E-SCOOTER

PILOT EVALUATION

CITY OF CHICAGO — MAYOR LORI LIGHTFOOT

JANUARY 2020

CHICAGO

LETTER FROM THE COMMISSIONERS

Dear Chicagoans,

You might have seen people riding electric scooters in some neighborhoods last summer. The City of Chicago piloted this emerging mobility alternative for the first time in 2019 with 10 providers renting e-scooters in west and northwest side neighborhoods. We wanted to use the pilot to test if e-scooters fit our priorities of increasing equitable neighborhood access to safe and affordable transportation options while lowering congestion and emissions. We hoped that people might use them to replace cars for short trips, connect to public transit and reduce their environmental footprint. We also wanted to see how challenges inherent to this new form of mobility, including sidewalk clutter, impact on people with disabilities and safety concerns played out over the duration of the pilot.

We are excited to see this comprehensive analysis and evaluation of the pilot being made available to the public. We applaud our BACP and CDOT teams for carefully designing the pilot program with a focus on equity and inclusivity, and for effectively managing the pilot without major issues. However, the program was not without challenges, specifically in regards to compliance, sidewalk management and concentration of rides. This evaluation provides a detailed analysis of those successes and challenges, along with lessons learned and ideas for going forward.

The City also encouraged feedback from the community and stakeholder groups on the e-scooter pilot and used this information as part of the following evaluation. The responses received highlight opportunities and challenges of e-scooters. While it is encouraging that e-scooters improved transportation access for many within the pilot area, it is also clear that they raise challenges that still need to be addressed as this mobility option is considered as a longer term option in our city.

We recommend a second pilot to put the findings of this evaluation into action. Over the next few weeks and months we will be listening to the public and stakeholders and we look forward to continuing the conversation into 2020.

Sincerely,

Rosa Escareno
Commissioner, Business Affairs
& Consumer Protection

Gia Biagi
Commissioner, City of Chicago
Department of Transportation

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Overview

Electric scooters, or e-scooters, are emerging as an alternative mode of transportation in cities across the United States due to the promise that they will enhance mobility, replace short car and ride-hail journeys and bridge the 'last mile' to and from public transit. However, this new mobility option has also brought operational challenges to cities, including safety concerns, sidewalk clutter and impacts on people with disabilities. To evaluate whether e-scooters can provide a sustainable, safe and equitable method of transportation for residents and to analyze the performance of e-scooters in conjunction with riders' characteristics and behaviors, the City of Chicago hosted a shared E-Scooter Pilot Program from June 15, 2019 to October 15, 2019.

Ten companies were issued Emerging Business Permits through the Department of Business Affairs and Consumer Protection (BACP) to operate 250 e-scooters each within a specified area on the northwest and west sides of the city. The characteristics of the service area enabled the City to evaluate the impact of e-scooters in a diverse demographic and geographical area with variations in access to transit or other forms of mobility. The framework and defining characteristics of Chicago's pilot program drew upon previous shared e-scooter programs in other cities as well as experience from the City's 2018 dockless bikeshare pilot. This evaluation provides an overview of the pilot along with an analysis of the key findings, focusing on utilization, equity, safety, company compliance and impact on the community.

E-scooter Utilization

Between June 15 and October 15, 821,615 e-scooter trips were reported by participating companies. Due to data downloading issues stemming from the difficulty involved with achieving perfect data compliance, 664,975 trips were available for analysis. As would be expected with a new transportation technology like e-scooters, a significant portion of the rides available for analysis appear to have been test rides or 'laps' that started in much the same place as they ended. To focus on e-scooter use as a transportation mode, those 'lap' rides were excluded for this analysis, leaving 407,296 trips to be analyzed.

Over the duration of the pilot, there was a significant decrease in e-scooter trips – the last week of the pilot saw half of the number of trips as the first week. E-scooters were used most frequently during the evening rush period on weekdays and between 3 and 4 pm on weekends. Despite regulations requiring e-scooter placement in priority areas, 77 percent of trips started or ended in the eastern, non-priority area of the pilot zone. The demand for e-scooters was concentrated in denser areas with other transportation alternatives available.

The data collected show that nearly half of all e-scooter trips started or ended near public transit[1], which includes bus stops. However, this does not provide any insight as to whether users were using e-scooters to replace a trip that could otherwise have been made by transit, versus connect to transit (i.e. using it for a first-mile or last-mile connection), or neither. Of survey respondents, 34 percent indicated they used e-scooters to connect to transit, but 22 percent indicated that they rode the bus less often and 13 percent indicated that they rode the train less often than prior to the pilot. Overall, there is still reason to question if e-scooters will increase transit use.

Finally, it is important to note that 30 percent of survey respondents indicated that they used an e-scooter to replace a trip that they would have otherwise made by walking. While this type of shift may have benefits for increasing convenience and overall transportation choices, it also has implications for sustainability and public health that should be considered.

Equity

A key characteristic of Chicago's e-scooter pilot program was the requirement that companies distribute half of their e-scooter fleets within the designated northern and southern priority areas each morning, in order to ensure accessibility to underserved community areas. Compliance with this requirement varied, with none of the 10 companies consistently meeting the 25 percent requirement in each area for their first deployment in the morning. Despite failing to achieve this metric, the rebalancing requirements did appear to increase e-scooter availability in underserved communities, particularly earlier in the day. However, the data submitted showed that e-scooter availability fluctuated based on time of day and location. By the evening rush period, potential riders in the West Loop and Milwaukee Avenue corridor were more than likely to find at least one available e-scooter within a half mile, while in the other pilot areas, e-scooter availability was less dependable the majority of the time.

[1] Trips were identified as near transit if they were within 60 feet of a bus stop or 300 feet of a rail station. The reason for the larger radius for rail stations versus bus stations is that the rail station locations are based on platform location and not entrance location; as a result, 60 feet is too short of a distance to capture e-scooters parked near the entrance to, for example, Blue Line stations in the middle of the expressway.

Company Compliance

To further regulate the geographical operation of e-scooters, geofencing technology was used to set e-scooter boundaries to remain within the pilot area, and to prevent use on trails such as the 606. While compliance preventing use on the 606 improved over the course of the pilot as the City continued to engage with the companies, geofencing trails and smaller geographies proved to be challenging. However, the geofencing of the pilot area as a whole proved to be successful, with relatively few e-scooters operating outside of the designated zone.

The City used data feeds and field enforcement to bring about compliance from the companies participating. However, inconsistencies in the data feeds from some of the companies made full compliance difficult, and the inclusion of 10 companies created challenges that could have been avoided with fewer companies participating.

Safety

The safety implications of e-scooters as a mode of transportation is still being determined. During the pilot, the Chicago Department of Public Health asked Illinois hospitals to report e-scooter injuries. In total, 192 probable Emergency Department visits were reported from June 15 to October 15 due to e-scooters. However, these results should be interpreted very cautiously due to a number of limitations outlined in the e-scooter injury analysis section.

Impact on the Community

To assess the performance and public reception of the e-scooter pilot, the City engaged with various stakeholders to develop the pilot and throughout its duration. Meetings were held with transportation groups, disability advocates, local chambers of commerce, community organizations and other stakeholders. Recommendations from these groups were used to develop the terms of the pilot, to make changes during the pilot and to inform the recommendations in this evaluation.

Additionally, the City conducted a month-long public online survey between September 24 and October 27, 2019. The demographics of the survey respondents represented a higher share of white, higher income and more educated participants than the overall demographics of the pilot geography, although rider respondents were more diverse than non-rider respondents.

In addition, most e-scooter riders were infrequent users, with 49 percent of riders having taken only one ride on a given company's e-scooters, while only 15 percent took five or more rides.

Survey respondents indicated that they were using e-scooters as alternatives to multiple modes, including ride-hailing services, walking, driving a personal vehicle or taking a CTA bus. However, when compared with actual data on ride-hail and Divvy trips, it appears that survey responses may overestimate the extent to which e-scooter use caused significant mode shift. All told, 59 percent of survey respondents thought shared e-scooters companies should continue operating in Chicago. However, responses differed greatly for non-riders and riders: 86 percent of riders thought the program should continue, compared to only 21 percent of non-riders.

Conclusion

The City is committed to providing equitable, accessible, affordable, sustainable and safe transportation options for all residents, particularly for those with limited transportation access. The e-scooter pilot showed promise that e-scooters could aid in filling transportation gaps by providing another alternative to cars for getting around the neighborhoods. However, the pilot also revealed some of the challenges. Ridership was geographically concentrated in areas with a high density of other options such as Divvy, bus and rail, rather than in areas with fewer options. Analysis of the data also indicates that the jury is still out on whether e-scooters connect riders to public transit or replace private car or ride-hailing trips. More work also needs to be done to lower the environmental impact of the short life cycle of e-scooters and business operations and to increase companies' rates of compliance with the City's equitable rebalancing requirements, as well as compliance in providing data in a complete and timely manner. It is clear that the regulations the City required prevented many of the problems experienced in peer cities, and the City is committed to continuing to explore innovative regulations to aid in any future e-scooter programs. Ultimately, providing an additional sustainable and equitable transportation option in the city has public safety, health, congestion, environmental, and social equity benefits for all residents. The City is committed to further exploring if e-scooters can be an effective mobility option in Chicago and implementing lessons learned from the first pilot in 2020.

RULES AND REGULATIONS THAT GOVERNED THE PILOT

The City of Chicago managed a shared e-scooter pilot between June 15, 2019 and October 15, 2019 to evaluate whether e-scooters can provide a sustainable, safe and equitable method of transportation for residents. The e-scooter pilot was implemented through an Emerging Business Permit issued by the Department of Business Affairs and Consumer Protection (BACP). Emerging business permits were issued to 10 companies (Bird, Bolt, grüv, JUMP, Lime, Lyft, Sherpa, Spin, VeoRide and Wheels). In constructing the rules and regulations of the pilot, the City set out to assess safety issues, impacts on the blind or visually impaired and other people with disabilities, operator performance in managing sidewalk clutter and access to buildings, the best locations for micromobility services and e-scooters' effects on the transit and Divvy systems and community choices.

Figure 1: Chicago Micromobility Regulations

	Defined Name in MCC	Specs	RIde in a Bike Lane?	Pass on the Right?	Need a Drivers License	Registered Vehicle	Park on Sidewalk/ Bike racks	Minimum age to ride	Children under 12 rider on sidewalks
Bike	Bicycle	100% human powered	✓	✓	✗	✗	✓	none	✓
Electric scooter or elec. skateboard	Low Speed Electric Mobility Device	<=26" wide No more than 15 mph	✓	✓	✗	✗	✓	Personal: none Shared: 18 or 16 w/ guardian	✓
Class 1 eBike	Low-Seed Electric Bicycle	Pedal-assist up to 20 mph	✓	✓	✗	✗	✓	none	✓
Class 2 eBike	Low-Speed Electric Bicycle	Throttle-assist up to 20 mph	✓	✓	✗	✗	✓	none	✓
Class 3 eBike	Low-Speed Electric Bicycle	Pedal-assist up to 28 mph	✗	✗	✗	✗	✓	16	n/a
Moped / Vespa	Motor-Driven Cycle	May have speed limitation	✗	✗	✓	✓	✗	16	n/a
Motorcycle	Motorcycle		✗	✗	✓	✓	✗	16	n/a

The pilot was enabled in April of 2019 when the City of Chicago passed an ordinance that legalized new modes of micromobility and set expectations for user behavior. The ordinance allows for a variety of mobility device types, including e-bikes, e-scooters, electric skateboards, hoverboards, electric unicycles and others. It sets a maximum device speed of 15 mph, allows for legal operation in a bike lane and prohibits device operation on the sidewalk. Figure 1 on the previous page identifies key regulatory features differentiating between various mobility devices.

The Pilot included the following additional regulations:

- **E-scooters could not leave the defined pilot area (see Figure 3)**
  The pilot area included 50 square miles on the west and northwest sides of the city bound by West Irving Park Road to the north, the North Branch Chicago River and North Halsted Street to the east, the South Branch Chicago River and South Cicero Avenue to the south, and the western boundary of the city limits to the west, ending at West Irving Park and continuing north to Irving Park and Harlem Avenue. This area covers about a quarter of the city's total geographic area. The service area was designed to test e-scooters in a diverse set of neighborhoods, with diverse populations, different community types, business districts and residential densities. Additionally, the service area covered communities with a diverse set of transportation options, including neighborhoods served well by CTA, Metra and Divvy bike-sharing, and some neighborhoods not served well by either or all of those services.

- **E-scooters were to be used and parked like bikes**
  The April 2019 ordinance passed by City Council gave e-scooter riders the same rights and responsibilities as people riding bikes. E-scooters were explicitly not allowed to be ridden on sidewalks. E-scooters were required to follow the same parking requirements as private bicycles, using designated public bike racks and corrals, covered bike parking shelters, retired Chicago parking meters and street signs. The use of e-scooters was limited to the City streets, bicycle facilities, paths and parks throughout the pilot area (excluding the 606). Following this guidance, e-scooters were required to be parked upright and with a minimum of six feet of clearance between the e-scooter and all public way obstructions. E-scooters were prohibited from being parked within 10 feet of street corners or intersections,

along building facades or blocking fire hydrants, bus stops or terminals, rail station entrances, loading zones or building access points.

Priority Areas

To ensure equity and provide service to underserved community areas, two priority areas were established within the pilot area. At least 25 percent of e-scooters were to be distributed in each area at the beginning of each day of operation, comprising 50 percent of each company's total e-scooter fleet.

Removal from Public Way

Per the pilot terms, companies were allowed to operate within the designated area from 5 am to 10 pm. Outside of these hours, e-scooters could not be available for rent, and they were required to be removed from the public right of way by midnight each night.

Geofencing

Participating companies were required to geofence[2] their e-scooter fleet to prohibit their use outside of the pilot area or other areas as designated by the City. For example, e-scooters were prohibited from accessing the 606 trail and certain areas around summer music festivals held in the pilot area. Pilot terms required that each e-scooter have the functionality to decelerate and ultimately stop within a quarter of a mile outside of the designated pilot area.

Data Sharing

Companies were required to share data with the City utilizing General Bikeshare Feed Specification (GBFS) and Mobility Data Specification (MDS) standards:

GBFS is the open data standard for bikeshare systems that was originally introduced by the North American Bikeshare Association (NABSA) in 2015. It makes real-time data feeds in a uniform format that can be made publicly available online. The data displays e-scooter availability by location.

MDS is a more recent standard that was introduced by the Los Angeles Department of Transportation in September 2018 and whose development is now supported by the Open Mobility Foundation. MDS builds on GBFS and expands the potential for data that cities could require from mobility operators.

[2] Geofencing is the use of Global Positioning System (GPS) or Radio-frequency identification (RFID) technology and geospatial data to create a virtual geographic boundary that enables software to trigger a response when a mobile device enters or leaves a particular area. RFID refers to a technology whereby digital data encoded in RFID tags are captured by a reader via radio waves. This is similar to barcoding, as data from a tag or label are captured by a device and stored in a database, but RFID can be read outside the line-of-sight.

Non-Smartphone and Unbanked Access

E-scooter companies were required to provide access for potential customers who do not have credit or debit cards or smartphones. Each company developed specific plans to accommodate these customers.

Education for Riders

Companies were required to educate e-scooter users to be courteous of public way use and encourage proper parking behavior. This included implementing marketing and targeted community outreach at their own cost, developing and distributing educational and outreach materials to alderman, police commanders, local chambers and community organizations, hosting a community event in the pilot area or presenting at the local Alderman's Ward Night. Additionally, companies' websites and mobile apps were required to have visible language that communicated applicable laws and regulations to customers. Customers were also required to agree to follow rider rules before unlocking an e-scooter. During the first month of the pilot, all e-scooters were equipped with a laminated card with a set of instructions and illustrations (Figure 2).

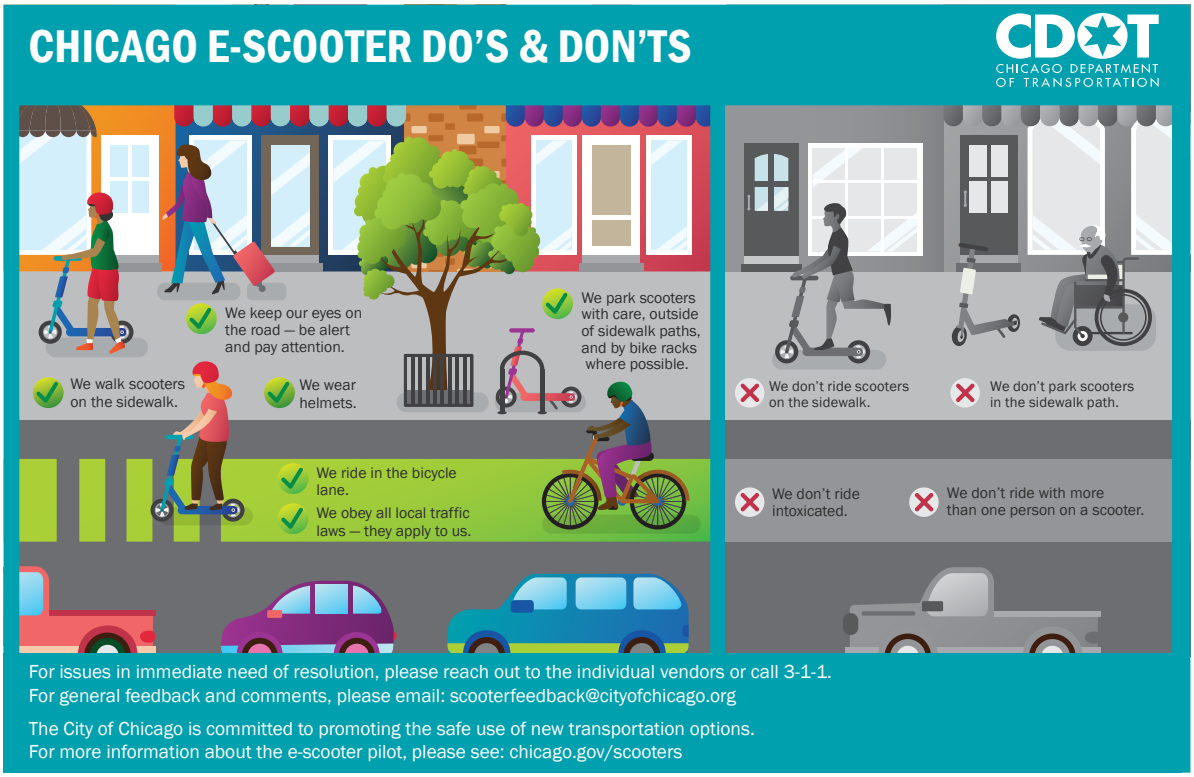
Access and Age Regulations

The pilot program also included requirements that companies develop an accessibility plan to address the needs and interests of people with disabilities. A company's accessibility plan could include accessible technology (i.e. apps, websites or software) or e-scooters with features to accommodate people with varying disabilities. Companies were required to prohibit participation by customers who were under the age of 18 years old without consent of a parent or guardian. Customers younger than 16 years old were not allowed to participate.

Fleet Size Allowance

Based on pilots of varying sizes in other cities and the square mileage of the pilot area, the City set the fleet size cap at 2,500 e-scooters divided equally among the participating companies.

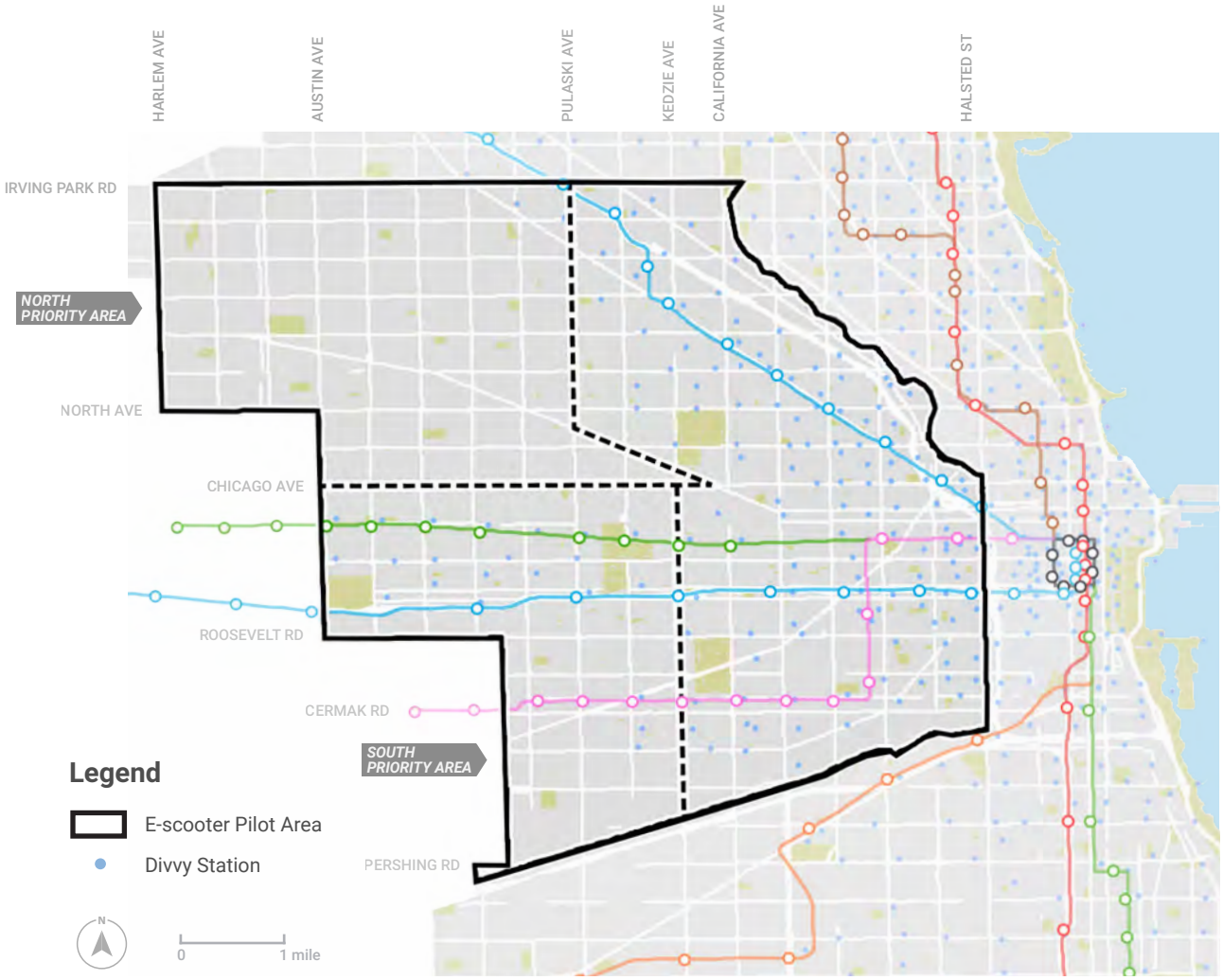
Figure 2: E-scooter Educational Flyer Used During the Pilot



PILOT AREA CHARACTERISTICS

The area selected for the pilot is located on the west side of Chicago, bounded by Halsted Street and the Chicago River on the east, Irving Park Road on the north, the City boundary and Harlem Avenue on the west and the Chicago River on the south. Two priority areas were identified within the pilot zone, where at least 25 percent of e-scooters were required to be placed every morning.

Figure 3: Base Map of the E-scooter Pilot Area



Demographics of Pilot Area

The pilot area has a demographic profile that is somewhat more diverse than the City of Chicago as a whole, including higher shares of hispanic or latinx residents and households living under 200 percent of the poverty line, but a lower share of black residents. The three sections of the pilot area vary in important ways. The majority of black residents living in the pilot area live in the south priority area, which also has the highest rate of households living under the poverty line and the lowest household density. The north priority area is predominantly hispanic or latinx. The remainder of the pilot area, particularly the area around the O'Hare branch of the CTA Blue Line, has a higher median household income, higher household and employment density and a higher share of white residents.

