)
Outline the local regulatory environment for micromobility, including key departments responsible in the jurisdiction(s) where a program might operate.

Decision: Based on this inventory of goals and resources, make the initial go/no-go decision of whether a micromobility partnership is both worthwhile (in terms of goals and potential benefits) and possible for your agency given its resources.

2. Engage Partners, Assess Needs, and Outline the Project

- Once you get started, be flexible and ready to iterate the partnership's specific form.
  - Approach potential partnerships not as singular events but as processes that will need to be regularly monitored and revisited. Build in opportunities to reflect on and refine the partnership. Map out possible phases for the gradual expansion of a successful program.

Table 7. Regulatory environment checklist.

Public Responsibility	Agency/Department
Public way	
Streets	
Sidewalks	
Transit stations	
Parking lots/structures	
Utilities	
Vehicle permitting	
Business permitting	
Construction	
Signage/wayfinding	
Advertising/sponsorship	
Data sharing/aggregation	
Law or code enforcement	
Other	

  - Whether you intend to create a one-off pilot or embark on a path to a permanent program, lay out a flexible process that allows for a cycle of information gathering, experimentation, performance monitoring and evaluation, and refinement (or, if appropriate, ending) of the partnership approach.
- Activate the internal team, starting with the project manager. Early on, create a succession plan in case the project manager changes roles or leaves the agency.
- Identify and engage potential project champions within your organization and in the wider community. Contact local stakeholders, particularly local DOTs or other regulators, to alert them to the project development underway.
- Define the project's potential customer base and assess their needs:
  - If you're focusing on a specific geography or community, perform a needs assessment that establishes existing levels of transportation access, walkability, and infrastructure and opportunities for improving access with micromobility. If the city or another entity is already ingesting micromobility usage data locally, this should be part of the picture.
  - Survey or meet with residents and community leaders to understand needs for reduced-fare options, non-smartphone access, cash or retail options for unbanked people, and translation of apps and program materials.
- Based on this assessment, define the geographic or community focus of the project, including identifying disadvantaged or historically underserved communities within the bounds you determine.
- Understand the outside operators' business cases (including private, nonprofit, and other models) and potential roles in a partnership.
  - Micromobility is a low-margin business, and as with any other good or service, operators in the sector must remain solvent to continue providing a product that agencies and the public find valuable. Transit agency partnerships can be appealing due to their potential to reach new users and markets, secure predictable revenues through subsidy or other funding support, or bolster an operator's reputation through association with a trusted local agency. But a project may have trouble attracting private partners if it creates excessive requirements, unnecessary regulatory burdens, or hurdles for participation (e.g., in insurance levels, fare integration, and data sharing) beyond what is already in existence in the local environment.
  - Equitable distribution of mobility choices and safer travel for people outside of cars should be core goals for all transportation programs. Beyond the service itself, cities and agencies should work together to provide supportive investments in safe infrastructure or link to other efforts like complete streets, mobility hubs, and so forth that can make micromobility (as well as general public biking and walking) safer and more equitable throughout the jurisdiction. Public agencies should be realistic about the ability of private startups (even those backed by considerable venture capital) to provide solutions for decades of neglect of communities and infrastructure.
  - Consider issuing a request for information (RFI) to better understand potential vendors' product features, limitations, and business needs. The RFI could include a draft project scope and could ask respondents to reflect on its realism in light of their capacity and offerings. Requesting cost estimates will also help inform the level of funding the project may need to secure.

3. Set Project Parameters and Secure Partners

- Based on the information gathered and relationships established in previous steps, set the parameters for the initial round of the partnership.
  - Define the specific services that the partnership should encompass as well as the geographic, regulatory, and other broad requirements within which it must operate.

