Micromobility in North Carolina

2024

Contents

Introduction

Micromobility is playing an increasing role as a viable short distance transportation option both nationally and in North Carolina. This report describes opportunities for actions to support the integration of micromobility into the state's transportation system and the role of the North Carolina Department of Transportation (NCDOT)'s Integrated Mobility Division (IMD) in providing technical assistance to North Carolina communities seeking to integrate micromobility options.

The findings and recommendations in this report have been informed by a study effort that began with a review of available literature on micromobility, followed by a survey of North Carolina communities to understand the current status of micromobility deployment in the state. The literature review and survey informed the development of recommendations and strategies to assist IMD in the implementation of a statewide program to support communities considering micromobility.

This report is organized into four major sections.

First, it establishes the context for NCDOT's efforts by defining micromobility and reviewing the state of the practice of micromobility implementation at national and state levels.

Next, it summarizes key findings from the literature review exploring insights from research and identifying emerging topics whose full impacts are yet to be determined.

Then, it highlights the findings from the survey of North Carolina communities to hone in on the status of micromobility implementation in North Carolina and the key concerns, challenges, and needs within the state.

Finally, it identifies the strategies and recommendations for NCDOT to consider to address micromobility needs in the areas of statewide policy, local implementation support, and agency program recommendations.

Context for Implementation of Micromobility

Micromobility is a relatively new and emerging mode of transportation. This section defines micromobility and provides context and trends relating to micromobility nationally and in North Carolina.

What is Micromobility?

The United States Department of Transportation (USDOT) defines micromobility as a category of modes of transportation that includes very light, low-occupancy devices such as e-scooters, e-skateboards, shared bicycles, and e-bikes (USDOT Bureau of Transportation Statistics, 2022).

Micromobility devices can be categorized into two broad groups: human-powered devices and motorized devices. Human-powered micromobility devices are moved by human pedaling or kicking and primarily include bicycles, skateboards, and standing push scooters. Motorized micromobility devices are low-speed, personal mobility devices that are either fully or partially motorized, such as electric pedal assist bikes (e-bikes), electric (sitting or standing) scooters (e-scooters), and electric skateboards (e-skateboards) (National Academies of Sciences, Engineering, and Medicine, 2022a).

As of 2022, 26 states (not including North Carolina) classify e-bikes into a three-tier classification system. Class 1 e-bikes, often called “pedal-assist e-bikes,” require the rider to pedal to initiate electric motor assistance, with some offering start-up aid after the rider stops. The maximum speed for Class 1 e-bikes in the United States (U.S.) is 20 miles per hour (mph), meaning the motor no longer assists above that speed. Class 2 e-bikes, or “throttle assisted e-bike,” do not require the rider to pedal to engage the motor but still have a maximum of 20 mph. Class 3 e-bikes, or “pedal-assisted high-speed e-bikes,” are similar to Class 1 e-bikes but have a higher maximum speed of 28 mph. While Class 3 e-bikes are considered bicycles in the U.S., some European countries consider them motor vehicles and require a driver’s license and vehicle registration (NASEM, 2022a). These three e-bike classifications, as well as e-scooters and other micromobility devices, are shown graphically and described in Figure 1.

Figure 1: Graphic Depictions and Definitions of Micromobility Devices

Device	Electric standing or sitting scooters (e scooters)	Electric bicycles (e-bikes)			Other[1]
					
		Class 1 Pedal assist (pedalec)	Class 2 Throttle assist	Class 3 Pedal assist (pedalec) at higher speed	
Example brands	**Shared:** Bird, Lime, and many others **Owned:** Inboard Glider, Segway 9Bot	**Shared:** Lime, Mobike, Ofo, Pace, Spin, and many others **Owned:** Most major bike brands; multiple passenger versions include Organic Transit (ELF) and Yuba	**Owned:** Several bike brands (less common than Class 1 and 3)	**Owned:** Several major brands; multiple passenger versions include Better Bike (PEBL), and Podride	**Owned:** Boosted, Inboard, Mellow Boards, Metroboard
Weight	Typically < 50 lbs	Typically < 100 lbs; multiple passenger versions near 200 lbs	Typically < 100 lbs	Typically < 100 lbs; multiple passenger versions near 200 lbs	< 50 lbs
Occupants	Single rider	Usually a single rider; some cargo e-bikes or bike cars designed for multiple riders	Typically designed for single riders	Usually a single rider; some designed for multiple riders	Single rider
Power supply	Electric motor typically < 750 watts	Electric motor typically < 750 watts	Electric motor typically < 750 watts	Electric motor typically < 750 watts	Electric motor typically < 750 watts
Product speed[2]	20 MPH or less; some cities apply additional speed restrictions	20 MPH or less	20 MPH or less	28 MPH or less	Most are 20 MPH or less though some can go up to 30 MPH
Operating space	Varies by place;[3] some cities restrict in crowded places	Varies by place;[3] usually allowed on bike transportation facilities and paths	Varies by place;[3] usually allowed on bike transportation facilities and paths	Varies by place;[3] some States restrict access on bike paths	Varies by place[3]
Regulated by	Consumer Product Safety Commission (CPSC), for personally owned devices[4]	CPSC (only for personally owned devices)	CPSC (only for personally owned devices)	CPSC (only for personally owned devices)	CPSC (only for personally owned devices)

[1] *This category includes e-skateboards; e-skates; e-boards or other self-balancing devices (sometimes called hoverboards or balance wheels).*

[2] *Speed intended for usage by manufacturer; this may be regulated by State or local ordinances and may differ from actual operating speeds or modifications made by the device user.*

[3] *In some circumstances, paths may have restrictions based on the Federal or State regulations, or the source of funding. These restrictions are often marked at the entrance to the facility, but not always.*

[4] *CPSC is a regulatory body that identifies if a product is safe to sell in the U.S. under the Consumer Product Safety Act. It does not regulate who can purchase a device or where or when devices can be legally ridden.*

Source: Sandt, 2019

Other definitions break micromobility down into classifications defined by weight and speed as shown in Table 1. The International Transportation Forum (ITF) (2020) generally defines micromobility as the use of vehicles with a mass of less than 350 kg (771.6 lbs) and a design speed of 45 km/h (28 mph) or less. While bikeshares and e-scooters are the most common micromobility devices, Table 1 details many others. In addition to Table 1, micromobility devices also includes motor scooters and devices designed for mobility impaired riders.