Figure 4: Selected Demographic Characteristics of the Pilot Area

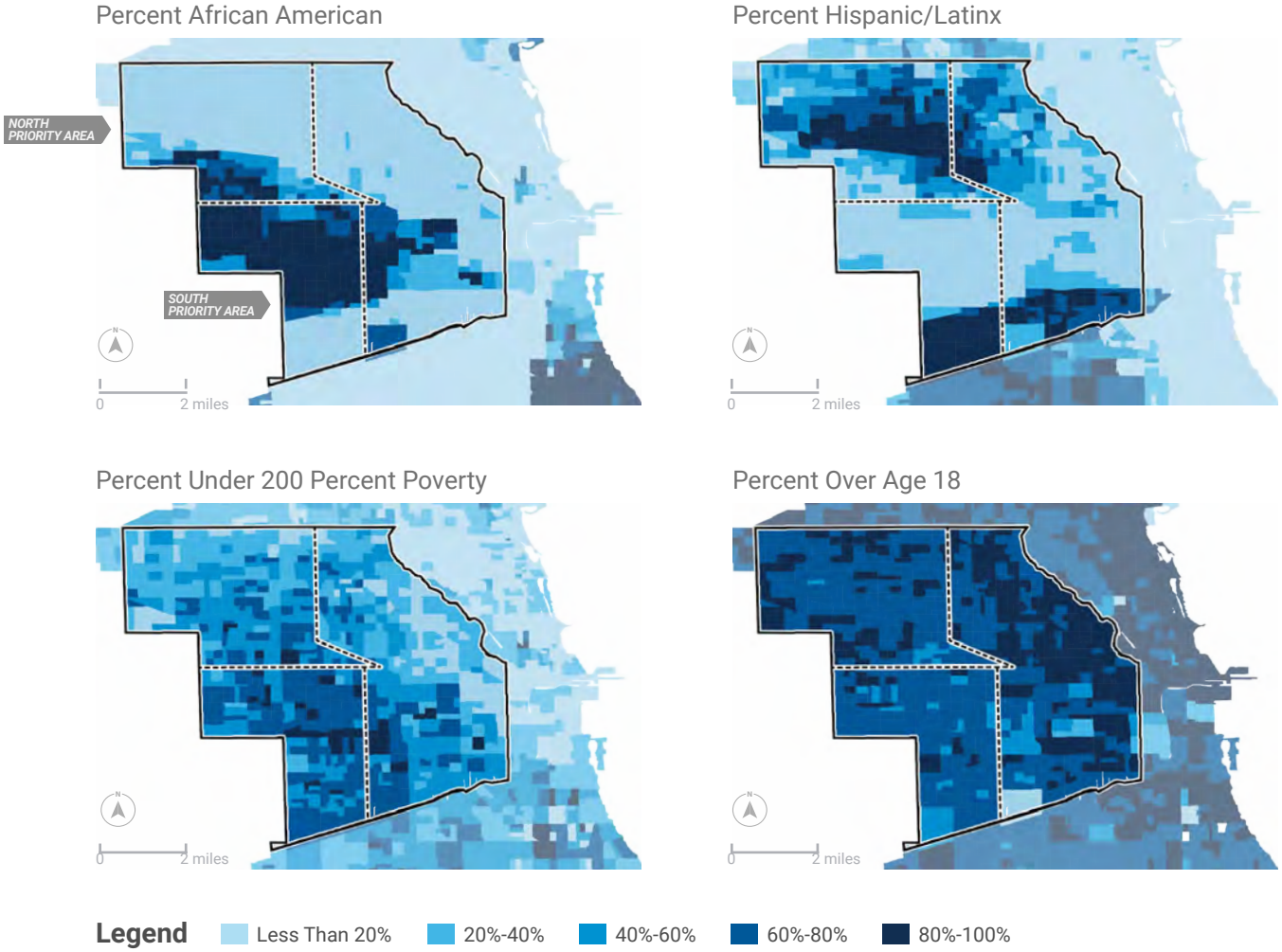


Figure 5: Population Density

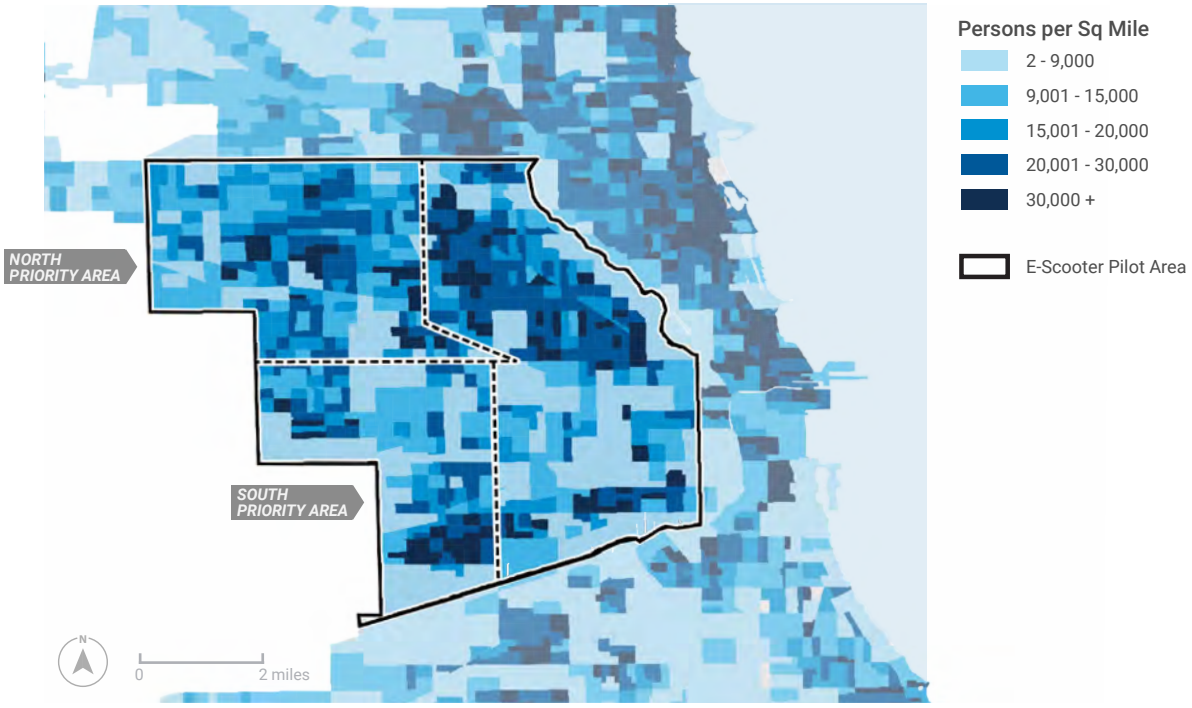
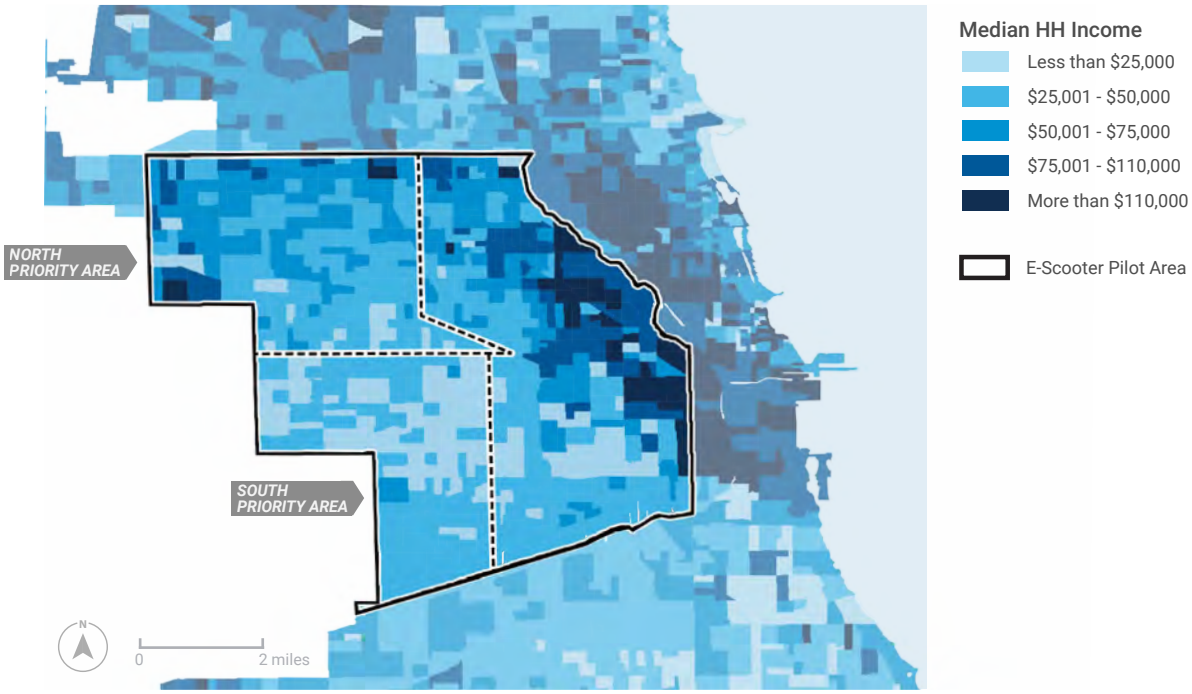


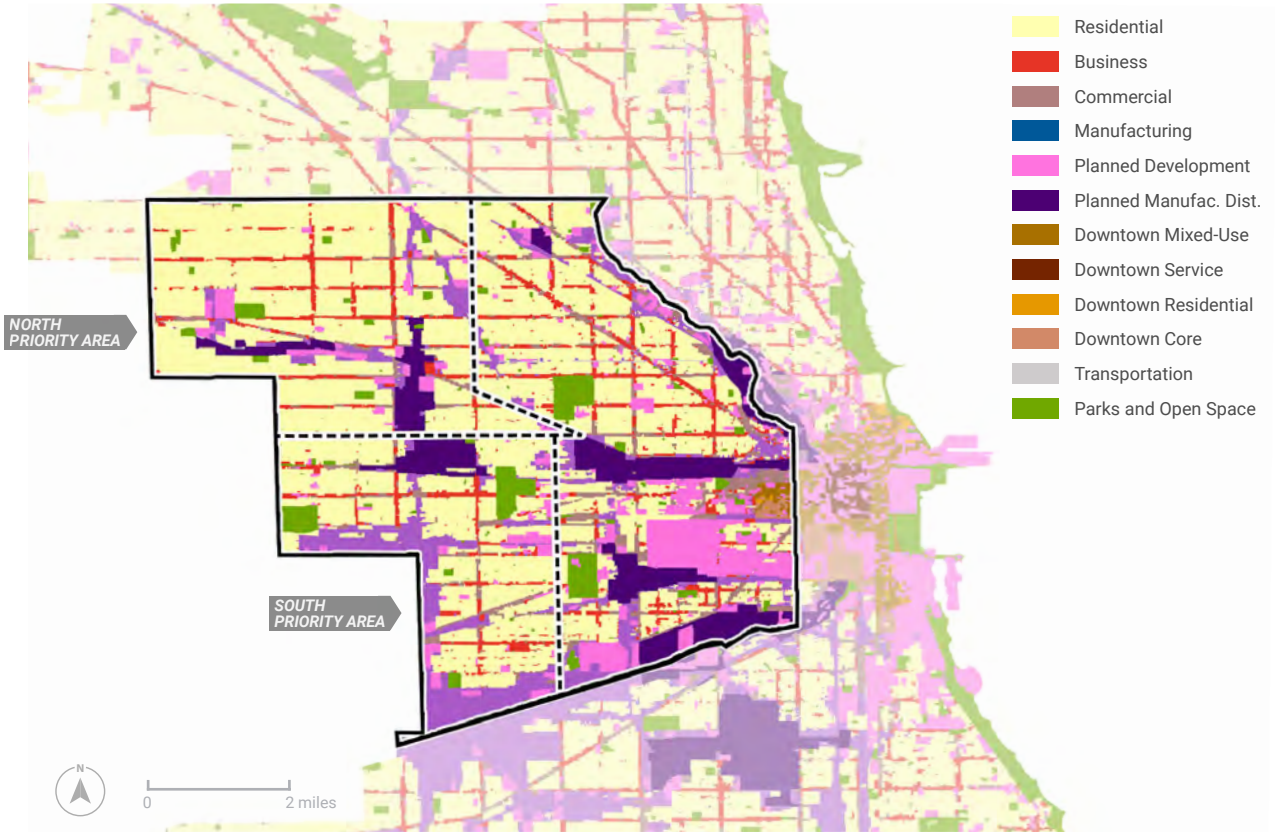
Figure 6: Median Household Income



Land Use in the Pilot Area

The pilot area includes a variety of land uses, which enabled the City to better understand e-scooter impacts at a variety of uses and densities. Both the north and south priority areas are primarily residential, while the eastern portion of the pilot area has a mix of residential and planned development uses.

Figure 7: Zoning - 2019



TRANSPORTATION AVAILABILITY AND BEHAVIOR

A critical element of the pilot is assessing whether e-scooters provide an increased range of mobility options for residents who could most benefit from them beyond what already is provided as part of the city's transportation ecosystem.

The Center for Neighborhood Technology's AllTransit Performance Score is a comprehensive score that looks at connectivity, access to land area and jobs, frequency of service and the percent of commuters who use transit to travel to work. This index compares transit availability in communities across the country. According to this measure, the entirety of the pilot area has a score of at least 7, which is high compared to the US as a whole. The eastern section of the pilot area and some portions of the south priority area have good transit availability. Transit availability is particularly important in the south priority area, where 37 percent of households have no vehicle, compared with 24 percent in the pilot area as a whole, and 27 percent in the city as a whole. The north priority area has more limited transit availability than the rest of the pilot area, no Divvy stations and fewer zero-vehicle households.

Figure 8.1: Transportation Assets — CTA Rail and Bus

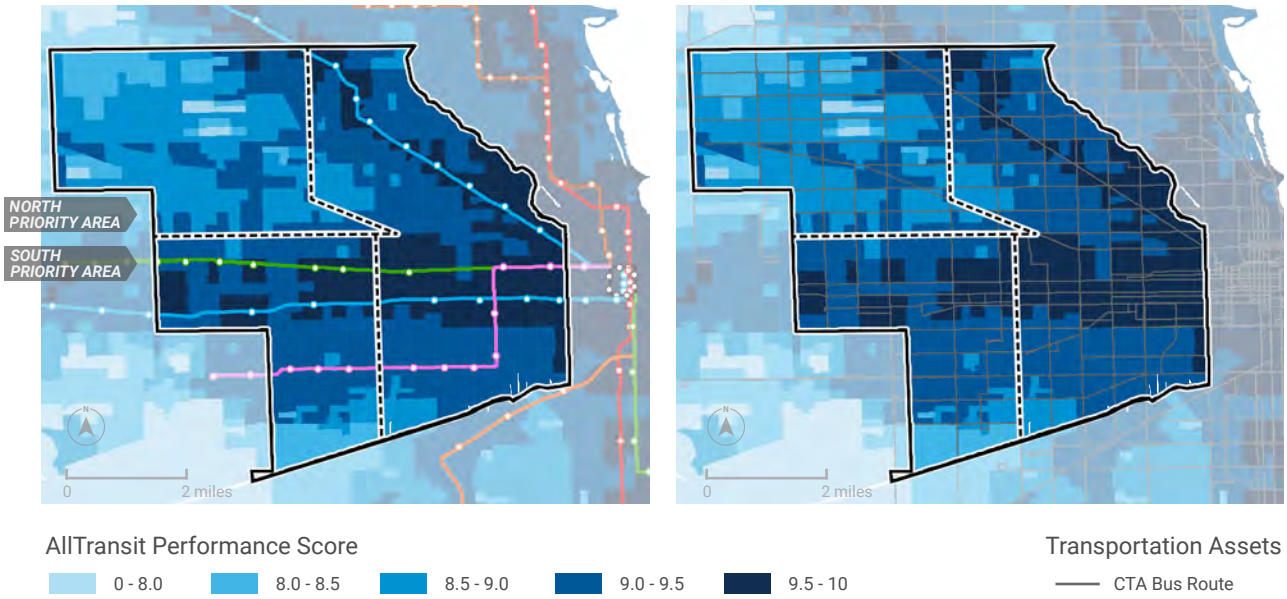


Figure 8.2: Transportation Assets - Bikeshare and Carshare

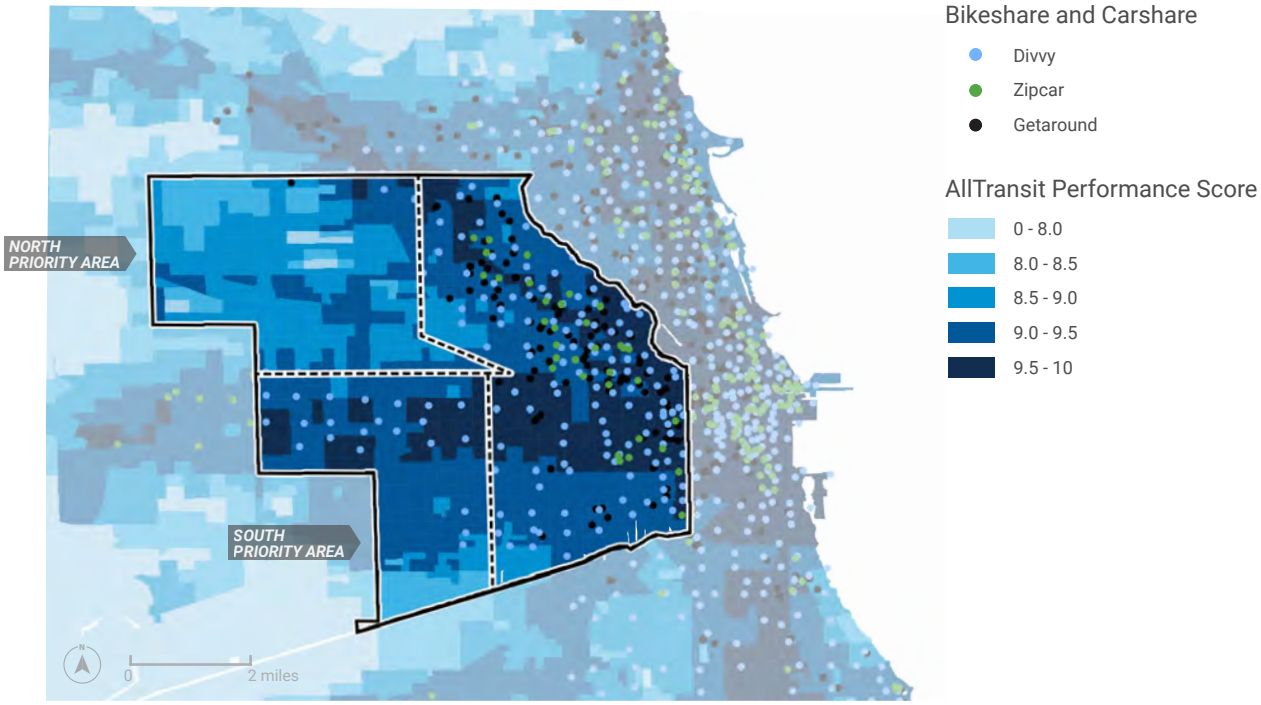
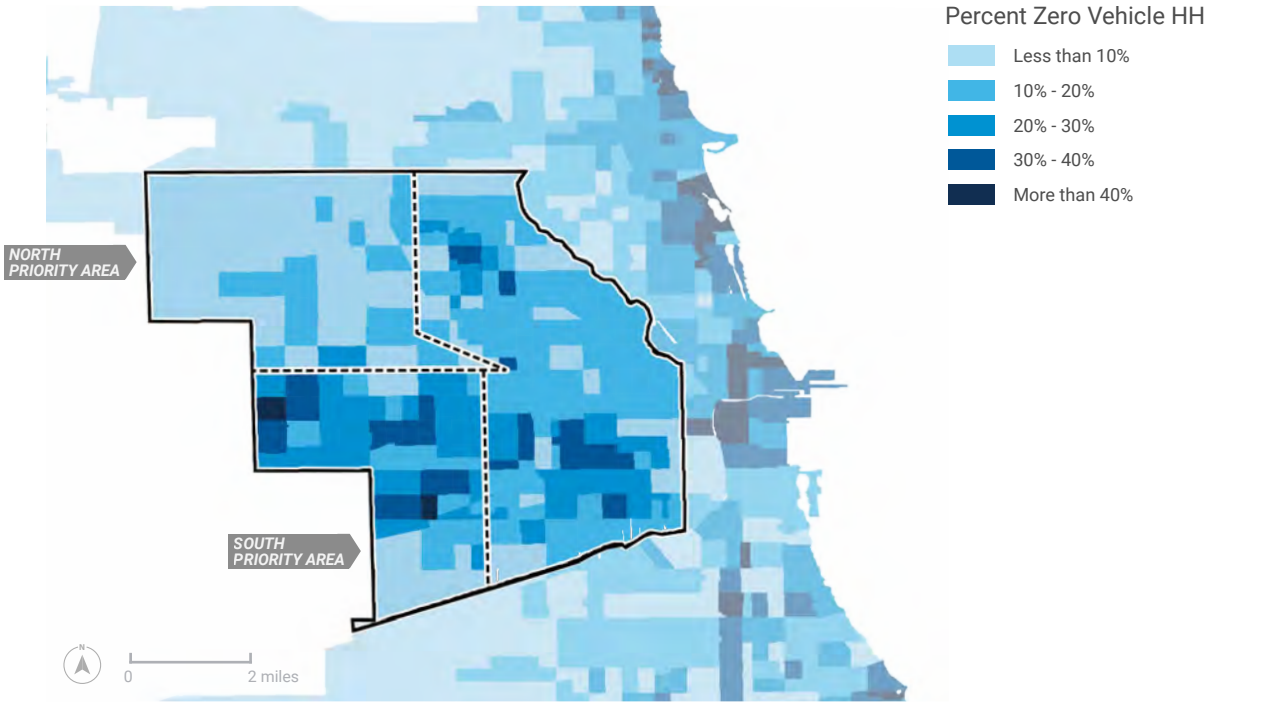


Figure 9: Zero Vehicle Households



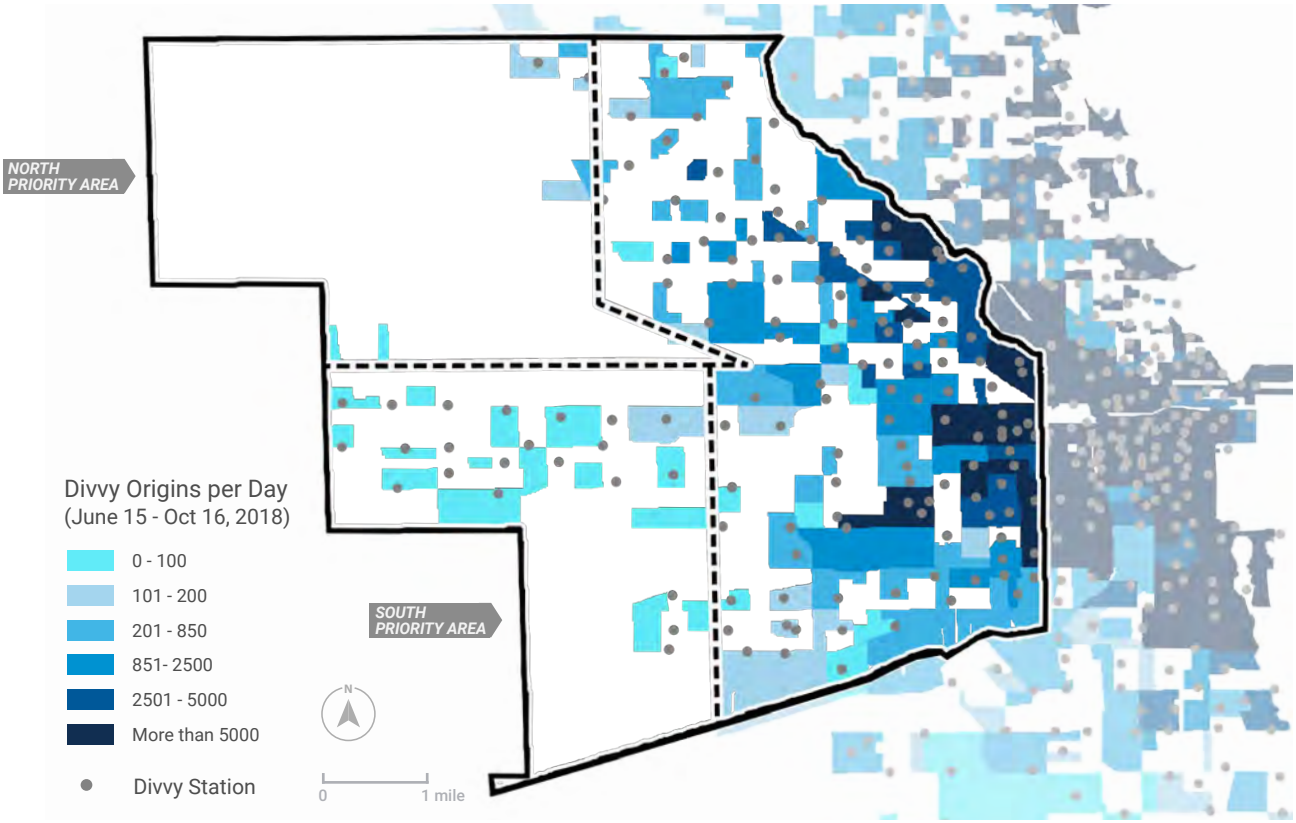
The result of these demographic and transportation factors is different transportation behaviors and challenges in different sections of the pilot area. The eastern section of the pilot area has higher transit, biking and walking commute shares than the north and south priority areas. Despite low vehicle availability, 52 percent of workers in the south priority area drive alone to work, and another 12 percent carpool. More than 20 percent of workers in both the north and south priority areas have one-way commute times of an hour or longer.

Table 1: Transportation Behavior Indicators

	Priority North Area	Priority South Area	Rest of Pilot Area	Total Pilot Area	Rest of Chicago	City as a Whole
Population	254,468	163,239	334,044	761,751	1,963,545	2,725,296
Households (HH)	78,868	49,672	130,668	259,208	788,263	1,047,471
HH per Acre	8.03	6.38	9.30	8.35	6.96	7.31
%Pop < 100% Poverty	19.8%	36.8%	20.4%	23.7%	19.5%	20.6%
%Pop < 150% Poverty	32.9%	55.4%	31.3%	37.0%	29.8%	31.8%
%Pop < 200% Poverty	44.7%	65.6%	39.8%	47.0%	38.6%	41.0%
Median HH Income	49,029	28,019	67,157	54,141	60,882	59,214
% Over Age 18	74.2%	68.8%	76.3%	74.0%	77.2%	76.3%
% Non-Hispanic White	19.7%	2.5%	37.3%	24.0%	36.1%	32.7%
% Non-Hispanic Black	18.0%	64.6%	15.2%	26.7%	31.4%	30.1%
% Hispanic/ Latinx	58.4%	32.0%	40.6%	44.7%	23.0%	29.1%
Employment (2015)	41,896	34,480	172,062	248,438	1,116,924	1,365,362
% HH with 0 Vehicles	16.6%	37.0%	23.8%	23.9%	27.5%	26.7%
% Commuters Carpool	11.3%	12.2%	7.7%	9.7%	7.8%	8.3%
% Commuters Bike	0.9%	0.5%	4.3%	2.5%	1.4%	1.7%
% Commuters Walk	2.4%	4.5%	6.5%	4.9%	7.8%	7.1%
% Commuters Transit	18.2%	29.4%	33.8%	28.2%	30.1%	29.7%
% Commute > 60 min	20.6%	21.2%	12.9%	16.8%	16.0%	16.2%
Avg Vehicles per HH	1.37	0.84	1.09	1.13	0.98	1.01
Divvy Trip Origins *(June 15 - Oct 15, 2018)*	1,663	1,465	301,619	304,747	1,568,388	1,873,135
Ride-Hail Trip Pickups *(June 15 - Oct 15, 2018)*	668,181	441,362	5,322,526	6,432,069	19,846,696	26,278,765

Divvy and ride-hail[3] use also varies throughout the pilot area, with the highest concentrations of both in the eastern portion of the pilot area. These modes have some similarities to e-scooter use, including app-based booking and payment. An important difference between the current Divvy system and e-scooters is that Divvy bikes can only be picked up and dropped off at docked station locations, although Divvy will be implementing more flexible lock-to capabilities in 2020.