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  - Map out operating areas, zones of special focus (e.g., equity priority areas, station areas), and other physical assets that will be part of the project. Define other parameters, such as hours of availability, transit lines, or routes where service will be focused.
  - Outline customer service and equity requirements, such as response expectations, discount programs, and access for people without smartphones or credit cards, and related outreach.
  - Identify operational parameters that will be subject to performance-based incentives, such as fleet caps, service areas, or fees.
  - Establish a budget and secure funding commitments from the parties or entities identified previously. Also decide if a performance bond or other risk-protection mechanism will be required.
  - Create a data policy that balances user privacy with agency needs for monitoring and evaluation and that is, ideally, in alignment with the local DOT. Also include any required collaboration with a third-party vendor or data aggregator. As data sharing and collaboration between multiple vendors are often sticking points in negotiations and implementation, identify the essential components of the policy.
- Establish the priority of the requirements identified previously—rank or score according to what is "must have" and what is "nice to have."
- Issue an RFP or other competitive call for partners (or respond to unsolicited proposals) with the specific requirements developed in the previous steps and the previously enunciated agency goals at the core.
- Evaluate proposals based on the established priorities.
- Negotiate the partnership agreement with one or more partners, folding them into the iterative process already underway through a flexible agreement that allows for the business relationship to be evaluated and revisited.
  - As part of the contract requirements, agree on the performance measures and data-sharing arrangement through which information will be provided to the agency and the frequency with which this will be evaluated.
  - Set the timeline for the partnership's evaluation and decision on its renewal, expansion, or winding down.

4. Launch, Operate, and Monitor

- Engage local stakeholders and project champions in preparation for launch.
  - Center the project's public goals in outreach efforts and marketing materials.
  - Focus on reaching new users in their own communities and through trusted voices. Use the transit agency's and the private partners' communication and advertising channels to reach a broader audience.
- Launch the partnership and begin to measure progress.
  - Check compliance with data-sharing agreements early in the performance period.
  - For programs that involve a public subsidy or other outlays for specific trips or locations, perform field checks to ensure that geofences, coupon codes, and so forth are working as agreed.
- Begin to compile regular performance reports based on key performance indicators (KPIs) and report to the stakeholder group, both within and beyond the agency.

5. Evaluate, Refine, and Start Again

- After enough time for the program to get on its feet (at least 3 to 6 months), begin to formally evaluate the partnership against its broader goals in addition to ongoing performance monitoring.

- Be prepared to adjust the parameters of the partnership or service midstream in response to changing KPIs and findings of the program evaluation or as unforeseen challenges or needs arise.
- Continue to provide stakeholders with regular performance reporting and periodic reports on the progress of the evaluation.
- After a set duration or budget expenditure, make the decision on whether to continue the partnership in its current form, expand it (e.g., to more partners, more stations, or a larger area), reduce it, or start to wind it down.
  - As part of this decision, think about the path for a project's transition from a pilot to a more permanent service offering by the agency and how this would change the shape of the partnership in the next iteration.
- Regardless of the decision on continuing the project, make the data and operational lessons created during each phase of the partnership as public as possible. This will both inform future service planning within your agency's service area and provide other agencies with more knowledge on how to build better partnerships for themselves.

Key Case Studies and Pilot Examples

The following case studies or example pilots, with information relevant to conceptualizing or forming partnerships, are described in the main text. They are summarized here for quick reference by readers seeking models for specific policy goals or challenges. This section also contains links to key documents relating to the case studies.

Implications for Transit Agencies

Transit Agency Funding for Micromobility

- Dayton RTA, KCATA, LA Metro, the COMET (SC): Public funds used to support micromobility for transit rider connections (details in Chapter 5).

Private Infrastructure Funding

- Portland, OR: Micromobility fees support program administration and enforcement, safe travel infrastructure, dedicated parking, and equitable access.
  - Administrative rule: https://www.portlandoregon.gov/citycode/article/690212.
- Phoenix and San Francisco: Company-funded scooter docking/charging stations near transit.