Table 1: Types of Micromobility Devices

Type	Weight	Speed	Device Examples
Type A	0 – 77.2 lbs	Power supply (if any) limits vehicle speed to less than 15.5 mph	Most bicycles, e-bikes, e-scooters, and self-balancing devices (i.e., Onewheels, hoverboards, Segways)
Type B	77.3 – 771.6 lbs		Cargo e-bikes and larger electric mobility devices
Type C	0 – 77.2 lbs	Powered with top speed between 15.5 – 28 mph	Some e-bikes, motor-powered bicycles, and electric unicycles
Type D	77.3 – 771.6 lbs		Some motor scooters

Adapted from Safe Micromobility, International Transportation Forum (2020)

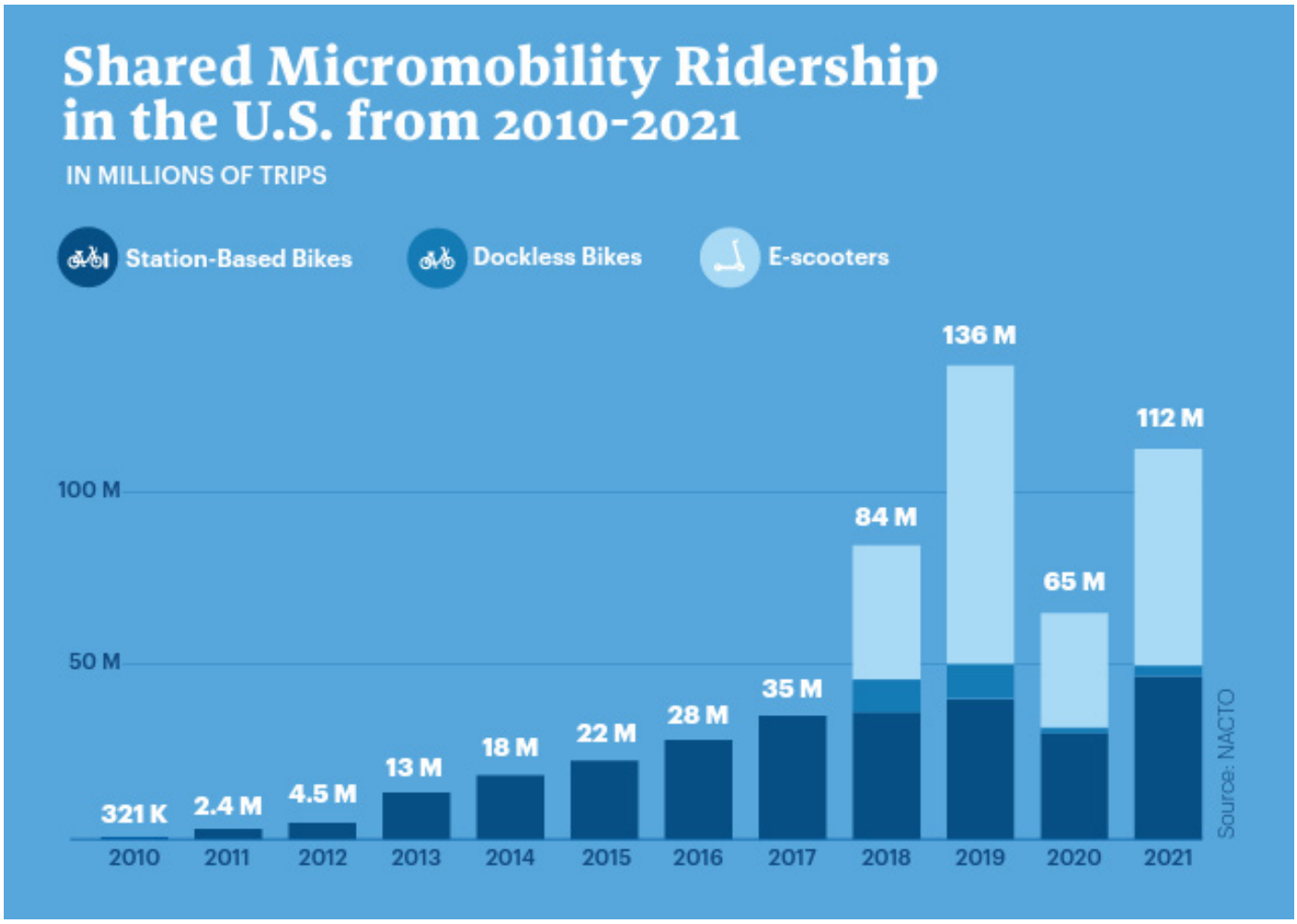
North Carolina legislation defines an "electric assisted bicycle" as "a bicycle with two or three wheels that is equipped with a seat or saddle for use by the rider, fully operable pedals for human propulsion, and an electric motor of no more than 750 watts, whose maximum speed on a level surface when powered solely by such a motor is no greater than 20 miles per hour." Electric assisted bicycles must adhere to the same road rules as bicycles but have a minimum age use of 16 years old. This is distinguished from Electric Personal Assistive Mobility Devices, which must be self-balancing non-tandem two-wheeled device with a maximum speed of 15 mph (North Carolina General Statutes §20-4.01, 2020).

How micromobility device classes are defined at the state level varies widely but has far reaching and important implications. For example, some states may classify an e-bike as a traditional bicycle while others classify it as a moped. This can translate to differing regulations around helmet requirements, license requirements, and where the vehicle can be driven. Inconsistencies in definition can lead to unreliable or incomparable data collection, challenges in developing programs or funding opportunities, and unclear policies.

What are the trends in micromobility in the U.S.?

Shared micromobility systems have grown rapidly since the first Northern American bikeshare system launched in Montreal in 2009. Half a billion shared micromobility trips have taken place in the U.S. between 2010 and 2021, with 112 million trips taken in 2021. This was a rebound close to pre-COVID-19 pandemic levels after a 70 percent decrease in 2020 (NACTO, 2022). These trends in ridership can be seen in Figure 2.

Figure 2: Shared Micromobility Ridership in the U.S. from 2010 – 2021 (NACTO, 2022)



During the COVID-19 pandemic, docked bikeshare systems stayed the most stable due to the public-private partnership business model that provided more consistent availability and investment compared to dockless bike and e-scooter systems, which are often operated and funded solely by private vendors (NACTO, 2022).

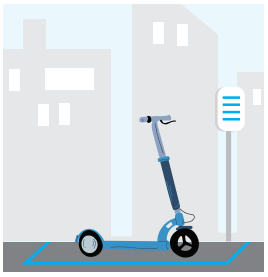
Docked bikeshare systems are primarily located in a small number of large cities (NACTO, 2022). Since 2019, total docked bikeshare systems have declined, while total docked bikeshare stations increased. Ridership trends for docked bikeshare also continue to increase after a rebound in 2021, following the onset of the COVID-19 pandemic in 2020, with docked bikeshare ridership surpassing 2019 levels (USDOT, 2022).

Types of micromobility systems

Docked*

Systems have permanent stations where devices must be picked up or dropped off.

**Also called "station-based"*



Dockless

Devices do not need to be locked to a permanent fixture, however, they may need to be parked within a defined area.

Dockless bikeshare and e-scooter systems, however, were slower to recover following the onset of the COVID-19 pandemic in 2020. Some of this decline was due to the consolidation of dockless bike and e-scooter systems in the private-sector market (USDOT, 2022 & NACTO, 2022).