Figure 10: Divvy Use Throughout the Pilot Area



[3] Transportation Network Providers in Chicago include Uber, Lyft and Via

Figure 11: Ride-Hail Use Throughout the Pilot Area

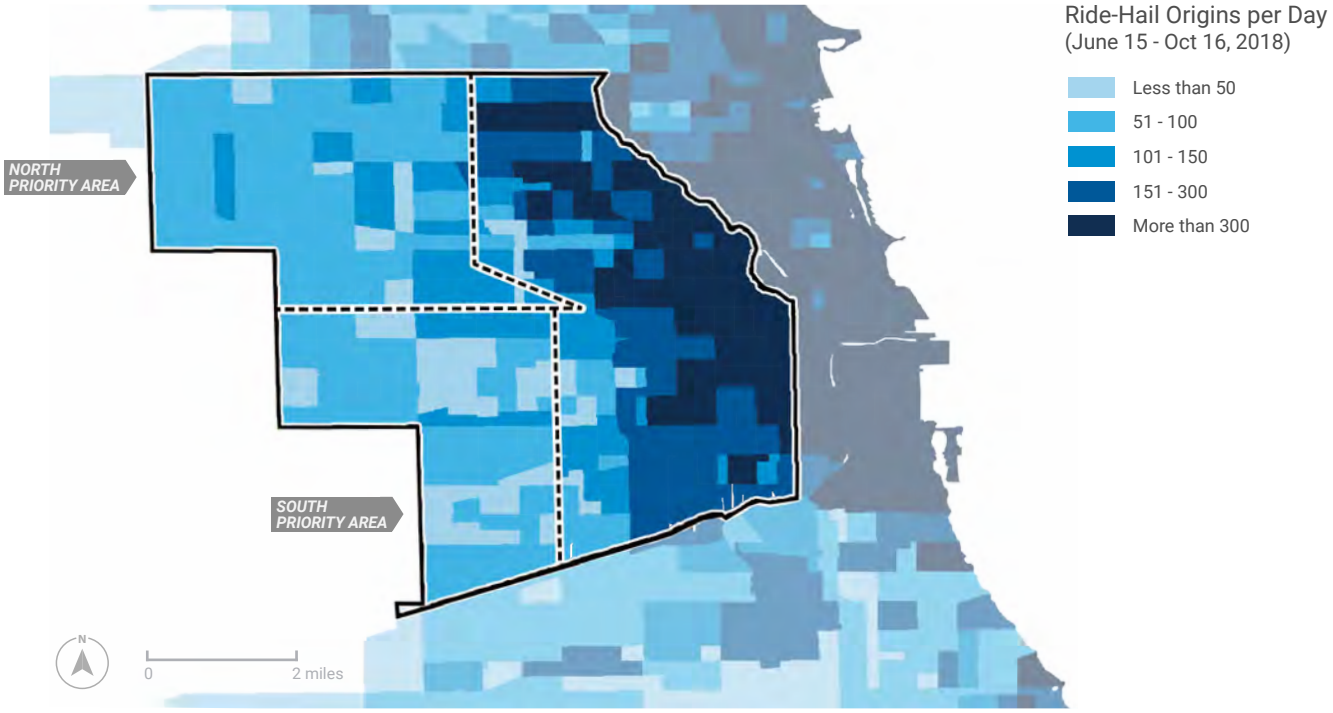
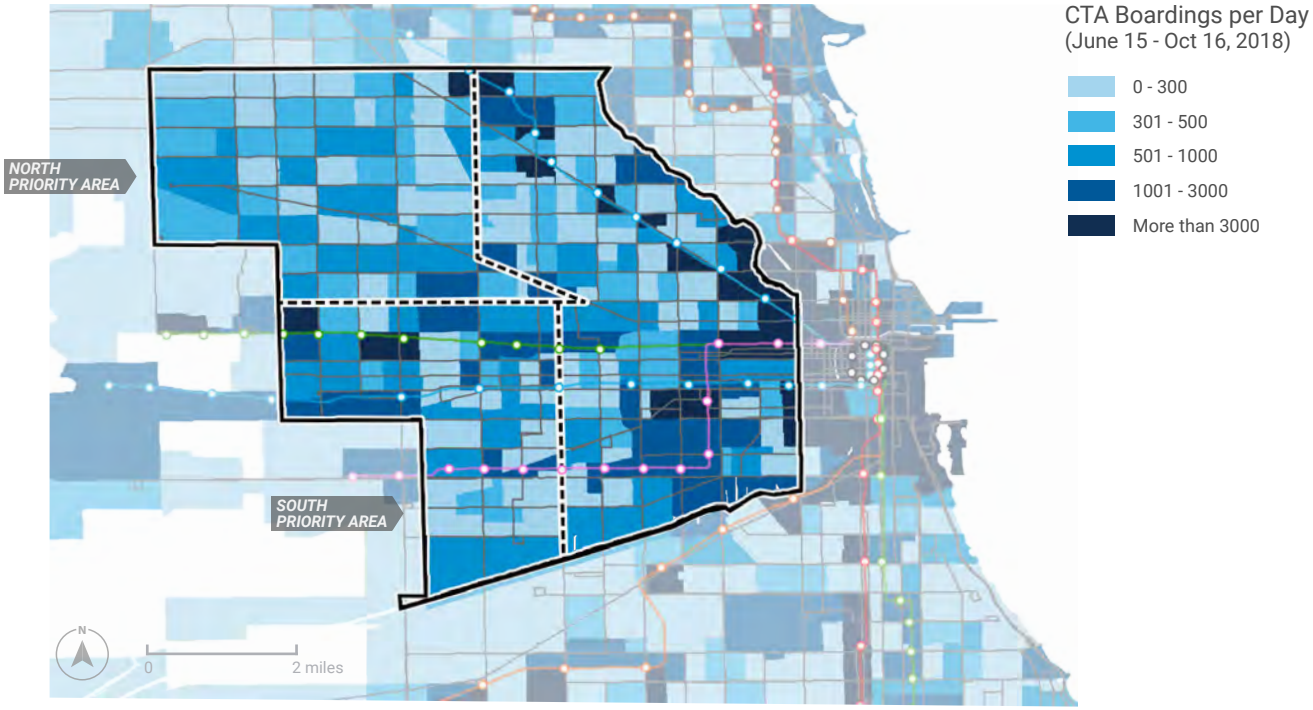


Figure 12: CTA Bus and Train Boardings Throughout the Pilot Area



RESULTS AND FINDINGS OF THE E-SCOOTER PILOT

E-scooter Utilization and Characteristics of Riders

Between June 15th and October 15th, e-scooter companies reported providing 821,615 rides in the city. Due to data downloading issues, 664,975 trip records were available for analysis as of November 1, 2019. As of November 1st, trip data were unavailable for seven days around Labor Day weekend, August 30th-September 4th, and September 6th. Some of the trip records had data quality issues such as missing or invalid location information (as described in more detail in the Data Collection Methodology and Limitations section). Some trips, "test rides," traveled a very short total distance (less than a quarter mile), while other "lap trips" were longer but ended in close proximity to where they started. These trips, which likely represent rides purely for entertainment, were excluded from the majority of the analysis that follows in order to focus on e-scooter use as a transportation mode. A subset of 407,296 trips was used to assess e-scooter use over the pilot period. This represents an average daily ridership of 3,366 per day.

Table 2: E-scooter Utilization Metrics

Total reported trips	821,615
Total trip records	664,975
Invalid trips*	41,560
Test rides	106,627
Lap Trips	109,492
Trips for analysis	407,296
Average Trip duration (length)	1.5 miles
Average Trip duration (time)	12 minutes
Total miles	611,000

**Invalid trips have missing or invalid location information*

Among the 10 companies participating in the pilot, Lime and Lyft provided the most rides (see Table 3). Wheels, grüv and Veoride had data downloading or data quality issues that limited the number of trips that could be used for analysis. Most of the analysis that follows is based on all trips from all providers.

E-scooter Usage Patterns

The number of lap trips and test rides declined precipitously over the course of the pilot, from 31 percent of valid trips in June to 15 percent of valid trips in October. However, even after excluding test and lap trips, average e-scooter use declined over the course of the pilot (see Figure 13). By the last week of the pilot, trip volumes were about half of what they were during the first week of the pilot.

As Table 4 and maps on the next page show, a majority of trips took place in the non-priority zone portion of the pilot area. Despite having only 45 percent of the population, 83 percent of the rides were taken in the eastern half of the pilot area. When looking at the maps in Figures 14 and 15, it is evident that the vast majority of those rides were taken in the West Loop and along the Milwaukee Ave corridor. Trips beginning in the priority areas tended to be longer in both distance and duration than trips originating in the eastern half of the pilot area.

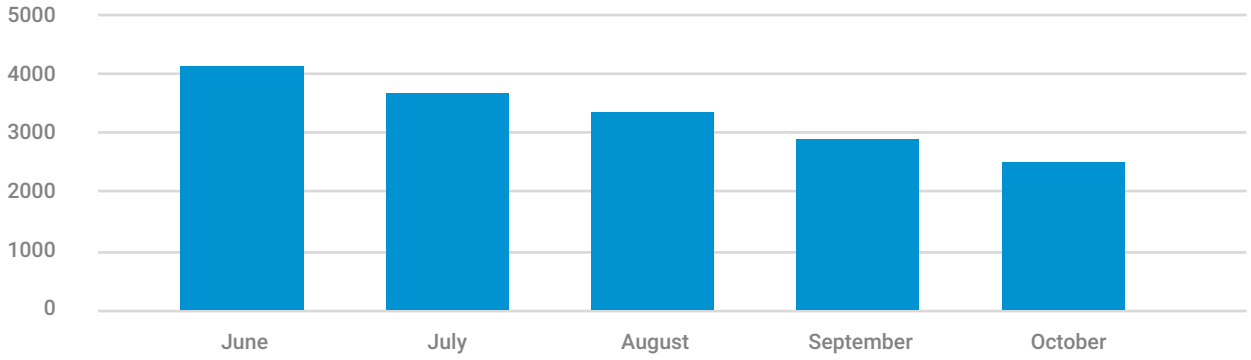
Table 3: E-scooter Trips Reported and Analyzed, by Company

Provider	Trips Reported	Trips Analyzed
Bird/Sherpa*	178,134	105,730
Bolt	45,324	29,092
Grüv	68,620	5,011
Jump	100,528	59,296
Lime	121,131	75,322
Lyft	119,116	80,467
Spin	55,463	37,172
Veoride	75,559	15,051
Wheels	57,740	155**

**Bird and Sherpa combined their MDS feed into one, making it difficult to separate in time for this analysis.*

***Wheels has failed to keep data in their MDS feed, hindering this analysis.*

Figure 13: Average Daily E-scooter Trips by Month



**Trip data were not downloadable from August 30th to September 6th*

Figure 14: Cumulative E-scooter Trip Origins

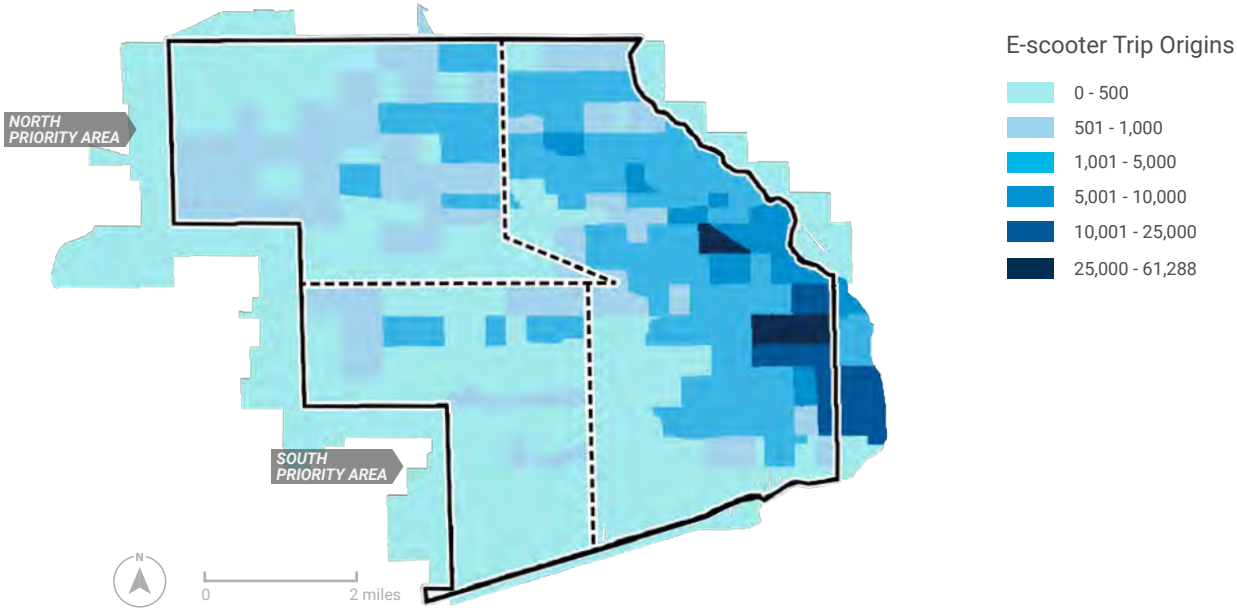


Figure 15: Cumulative E-scooter Trip Destinations

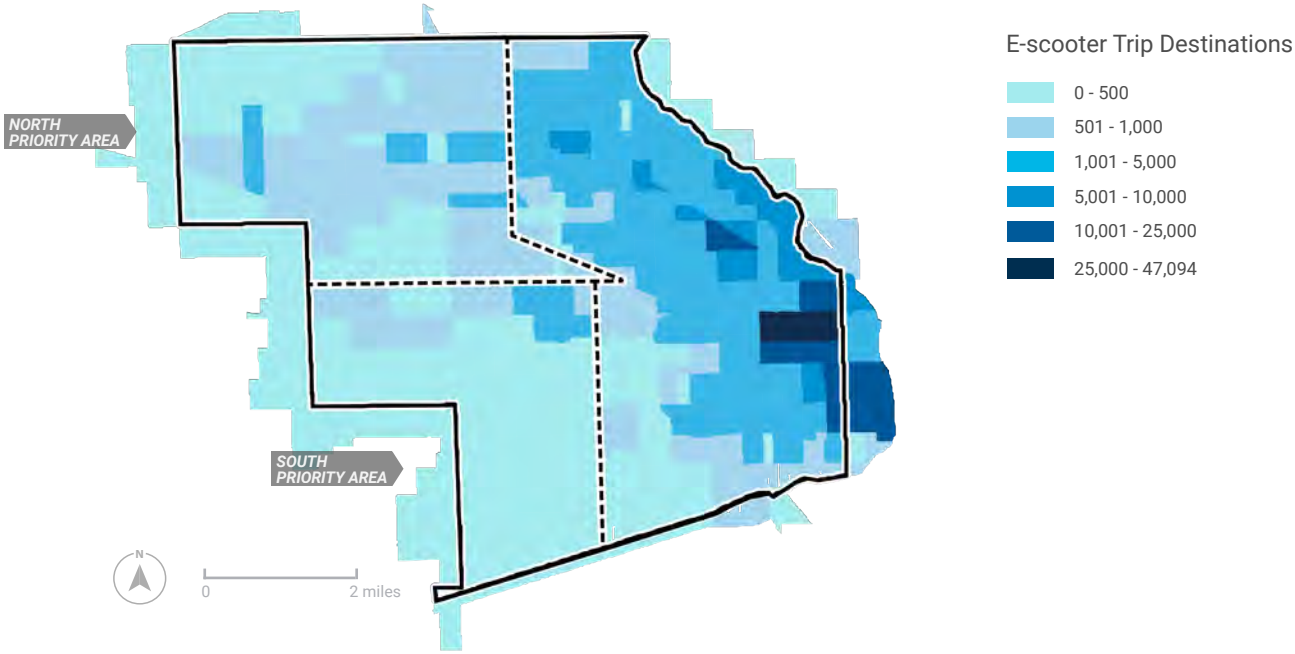


Table 4: E-scooter Trip Length by Origin

	Trips	Percent of Total	Average Distance in Miles	Average Route Length in Miles	Average Duration in Minutes
Priority Area North	39,278	9.7%	2.05	2.15	17
Priority Area South	20,339	5.0%	2.17	2.3	20
Rest of Pilot Area	337,196	82.9%	1.41	1.4	11
In Chicago, but Outside of the Pilot Area	10,171	2.5%	1.42	1.38	11

Frequency of Origins, Destinations and Origin-Destination(OD) Pairs

As with Divvy and ride-hail trips, the majority of e-scooter trips started or ended in the eastern half of the pilot area, specifically the far eastern edge near the West Loop and along Milwaukee Ave. Overall, 77 percent of trips started and ended in the eastern section of the pilot area. Of the remainder of the trips, more began or ended in the north priority area than the south priority area. The north priority area has the lowest Divvy availability; therefore, e-scooter use there may indicate that e-scooters filled a micromobility gap, or that the morning deployment was more successful by the companies in the north area, compared to the south area.

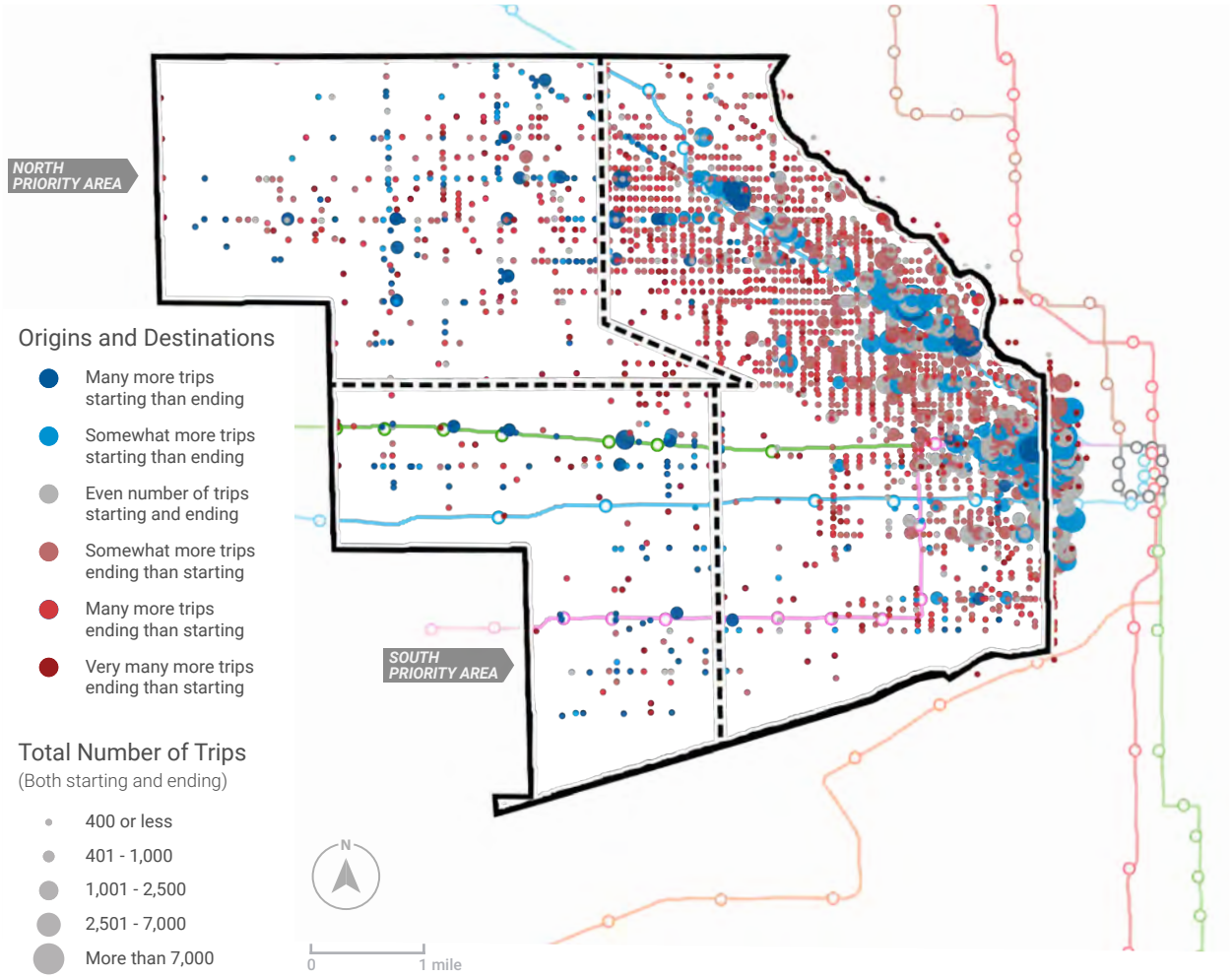
At the neighborhood level, the most common origin and destination neighborhoods were the Near West Side, West Town and Logan Square. Partially due to the short nature of e-scooter trips, many trips remained within a single neighborhood.

Table 5: Top 10 Origin and Destination Flows Between Community Areas of the Pilot Area

Trip Start Comm. Area	Trip End Comm. Area	Trips
Near West Side	**Near West Side**	92,367
West Town	**West Town**	73,945
Logan Square	**Logan Square**	38,697
Near West Side	**West Town**	22,415
West Town	**Logan Square**	19,436
Logan Square	**West Town**	16,513
West Town	**Near West Side**	15,836
Austin	**Austin**	6,729
Belmont Cragin	**Belmont Cragin**	6,288
Logan Square	**Avondale**	6,167

Figure 16 shows trip origins and destinations, aggregated to the nearest intersection. The size of the circle represents the number of trips starting or ending at that location, and the color indicates whether more people started at that location or ended there. In the priority areas, trips tended to begin at centralized points, and end at more dispersed locations. This pattern is particularly evident in the northern priority area, where major origin points occur along the pilot area's north-south arterials. These may be deployment points where e-scooters began each day. This map once again demonstrates the heavy concentration of trip origins and destinations in the West Loop and along Milwaukee Avenue.

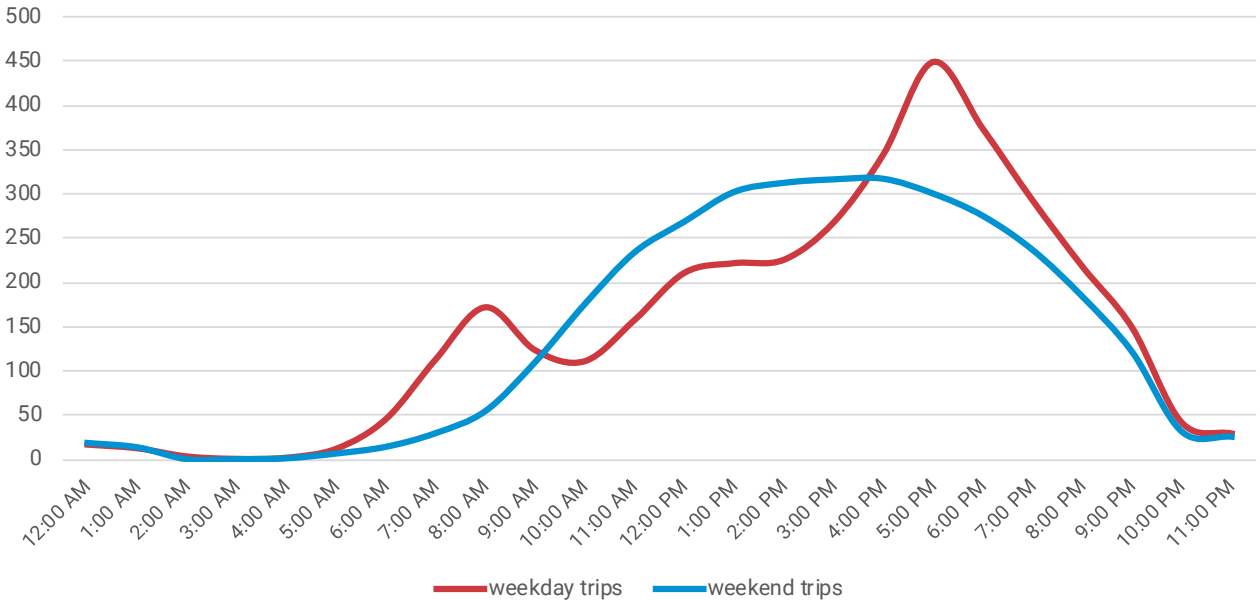
Figure 16: Trip Origins and Destinations by Intersection



Trips by Time of Day

Weekday e-scooter trips did not follow a traditional weekday commute pattern, unlike travel patterns for transit and cars,[4] which show a roughly equal morning and evening peak. E-scooter use is significantly higher during the afternoon and evening rush period than it is during the morning commute. Weekday Divvy bikeshare usage also shows a higher afternoon peak, compared to mornings; however, the disparity is not as significant. More research is needed to understand why micromobility riding does not follow traditional patterns, but it may lend evidence that the market for e-scooters is not entirely work or school oriented. E-scooter use did decline precipitously in advance of the 10:00 pm deadline for e-scooter removal from the streets but did not cease altogether. On the weekends, e-scooter use peaked between 3 and 4 pm, which follows a very typical weekend pattern for other transportation modes.

Figure 17: Average Daily Trips by Start Hour

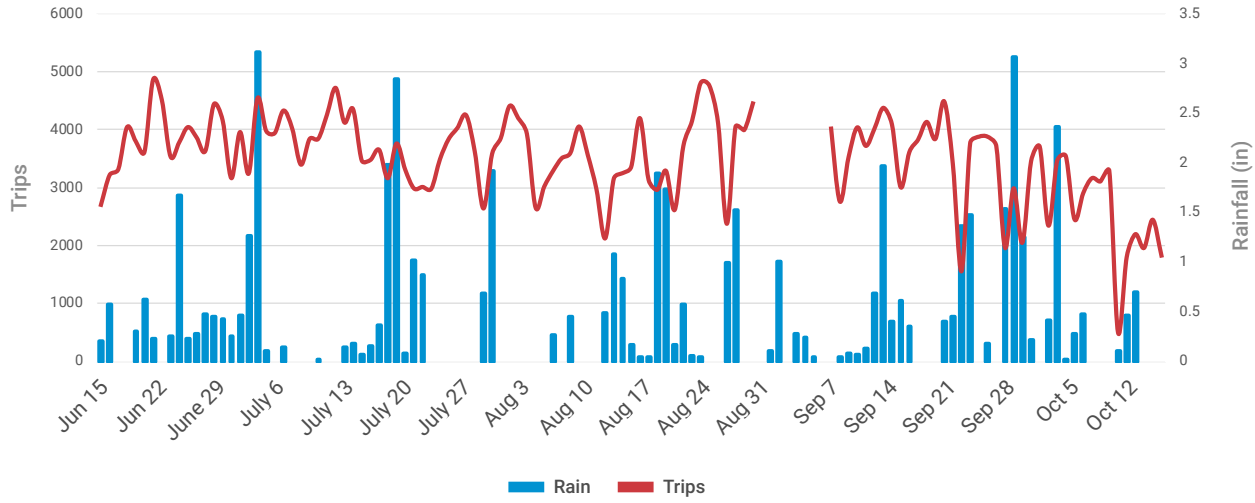


[4] CMAP Travel Use Survey, https://www.cmap.illinois.gov/onto2050/snapshot-reports/transportation-network/travel-trends/trips-by-time-of-day

Impact of Precipitation

Surprisingly, precipitation did not seem to be a significant factor in e-scooter ridership. In fact, the wettest days during the pilot saw slight upticks in the number of e-scooter trips, potentially indicating riders using e-scooters to expedite soggy walking trips.