Expanding Micromobility to People with Disabilities

- Seattle: Nonprofit partnership to provide adaptive cycles.
- Oakland: Scooter permit program requires all operators to provide adaptive scooters and accessible apps.
  - Permit terms: https://bit.ly/3l8KbWX.

Agency–Micromobility Partnership Approaches

Transit Agency–Led Operation or Integration of Services

- Dayton RTA: Direct agency operation and maintenance of bikeshare and scooter services, with vehicles supplied by vendor; cooperation with chosen data aggregator required by municipal administrative rules and regulations.
  - Scooter service agreement: https://www.apta.com/wp-content/uploads/Spin-Agreement.pdf.
  - City administrative rules: https://www.apta.com/wp-content/uploads/Electric-Transportation-Device-Rules-and-Regs-2.pdf.

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- KCATA (Kansas City): Close collaboration with nonprofit operator for agency-branded bike and scooter operations.
  - Sponsorship agreement: https://bit.ly/3bxy3vn.
- The COMET (Columbia, SC): Agency-subsidized bikeshare stations, free rides for bus users. Uses FTA 5307 "associated transit improvements" funds to finance system expansion and transit connections.
- Metro Bikeshare (LA): Agency-branded bikeshare with third-party vendor and separate equipment supplier.
  - Board report and resolution: https://boardagendas.metro.net/board-report/2015-1107/.
- Capital Metro (Austin): Inter-local agreement with city to co-invest and co-manage local bikeshare program, which is branded as an extension of the transit agency.
  - Inter-local agreement (p. 67): https://bit.ly/3v5ARrD.

Subsidizing Specific Ride Types or Creating Connections

- SacRT (Sacramento, CA): Free light-rail trips for same-day dockless bikeshare users; e-bike charging hubs deployed at stations.
  - Offer details: https://www.sacrt.com/apps/sacrt-to-offer-free-rides-on-light-rail-to-jump-bike-users/.
- SMART (Sonoma and Marin Counties, CA): Hybrid e-bikes deployed at rail stations and key locations in rail corridor.

City–Transit Agency Policy Collaboration

- Denver RTD/City and County of Denver: Interagency collaboration on micromobility parking program to promote vehicle placement and rebalancing to stops throughout city and regional transit service area. City permit program harmonized with RTD license program and designated micromobility parking at agency-owned locations; also intended to limit interference with pedestrians.
  - City permit requirements: https://bit.ly/2PGwN0u.
  - RTD dockless guidelines: https://bit.ly/3bv8k6Y.

Mobility Hubs and Modal Integration

- Metro Transit (Twin Cities, MN): Transit agency collaboration with city, county, mobility providers, and neighborhood organizations to pilot mobility hubs for multimodal connections and placemaking.
- LADOT and LA Metro: At key rail stations, a system of multimodal hubs, including bikeshare, microtransit, and coordination with other shared mobility and mobility-on-demand services. Includes payment integration and connections to other community institutions and social services.
  - Integrated Mobility Hubs RFP: https://www.citymart.com/bids/lamobilityhubs.
- Move 412/Pittsburgh Mobility Collaborative: Consortium-based approach to providing a multimodal suite of mobility options, including shared bikes and scooters, mobility hubs with charging, carshare, carpooling, and apps to facilitate unified payment and information.
  - Program information: https://www.move412.com/what-is-move-pgh.
  - Selected proposal: https://cdn.theatlantic.com/assets/media/files/pittsburgh_rfp.pdf.

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APPENDIX A

Data Methodology

Travel Survey

The travel survey discussed in Chapter 3: Micromobility Users and Utilization was derived from the Populus Groundtruth dataset, which consists of representative data on transportation decisions, including public transit use, vehicle ownership, and new mobility service adoption and utilization, ride hailing, carsharing, bikesharing, and e-scooter sharing. The data in this report focus on the scooter users surveyed and the decisions they made around micromobility use and transportation choices.