Several micromobility trends have become clear in the past several years:

- **Changes in shared micromobility travel patterns.** Pre-COVID-19 pandemic, micromobility saw distinct peaks in the AM and PM rush hour time periods. However, due to an increase in remote and hybrid work schedules since the pandemic, trips have shifted away from the AM/PM rush hour and increased throughout the day. Additional reasons for changes in trip distributions are an increase in the use of micromobility for non-work trips and shift workers commuting at off-peak hours.
- **Single-use/non-member versus membership-based shared micromobility trips.** Average trip lengths for all shared micromobility trips in 2020 and 2021 were similar to 2018 and 2019 trips. The main difference was between members and non-members: typical shared micromobility system members averaged an 11 – 15 minute, 1 – 1.5 mile trip, while single-use/non-member users averaged a 24 – 28 minute, 2.4 – 2.7 mile trip. Single ride and day pass trips in 2020 and 2021 also increased from previous years.
- **Increase in shared micromobility trip cost.** While trip lengths on shared micromobility have stayed consistent over time, prices have increased substantially since 2018 – doubling for e-scooters and e-bikes. These price increases impacted dockless systems more as they were less likely to be regulated by a municipality. Additionally, some systems are priced on a per-minute basis, which makes pricing more variable based on speed, number of stops, and location of parking and/or docking stations.
- **Shared micromobility system usage based on system size.** Large docked bikeshare systems see more daily use than smaller systems, with the exception of some warmer vacation-destinations, such as Honolulu's Biki system. E-scooter system usage is not exclusively based on the size of the fleet. For example, Denver, a city popular for outdoor recreation, has wider utilization compared to Atlanta and Chicago which have larger e-scooter fleets (NACTO, 2022).
- **Increase in e-bikes as an option in shared micromobility systems.** E-bikes have become particularly popular for docked bikeshare systems, with shared e-bike trips almost doubling from 9.5 million in 2018 to 17 million in 2021. By the end of 2021, two-thirds of docked bikeshare systems had e-bikes, with e-bikes making up a quarter of those system's fleets. Some systems switched completely to e-bikes, such as Charlotte, North Carolina in 2020 (NACTO, 2022).
- **Adding accessible options to shared micromobility systems.** While e-bikes are more accessible to certain physically challenged groups compared to purely human-powered bikes, micromobility is often seen as inaccessible to older populations and persons with disabilities due to the level of physical ability required to operate stand-up scooters and traditional shared bikes and e-bikes. Micromobility devices can be designed with persons with disabilities in mind. Sit-down scooters and modified e-bike designs, such as recumbent bicycles and tricycles, are expanding options to accommodate a wider range of users with different levels of physical abilities. Some municipalities are requiring micromobility companies to provide these vehicle options. For example, Oakland, California requires scooter providers

to offer an accessible vehicle with a seat and wider wheelbase (Wright, 2020). In 2022, Helbiz, an e-scooter company, introduced wheelchair attachment and sit-down scooter options in Charlotte, North Carolina (WSCOTV.com News Staff, 2022).

- **Expanding who utilizes shared micromobility options.** Diversifying micromobility device types and implementing free or discounted programs are creating more opportunity for low-income workers and both older and younger populations to access micromobility for getting to jobs and destinations in their communities. However national trends continue to show most micromobility users are disproportionately white, male, and young with higher income levels (Aman et al, 2021; Dill & McNeil, 2020; Washburn, 2020). Some of the overrepresentation of white and higher income riders is due to the fact providers deploy more micromobility devices in high density areas of cities represented by predominantly white and high-income populations (Aman et al., 2021). Conversely, transit dependent areas, low-income communities, and minority communities are frequently found to have little to no access to micromobility (Dill & McNeil, 2020; Johnston et al., 2021).

What is the status of micromobility in North Carolina?

Several municipalities and institutions have implemented shared micromobility systems across North Carolina, including university campuses, small towns, and larger cities. Figure 3 highlights known bikeshare and e-scooter systems in North Carolina as of 2023 based on a combination of the USDOT Bureau of Transportation Statistics "Bikeshare and E-scooter Systems in the U.S." map and the results of the survey conducted as part of this report (USDOT, 2022).

All the systems shown in Figure 3 include an e-scooter component with the exception of the University of North Carolina at Chapel Hill and University of North Carolina at Pembroke which operate a dockless e-bikeshare system and a docked bikeshare system, respectively. The e-scooter system in High Point is only deployed on a temporary basis during the annual High Point Furniture Market.

Figure 3: North Carolina Shared Micromobility Systems Map (2023)

Source: USDOT, 2022 and surveys conducted in 2023 as a part of this report (Appendix A).

Several of the locations with e-scooter systems also include dockless e-bikeshare systems, such as Greensboro, North Carolina State University, University of North Carolina at Wilmington, and Winston-Salem. Winston-Salem also has a docked bikeshare system along with Charlotte and Raleigh. Raleigh also operates a docked e-bikeshare system.

While much of the micromobility ridership data in North Carolina is not made public or even available to the municipalities, some municipalities have negotiated agreements with vendors to share ridership information. This is the case in Durham, which has an online Ride Report dashboard. This dashboard collects e-scooter data on trips, distances, speed, and activity. Between June 3, 2019 and March 31, 2023, 562,000 e-scooter trips have been taken in Durham by 285,439 people on 394 devices. The majority of these trips took place downtown and on the campuses of Duke University and North Carolina Central University. During that nearly four-year span there was an average of 400 scooter trips per day traveling an average of 600 miles per day.

Micromobility in North Carolina continues to grow, but the survey conducted as a part of this report shows challenges across the state with parking dockless devices, tracking micromobility safety, and securing sustainable funding sources. Cities are increasingly implementing more organized micromobility systems, often in response to chaotic experiences from vendors providing micromobility devices on public streets overnight without any regulations in place. More municipalities are conducting Request for Proposals (RFP), carefully negotiating contracts with vendors, and integrating micromobility into planning efforts, including parking and pedestrian and bicycle infrastructure.

Tracking North Carolina Micromobility Crash Data

NCDOT's Transportation Mobility and Safety Division tracks micromobility crashes and has released annual assessments since 2018, when micromobility systems began to be deployed in North Carolina. However, the small number of micromobility crashes that the Transportation Mobility and Safety Division are able to track makes it difficult to draw any trends from the data or locate hot spots. This issue is exacerbated with most micromobility vendors refusing to share trip location data. Between January 2018 and July 2022, 304 micromobility crashes were found in the Division's system with no fatal crashes reported.

Another reason it is difficult to gather micromobility safety data for North Carolina is the reliance on police reports which are not currently designed to document crashes involving micromobility devices resulting in differences in reporting methodology based on the municipality and their officer training. NCDOT is currently working on a crash form update for the Division of Motor Vehicles (DMV), with stakeholder input on the crash report forms in relation to micromobility. A field is being added to these crash reports to record "person-type," which includes "powered personal conveyance" such as e-scooters, "powered or power-assisted pedal cyclist," and "other pedestrian" which includes wheelchairs, skateboards, and kick-scooters. This breakdown of micromobility types can help in analyzing and implementing micromobility safety measures in North Carolina.

Literature Review Summary

Available literature on micromobility was reviewed to understand how micromobility is defined and deployed across the country to identify approaches to policy, regulations, and coordination. Additionally, micromobility literature was reviewed to consider effective planning and implementation strategies; to determine infrastructure considerations; to understand innovations and data issues; and to identify the key considerations in North Carolina. Key findings of the literature review are summarized below. The full literature review is in Appendix A.

What does the research say about the status of micromobility across the country?

Micromobility is a relatively new concept in transportation, resulting in largely ad hoc community responses and approaches. Therefore, it is critical to establish a shared understanding of micromobility and how state Departments of Transportation (DOTs) and communities are addressing it. Although micromobility devices may be individually owned, the recent surge in micromobility is due to shared use device fleets by private companies, also called shared micromobility systems (Price, 2021). These shared systems, typically comprised of bikes, e-bikes, and/or e-scooters, are either docked, with permanent stations where devices must be picked up or dropped off, or dockless systems, which allow users to park anywhere within a geographic region, sometimes with additional regulations (Davies, Blazejewski & Sherriff, 2020). E-scooter systems have grown since the COVID-19 pandemic and are found in cities of varying sizes, while bikeshare programs tend to be in larger cities (USDOT, 2022).