Figure 18: Daily E-scooter Trips and Precipitation

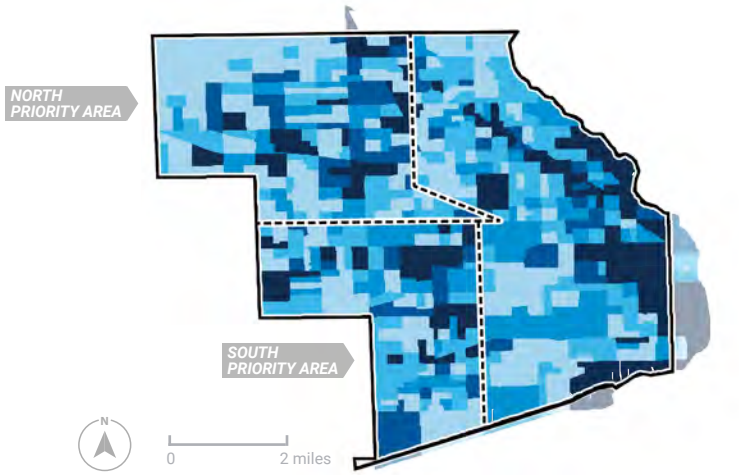


*Trip data were not downloadable from August 30th to September 6th

E-scooter Availability and Utilization Rates

Figure 19 displays the number of days over the course of the pilot that e-scooters were available in the census block group, by time of day. This data further bolsters the finding that during the morning deployment, e-scooters are frequently dropped off in the same place day after day, and that they tended to be deployed in centralized locations, particularly within the priority areas. By the middle of the day, many of the e-scooters that started in the priority areas have moved to the eastern half of the pilot area. By the evening rush, potential riders in the West Loop and Milwaukee Avenue corridor are almost guaranteed to find at least one e-scooter nearby, while in most of the rest of the pilot area, e-scooter availability was less dependable.

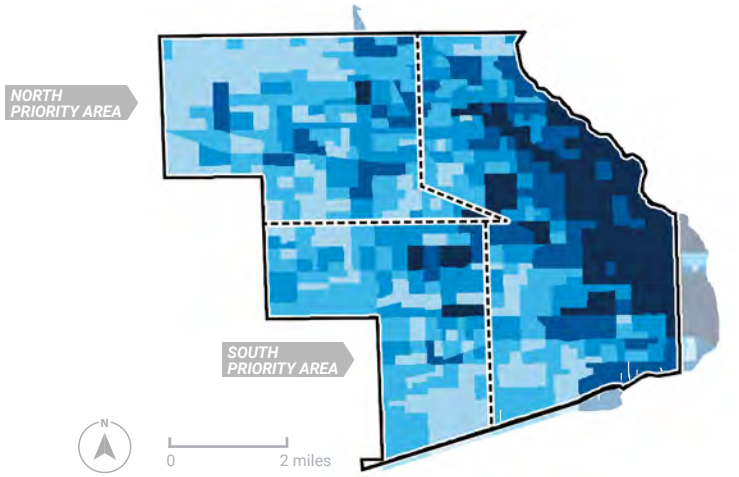
Figure 19: Maps Comparing E-scooter Availability by Time of Day



4:00am - 10:00am

Days of Available E-scooters

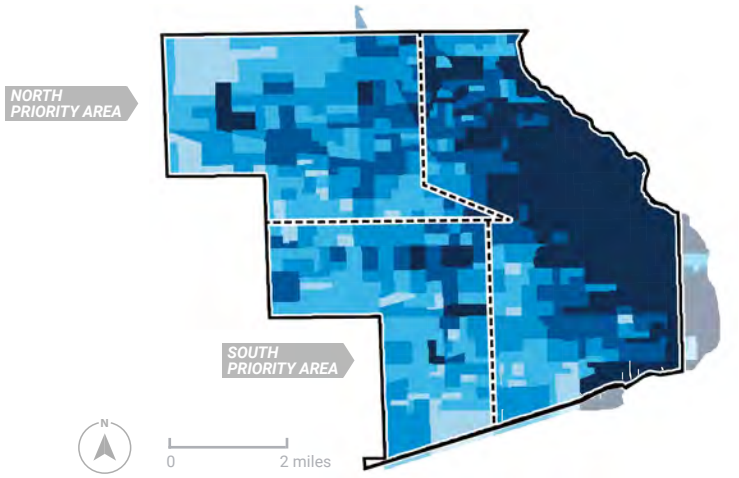
- 0 - 25
- 26 - 50
- 51 - 74
- 75 - 99
- 100 - 124



11:00am- 1:00pm

Days of Available E-scooters

- 0 - 25
- 26 - 50
- 51 - 74
- 75 - 99
- 100 - 124



4:00pm - 6:00pm

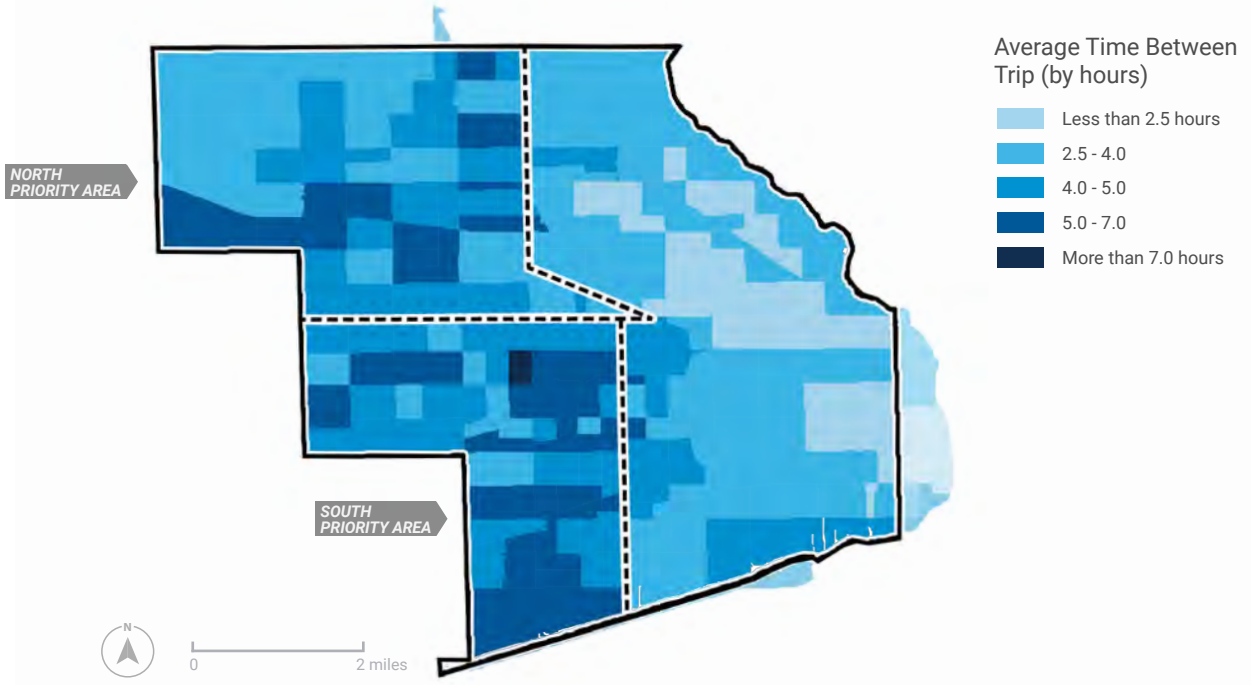
Days of Available E-scooters

- 0 - 25
- 26 - 50
- 51 - 74
- 75 - 99
- 100 - 124

Trips Per E-scooter Per Day

E-scooters appear to spend the majority of their time waiting to be used. The average e-scooter was used for around three trips per day and was in use for about a half hour per day, or about three percent of the operational time period from 5 am to 10 pm. The amount of time between rides varies by geography, with e-scooters more likely to be in frequent use along Milwaukee Avenue. Despite having significantly fewer available e-scooters and trips, the northern priority area saw relatively frequent use of the e-scooters that were available compared to the southern priority area. In much of the southern priority area, there were on average five to seven hours between trips on any given e-scooter.

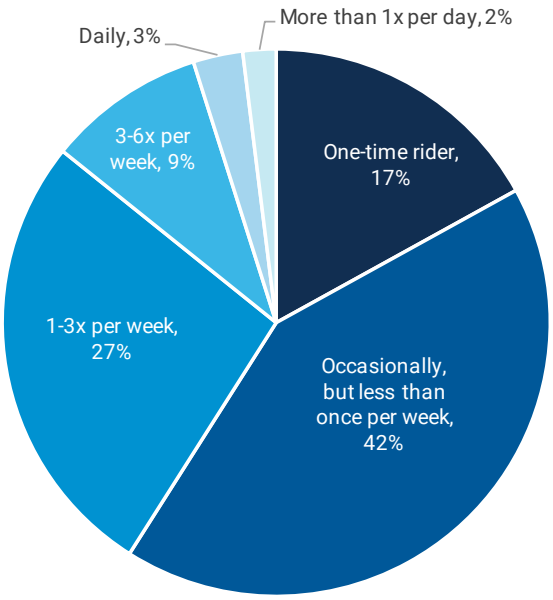
Figure 20: Average Time Between Trip by E-scooter



Frequency of E-scooter Use

Data provided to the City by the e-scooter companies indicate that most e-scooter users were infrequent or occasional users. Nearly half (49 percent) of riders only took one ride on a given company's e-scooter, while only 15 percent took five or more rides. However, this likely underestimates how frequently individuals used e-scooters, as some riders used more than one company's e-scooters.

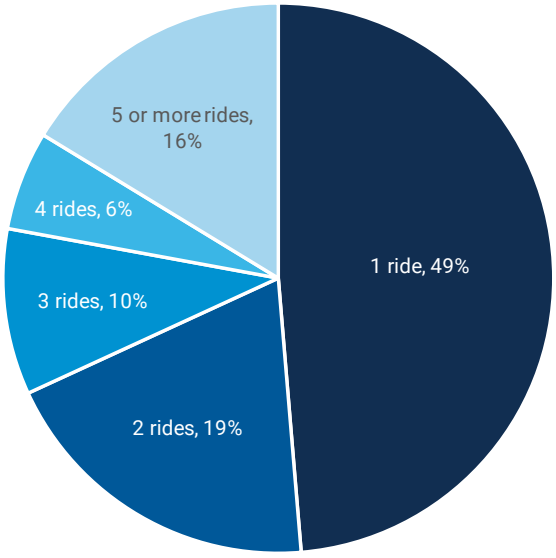
Figure 21: Number of E-scooter Rides per User, Reported by Companies



Utilization Analysis of the Online E-scooter Survey

In addition to the trip data, the City conducted a survey from September 24th – October 27th, 2019 to better understand the experiences of e-scooter riders and non-riders. The survey provides another window into frequency of e-scooter use. A total of 12,446 people responded to the survey, of whom 64 percent reported riding e-scooters at least once during the pilot. The demographics of the survey respondents represented a higher share of white, higher income and more educated participants than the overall demographics of the pilot geography, although rider respondents were more diverse than non-rider respondents.

Figure 22: Number of Rides per E-scooter user, Reported by Survey Respondents



Survey respondents indicated that they were using e-scooters as alternatives to multiple modes, including ride-hailing services, walking, driving a personal vehicle or taking a CTA bus. However, when compared with actual data on ride-hail and Divvy trips, it appears that survey responses may overestimate the extent to which e-scooter use caused significant mode shift. Among rider respondents, 17 percent reported only using e-scooters once, and the largest percentage (42 percent) reported being an occasional e-scooter rider. Comparing the survey responses to the frequency data provided by the companies suggests that frequent (weekly and daily) e-scooter users are likely overrepresented among survey respondents, while one-time users are likely underrepresented.

Survey respondents' motivations for trying e-scooters for the first time varied by how frequently they reported using e-scooters. Occasional and one-time riders were the most likely to try e-scooters because they were curious or thought they looked fun, and least likely to choose e-scooters because of perceived environmental benefit or because they were a more convenient means of transportation. Respondents who rode at least weekly were more likely to cite saving money on transportation, more convenient travel and environmental benefits.

Table 6: Reason for Trying E-scooters, by Use Frequency*

	Save Money on Transportation	Get Around More Easily/ Faster	It's Good for the Environment	Looked Like Fun/ Curious to Try it Out
More than 1x per day	70%	85%	68%	74%
Daily	70%	93%	64%	69%
3-6x per week	65%	93%	59%	74%
1-3x per week	57%	93%	49%	79%
Occasionally, but < once per week	35%	78%	29%	84%
I've only ridden once	11%	32%	8%	88%

**Note: Respondents could select more than one answer option, resulting in a total percentage of over 100.*

E-scooter riders reported using e-scooters for a variety of purposes. The data showed the potential for e-scooters to be utilized for commuting purposes and connecting to transit. Respondents who reported using e-scooters at least three times a week were most likely to report commuting by e-scooter and using e-scooters to connect to public transit. Less frequent e-scooter users were shown to use e-scooters more often for recreation, applying to residents and visitors alike. More frequent users rode e-scooters to work and to connect to transit.

Table 7: Trip Purpose for E-scooter Use*

	Commute	Go To or From Transit	Go To or From School	Social/ Entertainment	Go To or From Restaurant
More than 1x per day	75%	49%	10%	32%	30%
Daily	70%	46%	11%	35%	31%
3-6x per week	60%	50%	6%	41%	40%
1-3x per week	38%	43%	7%	50%	47%
Occasionally, but < once per week	23%	32%	3%	58%	48%
I've only ridden once	10%	12%	1%	39%	21%
Overall	30%	34%	4%	50%	42%
Visitors	N/A	36%	N/A	41%	33%

	Exercise	For Fun/ Recreation	Shopping/ Errands	Go To/From Work-Related Appointment	Other
More than 1x per day	3%	28%	39%	15%	3%
Daily	3%	25%	35%	12%	3%
3-6x per week	2%	28%	35%	12%	3%
1-3x per week	2%	35%	36%	12%	3%
Occasionally, but < once per week	2%	46%	28%	9%	5%
I've only ridden once	2%	52%	10%	4%	13%
Overall	2%	41%	28%	10%	5%
Visitors	1%	46%	19%	N/A	9%

**Note: Respondents could select more than one answer option, resulting in a total percentage greater than 100.*

E-scooter trip data is not detailed enough to provide information about whether riders parked e-scooters properly or rode e-scooters in the appropriate places. However, 30 percent of respondents indicated that e-scooter parking contributed to a negative experience during the pilot, and 37 percent reported that riding on sidewalks similarly negatively affected their experience of the pilot. Non-riders were more likely to cite these behaviors as problematic than riders. Among riders, 24 percent admitted to using the sidewalk at least some of the time, and five percent said they rode on the sidewalk at least half of the time.

When asked about the rules of the e-scooter pilot, riders were slightly better-informed than non-riders, but significant gaps in understanding remained. About half of riders correctly indicated that e-scooters were not allowed to be ridden on the 606 trail or on the sidewalk. Of non-riders, 36 percent said that they did not know what the rules for e-scooter operation were.

Table 8: Riders and Non-Riders: E-scooter Operation Rules Knowledge

"Which of the following are laws related to e-scooters in Chicago? (select all that apply)

Options	Nonrider	Rider	Total
E-scooters are not allowed to be ridden on the sidewalk	49%	61%	57%
E-scooters are not allowed to be ridden on the 606	36%	46%	42%
All users must wear a helmet when riding an e-scooter	20%	32%	28%
E-scooters are not allowed to be ridden or parked in Chicago Parks	19%	24%	22%
E-scooters are not allowed to be ridden in the street	5%	2%	3%
I don't know what the e-scooter laws are in Chicago	36%	11%	20%
None of the above	2%	1%	1%

On-Street E-scooter Behavior Observations

In addition to online survey responses, the City conducted e-scooter riding and parking observations during the pilot to gain a more wholistic understanding of ridership behaviors. Data was analyzed from a total of 57 observations conducted at different times in 18 locations across the pilot area. Staff observed a total of 776 moving e-scooters and 939 parked e-scooters during all the observations combined. Bike lanes existed on at least one street at 7 of the 18 field locations. All onsite observations were conducted during two-hour periods between 7:45 am to 8:00 pm, between August 6th to September 24th, 2019.

80.8%

80.8% of e-scooters were parked properly on the sidewalk. 18.4% were improperly parked on the sidewalk. 0.7% were on the street.

During these on-site observations, City staff recorded the number of e-scooters and riders that adhered to riding and parking regulations, riders' helmet usage and the public way type used (bike lane, sidewalk or street).

Observations of Riders in Motion

- 10 percent of riders used the sidewalk when riding on a street with a bike lane.
- 15.2 percent of riders used the sidewalk when riding on a street without a bike lane.
- 3.6 percent of riders were observed riding their e-scooters in an unsafe manner (the exact nature of unsafe riding was not recorded and relied upon the surveyor to make a subjective call).
- 2.7 percent of riders were observed wearing a helmet.

Observations of Parking

- 80.8 percent of e-scooters were parked properly on the sidewalk.
- 18.4 percent of e-scooters were parked incorrectly on the sidewalk, either hindering the sidewalk, intersection or a bike rack.
- 0.7 percent of e-scooters (7 e-scooters total) were parked incorrectly on the streets.

E-SCOOTERS AND OTHER TRANSPORTATION MODES

The purpose of the e-scooter pilot was to evaluate the viability of e-scooters as a mobility option. Therefore, it is important to understand the impact of e-scooter use on the broader transportation ecosystem. The online survey provides a crucial window into the experiences of e-scooter riders and non-riders. However, these responses should be viewed with caution due to relatively small sample sizes and some indications that survey respondents may not be representative of all those who rode or encountered e-scooters over the course of the pilot. Supplementing online survey responses with additional data on ride-hail trips, transit ridership and Divvy use can help validate the online survey results. The combination of survey responses and other data on travel behavior provides some indications of the effect e-scooters had on riders' transportation choices, as well as on non-riders' experiences of the transportation system. These findings are not definitive but provide information that could be tested further in the future.

Figure 23: Chicago E-scooter Pilot Program Online Survey

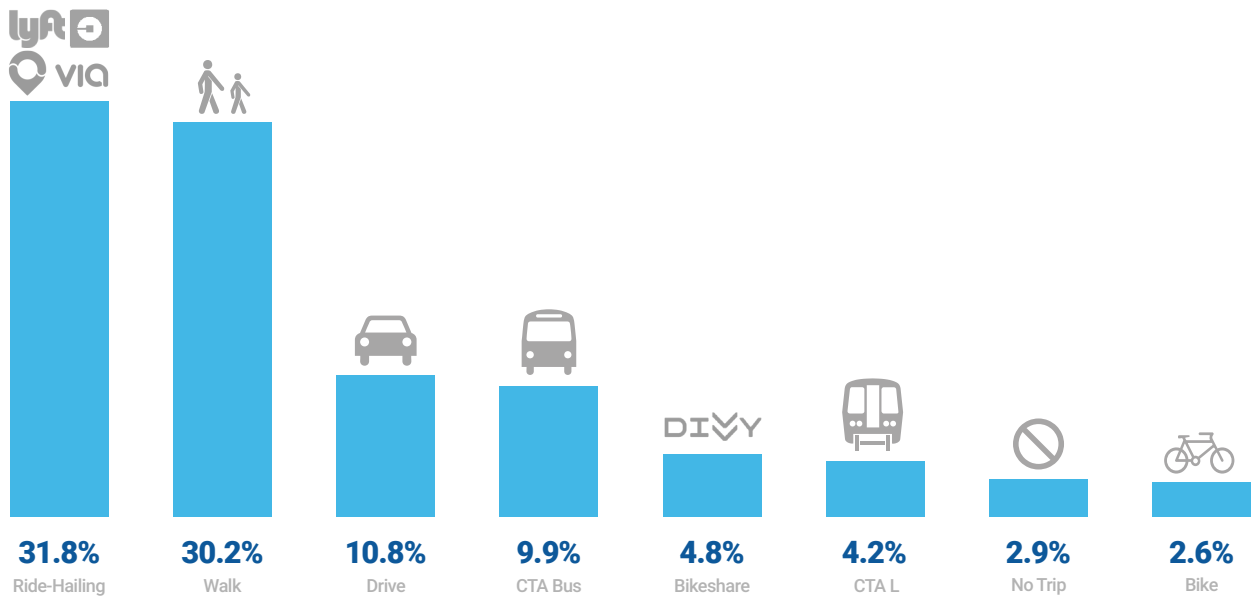
Online Survey and Mode Choice

Survey results indicate that potential e-scooter users are primarily considering e-scooters as alternatives to a variety of modes, including ride-hailing services (such as Uber, Lyft and Via), walking, driving a personal vehicle or taking a CTA bus. These findings are consistent with other recent e-scooter pilots in Portland, OR, Santa Monica, CA and Arlington, VA.

When asked to think about their last e-scooter ride, nearly 43 percent of Chicago survey respondents reported that if an e-scooter had not been available, they would have either used a ride-hailing service or driven a personal vehicle, indicating e-scooters' potential to decrease dependency on ride-hailing services and personal vehicles. However, 30 percent indicated that they would have walked, and nearly 15 percent reported that they used e-scooters to replace a public transit trip.

Figure 24: Survey Respondents Mode Choice if an E-scooter is Not Available

"If an e-scooter had not been available, how would you have gotten to your destination?"



In addition to providing information about alternatives for a specific e-scooter trip, survey respondents reported on changes in their overall use of other transportation modes during the e-scooter pilot. The table below shows the percent of survey respondents who reported decreasing their use of other modes. Unsurprisingly, more frequent e-scooter users reported more significant changes in travel behavior than occasional or infrequent e-scooter users. Consistent with the responses for individual trip mode replacement, more e-scooter users reported reducing ride-hail use, personal cars, walking and CTA bus use than CTA train, Divvy or personal bike use.

These survey results support the idea that e-scooters are reducing passenger vehicle use and increasing sustainable transportation mode share, but it is important to compare with other available data on the transportation system. Below is a more detailed assessment of the potential effect of e-scooters on the use of ride-hail, Divvy and the CTA.

Table 9: Percent of Users by E-scooter Use Frequency Who Reported Reducing Use of Other Modes

	Daily	Weekly	Occasional	Once	Overall
Ride-hail Use	63%	64%	36%	5%	42%
Driving	42%	37%	16%	4%	23%
Walking	41%	28%	14%	3%	18%
CTA Bus Use	36%	28%	13%	4%	18%
CTA Train Use	27%	17%	7%	2%	11%
Divvy Use	26%	16%	11%	3%	12%
Personal Bike Use	20%	12%	6%	2%	8%

Transportation Network Provider Use

The use of ride-hailing services, or TNPs, have increased threefold in Chicago since 2015. While they may provide a potential alternative to reduce personal vehicle ownership and may supplement the transit network for trips that are difficult to make, there is substantial evidence that TNP travel is increasing congestion in areas of already high congestion and transportation access, while reducing transit ridership in the same areas. Further, in the downtown area, three out of four trips are requested as single passenger rides further compounding congestion.

If e-scooters replace short TNP trips, as the survey results appear to indicate, they could alleviate congestion. In addition to being the most frequent mode people reported replacing with e-scooter travel, the survey results indicate that frequent TNP users were most likely to reduce their use of these services. This survey data would appear to support the theory that e-scooters might be displacing the short, single occupancy TNP trips that have the biggest impact on local congestion. However, analysis of TNP data submitted to the City indicates that estimates of mode shift derived from survey results should be treated with caution. User surveys appear to be overestimating the degree to which e-scooters are replacing TNP trips.

Approximately 2.8 million TNP trips started and ended within the e-scooter pilot area between June 15th and October 15th, 2019—nearly 40 percent of them less than 2.5 miles in length. These trips were largely concentrated in the same places that e-scooter use was concentrated—in the eastern half of the pilot area, particularly along Milwaukee Avenue. While 400,000 e-scooter trips are only about 15 percent of the number of TNP trips that took place during the pilot period, there are enough e-scooter trips that if the online survey results are correct, there should be a measurable difference in TNP use during the pilot compared to same period in 2018, and compared to areas that did not have e-scooters available.

If 30 percent of the 400,000 e-scooter trips replaced TNP trips, per the online survey results, there should be 122,000 fewer TNP trips in 2019 versus the same period in 2018, or a decline of more than four percent. But rather than declining, the number of TNP trips in the pilot area increased by 21 percent. This increase on its own is not necessarily incompatible with e-scooters replacing TNP trips, as TNP use is growing across the city. Comparing the year-over-year increase in TNP trips in the pilot area to the increase in TNP trips outside the pilot area reveals nearly identical rates of growth (21 percent versus 22 percent).

Divvy Use

On the whole, survey respondents did not report significantly reducing Divvy use due to the availability of e-scooters. In fact, half of rider survey respondents reported never using Divvy, suggesting that e-scooters and Divvy riders may be different markets, or reflecting limited Divvy availability within the pilot area. Among e-scooter users who reported using Divvy at least weekly, 30 percent reported decreasing their Divvy use. However, seven percent reported increasing their Divvy use, which is a higher share than was reported for other modes.

As with TNPs, the trip data for Divvy use in the pilot area tells a slightly different story than the survey results. According to available trip data, it appears more likely that e-scooters had the effect of slowing growth in Divvy ridership than slowing TNP ridership. Compared to the same time period in 2018, Divvy ridership increased by one percent in the pilot area. In the rest of the city, Divvy ridership increased by six percent. Furthermore, the number of Divvy trips with one end in the pilot area increased more quickly than trips with both ends in the pilot area, perhaps indicating that some potential Divvy users chose an e-scooter instead for trips where this was possible or were using Divvy for longer trips outside of the pilot area. This is contrary to the survey findings, where respondents indicated they were more likely to use e-scooters to replace TNP trips than to replace Divvy trips.

Even if e-scooter riders and Divvy riders are different customers, they appear to be using e-scooters in the same places where people are using Divvy. Comparing Divvy use and e-scooter use at the census block group level shows that the places with the highest frequency of Divvy pickups are also the places with the greatest number of e-scooter pickups. The most significant outliers tend to have relatively high use of both e-scooters and Divvy and tend to be in the remainder of the pilot area where there is more robust Divvy service available rather than in the priority areas.

Table 10: E-scooter Survey Respondents: Change in Divvy Use

	Number of Respondents	Percent of Respondents who Reported Using Divvy...		
		Less Often	About the Same	More Often
Daily	90	24%	62%	13%
More than 3x per week	214	33%	60%	7%
1-2x per week	369	33%	61%	7%
Less than 1x per week	910	27%	69%	4%
Never	2232	10%	90%	1%
Total	**3815**	**18%**	**80%**	**3%**

CTA Use

Most survey respondents were at least occasional users of the CTA system, and more likely to be daily users of CTA trains than CTA buses. Respondents were also more likely to report reducing bus use than train use due to the availability of e-scooters.