The results summarized here are based on a representative sampling of the populations of 18 metro areas: Atlanta, Austin, Boston, Chicago, Denver, Houston, Knoxville, Los Angeles, Memphis, Nashville, New York City, Portland, San Antonio, San Diego, San Francisco, San Jose, Seattle, and Washington, D.C.

For the purposes of this analysis, the researchers examined Populus data collected from mid-May to mid-October 2019 from over 15,000 individuals. Based on rigorous methods, key demographic variables (age, income, race, and gender) from this sample match those of the actual populations at the metro level.

The 18 metro areas were grouped by common population and transit metrics gathered from U.S. Census data, which helped to condense the results' reporting. The metrics used to group the metro areas included population, population density, housing unit density, gross domestic product per capita, and transit ridership per capita. Based on the grouping, most of the metro areas sampled fell into the low-density, low-transit-use cluster. After reviewing the cluster standard error, the researchers found that it was not advantageous to increase the number of groups as it increased the error.

Micromobility and scooter adoption by region was associated with the home region of the person surveyed. For example, a person who resides in New York City who had tried using a shared scooter while visiting San Diego would be counted as a scooter user who would be included in the New York regional sample.

Weighting by Frequency of Use

The results presented in the How and Why People Use Scooters section of Chapter 3 are based on trip-weighted responses, with weights equivalent to estimated monthly scooter ridership based on reported frequency of scooter use. While over 1,500 survey respondents had used shared electric scooters, some users were regular, frequent riders (daily or almost daily), while others had not ridden a scooter in the previous 3 months and may have only tried using them once while traveling. This trip-weighted method of analysis better reflects the impacts of the use of shared electric scooters in accordance to their actual utilization.

Micromobility Data

Populus used two sets of data on micromobility for the Micromobility Usage Patterns and Impacts section of Chapter 4:

- Trip data obtained from docked bikeshare systems, and
- Trip data from dockless shared-scooter operators (with their permission and the permission of the cities where they operate)

The scooter data were not collected specifically for this project but were used in an aggregated form so that individual trips and sensitive information about individual users and scooter company operations were obscured.

Docked bikeshare data were cleaned to only include the regions in which the researchers were interested and over the time frame needed for the data comparison.

Scooter trip data were used in the transit analysis to look at trips starting and ending around transit locations. For the maps of scooter usage in Chapter 4, data were aggregated by location (i.e., no individual trips are identified) and across operators. Trip origins and destinations were aggregated in hex-style representations to create a grid of equal size areas. Each hex area has an edge-to-edge length of approximately 175 meters. For each region, 1 month's worth of data (from October 2019) were used. The darker areas are those with more trip origins or destinations. Actual counts are not shown and vary by region. The maps show the relative count quantiles specific to that region.

APPENDIX B

Digital Policy and Compliance

Digital policy, compliance, and enforcement are important tools in shared micromobility programs as they help ensure that city and transit agency policy outcomes are achieved.

- **Digital policy –** The universe of data-driven procedures, tools, and policies that a city or regulating agency uses to manage a micromobility system operating within its jurisdiction.
- **Compliance –** Cities and regulating agencies use micromobility data that are shared with them or that they are able to collect to understand if operators are in compliance with agreed upon regulations and service-level agreements. Performance data convey whether providers are operating in agreed upon areas adhering to geofenced areas, meeting their maximum fleet deployment, and responding to complaints in a timely manner.
- **Enforcement –** When providers are shown to not be compliant with service-level requirements and other digital policies, regulating agencies can impose fines and other penalties to ensure compliance in the future. Enforcement actions can range in severity and include impounding improperly parked devices, limiting legal fleet size, fines, suspension, and revocation of permits.

Different Approaches to Digital Policy, Compliance, and Enforcement

The following sections show examples from cities with a range of different approaches to digital policy, compliance, and enforcement of micromobility operators. These examples focus on municipalities as opposed to transit agencies. As discussed previously, cities regulate micromobility, and to enact digital policy with transit operations in mind, coordination is critical.