Based on the inclusion of micromobility in new federal bills and the 2021 round of the USDOT Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant awards, there are several new opportunities for micromobility. Opportunities also include micromobility funding explicitly mentioned in the Congestion Mitigation and Air Quality (CMAQ) and Surface Transportation Block Grant Programs (STBG), as well as a new Carbon Reduction Program that will promote non-single occupancy vehicle trips to reduce transportation emissions.

How do policies, coordination efforts, and regulation affect micromobility?

Virtually all management and regulation of micromobility in the U.S. takes place at the local/municipal level. Laws and ordinances around micromobility vary greatly between different states, cities, and jurisdictions. Following the initial rush to manage the influx of micromobility options, it became evident that variability in local regulations and requirements had created challenges. The Governor's Highway Safety Association recommends that regulations be established by state legislatures while still allowing local governments the ability to manage devices based on local conditions (Fischer, 2020).

Regulations and ordinances may apply to micromobility users, vendors, and service providers or those involved in collecting, reporting, and sharing data. Examples of the types of micromobility issues addressed in regulations or local ordinances include locations where devices are permitted or prohibited, parking requirements, maximum speeds, permit requirements and fees, and data sharing requirements. The primary roles that state DOTs serve regarding micromobility include developing guidance, performing research, collecting data, and promoting the implementation of micromobility. State DOTs are rarely involved in regulating or enforcing regulations on micromobility (NASEM, 2022a). Some state DOTs have worked to develop pilot projects, but DOTs could play a greater role in creating and supporting pilot projects in general (AASHTO, n.d.).

How is micromobility planned for and implemented in communities?

Planning for micromobility starts with understanding how micromobility fits into the broader transportation network and many municipalities will conduct a feasibility analysis as a first step. Research found that some feasibility analyses were designed to guide early decision-making, such as identifying any significant barriers to implementation of a shared micromobility system, while other feasibility analyses outlined specific recommendations and implementation options for creating a shared micromobility program (City/County Association of Governments of San Mateo County Bicycle and Pedestrian Advisory Committee, 2022).

An important aspect of micromobility is its potential to increase access and equity for all. Micromobility can augment first/last mile access to and from transit, serving as a short distance service extension for transit dependent communities. The emergence of more accessible micromobility devices increases the potential for micromobility to serve a wider spectrum of persons with disabilities. Additionally, diversifying micromobility device types and offering free or discounted programs are creating more opportunities for low-income workers and both older and younger populations to access micromobility for getting to jobs and other destinations in their communities.

Micromobility also has the potential to boost tourism and, therefore, local economies. Bikeshare and e-scooters are popular ways for tourists to explore a new city as they are faster than walking and allow users more interaction with their local environments than a car trip (Burke, Yang, Kaufman & Leung, 2021). Since tourists can make quicker trips using bikes, e-scooters, or e-bikes, they are able to visit more destinations, which translates to more money being spent within the local economy (Burke, Yang, Kaufman & Leung, 2021).

What infrastructure is needed for micromobility?

Micromobility systems are safest when paired with a robust network of interconnected bike lanes (NACTO, 2019). More research is needed to gain a full understanding of micromobility safety. Based on the data available for e-scooters, single device crashes comprise the majority of recorded crashes, not collisions. The most common reasons for these crashes were roadway surfaces or features, loss of balance, stationary objects, and vehicle issues. Inexperience also plays a role. (NASEM, 2022b).

Parking is one of the biggest challenges for micromobility programs. Most complaints about micromobility programs are related to improperly parked devices that block sidewalks and create safety hazards and accessibility issues (NACTO, 2019c; Transportation for America, 2022b). Municipalities and vendors have found a myriad of ways to deal with parking for micromobility devices, including designated areas for parking, geofencing to prevent vehicles from being parked in areas where they are not allowed, and requiring vehicles to be locked to specific physical infrastructure (e.g., corral, bike rack).

What are current practices in data collection and sharing?

Data collection and sharing varies widely across vendors and their public or institutional partners, making it a challenge for some municipalities and the research community to fully evaluate some micromobility programs (T4A, 2022a). Micromobility data sharing is important for municipalities to effectively integrate micromobility into their transportation network, create supportive policies, evaluate safety, and collaborate with state agencies and other municipalities. Best practices include adopting clear data sharing agreements, data use standards, publishing clear policies, practicing data minimization, limiting data access, using third party data aggregators, and deleting raw data as soon as possible (Ride Report, 2020). The primary two standardized systems for data sharing are General Bikeshare Feed Specification (GBFS) and Mobility Data Specification (MDS) (Li & Wang, 2022). Including micromobility as an element of Mobility-as-a-Service (MaaS) is an emerging concept that has not yet been fully integrated in the U.S. but has potential to further connect micromobility and transit options.

What does the literature suggest for the future of micromobility in North Carolina?

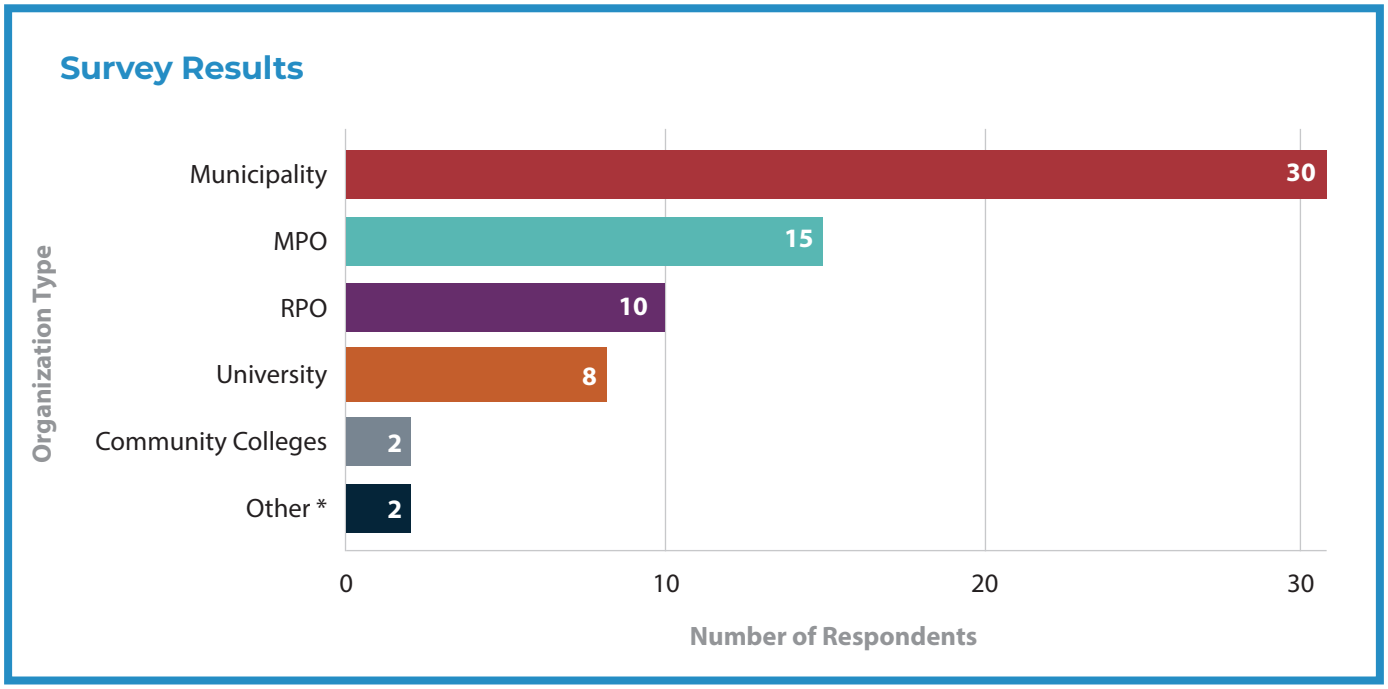
While relatively new to the U.S. transportation system, micromobility programs provide ample opportunities to enhance current transportation networks. NCDOT is uniquely positioned to provide technical assistance to communities across North Carolina interested in implementing micromobility. NCDOT could leverage its role to promote clarity and consistency for how micromobility devices are defined, how regulations are developed and enforced, and how data is captured and managed. This literature review is a starting point and summary for further NCDOT engagement in micromobility, including to:

- Provide clearer definitions for micromobility devices and regulations.
- Create consistent data collection and management standards.
- Promote micromobility awareness and education.
- Coordinate between communities and vendors where appropriate to support implementation.
- Conduct local feasibility analyses.
- Issue pilot programs to test micromobility programs.
- Seek funding opportunities.

Summary of Survey of North Carolina Communities

An online survey of select municipalities, Metropolitan and Rural Planning Organizations (MPOs and RPOs), and universities and community colleges across North Carolina was conducted from February 14 to March 24, 2023. In total, 65 of 128 invited organizations responded to the survey, resulting in a 51 percent response rate. More than half of respondents represented municipalities, as shown in Figure 4. A full synthesis of the survey results can be found in Appendix B.

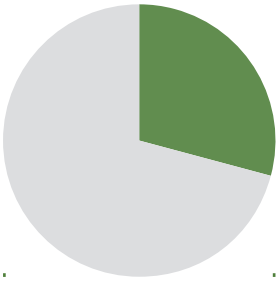
Figure 4: Survey Respondents by Organization Type



*"Other" includes one council of governments and one transit agency.

How are North Carolina communities planning for and implementing micromobility?

The survey effort provided insight into the types of micromobility systems operated in North Carolina, as well as the status of micromobility planning efforts in communities without an existing micromobility system.



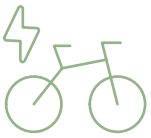
within the 29%

Communities with Existing Micromobility Systems

29% of respondents have a micromobility system present in their community

Types of micromobility systems:

74% have dockless e-scooter share



32% have dockless e-bikeshare

26% have docked bikeshare

*Other systems include **dockless bikeshare (21%)** and **docked e-bikeshare (11%).***

Future plans for existing systems:*

47% plan to add or expand services or systems within 2 years

32% have no plans for changes

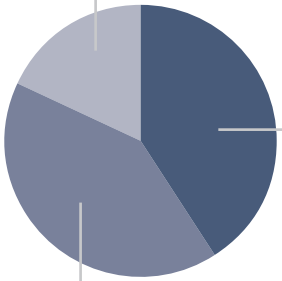
26% are evaluating or implementing a pilot project

**Respondents could select multiple options and only the top selections are shown. As a result, values will not sum to 100%.*

within the 71%

Communities Without Existing Micromobility Systems

71% of respondents do not have micromobility systems present in their community



17.4% of respondents considered planning for micromobility systems but decided not to proceed

41.3% of respondents without micromobility systems have not considered planning for micromobility

41.3% of respondents without micromobility systems are or may consider planning for micromobility in the future

What potential benefits and challenges were identified by survey respondents?

All respondents were asked to share their feedback on micromobility benefits and challenges from their perspective. The most common responses are outlined below.

Benefits

57% Promoting walkable and bikeable community land use

41% Equity

40% Accessibility

Challenges

51% Safety of riders and other road and sidewalk users

46% Payment issues (sign ups, equity, payment integration)

42% Micromobility devices blocking sidewalks and other facilities

41% Infrastructure/design to support micromobility modes

Note: Respondents could select multiple options for each of these questions, thus figures reflect the percentage out of 100% for each independent Benefit and Challenge and do not sum to 100%.

Respondents were asked to share lessons learned and best practices identified through their experience with micromobility in their community. Lessons learned shared by respondents included:

- Update local ordinances to address micromobility.
- Keep management approach and fee structure simple, especially for smaller programs.
- Set a clear standard for vendors in the permitting process.
- Create strong relationships with vendors to address questions of abandonment and/or misplacement of devices.
- Engage with other communities and micromobility vendors to develop research together.
- Limit the number of vendors.
- Utilize a vendor with a local presence.
- Coordinate with major employers.
- Develop a sustainable funding source.
- Have strong parking regulations, clear geofences, slow-zones, and no ride zones.

What kind of support do North Carolina communities need?

Respondents were provided with a list of potential resources and support NCDOT could provide and asked to select the top three most important benefits from micromobility.

The most selected answers were:

- Technical/planning assistance (68%).
- Prepared resources such as guidance, fact sheets, or tools (53%).
- Assistance with compliance or other legal requirements (42%).
- Assistance brokering deals with vendors (39%).

Pilot Project Opportunities
67% of survey respondents are interested in working with IMD on a pilot project.

NCDOT Strategies and Recommendations

The micromobility context summary, literature review, and survey of North Carolina communities provide a foundational understanding of the current state of practice for implementing micromobility. The following sections provide insights and opportunities relating to NCDOT's potential role in three key areas of micromobility: statewide policy, local implementation, and program recommendations.

Policy

Provides an overview of current state policies and statutes to identify potential gaps and opportunities that will inform NCDOT's future policy direction. This section also explores compliance issues and the potential roles and responsibilities for the state, NCDOT, local governments, and other partner agencies and policymakers.

A. General Statutes (G.S.) and Policy Review

B. Roles and Responsibilities

C. Compliance

Implementation

Explores key issues relating to micromobility implementation by communities to identify the resources and technical assistance that NCDOT can provide to support implementation of micromobility systems statewide.

A. Funding Support Programs

B. State, Regional, and Local Coordination

C. Micromobility Network Planning

D. Standardized Ordinances

E. Safety

F. Data

G. Emerging and Future Considerations

Recommendations

Identifies the program or statewide actions and strategies NCDOT can develop in key areas to guide micromobility implementation now and into the future.

A. Program Integration

B. Education

C. Emerging Practice Areas

D. Pilot Projects

Policy

NCDOT's core functions include providing statewide leadership and policy direction for all modes of transportation. Key topics relating to policy direction are: General Statutes and Policy Review; Roles and Responsibilities; and Compliance.

A

General Statutes and Policy Review

As micromobility services in the state expand, it is important for NCDOT to have a clear understanding of existing state-level statutes, policies, and gaps related to micromobility. This understanding will inform the development of future policies and coordination with the legislature to address statutory issues.

B

Roles and Responsibilities

Providing effective leadership and technical assistance to support micromobility across the state will require coordination with a wide range of stakeholders and partners. Identifying the roles and responsibilities of the different levels of government, public agencies, and other partners will support the development of ongoing micromobility partnerships and allow NCDOT to develop models for effective collaboration.

C

Compliance

Compliance issues around micromobility are also a key policy issue for NCDOT to consider. Currently, there is very little data relating to compliance issues, although it is anticipated to be a topic of increasing importance in the future.