The trip data indicate that nearly half (47.4 percent) of e-scooter trips either started or ended within 300 feet of a train station or 60 feet of a bus stop, while nine percent of trips both started and ended near a transit stop. This does not necessarily indicate that all these trips were "last mile" connections to transit; many of these riders were likely traveling to or between destinations near the transit stop. Trips appear to be more likely to be "last mile" than "first mile"—that is, they were more likely to start near transit than end near transit. This may be because e-scooters were more likely to be available near transit than away from transit. In keeping with the survey responses, e-scooter trips appeared to be more likely to replace bus trips than rail trips. In addition, the very low percentage of survey respondents that said they rode CTA bus or rail more often indicates that availability of e-scooters did not increase public transit use.

Table 11: E-scooter Survey Respondents: Change in CTA Bus and Train Use

Pre-Pilot Frequency of CTA Bus Use	Number of Respondents	Percent of Respondents who Reported Using CTA Buses...		
		Less Often	About the Same	More Often
Daily	734	26%	71%	3%
More than 3x per week	707	31%	65%	3%
1-2x per week	813	25%	70%	5%
Less than 1x per week	1436	22%	76%	1%
Never	901	11%	88%	2%
Total	**4591**	**22%**	**78%**	**3%**

Pre-Pilot Frequency of CTA Train Use	Number of Respondents	Percent of Respondents who Reported Using CTA Trains...		
		Less Often	About the Same	More Often
Daily	1240	9%	87%	4%
More than 3x per week	899	15%	80%	5%
1-2x per week	895	14%	80%	5%
Less than 1x per week	1204	16%	81%	4%
Never	420	15%	83%	2%
Total	**4822**	**13%**	**82%**	**4%**

The transit stops that saw the highest e-scooter volume are unsurprisingly in the areas with the highest overall e-scooter volume, along the CTA Blue Line and the Milwaukee, Damen, Armitage, North and Halsted bus lines. Of trips that both started and ended near transit stations, the most common locations were along the Halsted and Diversey bus routes.

Table 12: Share of E-scooter Trips Starting and/or Ending Near Transit

	Bus	Rail	Any Transit
All trips starting or ending near transit	41.3%	20.7%	47.4%
Potential "first mile" trips (trips ending near transit)	23.1%	8.1%	26.2%
Potential "last mile" trips (trips starting near transit)	25.3%	13.5%	30.4%
Potential transit replacement trips (starting and ending on one transit route)	1.8%	0.5%	2.2%

Figure 25: Map of E-scooter Trips That Ended Near Metra and CTA Transit Stops

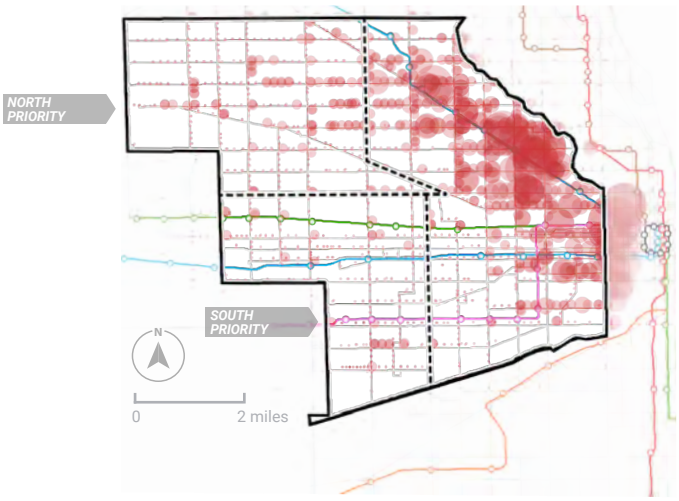
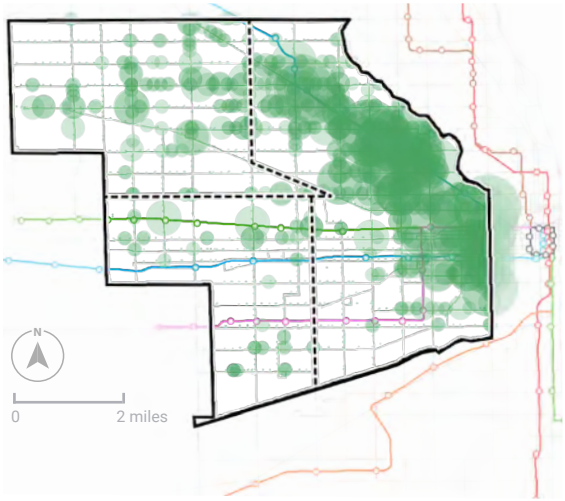
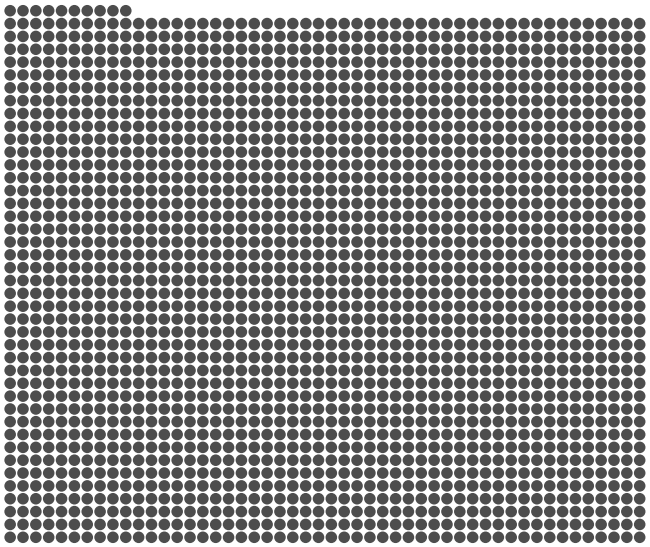


Figure 26: Map of E-scooter Trips That Started Near Metra and CTA Transit Stops



38 MILLION

Trips in the pilot area made w/o a private car (June 15–October 15)



CTA BUS

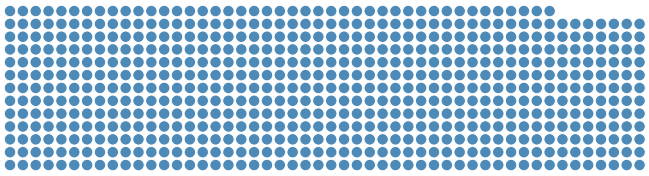
20.6 Million Trips

(2019, trips beginning in the pilot area)

CTA RAIL

10.1 Million Trips

(2019, trips beginning in the pilot area)



TNP (UBER, LYFT, ETC.)

6.4 Million Trips

(2018, trips beginning and ending in the pilot area)

E-SCOOTER

821,625 Trips

(2019, trips reported as part of the pilot)

DIVVY

304,747 Trips

(2018, trips beginning and ending in the pilot area)

VEHICLE MILES TRAVELED AND GREENHOUSE GAS EMISSIONS

E-scooters have the potential to reduce vehicle miles traveled (VMT) and greenhouse gas emissions to the extent that they shift travel from cars to active modes of transportation. Although the above analysis indicates that survey results likely overestimate the degree of behavior change caused by e-scooters, they provide a useful potential benchmark for the maximum amount by which e-scooters may have reduced carbon emissions and VMT. Based on a total of 407,296 trips for transportation purposes, an average trip distance of 1.5 miles, and assuming the mode shift information in the survey is correct, the e-scooter pilot may have eliminated 179,251 vehicle trips. After accounting for additional miles driven by TNPs and taxis when traveling to pick up passengers, the pilot may have eliminated as many as 300,000 miles of vehicle travel, which translates to approximately 116 tons of CO2. At the same time, the pilot could have generated as many as 191,000 new active transportation trips, including trips that people would not have taken at all but for e-scooters.

However, e-scooter operations are not completely carbon neutral. A recent study from North Carolina State University estimated that e-scooters generate between 150 and 200 g of CO2 per mile, 43 percent coming from collection and distribution and only 4.3 percent coming from the electricity used to charge the e-scooters.[5] Based on these estimates, the e-scooter trips taken during the pilot and the transportation used to rebalance the e-scooters generated between 50 and 60 tons of CO2 emissions, or about half as much as the upper estimate of the number of tons removed by shifting trips out of passenger vehicles. This estimate is highly dependent on the emissions involved in collecting, rebalancing and recharging e-scooters each evening, and may be lower if companies employ low-emission strategies for e-scooter collection. There are additional factors to consider, such as the changes in emissions based on reductions in transit and Divvy use, but these impacts are likely to be relatively small.

[5] *Hollingsworth, Copeland, and Johnson, "Are e-scooters polluters? The environmental impacts of shared dockless electric scooters." Environmental Research Letters, 2019. https://iopscience.iop.org/article/10.1088/1748-9326/ab2da8*

E-SCOOTERS AND CTA OPERATIONS

In addition to evaluating the impact of the e-scooter pilot on transit ridership, it is also important to evaluate whether e-scooters impacted CTA bus or rail operations. As noted in the section on e-scooter pilot rules and regulations, e-scooters were not allowed to be parked within 10 feet of bus stops and terminals or rail entrances, in order to avoid impeding transit customers from using CTA buses or trains.

10

E-scooters were not allowed to be parked within 10 feet of bus stops and terminals or rail entrances.

In addition, consistent with the policy for Divvy bikes, e-scooters were not permitted on CTA buses or trains, or in CTA rail stations. The bike racks on the front of the CTA buses were not able to accommodate e-scooters as the wheels must be 16 inches or more in diameter in order to be properly secured. The pilot rules were intended to maintain safety and accessibility for pedestrians and CTA customers, and to minimize negative impacts on CTA customers, especially customers with disabilities.

CTA employees were instructed to report any issues with e-scooters that interrupted service or resulted in e-scooters on CTA property. Overall, CTA bus and rail operations were not greatly affected by the e-scooter pilot. However, a few problems that impacted service were identified based on reported issues and observations from CTA Operations staff and managers. A deployment of a higher number of e-scooters, or an expansion of the service area boundaries, could result in more impacts to CTA operations. The downtown area would likely be particularly susceptible, given the existing high density of uses on streets and sidewalks.

Impacts to CTA Bus Operations

The most commonly reported issue that impacted CTA bus operations was customers attempting to board CTA buses with e-scooters (reported seven times). In some cases, communication between CTA Operators and customers caused delays to buses and passengers. There was also one instance reported where an Operator was unable to deploy the wheelchair ramp due to several e-scooters being parked in the bus stop. Anecdotally, this problem occurred more frequently than was officially reported and to resolve this issue, Operators sometimes had to exit the vehicle to move an e-scooter out of the way.

As use of bike lanes may increase further with the addition of e-scooters, street design should be carefully considered to organize street space, while still prioritizing the smooth operations of buses.

Regarding street operations with e-scooters, Operators reported observing that e-scooter use in bike lane facilities increased during the pilot. There are many benefits of building infrastructure to improve and increase biking, but it is important to note that bike lanes often utilize the street space that buses need to access bus stops, and conflicts can arise, potentially slowing operations for all users. As use of bike lanes may increase further with the addition of e-scooters, street design should be carefully considered to organize street space, while still prioritizing the smooth operations of buses. Greater implementation of street design features such as boarding "islands" at bus stops, with bike lanes fully separated, is one example of how to address this.

CTA Rail Operations

The most commonly reported issue for CTA rail operations was customers attempting to bring e-scooters into rail stations and on trains (reported eight times). Additionally, one e-scooter was reported on the rail right-of-way, which had to be retrieved by a CTA employee, and caused delays to rail service.

CTA Operations reported some build-up of e-scooters near a few Blue Line rail station entrances that impeded customers from accessing stations. However, pile-ups of e-scooters at rail stations was not a widespread issue during the pilot.

PILOT EQUITY PROVISIONS

As described in the usage section above, e-scooter use was lower and e-scooters were less consistently available throughout the day in the priority areas of the pilot compared to the remainder of the pilot area. Some companies were better at achieving the rebalancing requirements than others, but none were able to consistently ensure 25 percent of their e-scooters were available in the priority areas throughout the pilot. Compliance was better in the northern portion of the pilot area than in the southern portion. According to e-scooter availability data, only one of the companies successfully managed to meet the rebalancing requirements of 25 percent in the priority north area consistently, and none met it consistently in the south priority area.[6] Despite uneven compliance, the deployment requirements made the morning the time when e-scooters were most equitably distributed. By mid-day, e-scooters were more heavily concentrated in the remainder of the pilot area.

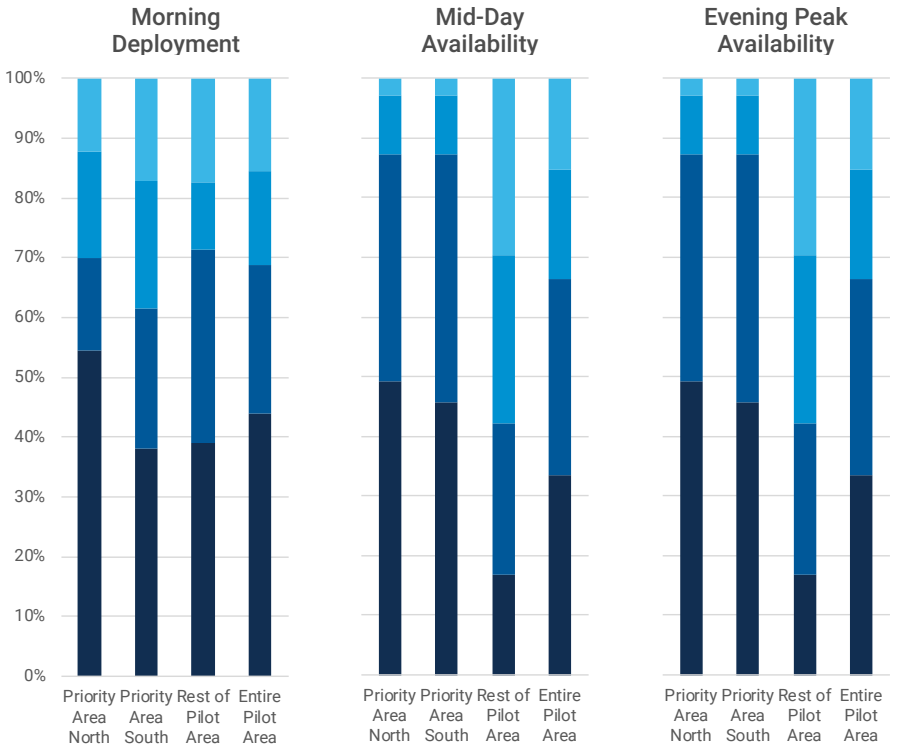
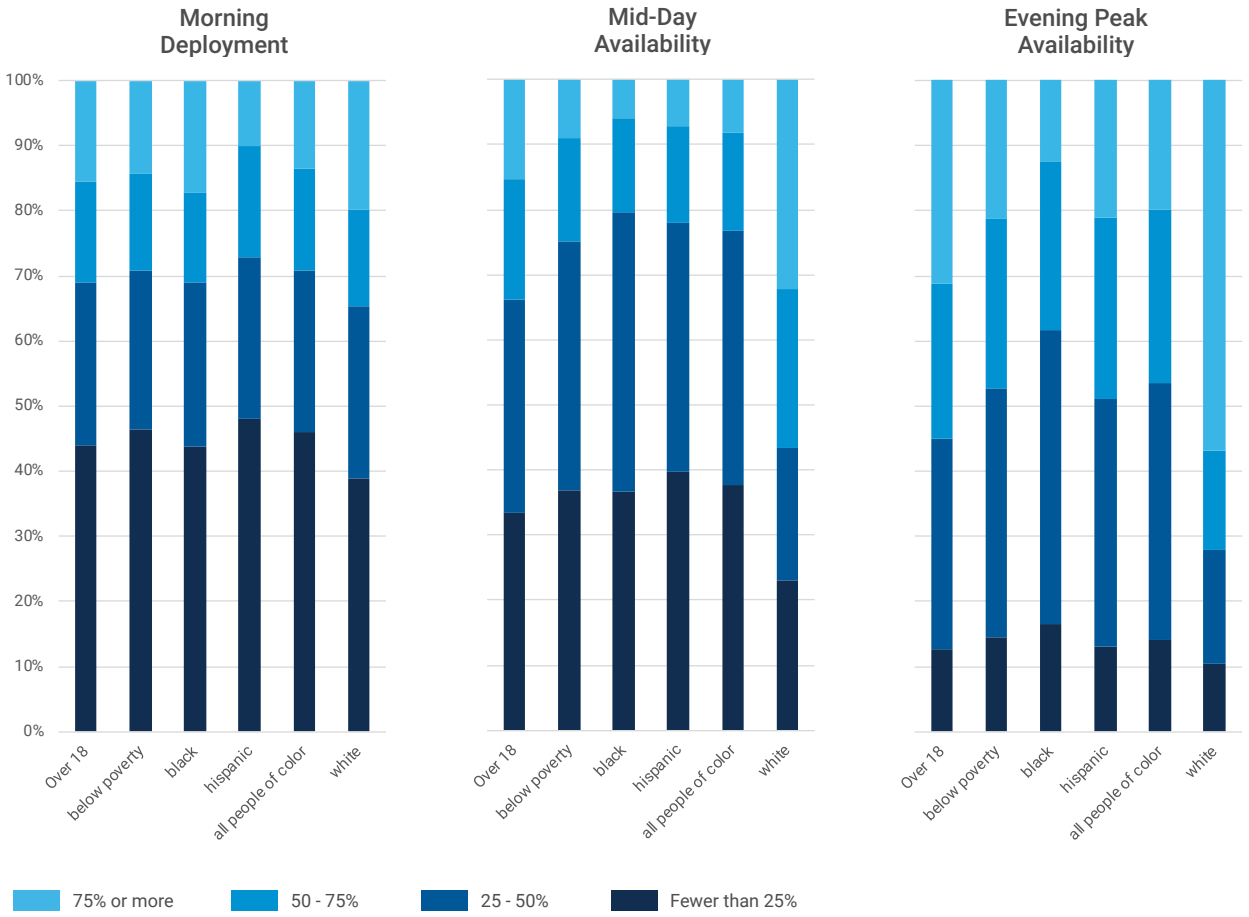


Figure 27: E-scooter Availability in the Priority Areas Throughout the Day

[6] *See Company Operations section for further commentary on data issues that prevent definitive conclusions on company compliance with rebalancing requirements.*

The charts below show the percent of the pilot area population by race and income by how consistently they had access to e-scooters over the pilot period. While e-scooter availability was more dispersed later in the day, meaning more residents had at least some access to e-scooters, racial disparities in access also increased as the day transpired. By the afternoon peak, 57 percent of white residents of the pilot area had access to e-scooters at least 75 percent of the time, but only 13 percent of black residents had the same level of access.

Figure 28: Percent of Pilot Area by Race, Income and Access to E-scooters



Demographics of the survey respondents skewed older, whiter, higher income and more educated than the pilot geography as a whole, although rider respondents were more diverse than non-rider respondents. Respondents who reported being daily riders were more diverse than respondents who reported being less frequent riders. The majority of non-rider respondents identified as female, while the majority of rider respondents identified as male.

Table 13: Demographics of Riders and Non-Riders as Identified by Survey Respondents

Gender	Nonriders	Riders	All
Woman	57%	34%	43%
Man	42%	65%	56%
Non-Binary or Transgender	1%	1%	1%

Age	Nonriders	Riders	All
<17	0%	0%	0%
18-24	3%	11%	8%
25-44	58%	79%	71%
45-64	29%	9%	17%
65+	11%	0%	4%

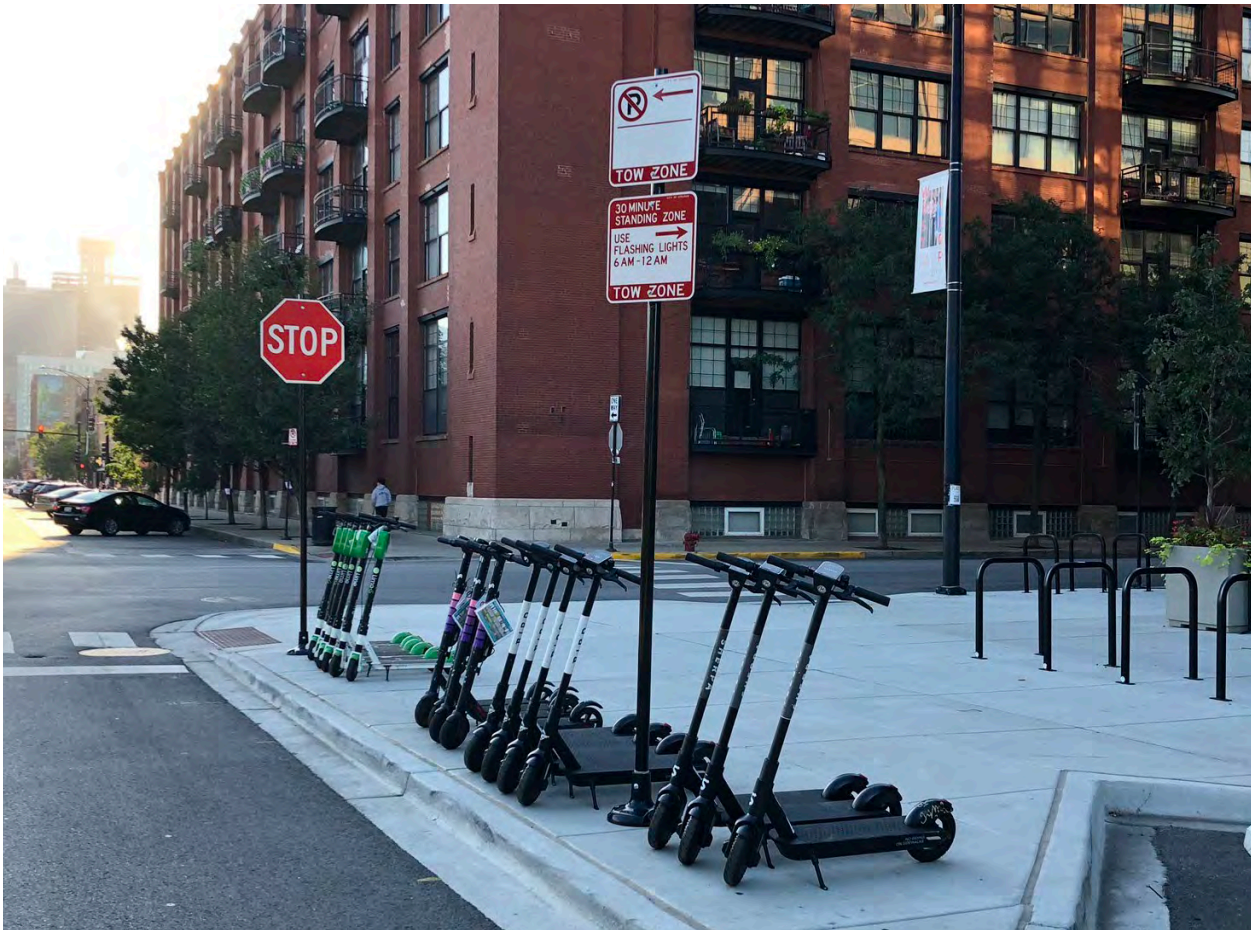
Income	Nonriders	Riders	All
$200k +	14%	10%	12%
$150k - $199k	9%	9%	9%
$100k - $149k	20%	21%	21%
$75k - $99k	19%	18%	18%
$50k - $74k	20%	22%	21%
$30k - $49k	12%	11%	11%
$15k - $29k	4%	5%	5%
Under $15k	2%	4%	3%

Race/Ethnicity	Nonrider	Rider	Daily Rider	Weekly+ Rider	Occasional Rider	1-Time Rider	All
Hispanic or Latinx	8%	12%	18%	12%	11%	13%	10%
White Alone not Hispanic	77%	72%	56%	73%	74%	72%	76%
Black	4%	6%	13%	6%	6%	4%	5%
Asian	5%	7%	8%	7%	7%	7%	6%
Am. Indian/Alaska Native	1%	1%	1%	1%	1%	1%	1%
Hawaiian/Pacific Islander	1%	1%	2%	1%	1%	0%	1%
Other	5%	3%	4%	4%	2%	5%	4%

Access for the Unbanked

One requirement of the e-scooter pilot was to include programs for the unbanked. Every company submitted a plan in the original application and these plans were posted on www.chicago.gov/scooters during the pilot program. These programs typically utilized pre-paid debit or gift cards (Bird, grüv, JUMP, Lyft and Sherpa) or an option to enroll in a benefits program (Bolt, Lime, Spin, VeoRide and Wheels). Reports of unbanked signups varied by company. Some companies reported the number of riders using the unbanked option, while others reported the number of cash trips. By either measure, unbanked riders' use of e-scooters was a small percentage of the total trips (less than half of one percent of all e-scooter trips). This could have been because the City only required companies to have cash options for unbanked riders without more rigorous requirements. It is important, therefore, for any potential future program to be more prescriptive about what is required in the equity plans.

Figure 29: E-Scooters Parked on West Randolph Street



E-SCOOTER INJURY ANALYSIS

The Chicago Department of Public Health (CDPH) analyzed potential injuries related to e-scooter use during the pilot period to help evaluate the potential impact of e-scooters on the safety of Chicago residents. During the pilot period, CDPH asked Chicago acute care hospital emergency departments (EDs) to tag the term "e-scooter" in their electronic health record systems for any patients who presented with injuries related to e-scooters (i.e. riders, pedestrians and cyclists). This allowed CDPH epidemiologists to review this data.

Methodology

Potential e-scooter related injury incidents were identified using Electronic Syndromic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE) – a public health system that allows analysis of hospital emergency department visit data. Queries using the term "scooter" were done in the ESSENCE platform to extract visits to Chicago EDs and patients with Chicago zip codes presenting to non-Chicago IL EDs. Each record was qualitatively reviewed to identify probable cases of injuries related to e-scooters during the pilot period.

Results

Twenty-six Illinois hospitals, including 18 Chicago hospitals reported 192 probable ED visits due to e-scooter injuries from June 15 to October 15, 2019. Twelve hospitals reported at least five e-scooter injuries. One hospital, Presence Saints May and Elizabeth Medical Center, located in the pilot area, reported 61 e-scooter injuries during the pilot period.

192

A total of 192 probable ED visits due to e-scooter injuries were reported.

This represents an average of 1.6 e-scooter injury incidents per day seen in Chicago, across all EDs. Seventy-three percent of all reported e-scooter-related injuries were persons between 18-44 years of age. Fifty-five percent of injuries reported were males. Most reported injuries (179; 93 percent) were sustained in persons operating an e-scooter.