Passive Digital Policy

Early in the development of municipal dockless mobility programs, cities began experimenting with geofences—a tool to communicate that specific rider or mobility service provider (MSP) behaviors are disallowed or required. These actions include disallowing riding in a specific zone, reducing the maximum operable speed in a specific zone, requiring trips ending in an area to have vehicles left in a designated parking area, slowing trips to a stop in a specific zone, disallowing MSPs from deploying vehicles in a specific zone, and requiring MSPs to deploy in a specific zone (including predetermined daily deployment numbers).

Early examples in the development of digital policy include:

- Santa Monica establishing a no-ride zone along a linear beachfront bike path,
- San Antonio establishing a no-ride zone around the Alamo national monument, and
- Portland (OR) preventing riders from leaving scooters in city parks and on important multi-use paths.

While geofencing is an important tool for cities and transit agencies to achieve positive operational, safety, and policy outcomes, one-way communication of digital policy without establishing a compliance protocol or a means to communicate performance eliminates cities' ability to understand the impact, viability, and efficacy of geofencing tools. This passive approach to digital policy does not allow for enforcement or ensure consistent application of the digital policy as designed by the public agency.

LADOT and Active Digital Policy

LADOT has taken a much more proactive role in developing digital policy to meet public mobility and right-of-way management objectives. LADOT has also established a clear nexus between outcomes, service-level agreements (SLAs), and compliance thresholds and enforcement actions. In 2019, LADOT established a special operations zone (SOZ) in Venice, which sought to address vehicle oversaturation and illegal riding on the Venice boardwalk and canals and to reduce vehicle speeds to 0 miles per hour. LADOT's hypothesis was that stronger use of digital policy to enforce parking and deployment rules would ensure a more organized public right-of-way.

The SOZ's impact was clear: MSPs adhered to restrictions on scooter deployments, and the existence of geofences led to dramatically lower presence of scooters on the Venice boardwalk and canals. LADOT also leveraged several enforcement actions once infractions were proven through MDS data. While this more sophisticated approach requires resources and investment in MDS technology, development and implementation of digital policy and compliance checking has proven to be more effective than passively requiring a type of geofence to be implemented.

While transit agencies like LA Metro have begun to experiment with geofenced parking and deployment incentives and restrictions at transit stations, digital policy and active compliance and enforcement should be developed and monitored in partnership with the cities that permit shared micromobility services. This will lead to more robust digital policies that reduce potential externalities (e.g., MSPs creating their own exclusion zones that respond to onerous parking fees set by transit agencies).

MDS, Communities Against Rider Surveillance, and Privacy

The MDS is a critical tool for establishing and ensuring the success of the Venice SOZ. MDS is an open-source system that communicates information and policy details between public agencies and MSPs operating in the public right-of-way. MDS enabled LADOT to convey and monitor adherence to digital policy.

Originally pioneered by LADOT, the specification is now managed by OMF. Over 80 cities and transit agencies have adopted MDS and can collect historical and real-time trip and vehicle status using MDS. MDS provides the structure for MSPs to share data with cities and also allows cities to communicate directly with MSPs through digital code.

Some organizations and MSPs have expressed concern about the ability to re-identify specific people using MDS trip data that have been anonymized and do not have the appropriate protections and management protocols established. In February 2020, amid a dispute between Uber and the city of Los Angeles over data-sharing requirements, an Uber-backed coalition established Communities Against Rider Surveillance (CARS), a group of community organizations that is raising awareness of privacy concerns and protesting MDS being imposed by governments.

While the debate around mobility data and privacy will continue, cities and transit agencies can adopt privacy principles, establish data use protocols, and partner with data platforms to ingest, aggregate, and safely visualize digital policy performance.

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAST	Fixing America's Surface Transportation Act (2015)
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GHSA	Governors Highway Safety Association
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TDC	Transit Development Corporation
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S. DOT	United States Department of Transportation

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