A. How do North Carolina General Statutes affect micromobility in the state?

While the North Carolina General Statutes provide definitions pertaining or related to some micromobility modes as shown in Table 2, North Carolina legislation does not specifically define, address, or provide regulation of the range of micromobility devices. Municipalities bear the brunt of overseeing the development of micromobility regulations, user safety, equitable access, parking, and more. Lack of staff capacity and access to technical resources related to micromobility at the local level can limit some communities to only being reactive to micromobility systems that pop-up overnight rather than being proactive to develop micromobility as a transportation option integrated into the transportation network of the community.

In North Carolina, bicycles are recognized as vehicles by the state, which necessitates adherence to specific lighting and equipment guidelines for their operation during nighttime. This classification contrasts with the treatment of Electric Personal Assistive Mobility Devices (EPAMDs), such as electric scooters, which are governed by a different set of rules. Municipalities can impose regulations on the operation of EPAMDs to ensure public safety, although they are prohibited from banning them outright. These 'scooters' are distinct from e-scooters (see Figure 1) which are not currently defined by the North Carolina general statutes.

Table 2: North Carolina General Statute Definitions of Vehicle Types Adjacent to Micromobility

Vehicle Type	NC General Statute	Definition
Bicycle	G.S. 20-171.1	A nonmotorized vehicle with two or three wheels tandem, a steering handle, one or two saddle seats, and pedals by which the vehicle is propelled, or an electric assisted bicycle, as defined in G.S. 20-4.01(7a).
Electric Assisted Bicycle	G.S. 20-4.01(7a)	A bicycle with two or three wheels that is equipped with a seat or saddle for use by the rider, fully operable pedals for human propulsion, and an electric motor of no more than 750 watts, whose maximum speed on a level surface when powered solely by such a motor is no greater than 20 miles per hour.
Electric Personal Assistive Mobility Device	G.S. 20-4.01(7b)	A self-balancing nontandem two-wheeled device, designed to transport one person, with a propulsion system that limits the maximum speed of the device to 15 miles per hour or less.
Motor-driven Bicycle	G.S. 20-4.01(27)i.	A vehicle with two or three wheels, a steering handle, one or two saddle seats, pedals, and a motor that cannot propel the vehicle at a speed greater than 20 miles per hour on a level surface. This term shall not include an electric assisted bicycle as defined in subdivision (7a) of this section.
Moped	G.S 20-4.01(27)j.	A vehicle, other than a motor-driven bicycle or electric assisted bicycle, that has two or three wheels, no external shifting device, a motor that does not exceed 50 cubic centimeters piston displacement and cannot propel the vehicle at a speed greater than 30 miles per hour on a level surface. The motor may be powered by electricity, alternative fuel, motor fuel, or a combination of each.

In regard to mopeds, G.S. 20-10.1 prohibits anyone under the age of 16 from operating a moped. G.S. 20-140.4 makes special provisions limiting the number of riders (including the operator) of a moped or motorcycle to only the number of persons specified by the manufacturer that it was designed to carry. G.S. 20-140.4 also requires the operator and all passengers to wear a properly secured safety helmet as defined by Federal Motor Vehicle Safety Standard (FMVSS) 218 unless the vehicle has completely enclosed seating or is equipped with a roll bar or roll cage. The statute further defines penalty fees for infractions and defines where additional court costs are to be remitted to. G.S. 20-129 requires lighted headlamps and rear lamps on all vehicles upon a highway, including mopeds.

Electric Assisted Bicycles per G.S. 20-4.01(7a) must have a seat or saddle for use by the rider, be fully operatable by pedals for human propulsion, and whose electric motor must not be more powerful than 750 watts and cannot exceed 20 mph solely under electric propulsion. According to G.S. 20-4.01(49) as amended by NC Senate Bill 739, Electric Assisted Bicycles shall be deemed vehicles and every rider of a bicycle or an electric assisted bicycle upon a highway shall be subject to the provisions of G.S. Chapter 20 except those which by their nature can have no application such as G.S. 20-4.01(23), definition of Motor Vehicles, which explicitly excludes bicycles and electric assisted bicycles.

Electric Personal Assistive Mobility Device as defined in Table 2, is limited to 15 mph or less and has additional provisions in G.S. 20-175.6 which exempts them from registration and permits their operation on public highways with posted speeds of 25 mph or less, sidewalks, and bicycle paths. It also requires operators to yield the right-of-way to pedestrians and other human-powered devices and states that operators shall have all rights and duties of pedestrians including those specified G.S. Chapter 20 Part 11. This provision also gives municipalities jurisdiction regulating the time, place, and manner of operation over public streets, sidewalks, alleys, bridges, and other ways of public passage but does not allow them to prohibit their use.

Lastly, bicycles are given additional requirements through G.S. 20-171.9 which makes it unlawful for any parent or legal guardian of a person below the age of 16 to knowingly permit that person to operate or be a passenger on a bicycle unless the person is wearing a properly secured protective bicycle helmet at all times. It also makes it unlawful for any parent or legal guardian of a person below the age of 16 to permit that person to be a passenger on a bicycle unless the person is able to maintain an erect, seated position on the bicycle, is able to be properly seated alone on a saddle seat, and, if the person weighs less than 40 pounds or is shorter than 40 inches in height, they must be properly seated in and adequately secured to a restraining seat.

Per G.S. 20-129(e), every bicycle must be equipped with a reflex mirror on the rear and if operated at night on any public street, public vehicular area, or public greenway, must be equipped with a lighted lamp on the front visible from a distance of at least 300 feet and a lamp on the rear with the same visibility or the operator must wear a reflective vest that is bright and visible from the same distance.

Challenges

- A rapidly growing micromobility industry is placing pressure on local governments to act now.
- Communities must balance encouraging eco-friendly mobility against addressing strained public infrastructure not designed for micromobility devices.

Opportunities

- Develop statewide guidance on micromobility to allow implementation and adoption of micromobility options less burdensome for communities.
- Opportunity to increase transportation options by making micromobility options more available and accessible.

NCDOT ROLE

- Consult with NCDOT Office of General Counsel and with the North Carolina Department of Justice (NCDOJ) to formulate and prepare initial drafts of micromobility legislation options for a future legislative session. Options to consider include:
  - » limited expansion of existing motor vehicles statutes (found at N.C. General Statues Chapter 20) to more clearly recognize and address micromobility devices;
  - » authorizing legislation to grant local governments a range of authority to regulate micromobility devices; and
  - » more extensive amendment of N.C. General Statutes Chapter 20 to address micromobility regulation issues such as areas of operation/parking, operator safety, and operational standards.

IMD ROLE

- Partner with municipalities to coordinate policy recommendations, collect and analyze user data, and establish a statewide model to leverage new forms of mobility.
- Facilitate information sharing among communities within the state on best practices and new approaches to managing micromobility being tested and developed in communities across the state.

B. What are the roles and responsibilities of NCDOT and other levels of government in implementing micromobility?

Transportation systems involve a wide range of agencies and partnerships, and micromobility is no different. Addressing micromobility at a programmatic level requires an understanding of the entities involved and the relationships among them.

Table 3 outlines the recommended roles and responsibilities of different levels of government related to micromobility implementation.