One injured child was riding on the back while a parent was operating the e-scooter. Ten pedestrians (five percent of injuries) were seen for treatment in EDs after being hit by someone operating an e-scooter; one cyclist was injured in this way. For one injury, whether the injured was a rider, pedestrian or a cyclist could not be determined from the hospital record. Of the 192 persons with e-scooter injuries reported during the pilot period, three (1.5 percent) required admission to the hospital.

During the pilot period, there were 821,615 total e-scooter rides. CDPH calculations show that there were 23.36 persons injured per 100,000 e-scooter trips taken during the pilot period.

Table 14: Reported E-scooter Injuries by Month and Age Group

Age Group (years)	MONTH 1	2	3	4	Total	Percent
< 5	1	0	0	0	1	0.5%
5 - 11	3	1	1	0	5	2.6%
12 - 17	8	4	1	3	16	8.3%
18 - 24	18	18	7	11	54	28.1%
25 - 44	33	21	17	15	86	44.8%
45 - 64	11	5	6	4	26	13.5%
65 +	1	2	1	0	4	2.1%
Total	75	51	33	33	192	100%

Figure 30: Percent of Injuries by Age Group

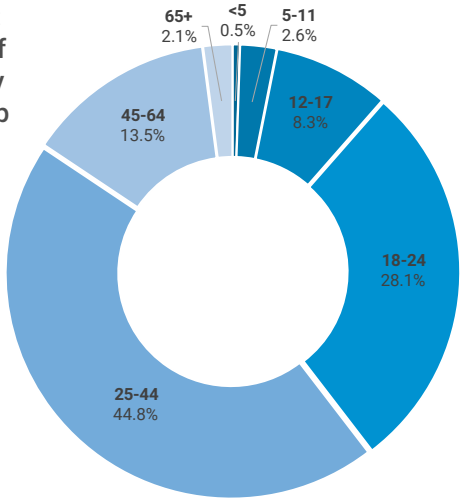
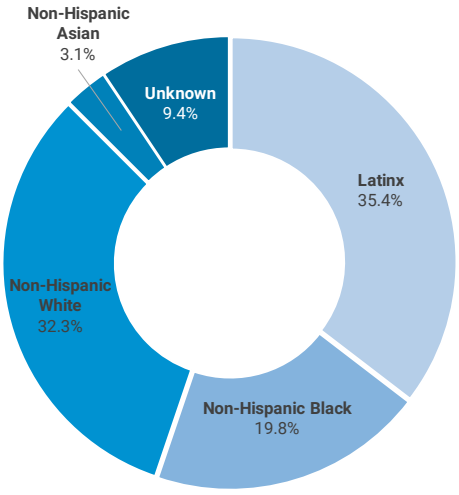


Figure 31: Percent of Injuries by Race Group



Limitations

These results should be interpreted very cautiously due to several important limitations. First, the data only captured people with injuries seen at Chicago EDs (and Chicago residents seen at non-Chicago Illinois EDs). People who were injured, but did not seek care, or who were seen in non-emergency department medical settings are not included. Second, the data only includes injuries that were labeled appropriately in the ED medical record. It is possible that injured individuals may have been misclassified and not identified. Finally, this data is only an estimate; CDPH cannot definitely assign injuries as being related to the e-scooter pilot.

Discussion

The overall safety of e-scooters is still being determined. E-scooters are a new, emerging mode of transportation and limited evaluation has been conducted to understand their impact on safety, or on health more broadly.

The closest comparable analysis was completed in Austin, Texas.[7] This study found on average, two injuries occurred per day and calculated that 20 persons were injured per 100,000 e-scooter trips taken during the study period. However, any comparison to Chicago results should be interpreted very cautiously due to several important limitations, including: differences in study location, duration, population and methodology. Considering these limitations, future health and safety considerations include:

- **Increase education** on safe e-scooter riding, such as wearing a helmet; obeying traffic laws; riding in protected bicycle lanes; maintaining a safe speed; and parking e-scooters with care.
- **Promote equity** in access, infrastructure and opportunity and provide safety protections for riders, pedestrians and cyclists through regulation of use.
- **Establish and strengthen injury surveillance** related to emerging modes of transportation to better understand impact.

[7] Austin Public Health (2018). Dockless Electric Scooter-Related Injuries Study. Retreived from https://www.austintexas.gov/sites/default/files/files/Health/Epidemiology/APH_Dockless_Electric_Scooter_Study_5-2-19.pdf.

PUBLIC INPUT, CUSTOMER AND STAKEHOLDER FEEDBACK

In the development and execution of the pilot, the City provided numerous pathways of engagement for residents, e-scooter customers and e-scooter companies. They included the online survey, a 311-complaint system, a feedback email, monitoring of social media, in-person stakeholder meetings and in-person engagement with e-scooter companies.

Online Survey - Positive and Negative Experiences

As discussed, the results of the online survey revealed some choices about mode shift, as well as positive and negative experiences and overall impressions of the pilot. Riders were more likely to report a positive experience of the e-scooter pilot than non-riders, and riders were more likely to support the continuation and expansion of e-scooter operations in Chicago.

Table 15: "If you had positive experience with the pilot, what contributed to your positive experience?"

	Riders	Nonriders	All
Speed of E-scooter	58%	2%	36%
Access to Mobility Options	50%	5%	32%
Affordability	63%	3%	38%
Fun	70%	4%	43%
Sustainability	46%	5%	30%
No Positive Experience	12%	83%	41%
Other	4%	8%	5%

Table 16: "If you had negative experience with the pilot, what contributed to your negative experience?"

	Riders	Nonriders	All
E-scooter Parking	14%	55%	30%
Riding on Sidewalks	18%	66%	37%
Safety	20%	59%	36%
Scooter Availability	28%	3%	18%
Number of Companies	17%	10%	14%
Company Adherence to Rules	8%	27%	15%
Cost	10%	3%	7%
No Negative Experience	45%	12%	32%
Other	12%	19%	15%

Table 17: "Do you think shared e-scooter companies should continue operating in Chicago?"

	Nonriders	Riders	Total	Nonriders	Riders	All
No	3033	815	3848	67%	10%	31%
Yes	786	4811	5597	17%	61%	45%
No response	717	2284	3001	16%	29%	24%

311 Calls

Affixed to each e-scooter was a 1-800 number for residents to call the company in the event of an errant e-scooter. The City set up a coding system in 311 to address complaints during the pilot and received 332 service requests. The majority of the complaints were related to improper e-scooter parking. Tables 18.1-18.4 provide an overview of the complaints by company, month and category. The number of 311 complaints decreased over the course of the pilot.

Table 18.1: 311 Statistics by Company

Company	Complaints
JUMP	65
Bird	54
VeoRide	31
Lime	26
Spin	24
gruv	22
Sherpa	22
Bolt	18
Lyft	17
Wheels	12
None indicated	41
Total	**332**

Table 18.2: 311 Statistics by Ward

Ward	Complaints	Ward	Complaints
1st	50	29th	7
27th	37	38th	6
32nd	34	26th	4
25th	23	45th	3
24th	22	47th	3
2nd	21	3rd	2
42nd	21	4th	2
31st	18	33rd	2
36th	13	40th	2
37th	11	20th	1
28th	10	21st	1
30th	10	22nd	1
35th	9	39th	1
43rd	8	41st	1
11tth	7	44th	1

Table 18.3: 311 Statistics by Complaint

Type	Complaints
Improper Parking	153
Abandoned E-scooters	59
E-scooter out of Zone	30
E-scooter Deployment	29
Riding Complaint	24
Other	37

Table 18.4: 311 Statistics by Month

Type	Complaints
June	73
July	105
August	80
September	61
October	13

E-scooter Feedback Email

To provide even more opportunities for feedback, the City of Chicago set up an email address where residents could send feedback. This email was designed to ensure that residents had an opportunity to provide general feedback throughout the pilot program. From the creation of this email account on July 3 through the end of October, the City received 557 feedback emails. Table 19 provides an overview of those emails.

Stakeholder Meetings

Feedback from stakeholders and community members was vital to the understanding of the pilot program. To ensure full feedback before, during and after the pilot, the City engaged with a group of over 50 representatives from various stakeholder groups throughout the city, including transportation groups, disability advocates, local chambers of commerce, community organizations and other stakeholders. The City convened this group for conversations leading up to the pilot, throughout the program and following its conclusion. The intention of these meetings was to ensure that the City was developing, managing and refining the program based on community feedback, while communicating rules and expectations directly to community groups.

Table 19: Summary of E-scooter Feedback Emails

E-scooter Feedback Emails

Classification	No. of Emails	Percentage
Positive	211	38%
Negative	286	51%
Neutral	60	11%
Total	557	100%

Breakdown of Positive Emails, by Category

Type	No. of Emails
Transit Accessibility	133
Easy/Fun to Use	74
Sustainability	36
Affordability	20
Safety	16

Breakdown of Negative Emails, by Category

Type	No. of Emails
Safety	266
Parking	191
Company Adherence to Rules	59
Availability	50
Number of Companies	31
Scooter Condition	11
Cost	4

During meetings prior to the pilot, on January 25 and April 25, the stakeholder groups made recommendations that were used to develop the terms of the pilot, including:

- **Removing the e-scooters from the public way every evening**
- **Keeping e-scooters out of the Loop**
- **Equity requirements to rebalance a portion of the e-scooters into priority zones**

On August 5, 2019, the City met with the National Federation for the Blind (NFB). At that meeting, the NFB recommended that the City:

- **Require the use of Braille on each e-scooter to identify company contact information**
- **Require e-scooter to emit a low-level noise to alert people who are blind or visually-impaired**
- **Require that all apps are fully accessible**

During the pilot, the City engaged regularly with the stakeholders via email and held a large stakeholder meeting at the halfway point of the pilot, on August 22. Through the feedback from this group, the City heard the following points of concern from the community:

- **E-scooter riding on the sidewalk has been a serious problem**
- **It is challenging to prevent e-scooters parked in the middle of the sidewalk**
- **There was not enough communication to residents**

Based on this feedback, the City revamped and simplified the communication on e-scooters and required companies to push a simplified safety and parking message to their users. The Chicago Department of Transportation also offered the opportunity to each company to partner with the City's Bicycling Ambassadors on free Learn-to-Ride e-scooter classes, and the City created an e-scooter safety video that was distributed on social media.[8]

[8] *The City's e-scooter safety video may be viewed at, https://www.youtube.com/watch?v=VDusb9vNK1Q.*

Following the pilot, the City held a final stakeholder meeting on November 14. At this meeting, and through other informal feedback from stakeholders, the City learned a few important points:

- **E-scooter companies have provided important employment opportunities in many neighborhoods.**
- **The City could have done a better job at communicating and enforcing the pilot terms.**
- **There was significant interest in conducting public education opportunities on safe e-scooter usage.**
- **Sidewalk riding and sidewalk clutter were the most serious problems.**
- **Any future program should emphasize equity, consider alternative measures to reduce sidewalk clutter and include braille and e-scooters that are audible.**

Feedback from Companies

In addition to ongoing communication throughout the pilot, the City hosted two formal meetings with each company. The first meetings were held in mid-July and served as a formal check-in after the first month of the pilot. During these one-on-one meetings, representatives from each of the companies met individually with employees from BACP, the Chicago Department of Transportation (CDOT), Mayor's Office for People with Disabilities (MOPD), Department of Innovation and Technology (DOIT) and the Mayor's Office to reflect on the first month of the pilot and ensure a success for the rest of the program. In addition to company-specific items, the following topics were covered with each company: how to prevent sidewalk riding and parking, methods to prevent riding on the 606, operational challenges the companies were facing to remove e-scooters from the public way each night, reports of missing e-scooters, complaints received from the disability community and procedures to geofence for the Pitchfork Music Festival. The City received the following feedback during these meetings:

- **Geofencing a small, narrow area like the 606 trail is challenging.**
- **Operationally, collecting all e-scooters within two hours each evening is a difficult task. It often took longer than two hours and some e-scooters are always left behind due to dead batteries or other issues. Picking up all e-scooters each evening is also less environmentally sustainable due to the increased miles driven.**

- **The required education flyer for e-scooters had too much information for riders to read.**

Following these meetings, the City implemented the following changes to the pilot requirements:

- **Required the companies to attach a new, simplified flyer to the e-scooters for the duration of the program, emphasizing not to ride e-scooters on the sidewalk or park them in the middle of the sidewalk.**

- **Required the companies to geofence the 606 trail, while giving them flexibility to decide how best to go about doing this to minimize the negative customer impact and ensure compliance.**

Towards the end of the pilot program, the City held another round of formal one-on-one meetings with each company. These meetings were held in late September. The intention of these meetings was to check-in on the programs as a whole and discuss procedures for the end of the pilot.

In addition to company specific items, the following topics were covered with each company:

- **Overview of additional data requests the City made to evaluate the pilot;**

- **End of pilot procedures;**

- **Upcoming company developments (such as the ability to have e-scooters with unique features including braille and lock-to technology, and the inability to ride on a sidewalk); and**

- **General feedback on the pilot.**

Additionally, the City learned that companies are generally open to braille on e-scooters and lock-to technology, with some hesitations, and that they are working hard to continue to improve the safety of their e-scooters. In addition to these formal meetings, the City of Chicago held regular informal check-ins with each company as needed and was in constant contact with all companies through hundreds of emails and phone calls.

Figure 32: Updated Flyer Attached to All E-scooters

IMPACT ON THE VISUALLY IMPAIRED AND OTHER PEOPLE WITH DISABILITIES

When Chicago announced its e-scooter pilot program, the disability community raised concerns based on experiences in other cities. News articles detailing e-scooters piled high in the streets blocking paths of travel and e-scooters being ridden on sidewalks created a sense of impending doom.

In response to these concerns and in addition to regulations aimed at maintaining clear paths of travel for people with disabilities, the City also required companies to develop an accessibility plan to address the needs and interests of people with disabilities. A potential company accessibility plan could include accessible technology (i.e. apps, websites, software), e-scooters with features to accommodate people with varying disabilities (i.e. seated e-scooters, lock-to technology and e-scooters that emit audible sounds to indicate their presence).

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

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

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

Despite these efforts, there are many ways in which the disability community can be affected by e-scooter programs. First, people with mobility disabilities can face serious barriers in the public way. E-scooters can be left on sidewalks blocking paths of travel, obstructing doorways to businesses, preventing safe access to a bus stop or rail station entrance, or preventing the use of curb ramps and safe paths to cross streets. Additionally, e-scooters ridden on sidewalks can also block paths of travel or collide with people who use wheelchairs or walkers.

People who are blind, visually-impaired, or who have mobility disabilities, appear to be the most affected by the presence of e-scooters. While only 2.7 percent of survey respondents reported having a disability of any kind, these respondents were more likely to report being inconvenienced by the placement of e-scooters on the sidewalk than respondents without a disability. Those with ambulatory and vision disabilities were the most likely to report being inconvenienced. E-scooters can potentially become unavoidable barriers on sidewalks and tripping hazards. The most complicated issue related to those who are blind or visually-impaired was the limited ways in which complaints could be filed to remedy problems. Inability to identify e-scooters or read any contact information provided on the e-scooters made it particularly difficult to file complaints or have e-scooters removed. While adding company contact information in braille to each e-scooter is a good suggestion, the number of people who are blind and use braille is limited.

Another issue affecting individuals who are blind or visually-impaired is that e-scooters operate almost silently. Chicago's regulations requiring bells on each e-scooter was beneficial and commended by the disability community. Another suggestion requiring e-scooters to emit a low-range, audible noise would be an additional benefit to people who are blind or visually-impaired.

Multiple regulations imposed by the City were aimed at maintaining clear paths of travel on sidewalks. Perhaps more than any of the regulations, the removal of e-scooters each evening prevented the accumulation of e-scooters blocking sidewalks and other paths of travel as experienced by other cities.

Many of the difficulties experienced by people with disabilities would be reduced by requiring e-scooters to lock to something to end a trip (i.e. lock-to technology). This would limit the likelihood of e-scooters being left in the middle of sidewalks and obstructing paths of travel for people who use wheelchairs or are blind or visually-impaired. However, there is a risk that lock to technology could increase the number of e-scooters left at bus stops, since bus stop sign poles could be used for locking e-scooters.

ENFORCEMENT AND COMPLIANCE OF PILOT TERMS

The City knew that enforcement of the pilot terms would be one of the most challenging parts of managing the e-scooter pilot. By receiving real-time data via MDS and GBFS feeds directly from the companies, the City was able to mitigate some of these challenges. The City was able to use the data to correct problems related to rebalancing, e-scooters leaving the zone and e-scooters left out overnight by using data to hold the companies accountable and issuing enforcement when necessary. Only one company did not receive any citations during the pilot; the other nine companies received at least one citation. The following citations were issued based on data that showed a failure to meet the pilot terms:

- Failure to collect e-scooters at night (citation issued based on data feeds) – Sherpa
- Failure to rebalance e-scooters - Bird, Bolt, JUMP and Sherpa

This relatively low number of citations reflects the following realities:

1. The data that the City of Chicago received from the companies is based on a relatively new set of standards and, as such, leads to some subjectivity and difficulties in interpretation. The live data feeds do not solve all challenges of enforcement. The data did not always reflect exactly what was happening on the ground operationally. For example, particularly at the beginning of the pilot, data on rebalancing indicated that many of the companies were not close to meeting the rebalancing goals. From conversations with companies and other data submissions, however, the City understood that operational staff that were turning e-scooters on inside their warehouses instead of when they were placed on the street, leading to inaccuracies in the data. As a second example of the challenge in interpreting the data, the City knew from 311 complaints, e-scooter feedback emails and anecdotal reports that there were problems with e-scooters with dead batteries that were not picked up for multiple days. This was unfortunately very challenging to quantify or enforce through the data because the e-scooter disappears from the data feed after its batteries go dead.

2. To varying degrees, all 10 of the companies had problems with their data feeds. In addition to the operational issue described above, the City found out very quickly that maintaining working data feeds that fit the MDS requirements was a challenge for every company. The City issued seven citations to the following six companies for failure to submit accurate data: Bird, Bolt, grüv (2), JUMP, Wheels and VeoRide. Particularly, grüv, Wheels and VeoRide had consistent issues with their data submissions throughout the pilot, making evaluation and enforcement very difficult.

3. Due to the reasons outlined above, the City of Chicago took the general strategy of using the data feeds to correct problems through warnings and by working closely with the companies as opposed to issuing citations for operational issues seen in the data. The City needed to balance the realities of the companies' capacity to meet the City's very strict pilot terms with the efforts to ensure proper enforcement. By taking this approach, the City maintained productive relationships with each company in working together to improve the program, while still issuing strong enforcement when necessary.

In addition to utilizing the data feeds for enforcement and compliance, BACP conducted two widespread enforcement missions over the course of the pilot program. The first mission took place during the week of July 8 and led to the citations listed below.

The second round of enforcement took place during the week of September 9 and led to the citations listed in Table 22.

The enforcement missions were incredibly useful to ensure compliance of the permit terms and to help the City understand the

Table 21: First BACP Enforcement Citations, by Company

Citation*	Bird	Wheels	Bolt	grüv	Sherpa	Spin
Operating Outside of the Pilot Zone	x					
Failure to Require Post-Ride Pictures			x	x		
Failure to Respond to Complaints Within Two Hours				x	x	
Failure to Be Responsive to Concerns 24 hours a day, 7 days a week		x				x
Failure to Affix Educational Brochure to E-scooter	x				x	

**A citation was also given to Wheels for failure to limit E-scooters to 15 mph. Upon conversation with the company, the City determined that Wheels was in fact in compliance.*

Table 22: Second BACP Enforcement Citations, by Company

Citation	Bird	Wheels	Bolt	grüv	Sherpa	Spin	Veoride	Lime
Failure to Respond to Complaints Within Two Hours	x	x	x				x	
Failure to Be Responsive to Concerns 24 Hours a Day, 7 Days a Week	x	x					x	
Failure to Have Cash Option on Website	x		x		x		x	
Failure to Affix Brochure to E-scooters							x	
Failure to Have Operational Bell							x	
Failure to Have Illuminated Front Light		x						
Failure to Have Website, Email and/or Phone Number on E-scooter						x	x	x

pilot program. During these efforts, BACP investigators rode e-scooters from all 10 companies, called the companies' toll-free numbers to correct problems and searched the companies' websites for required information. Of the issues that led to citations, the most concerning to the City were the failure to be responsive to concerns and the failure to respond to complaints within two hours. Responsiveness to issues raised by the community is essential to a successful e-scooter program. Companies that either failed to answer phone calls on their toll-free number or failed to correct problems in a timely manner demonstrated a significant lack of compliance with the pilot terms. However, the overall compliance rate was 73 percent with these issues, showing that many of the companies complied.

The challenge of enforcement through both the data and BACP missions makes clear an important difficulty inherent in the pilot. There were significant operational challenges to ensure full compliance and proper pilot management due to the inclusion of 10 companies in the pilot.

Of the issues that led to citations, the most concerning to the City were the failure to be responsive to concerns and the failure to respond to complaints within two hours.

With 10 companies, BACP missions required more resources and took more time, data issues took longer to recognize and correct, close management of each company's operations was impossible and criteria for enforcement action was challenging to

develop. It is essential that any potential future e-scooter program limit the number of companies.

For example, technical data issues made it difficult to assess the exact number of e-scooters each company deployed and adherence to overall cap. According to the available data, two companies were over their caps for much of the pilot period, while many were significantly under. Despite this, the total number of e-scooters available was substantially below the aggregate maximum of 2,500.

Table 23: Average Monthly Number of E-scooters, by Company

Company	June	July	August	September	October	Overall
Bird	276	260	250	256	196	251
Bolt	151	135	126	113	85	124
Jump	427	356	301	201	142	288
Lime	187	175	181	211	174	187
Lyft	143	133	135	145	124	137
Sherpa	160	160	245	259	207	211
Spin	111	89	161	136	115	124
Veoride	167	203	149	136	156	163
Wheels	61	81	84	177	159	112
Clevr	0	8	176	241	170	126
Total	**1684**	**1600**	**1808**	**1876**	**1528**	**1722**

Geofencing Compliance

The 606 Trail

E-scooter riding was not allowed on the 606 Trail. The maps in Figure 34 show a section of the 606 Trail with the e-scooter routes from three weekends during the pilot period, a weekend in June, a weekend in July and a weekend in October. The maps indicate the difficulty in geofencing a narrow geography or implementing exclusion areas due to GPS inaccuracy.

Figure 33 shows the number of trips that intersect the 606 Trail for at least a quarter of a mile. Combined, these figures show that compliance with the 606 geofence improved significantly over time, but it took most companies until August to fully implement.

Figure 33: E-scooter Trips on the 606 Trail Greater than 1/4 Mile

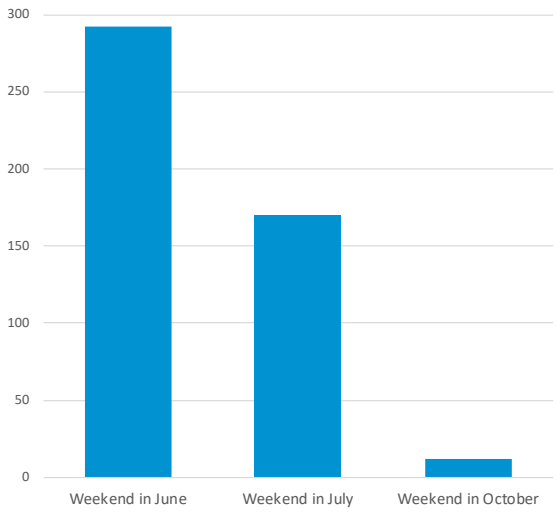
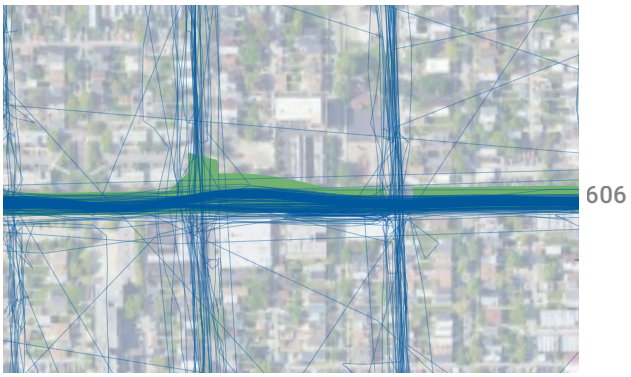
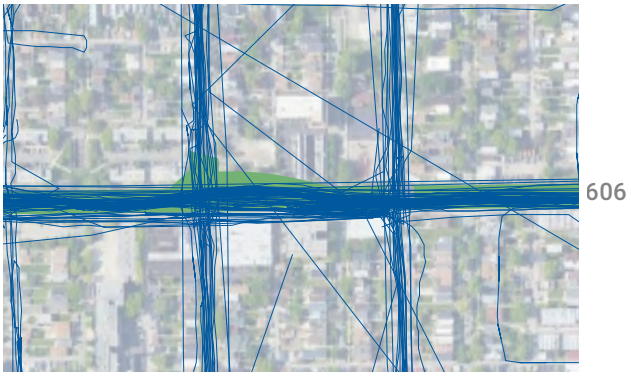


Figure 34: Maps of E-scooter Use on the 606 Trail by Time Period

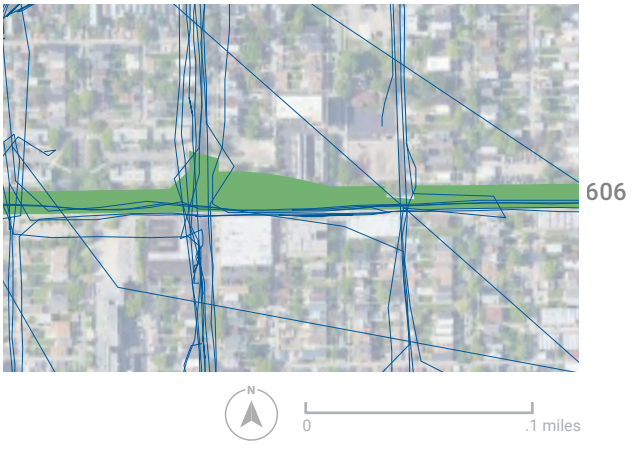
Weekend in June



Weekend in July



Weekend in October



The Pitchfork Music Festival

E-scooters were not allowed within a geofence defined by the City on the weekend of the Pitchfork Music Festival, July 19th – July 21st. The maps in Figure 37 show the geofence around Union Park on the festival weekend and the following weekend. The neighborhood around the festival was one of the highest e-scooter usage areas and saw even higher demand during Pitchfork.

Figure 35 compares the number of trips ending within the geofence during Pitchfork and the weekend after, and shows that overall, more trips ended within the geofenced area when the restriction was in place than the next weekend when the geofence was not active.

Despite increased numbers of trips ending in the geofenced area during the festival, comparing the number of trips that ended within the geofence to the trips that ended in the surrounding neighborhood shows that the geofence was moderately successful in managing the influx of e-scooter demand (see Figure 36).

Figure 35: E-scooter Trip Ends in Pitchfork Geofence

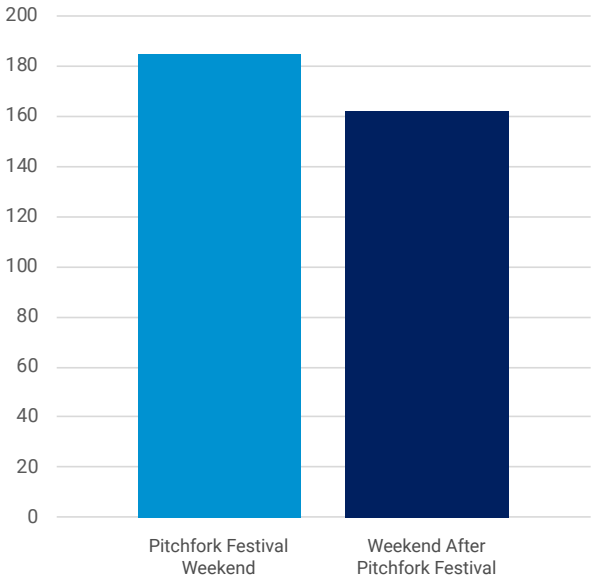


Figure 36: Percent of Trips Near Pitchfork Festival Ending within Geofence

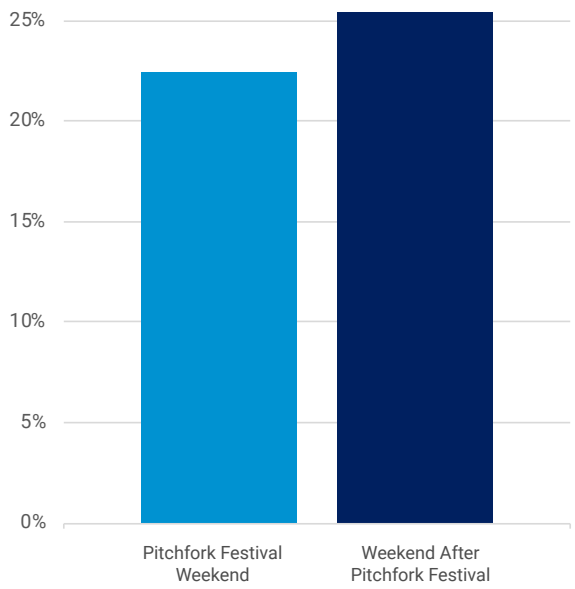
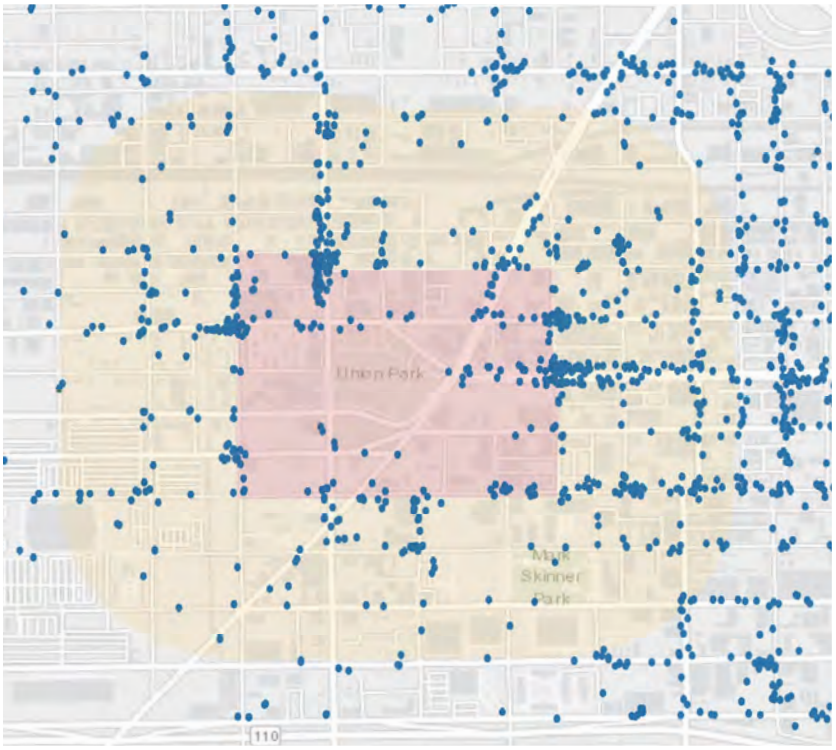


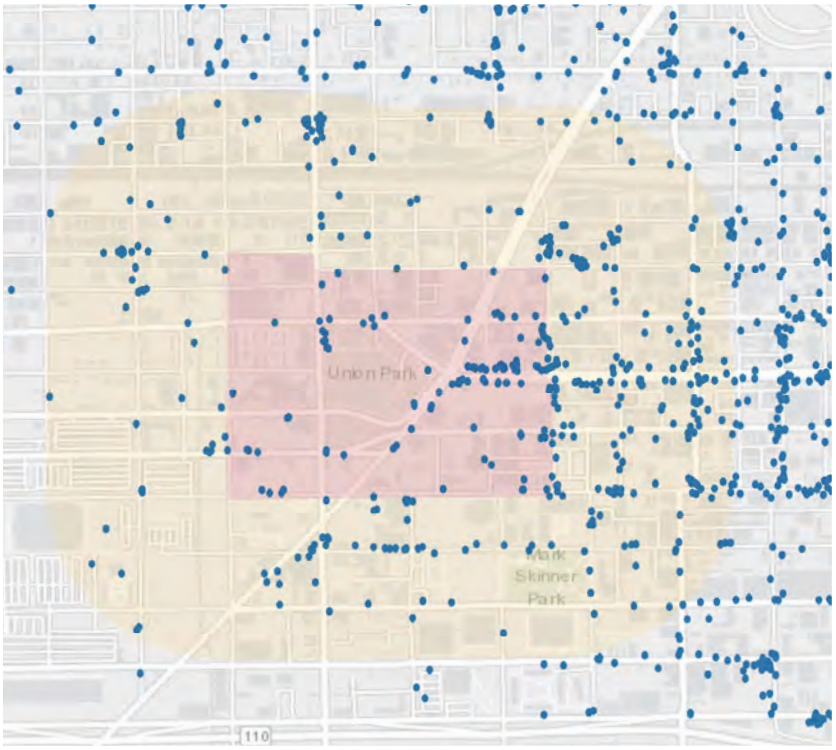
Figure 37: Map of the Geofence Around Pitchfork



Pitchfork Festival Weekend

Pitchfork Festival Geofence
1/4 Mile Buffer
E-scooter Trip Ends

N
0
1/8 mile



Weekend After Pitchfork Festival

Pitchfork Festival Geofence
1/4 Mile Buffer
E-scooter Trip Ends

N
0
1/8 mile

Riot Fest

E-scooters were also not allowed within a geofence defined by the City on the weekend of Riot Fest, September 13th to September 15th. Comparing Pitchfork and Riot Fest, it is clear that Riot Fest occurs in a part of the city that had lower overall e-scooter usage than Pitchfork. Riot Fest is later in the summer than Pitchfork, and the compliance with the geofence improved. While the number of e-scooter trips to the neighborhood more than doubled during the weekend of the festival compared to the following weekend, the share of trips ending within the geofenced area was cut almost in half.

Figure 38: E-scooter Trip Ends in Riot Fest Geofence

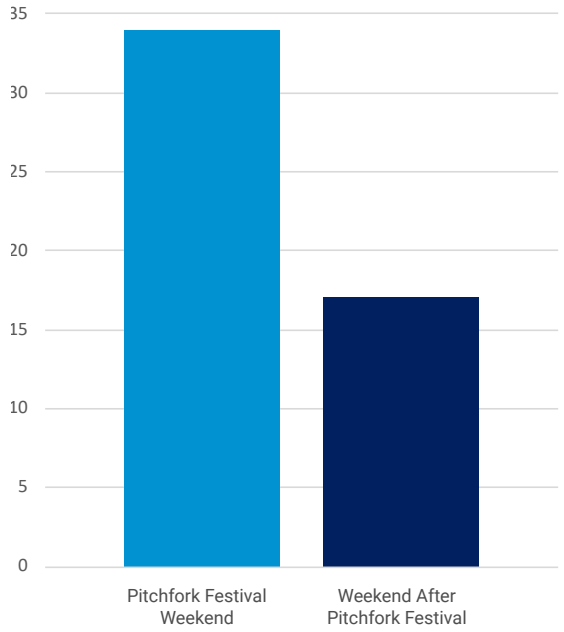


Figure 39: Percent of Trips Near Riot Fest Ending within Geofence

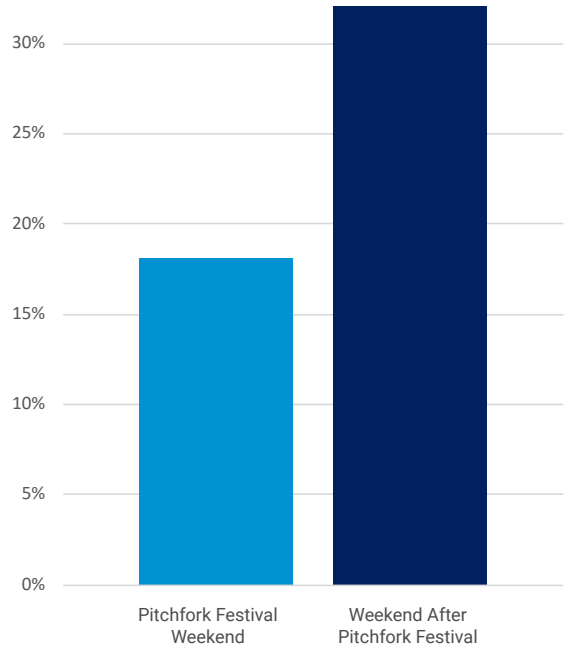
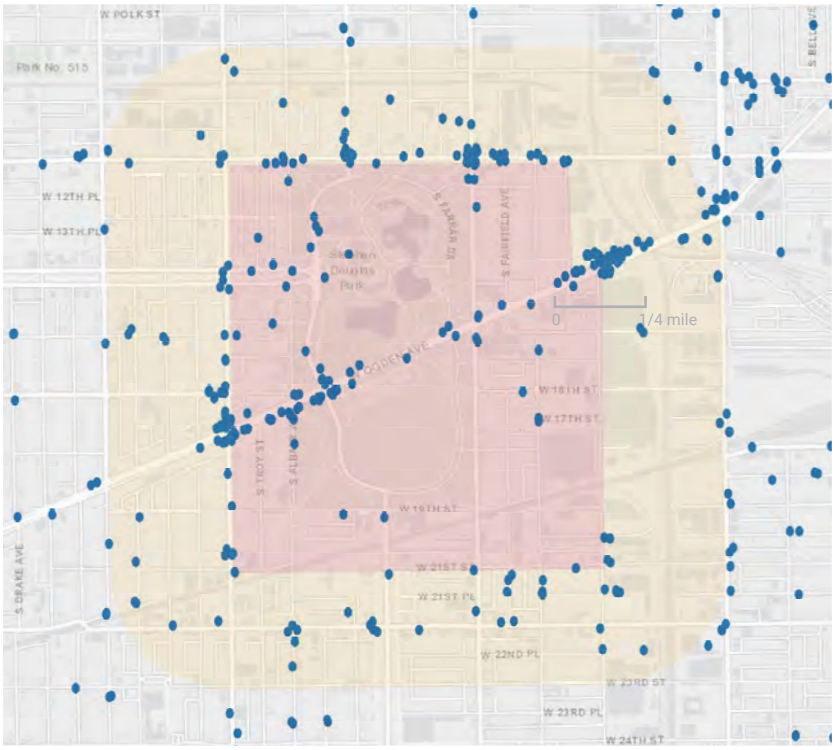


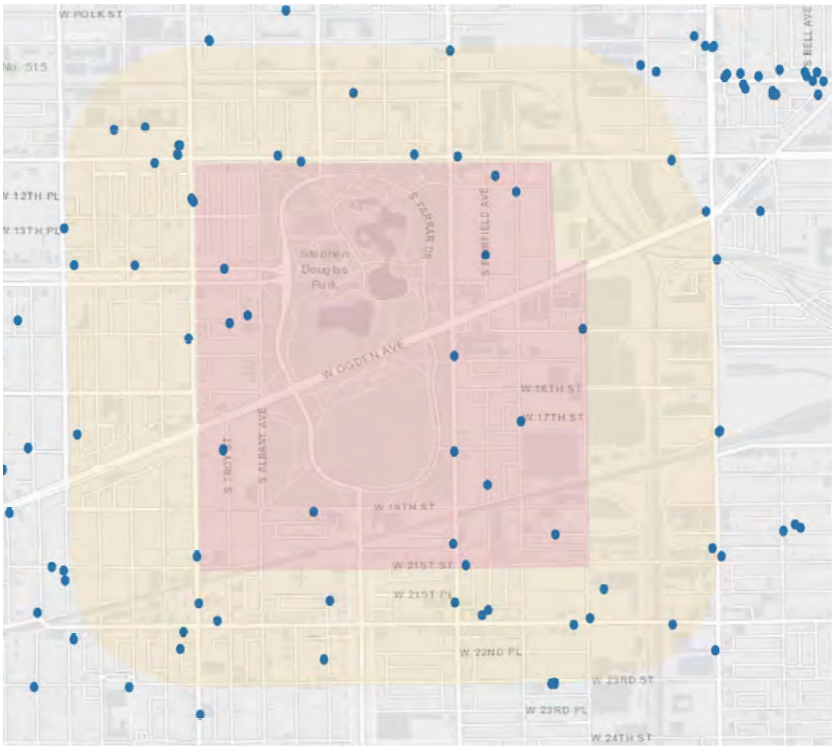
Figure 40: Map of the Geofence Around Riot Fest



Riot Fest Weekend

- Riot Fest Geofence
- 1/4 Mile Buffer
- E-scooter Trip Ends

N
0 1/4 mile



Weekend After Riot Fest

- Riot Fest Geofence
- 1/4 Mile Buffer
- E-scooter Trip Ends

N
0 1/4 mile

DATA COLLECTION METHODOLOGY AND LIMITS

As location-tracking technology has become ubiquitous, many cities have begun to routinely require detailed location and event data from private mobility providers who operate in the public way. Chicago has been collecting trip data from both taxis and ride-hail companies since 2014. Given that private mobility providers already collect and maintain detailed data for their own business use, public agencies like BACP who oversee permitting for these providers require them to submit that same data for the public's benefit. The data is used to ensure customer protection and public safety, ease congestion, address mobility inequities and study the City's evolving transportation network. Chicago continued this practice by requiring e-scooter companies to submit detailed data as a condition of receiving a permit to use the public way for their services.

Chicago's E-scooter Pilot required the use of MDS, the standard through which many cities across the world had already begun to collect mobility data. MDS offers a choice between two collection methods. One method, called "Provider," requires each company to maintain two Application Programming Interface (API) endpoints: one containing data on e-scooter trips, and the other containing data on e-scooter events beyond just trips, such as a removal from the street for maintenance. Regulators using MDS must choose either to constantly fetch data individually from each mobility company's hosted technology or host their own technology and require mobility providers to constantly load data into it. Alternatively, a regulating entity could choose to implement both methods.

Chicago did not specify in its permit requirement which version of MDS was required, which allowed flexibility in implementing a data collection framework. During the pilot, Chicago used Provider API because it was more widely used and better known by e-scooter companies and software companies who offer regulators services for reading, downloading and analyzing data. Due to the relatively new set of standards through which the City received data from the companies, there were some limitations in subjectivity and data interpretation. As discussed in the Enforcement and

Compliance of Pilot Terms section of this evaluation, challenges that were experienced include data not always reflecting exact ground operations. In addition, the City faced challenges in enforcing requirements for every company in maintaining working data feeds that met MDS standards, resulting in seven citations to six companies for failure to submit accurate data.

6

Six different companies in the e-scooter pilot were cited for failure to submit accurate data.

In addition to MDS, Chicago required the monthly submission of spreadsheets to collect other data not captured by MDS. The monthly submissions contained customer service requests handled by the e-scooter companies and maintenance logs for e-scooters. Other data was provided by e-scooter companies to help answer key questions presented in this evaluation. No personally identifiable data was requested from the e-scooter companies.

Chicago also required the e-scooter companies to establish public data feeds that complied with the General Bikeshare Feed Specification (GBFS). These feeds, available to the general public, allowed third-party software companies to obtain real-time locations of e-scooters that were available for rent. As a result, multiple third-party services consolidated the data from the 10 e-scooter companies' feeds into a single app, providing for a streamlined experience for people looking for a e-scooter to ride.

Chicago experimented with Shared Streets, Populus, Remix and Ride Report for using MDS data to manage mobility, and also ingested and analyzed MDS data directly from the Provider APIs. The data obtained from the "Trips" API endpoint was straightforward and tracked well with how Chicago and other cities already collect data from other mobility companies. It allowed for calculating typical metrics and engaging in geospatial analysis. The data obtained from the "Status Changes" API endpoint provided other valuable information about e-scooters, but also presented some challenges. The data itself consists of certain event reports about a changing state of a single e-scooter at a point in time. The data is not a snapshot of the state of the fleet—rather it is a set of individual "pings" about the state of each single e-scooter.

A number of complicating factors made evaluating the status changes data difficult. First, e-scooter companies have different standards for determining when and whether a certain status change event should be triggered. Second, the companies did not all use the same names for status changes, which made it difficult to map the events reported by different e-scooter companies to a common framework for analysis. Third, the status changes often did not follow a logical flow; an event would be reported, but it should have been impossible for that event to happen after the most recent event. For example, an e-scooter might first be reported as taken off the street for maintenance, but then is next reported as starting a passenger trip without being reported as back on the street, an impossible sequence of events. Finally, a e-scooter would often report being on the street and then was never heard from again, even though it was no longer on the street. In such a case, an event that the e-scooter was removed or was shut off due to a low battery should have been received. Without that second event, the data seemed to indicate the e-scooter was on the street indefinitely, even though other evidence conflicted with that assumption.

These complicating factors led to disagreement in various metrics that are calculated from the data. Important metrics flow from status change data, such as on-street fleet size and geographic distribution of e-scooters. The lack of certainty with the underlying data caused difficulty in establishing metrics that were agreed upon by all stakeholders involved. As a result, Chicago placed special emphasis on the importance of qualifying the quantitative data with all available indicators of data quality. Among the resources consulted, Chicago considered extensive talks with and evidence offered by the e-scooter companies, the MDS data, custom metrics designed to test theories about data quality, results of inspections and field audits, conversations with other cities about e-scooter programs and consultations with individuals who have extensive MDS data experience. Ultimately, the analysis performed for this evaluation and for safety and compliance during the pilot required judgment and collaboration to ensure that conclusions were supported by all available evidence.

EMERGING E-SCOOTER TECHNOLOGY REVIEW

E-scooters are a new vehicle type with emerging technologies that pose unique challenges to the regulatory environment. As the sector is evolving, it is important for the City to consider the impact on resident safety and be aware of technology advancements that could solve some of the challenges e-scooters present in a dense urban environment. In regulating micromobility devices, cities and industry are learning together, establishing new practices and novel forms of public and private collaborations, while these technologies are being rapidly deployed in a wide variety of conditions and climates. Specific consideration needs to be given to parking innovations, Radio Frequency Identification (RFID), e-scooter model safety improvements, geofencing, device durability, enhanced communications and integrated reservations.

Figure 41: E-scooters Parked on the Sidewalk in Chicago

Innovations in E-scooter Parking

Managing e-scooter parking and storage has emerged as a particularly complex issue. Dockless micromobility devices by nature are not constrained by the need to park in stations or common collection points. In contrast, traditional dock-based bike share systems like Divvy rely on bicycles being picked up and retrieved from specific stations. With dockless devices the location of where and how the device is parked is left up to the customer. As a result of this flexibility, there are often reports of the devices blocking sidewalks and making public right of way impassible.

Lock-to Technology

Locks are being explored by some shared e-scooter operators with the expectations that they will help keep e-scooters locked to street infrastructure and ensure a clear path of travel for pedestrians. With the exception of bicycle parking facilities, most street infrastructure is not designed to accommodate e-scooter locking. In urban areas the demand for convenient bicycle parking can be extremely high. Thus, for locks to be a successful solution, cities will need to increase the supply of facilities for micromobility parking.

Infrastructure and Hubs

Developing e-scooter specific infrastructure may assist cities in making shared systems more consistent and understandable, and manage the impacts of dockless parking. The City of Santa Monica (and other municipalities) have been experimenting with e-scooter drop zones since late 2018. These are dedicated spaces demarcated by flexible bollards or paint adjacent to transit centers and key destinations. The spaces have been demarcated both on sidewalks and streets.

Some e-scooter companies are providing hard wired docking stations to park and charge devices. This transformation back to station-based systems may offer an opportunity to contribute to more orderly sidewalks and public areas by providing a centralized place to store the devices. It also moves the burden of implementing and maintaining this infrastructure from cities to the companies themselves.

Figure 42: E-scooter Charging Hubs

E-scooter Model Safety Improvements

Providing accessible e-scooter models is important so that those who may find it physically difficult to ride a traditional e-scooter can still participate in and benefit from the program. Several companies (i.e. Ojo, Razor, Wheels) now offer seated e-scooter models with larger wheels and a more stable frame geometry that is less physically demanding than traditional models. Ojo's seated e-scooters typically cost more per ride than standing e-scooters but can travel faster and longer distances. Ojo also features a three-wheeled trike that offers longer and faster trips for any user and a much more stable experience for riders with physical limitations.

Shared micromobility companies are also beginning to develop systems to encourage helmet use or deploy helmets along with the mobility device. Using AI software in their apps, VeoRide and Bird have both tested a system that rewards users who take a picture of themselves wearing a helmet. Wheels runs fleets of compact e-bikes with helmets included in a back compartment that have biodegradable, one-use head liners. Meanwhile, helmet vending machines have existed for the better part of the last decade, but so far, they have not become widespread.

Figure 43: Wheels' Seated E-scooters

RFID

Current limitations of GPS do not allow for accurate management of e-scooter parking. As designs for these facilities and micromobility devices evolve, communication technologies such as Bluetooth, RFID or Dedicated Short Range Communications (DSRC) can be built in and harnessed to help manage the exact placement of e-scooters. RFID technology, for instance, requires a tag to interact with a reader at close range. Requiring a user or company to place an e-scooter close enough to a target destination to trigger the RFID verification process can ensure very accurate siting.

Better technologies could allow the city to more accurately and reliably control where e-scooters can be returned to and where they would have to be placed each day. These improved technologies could also more accurately control where e-scooters are not allowed to go or where speed reductions are necessary.

Geofencing

Geofencing is an essential technique to ensure that e-scooters can maintain an effective density and can be prohibited in specific areas. This technology is an emerging one that currently has limited accuracy. Most e-scooter geofencing technologies use GPS, which is currently accurate within five to 10 feet (depending on the nearby infrastructure and building heights). In the context of reducing sidewalk clutter and ensuring proper e-scooter parking, this technology is simply not accurate enough. Geo-fencing by GPS is required for implementing speed restrictions and creating service areas or exclusion zones.

In Chicago geo-fencing was used to set the boundary for the pilot service area. The City also worked with participating companies to utilize this technology to manage e-scooter use during specific events. Geo-fencing was less successful when utilized for prohibiting e-scooter use in narrow areas such as Chicago's 606 trail. The right-of-way width of the 606 averages 30 feet, and the trail passes above many streets where e-scooter access was allowed. Thus, restricting access to the 606 proved challenging; speeds were limited on the 606 for the safety of those operating underneath the 606 or on adjacent streets.

Figure 44: Chicago's 606 Trail

Device Durability

A study of shared e-scooters in Louisville, KY indicated that the e-scooters average time in use was limited to 28 days[9]. After this short amount of time in use, the devices must be replaced. E-scooter lifespan is a key factor in e-scooter company business planning, and the models chosen may not be optimal for the operating conditions found in US cities (i.e. ridden multiple times a day, variable weather conditions, customers who are over the e-scooter weight limit of 200 lbs). Third generation e-scooters are much more durable than their predecessors, but maintenance and replacement costs pose a significant burden to operators and should factor into a city's sustainability analysis of e-scooter programs.

Enhanced Communications

It is important to safely communicate information to e-scooter users. Limitations of current communication technologies require the use of a smartphone to receive alerts or messages. As a result, either the alerts or messages are ignored, or the customer puts themselves in danger by simultaneously riding and reading their phone. While the current e-scooter platform allows some auditory and tactile signals, as technologies further improve, the device capabilities could be expanded to allow text and text to speech messages to ensure effective and timely communications.

Integrated Reservation Platforms

Mobility as a Service (MaaS) is a framework for integrating reservations and payments for multiple modes of transportation in a unified user environment. At its core, this means that a single application can facilitate how we chose when, where and how to travel. E-scooters and other forms of micromobility are key components of MaaS systems in development and in use around the world. As these tools may become commonplace for Chicago residents, it is important that e-scooter companies design their systems using common communications protocols such as GBFS and MDS and that their policies promote MaaS participation and encourage MaaS applications to reserve and pay for trips on their e-scooters. Additionally, it is important that e-scooter companies work with Ventra's administrating body, CTA and Cubic Transportation System, to develop opportunities to integrate with Ventra application as a payment method for e-scooter trips. The Ventra mobile payment application is a successful tool for transit users in Chicago that allows the customer to pay for and utilize many of the region's public transportation options.

[9] *Quartz (2018). Shared Scooters Don't Last Long. Retrieved from https://qz.com/1561654/how-long-does-a-scooter-last-less-than-a-month-louisville-data-suggests/.*

WHAT THE CITY LEARNED

The City of Chicago's E-Scooter Pilot Program demonstrated both the potential of shared e-scooters to enhance mobility in Chicago and key challenges to utilizing e-scooters as a sustainable, safe and equitable method of transportation. While e-scooter technology is improving, growing pains still exist and need to be addressed with smart policy solutions if the City is to capitalize on the potential of e-scooters to enhance the mobility of residents. As such, the following lessons emerged from the City's analysis and experience managing the pilot:

Residents are polarized on the addition of e-scooters to Chicago's transportation network. Feedback from residents on the pilot varied but seemed polarized, with those who used e-scooters overwhelmingly recommending continuing a program, while those who did not ride e-scooters recommending discontinuation of a program.