Table 3: Recommended Roles and Responsibilities

LEVELS OF GOVERNMENT	
	**Federal** • Provide grants and funding to states, DOTs, and local municipalities • Provide guidance on regulations and rule making
	**State (legislature)** • Define micromobility device types • Define requirements for licensing, permitting, and helmet use
	State (DOT) • Provide technical resources to communities • Encourage communication and collaboration between regional planning organizations, municipalities, universities, and other agencies • Support pilot projects • Encourage the adoption of data standards • Communicate federal grant information and opportunities
	**Local** • Provide planning and implementation resources • Advise and review vendor agreements • Review and advise on micromobility ordinances

NCDOT is working to refine its role, and particularly the role of IMD, in shaping micromobility throughout North Carolina.

Challenges

- Roles around the implementation and regulation of micromobility have not been clearly delineated and continue to evolve.

Opportunities

- Structures and programs for micromobility can be built from the ground up.
- NCDOT is already connected to many of the partners likely to be involved in micromobility implementation.

NCDOT ROLE

- Take the lead in defining roles and responsibilities for micromobility in the state.

IMD ROLE

- Serve as a primary point of contact for micromobility technical support and coordinate among NCDOT business units as needed.

C. What are key compliance considerations for micromobility?

Micromobility efforts must comply with local, state, and federal rules and regulations. They must also comply with established data standards to ensure streamlined reporting and effective integration with other systems. Currently, very little research and few resources on micromobility compliance are available, although this is expected to change in the future.

Challenges

- There is a lack of available literature on data compliance and federal and state compliance practices regarding micromobility.

Opportunities

- Perform further research on micromobility data and regulatory compliance.

NCDOT ROLES

- Monitor compliance data as it becomes available.
- Identify emerging issues and address compliance needs.

IMD ROLE

- Stay abreast of updates to state and federal regulations impacting micromobility and plan accordingly.

Effective Practices

- **Monitor compliance with data standards** – After data standards are established, shared data can be monitored for consistency and compliance and reported more effectively.
- **Monitor compliance with federal and state micromobility regulations** – While few resources are currently available, in the future additional state and federal regulations may be introduced and compliance will be monitored.

Resources

- Complete Guide to U.S. Electric Scooter Laws by State 2025

Implementation

Micromobility systems in North Carolina are growing, with expansion of existing systems and ongoing implementation of new systems. NCDOT is well positioned to provide resources and technical assistance in the following areas to support communities implementing or expanding micromobility:

A

Funding Support Programs
NCDOT can help communities identify funding opportunities to support local micromobility objectives.

B

State, Regional, and Local Coordination
NCDOT can serve as a liaison to facilitate communication at the state, regional, and local levels to achieve common goals and effective coordination around micromobility implementation in the state.

C

Micromobility Network Planning
NCDOT can support planning for integration of micromobility into the state's multimodal transportation system to optimize transportation networks.

D

Standardized Ordinances
NCDOT can establish models for communities to adopt appropriate ordinances for effective micromobility deployment and increased consistency within the state.

E

Safety
NCDOT can collect data and share information and best practices to increase safety around micromobility usage.

F

Data
NCDOT can establish data standards and provide technical assistance in data sharing, contract mechanisms, and other recommended practices to increase access to micromobility data.

G

Emerging and Future Considerations
NCDOT can monitor micromobility information to identify trends, emerging considerations, and future needs.

A. What funding resources are available for micromobility?

New funding opportunities for micromobility are available through a variety of programs, particularly in new federal bills and the 2021 round of the USDOT RAISE grant awards. Funding sources should be reviewed carefully as some only allow for micromobility to be included as a component of a larger transportation project, such as a mobility hub, and some restrict eligible micromobility system components. Additional information on funding sources are outlined in Table 4 (NABSA, 2022).

Table 4: Micromobility Federal Funding Opportunities

Funding Source	Eligible Recipients	Eligible Projects	Funding Type
Accelerating Innovative Mobility	• Primary recipients are transit agencies and local, state, or tribal governments • Primary recipients can identify strategic partners that include micromobility providers	• All activities leading to the development and testing of innovative mobility, such as planning and developing business models, obtaining equipment and services, acquiring or developing software and hardware interfaces to implement the project, operating or implementing the new service model, and evaluating project results	• Discretionary
Advanced Transportation Technologies & Innovative Mobility	• State or local government, a transit agency, MPOs (MPOs of 50K – 200K population now eligible), a multi-jurisdictional group or a consortia of research institutions	• Projects that improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment	• Discretionary • Cooperative agreements
Carbon Reduction	• State DOTs receive federal funding; 65 percent is suballocated to MPOs; and MPOs have the authority to allocate funding within the region	• Funding available for facility planning and design, network integration, technology, street and curb design, and possibly vehicle acquisition	• Formula
Center of Excellence on New Mobility and Autonomous Vehicles	• Institutions of higher education, public or private research institution, non-profit	• Studies, research and development, best practices, and modeling • Direct acquisition or operations not eligible	• Cooperative agreement

Funding Source	Eligible Recipients	Eligible Projects	Funding Type
Congestion Mitigation & Air Quality Improvement Program (CMAQ)	• State DOTs receive and distribute federal funding • Opportunity for local governments to engage with state officials in securing funding for newly eligible projects • States provide separate guidance regarding their own process	• Explicit eligibility for micromobility projects (bike and scooter share systems) • Details pending release of new guidance but typically for capital projects, vehicle acquisition, planning • Operational support unlikely	• Formula
Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	• States, U.S. territories, or local government • Public agency or publicly chartered authority established by one or more states • Special purpose district or public authority with a transportation function, including a port authority • Tribal government or a consortium of Tribal governments • A partnership between Amtrak and one or more eligible entities • A group of eligible entities	• Opportunity to incorporate micromobility into funding applications, particularly to bolster scoring on criteria for climate, equity, access, and/or land use where micromobility can add a benefit or be incorporated into a broader project or plan	• Discretionary
Surface Transportation Block Grant Program (STBG)	• State DOTs, MPOs, direct suballocation for regions 200K+ in population, and expanded authority for regions 50K – 200K	• Projects can be included in Transportation Improvement Programs (TIP) • Shared micromobility is not explicitly referenced but could be an element within several eligible project categories	• Formula funding to states with direct allocations for programs (such as TAP) and suballocations to larger MPOs
Transportation Alternatives Program (TAP)	• MPOs provide competitive grant funding to local governments, government agencies, or non-profit entities	• Primary funding source of bike and pedestrian infrastructure • Possible opportunity to broaden eligibility to shared micromobility in grant guidance document	• Formula funding to states • Competitive funding from MPOs to projects

Note: Requirements for matching funds are not shown in Table 4. Individual grant opportunities should be reviewed in greater detail for any matching funds required.

Source: Adapted from NABSA, 2022

Challenges

- Funding eligibility subject to more expansive federal, state, and local coordination requirements.
- Variability in defining vehicle classes lead to inconsistencies in micromobility regulations (e.g., bicycle vs. moped), which in turn challenges funding opportunities.
- Micromobility could place new and additional demands on existing infrastructure and services, which are already underfunded in some fast growing cities.
- Securing/identifying sustainable operational funding to keep micromobility trip costs affordable and maintain the long-term viability of micromobility systems as a transportation option.
- Notice of funding opportunities and grants are very competitive.

Opportunities

- Opportunity to implement projects which advance federal, state, and local micromobility goals around equity, reducing vehicle miles traveled, and reducing greenhouse gas emissions.
- Opportunity to introduce micromobility services in more underserved communities.
- Opportunity to set standards and work with policy makers and stakeholders to define and differentiate the range of micromobility devices resulting in clarity to seek competitive federal or state grants.
- Opportunity to create stronger partnerships and coordination between state, local agencies, and transit operators to scope, plan, design, and explore how to pay for more integrated, multimodal transportation systems.
- Opportunity to pilot micromobility services which track the true cost of managing and operating systems to report both benefits and inform communities interested in launching micromobility service in the future.
- Opportunity to coordinate with local partners to build the case for micromobility benefits.