E-Scooters will be a mode choice for some residents and visitors. Overall, the use of e-scooters, as indicated by the 821,615 rides taken over four months during the pilot and the online survey results, shows that some residents and visitors found e-scooters a good alternative transportation choice, or fun to ride.

The demand for e-scooters was highest in denser areas with numerous transportation alternatives. While ridership levels are an important factor, considering that demand was strongest in areas already well served by transit and other mobility options, it is not clear whether e-scooters were a game-changer for Chicago's mobility landscape.

E-scooter riders tended to be whiter and wealthier. According to riders who responded to the City's online survey, 72 percent of riders identified as white alone. Comparatively, 12 percent identified as hispanic or latinx, seven percent identified as asian and six percent identified as black. Of riders, 58 percent identified as having an income of $75,000 or greater.

The priority area requirement was needed to improve equity—more consistent enforcement of rebalancing would have guaranteed even more success. If the City had not created a re-balancing requirement, the market would have not guaranteed an equitable distribution of e-scooters. Some companies complied better than others with the priority area requirements.

Access to e-scooters for unbanked customers and those without smartphones needs to be improved. During stakeholder meetings, it was noted that potential customers were having difficulty accessing these programs from various companies. Additionally, based on the data submitted to the City, unbanked usage rates were low. Any potential future program needs to be more prescriptive and rigorous requirements for these potential riders.

Relying on companies and riders for organized and safe parking of e-scooters is hit-or-miss, and is one of the largest pain-points. Errantly parked e-scooters created conflicts at times with ADA access and overall pedestrian access and safety. People who are blind or visually-impaired likely were the most affected by the presence of e-scooters, as improperly parked e-scooters created potential barriers on the sidewalks and tripping hazards. On-street observations showed that most e-scooters were parked appropriately most of the time, but even one or two errantly parked e-scooters caused problems, reflected negatively on the program and required significant staff time from the City to address.

E-scooter impact on public transportation use is unclear. Most e-scooter riding appears to have been independent of the transit system, as only three percent of survey respondents said they rode CTA bus more often, four percent of residents said they rode CTA rail more often. While 34 percent of survey respondents indicated they used e-scooters to go to or from public transit, 14 percent said they would have made a bus or rail trip if an e-scooter was not available.

The impacts on Divvy are also uncertain, but there is further evidence people want micromobility options, like e-scooters and dockless bikes. There is not enough evidence that e-scooters replaced rides on Divvy, or that it increased the demand for Divvy. Survey respondents indicated they were more likely to use e-scooters to replace ride-hailing trips than to replace Divvy trips. In fact, available ride trip data showed that e-scooters may have had the effect of slowing growth in Divvy ridership as Divvy ridership increased by one percent in the pilot area compared to six percent in the rest of the city. However, since e-scooter ridership did well in areas that do not have Divvy today, it indicates that there is demand for these types of mobility options.

There is evidence that e-scooter trips are replacing walking in some cases. Of survey respondents, 30% indicated they would have walked if an e-scooter had not been available. The sustainability and public health impacts of such a transportation shift need to be considered.

The number of companies participating in the pilot made enforcement and operations challenging. With 10 companies participating, the City particularly experienced challenges in companies' compliance with data requirements and in conducting widespread enforcement missions concerning citations. Any potential future program will need to limit the number of companies.

Most companies did not deploy the maximum amount of allowable e-scooters (250 per company) and most e-scooters appeared to spend the majority of time waiting to be used. Online survey respondents did not identify a lack of available e-scooters as a top concern. The average e-scooter had approximately three trips per day and was in use for about a half hour per day, or about three percent of the operational time period from 5 am to 10 pm.

The e-scooter fleet size cap and operation hours appear to have prevented e-scooter pile ups. While 2,500 of e-scooters may be a conservative fleet size cap, it could be part of the reason why Chicago did not experience some of the e-scooter pile ups experienced in peer cities. Similarly, the operation hours of e-scooters (5 am to 10 pm) and the removal of e-scooters by companies each evening by midnight prevented the accumulation of e-scooters blocking sidewalks and other paths of travel. In addition, the hours and nightly removal seemed to aid in the relative order of e-scooters on the public way, compared to anecdotes from peer cities.

Data provision and standards are an absolute necessity. The City could not have managed, nor assessed the impacts of the pilot without the GBFS and MDS data standards and requiring the companies to provide data to the City.

Taking e-scooters off the streets at night was the right call for a pilot, but it appears costly and unsustainable. Not only did this keep e-scooter riding at night and impaired riding at a minimum, but it seemed to have forced the companies to have a better balancing effort in the morning. However, the e-scooter removal policy does have negative environmental implications, due to the emissions associated with the additional miles driven to collect and distribute all e-scooters every morning.

E-scooters are a new, emerging mode of transportation and limited evaluation has been conducted to understand their impact on safety. CDPH captured reports of 192 e-scooter injuries during the pilot, however, the injury analysis has significant limitations. Injury data was captured from emergency departments, only if labeled correctly and if the injury was reported. Of the injuries reported, 73 percent of those injured were

between ages of 18 and 44, 55 percent were male, 35.4 percent were latinx, 32.3 percent were white, 19.8 percent were black and 3.4 percent were asian. Most of the injuries resulted from those operating an e-scooter themselves (93 percent), while five percent were pedestrians injured by an e-scooter.

There is a desire for more education to be conducted to introduce e-scooters to residents and increase public safety and accessibility. Based on street observations, stakeholder input and survey responses, residents need additional education on safe e-scooter riding, such as the importance of wearing helmet and not riding on the sidewalk.

E-scooter companies provided employment opportunities in many neighborhoods. A stakeholder group representing transportation groups, disability advocates, local chambers of commerce and community organizations, identified that the e-scooter pilot resulted in important employment opportunities for residents that were part of e-scooter operation teams.

E-scooters with dead batteries created challenges for enforcement. Based on 311 complaints, e-scooter feedback emails and anecdotal reports, there were problems with e-scooters with dead batteries that were not picked up for multiple days. This was challenging to quantify or enforce through the data because the e-scooter disappears from the data feed after a battery dies.

Limiting e-scooter speeds seemed to help with compliance of e-scooters not being ridden on the 606 trail. Geofencing to restrict access in narrow areas such as the 606 trail proved challenging, but limiting the speed of e-scooters on the trail and adjacent streets appeared to decrease the incidence of e-scooters being ridden on the trail.

The instructions for the end-of-ride photos need improvement. Frequently, a rider would take a picture of the e-scooter's QR code instead of the e-scooter and its parking location, which made it difficult to identify where the e-scooter was parked.

POLICY RECOMMENDATIONS

Based on the learnings from the E-Scooter Pilot Program, the City recommends the following policies for any future e-scooter program to integrate it as part of an equitable, accessible, safe and sustainable transportation network:

To ensure equity and provide services to underserved community areas:

Maintain the existence of priority areas and enhance requirements and regulations to keep availability of e-scooters high throughout the day. A focus on underserved areas is necessary to ensure equity of this new mode so that it can effectively fill gaps in the transportation network.

Improve systems for unbanked users and people without smartphones so that they can easily access e-scooters. Complaints received by the City during the pilot suggested that some companies' programs were difficult to access, and could be one reason for low usage numbers among the unbanked. Therefore, any future program would need to be more prescriptive in these requirements.

Ensure residents have opportunities for employment with e-scooter companies.

To ensure e-scooters do not clutter the sidewalk and impact people with disabilities:

Test measures such as lock-to technology to better organize the sidewalk space. These measures would limit the likelihood of e-scooters being left in the middle of sidewalks and obstructing paths of travel for people who use wheelchairs, are blind or are visually-impaired. As most street infrastructure is not designed to accommodate e-scooter locking, for locks to be a successful solution, the City will need to increase the supply of facilities for micro-mobility parking. The City should also proceed with caution due to the risk of locked e-scooters blocking access to CTA bus stops or other ADA-compliant accessible paths.

Improve the accessibility of e-scooter smartphone apps and place braille on e-scooters to enable those who are blind or visually impaired to identify e-scooters and more easily report e-scooters that impede the public way.

Consider a requirement for e-scooters to produce a low emitting sound to alert individuals who are blind. or visually impaired. While adding company contact information in braille to each e-scooter is a good suggestion, the number of people who use braille is limited.

Improve the instructions for the end-of-ride photo. Apps potentially could display a sample parking photo that fulfills the requirements to help users comply with e-scooter parking regulations.

To ensure e-scooters contribute to a sustainable transportation system:

Identify ways to reduce the miles driven by companies picking up and distributing e-scooters, such as modifying the requirement that all e-scooters be picked up every night.

Develop metrics and require reporting from companies to track overall environmental footprint of e-scooters, including emissions associated with charging, distribution and the overall lifecycle impacts of individual e-scooters. This should also include tracking travel behavior and mode shift trends, to help ensure the overall impact of e-scooters is to replace higher impact trips (i.e. single or low occupancy vehicle trips) and not replace lower impact trips (i.e. bike, walk or public transit).

Expand investments in city-wide transportation infrastructure to support travel behavior shift to modes with lower impact. This includes bus priority treatments such as bus-only lanes, as well as continued investment in improving facilities for bikes or e-scooters and pedestrians. Since the public right-of-way is limited, in some cases this may mean repurposing space that is currently allocated for higher impact modes, such as curbside parking, curbside loading and general purpose travel lanes.

To ensure the safe use of e-scooters:

Consider slow down zones on trails and other high use corridors. The slow down zone on the 606 seemed to decrease the amount of trips that occurred on the trail.

Require even more education programs to aid in safety and perception concerns. Education should be focused on safe e-scooter riding, such as wearing a helmet, obeying traffic laws, riding in protected lanes, maintaining safe speeds and parking e-scooters with care. Such educational workshops could also help address the fact that based on street surveys, a very small percentage of riders wore helmets during the pilot.

Require e-scooter device capabilities to allow text and text to speech messages to ensure effective and timely communications to riders. Currently, alerts are communicated via the rider's smartphone, which means they are either ignored or the rider puts themselves in danger by simultaneously riding and reading their phone.

Encourage e-scooter companies to utilize communication technologies such as Bluetooth, RFID or Dedicated Short Range Communications to help manage the exact placement of e-scooters on the public way.

To improve enforcement capability:

Limit the number of e-scooter companies to reduce the burden of oversight and enforcement.

Set higher standards for data quality and technology abilities (i.e. geofencing and MDS) that will allow the City to better enforce exclusion areas and other regulations and evaluate the program.

Find a better solution to "dead" e-scooters so that the e-scooter does not disappear from the data feed and e-scooters with dead batteries can be more easily quantified and addressed.

To ensure the overall success of any future e-scooter program:

Proceed with caution in allowing e-scooters to operate in dense areas with prolific transportation options, such as the downtown area. The City did not include the downtown area in the pilot area due to the density of the area, the limited sidewalk space for parking and the prolific alternative transportation options available. Many stakeholders have recommended excluding the Loop from any future e-scooter program for the same reasons, but others have identified the exclusion as a factor that limited e-scooter utility.

Require e-scooter companies to design their systems using data protocols such as GBFS and MDS and to develop opportunities to integrate with the Ventra application as a payment method for e-scooter trips. This will create a unified user environment to reserve and pay for multiple modes of transportation in the city.

SPECIAL THANKS TO

The Center for Neighborhood Technology, who provided the in-depth e-scooter utilization analysis included in this evaluation, and without whom such a thorough analysis would not have been possible.

Sam Schwartz, who provided design and layout support for the evaluation.

APPENDIX

City Administration

The work of administering an e-scooter pilot goes beyond the functions of a department of transportation. Several city departments and agencies were involved in the administration of the pilot, including the Chicago Department of Transportation, the Department of Business Affairs and Consumer Protection, Department of Innovation and Technology, Fleet and Facility Management , Emergency Management and Communications, Streets and Sanitation, Department of Law, the Mayor's Office for People with Disabilities and the Mayor's Office. On a weekly basis, a core team of policy and program staff met to engage with the companies, community organizations or the media, review and analyze trip data and make strategic programmatic decisions about the pilot. Operational departments were involved in resolving complaints and coordination around large events.

Additional Findings of the E-scooter Pilot

Frequency of Priority Area Trips

Most e-scooter trips started or ended outside the priority areas. More trips began or ended in the northern priority area than the southern priority area. Partially due to the short nature of e-scooter trips, many trips remained within a single area.

Table 24: Frequency of Origins and Destinations Between the Priority Areas

Trip	Priority	Priority Area South	Rest of Pilot Area	Outside of Pilot Area	Grand Total
Priority Area North	27,164	1,920	9,112	725	38,921
Priority Area South	2,563	13,609	3,665	156	19,993
Rest of Pilot Area	7,591	2,356	314,355	12,748	337,050
Outside Pilot Area	192	30	8,718	1,221	10,161
Grand Total	**37,510**	**17,915**	**335,850**	**14,850**	**406,125**

Educational Attainment of Online Survey Respondents

Survey respondents indicated they had a higher level of educational attainment.

Table 25: Educational Attainment of Survey Respondents

Educational Attainment	Nonriders	Riders	All
Doctorate	11%	6%	8%
Master's Degree	29%	20%	24%
Some Post-Gradudate	7%	4%	5%
Technical Degree	1%	1%	1%
College Degree/ 4-Year	39%	52%	47%
2-Year Degree	2%	2%	2%
Some College	7%	9%	8%
High School Degree	2%	3%	2%
Some High School	0%	1%	0%
Other	2%	1%	1%

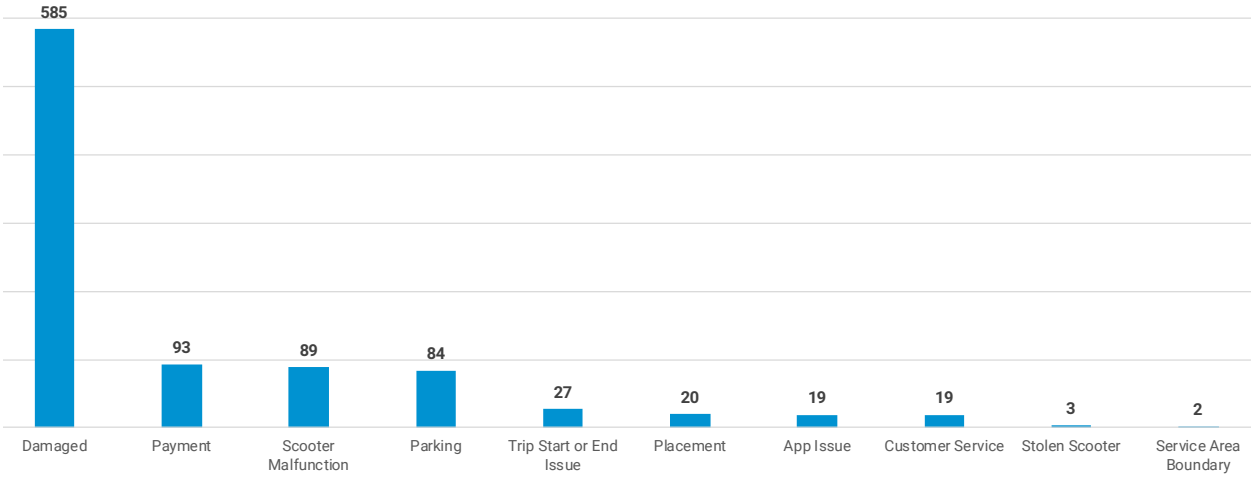
Customer Report and Maintenance Request Submissions

Companies were required monthly to submit two data sets containing customer reports and maintenance requests. All companies except one submitted all their required data for customer reports and maintenance requests. However, during the data collection process, a number of companies had to be prompted multiple times in order to receive submissions.

Figure 45 shows the customer reports that were analyzed from each of the 10 companies to identify the top 10 most frequent types of reports from e-scooter riders. A challenge that arose during data analysis was the different labeling methods used for each company in categorizing different types of reports, resulting in difficulty in organizing and synthesizing data across companies. Consequently, the data reflected in the graph below pulls from the 100 most frequent data entries, which reflect the majority of the customer reports (14,839 out of 18,758 reports). By far, the customer report with the highest number of entries was "N/A" or "Other" at 13,898 entries out of 14,839, and these entries were excluded in the final rendition of Figure 45. While this is a summary of the majority of customer reports submitted by companies, the actual figures should be viewed as an educated estimate, and not exact figures, as the raw data was subjectively processed and interpreted for the purposes of data analysis.

According to the analysis, damaged e-scooters were, by a large margin, the most common customer report at a total of 585 reports. Other frequent customer reports included payment problems, e-scooter malfunctions and parking issues.

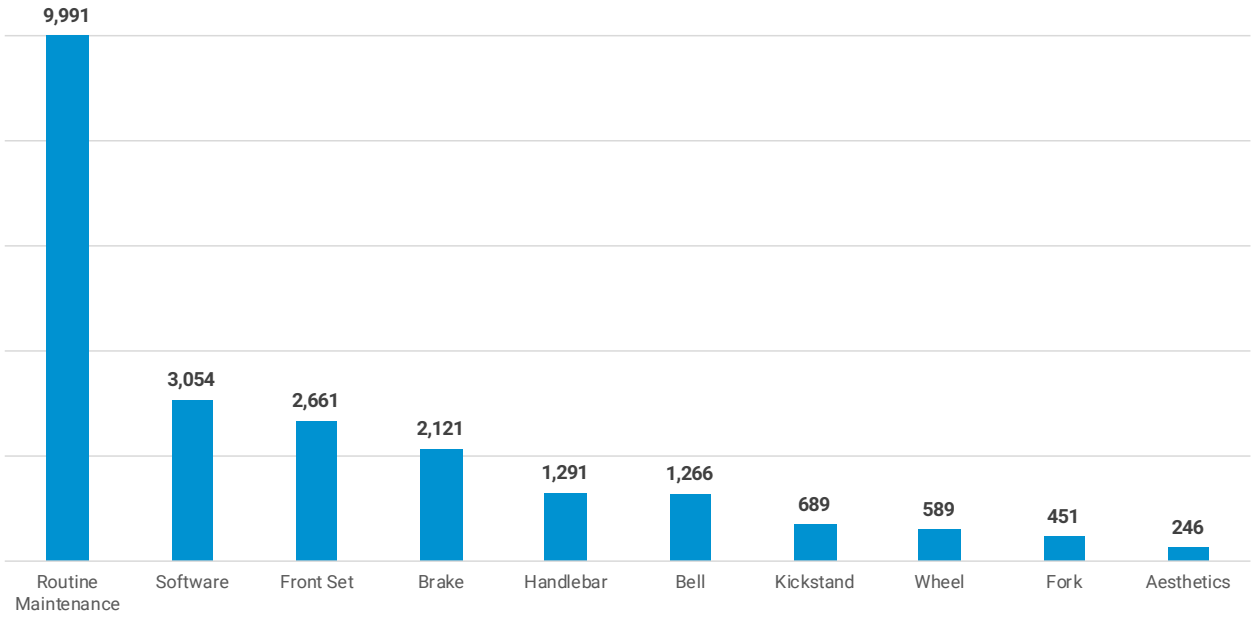
Figure 45: Top 10 Customer Reports During E-scooter Pilot



A similar challenge to the customer reports analysis arose in utilizing the data for maintenance requests. Each company had distinct ways in which they labeled their maintenance request entries, making it difficult to compare requests across companies. As such, the data that was analyzed and displayed using the same methodology for customer reports; Figure 46 draws from the top 10 most frequent maintenance requests, a significant majority of the total entries (51,617 out of 55,713 maintenance requests).

By far, the maintenance request with the highest number of entries was "NA" or "Other," at 29,258 out of 51,617 entries, and these entries were excluded in the final rendition of Figure 46. As with the customer report data analysis, this is a summary of the majority of maintenance requests data from companies, and the actual figures should be viewed as an approximation, not exact figures, as the raw data was subjectively processed and interpreted for the purposes of data analysis. Routine maintenance check requests were, by a large margin, the most common maintenance request at a total of 9,991 requests. The next most frequent requests included issues with the e-scooter pilot program's software, front set (the upper front part of the e-scooter's structure, including e-scooter stem, neck, handlebar and collar) and brakes. These findings provide useful insights for the City to consider in ensuring companies are holding high standards for safety and maintenance.

Figure 46: Top 10 Maintenance Requests During E-scooter Pilot Program



End of Ride Pictures

During the pilot, a total of 147,497 parking photos were submitted. Companies were required to ask riders to submit a photo of the e-scooter properly parked at the termination of a ride. For this analysis, 200 photos were randomly selected and individually analyzed and categorized according to the parking location indicated in the photos. This exercise was conducted to test whether the photos submitted could be used to identify any significant patterns in the types of photos submitted, and whether requiring photo submissions at the time of parking would encourage riders to adhere to e-scooter parking regulations. The analysis indicated the following:

- **76 percent of photos showed e-scooters being parked properly on the sidewalk.** Within these photos, 68 percent of parking photos showed e-scooters parked properly on the sidewalk, away from bike racks, and eight percent of photos showed e-scooters parked properly on the sidewalk, near a bike rack.

- **Six percent of photos showed e-scooters being parked improperly.** Within these photos, four percent of photos showed e-scooters parked improperly on a sidewalk, and two percent of photos showed e-scooters parked improperly on a street.

Compared to the data from the onsite e-scooter observations, the parking photos showed a lower percentage of improperly parked e-scooters (six percent compared to 19.1 percent of improperly parked e-scooters observed during the onsite surveys). However, the parking photos also showed a slightly lower percentage of properly parked e-scooters (76 percent compared to 80.8 percent properly parked e-scooters observed during onsite surveys). Challenges with the parking photo data include the following:

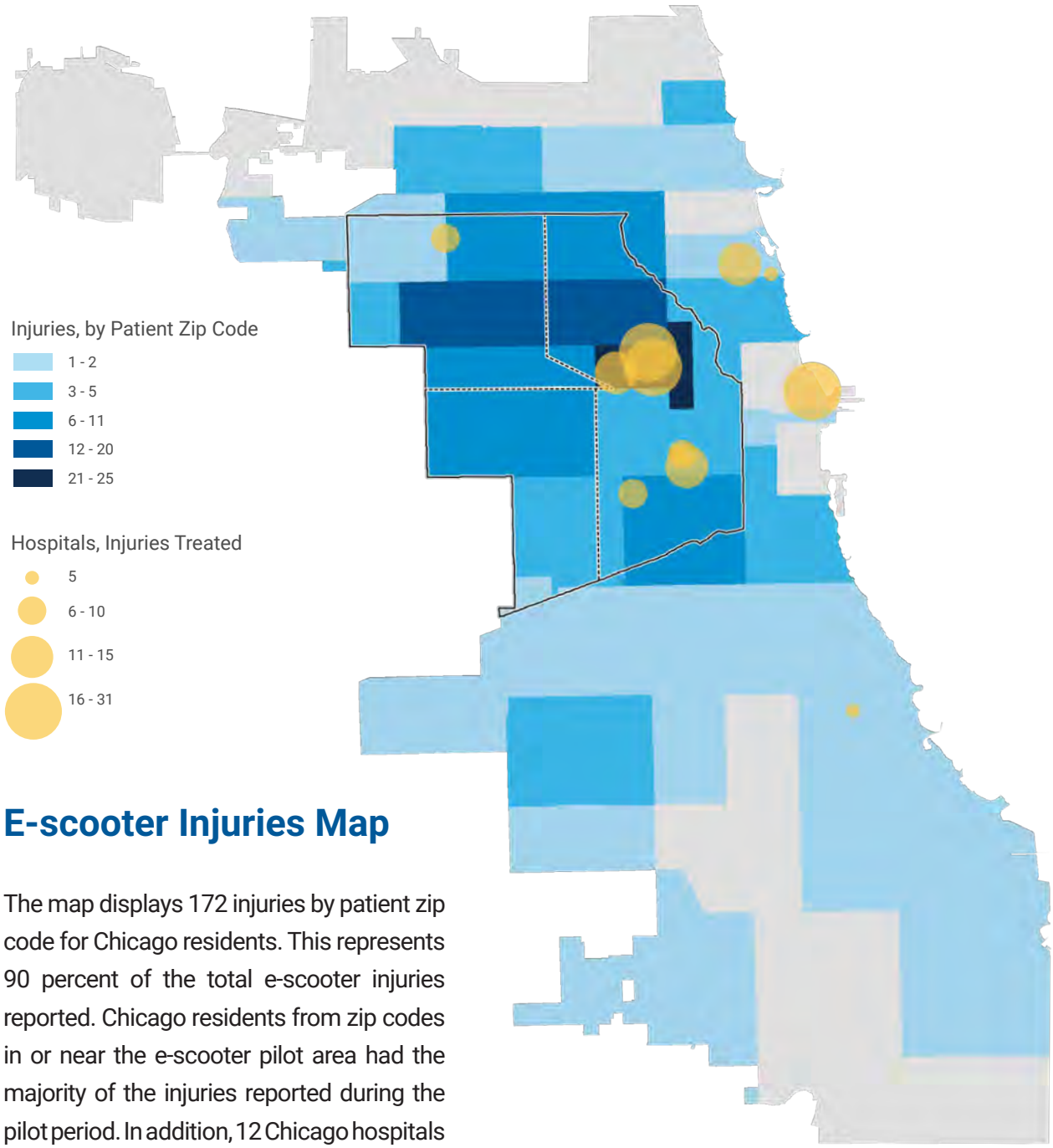
- **Frequently, a rider would take a picture of the e-scooter's QR code instead of the e-scooter and its parking location**, making it difficult to identify where the e-scooter was parked. Clearing this miscommunication of parking photo directions may be helpful going forward, potentially through the app displaying a sample parking photo that fulfills the requirements.

- **Several parking pictures showed the e-scooter technically parked "properly" on the sidewalk, but in reality, it would impede the passage of pedestrians** due to either the placement of the e-scooter in the middle of the sidewalk, or the narrowness of the pedestrian path.

- **Multiple photos showed e-scooters parked in parking lots.**

- **From the photos, it was difficult to tell whether the e-scooter was parked improperly within 10 feet of an intersection.**

Figure 47: E-scooter Injuries by Patient Zip Code and Chicago Hospitals Reporting At Least Five E-scooter Injuries, June 15 - October 15, 2019



E-scooter Injuries Map

The map displays 172 injuries by patient zip code for Chicago residents. This represents 90 percent of the total e-scooter injuries reported. Chicago residents from zip codes in or near the e-scooter pilot area had the majority of the injuries reported during the pilot period. In addition, 12 Chicago hospitals that treated at least five e-scooter injuries are displayed with gold circles increasing in size based on the number of injuries seen at each emergency department.


CHI