IMD ROLES

- Regularly communicate and update the list of emerging and evolving funding opportunities with planning partners, local officials, and key stakeholders. Efforts to share funding opportunities could go hand in hand with providing technical assistance and guidance to partners.
- Identify funding opportunities which advance federal, state, and local transportation goals and demonstrate a wide cross-section of system benefits. Micromobility can be implemented through a broad set of grants and pilot projects in the new Infrastructure Investment and Jobs Act (IIJA) federal bill for safe streets, restoring communities, carbon reduction, and shared mobility uses. A concerted focus on these opportunities and reporting their outcomes will raise the profile of micromobility as an emerging transportation solution in North Carolina.
- Support additional research to explore innovative methods cities around the world use to oversee, administer, and fund micromobility programs which may be applicable to North Carolina communities.

Resources

- Introduction To U.S. Federal Transportation Funding
- Play 7: Unlock Funding. Mobility Hub Implementation Playbook
- Pedestrian and Bicycle Funding Opportunities: U.S. Department of Transportation Transit, Safety, and Highway Funds

B. How can NCDOT facilitate effective coordination among micromobility partners?

Effective coordination among NCDOT business units and other state, local, and regional entities is essential for implementing successful micromobility programs. Coordination is needed not only to implement micromobility, but to support efforts to address regulatory issues, standardize data collection, and programmatically monitor safety concerns.

IMD can serve as the primary resource for micromobility questions, including effective strategies for coordination. Within NCDOT, IMD can interface with internal NCDOT offices responsible for different stages/steps of the project development process. The early identification of micromobility in long range planning can cascade through design and scoping decisions that accommodate micromobility service in communities. IMD may also wish to monitor and track efforts led by other NCDOT business units that may have an impact on micromobility and ensure that communities implementing micromobility are informed of potential changes in policy or practice that may affect their micromobility project or system. Key elements of internal NCDOT coordination are illustrated in Figure 5.

For external partners, IMD can serve as the primary NCDOT point of contact for micromobility topics and model appropriate communication strategies. IMD can serve as a resource to communities working to implement micromobility and be prepared to help them identify stakeholders, develop coordination strategies, and share lessons learned among communities. IMD can interface with stakeholders at the local level as shown in Figure 6 who need technical expertise and resources to make informed decisions on micromobility. Timely communication of grant opportunities, industry and regulatory changes, and familiarity with vendors positions IMD to be an increasing resource and "one stop shop" of trusted advice.

Figure 5: Micromobility Coordination within NCDOT

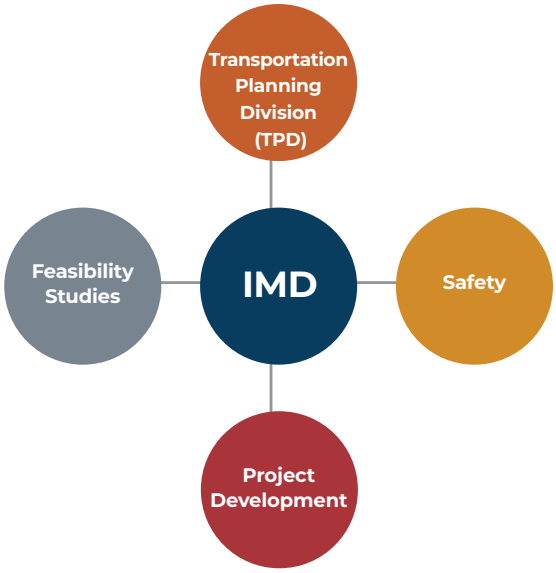
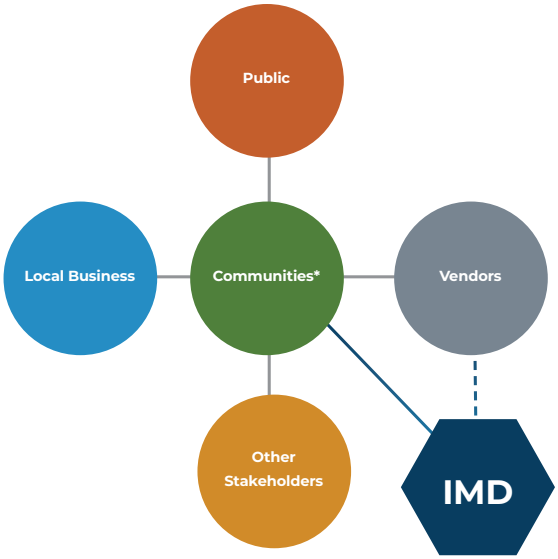


Figure 6: Micromobility Coordination with External Stakeholders



*Includes university/campus communities

Challenges

- To date, micromobility has been implemented in an ad hoc manner.
- Micromobility is relatively new and its role within the transportation system may be overlooked.

Opportunities

- Develop programmatic approaches and models for effective coordination for micromobility implementation.
- Seek opportunities to integrate micromobility into wider transportation efforts.

Effective practices

- **Develop resources for communities** – Develop models for coordination, including stakeholder lists and recommended practices for implementing micromobility.
- **Build relationships among micromobility practitioners** – Establish ongoing dialogues and relationships with communities, vendors, and others involved in implementing micromobility.

NCDOT ROLE

- Integrate micromobility considerations into comprehensive and metropolitan long range plans, statewide safety programs, and other data collection initiatives.

IMD ROLES

- Provide resources to help communities develop coordination strategies to support micromobility.
- Establish internal and external partnerships to support integration of micromobility into plans and department initiatives.
- Coordinate among NCDOT business units to incorporate micromobility considerations in relevant efforts.
- Monitor and track NCDOT efforts that may affect micromobility.
- Disseminate micromobility lessons learned and ensure knowledge is shared among micromobility partners.
- Communicate grant opportunities and regulatory changes to communities on a regular and timely basis.

C. How can NCDOT support planning for the integration of micromobility into transportation networks?

When planned for correctly, micromobility can be seamlessly integrated into the transportation network. Micromobility has the potential to support a reduction in single-occupancy vehicle trips by direct replacement of short trips or encouraging the use of public transport by enhancing connectivity and convenience.

Micromobility services complement public transportation by offering first/last mile connectivity for transit users. Services such as e-scooters and bikeshare programs offer transit users ways to get to and from public transportation nodes. Micromobility can also enhance the user experience of public transportation by offering more choice and control over their journeys.

Micromobility services provide alternative modes of travel for short distances, especially in urban areas. Micromobility also provides options for leisure trips and tourism in addition to essential travel needs. Micromobility options may also be used in areas/regions predominantly served by short trips such as educational institutions, corporate campuses, tourist areas, and military bases.

Challenges

- Introduction and speed of adoption of micromobility services have been disruptive to existing transportation networks.
- Existing micromobility services may have been introduced without network planning.
- Access to transportation network data may be limited, or data may not be consistently available for all modes.
- Additional data is needed for micromobility service planning such as multimodal patterns, vehicle traffic, door-to-door transit routes, logistics insights, and demand rankings.

Opportunities

- Service and site suitability for micromobility may be determined by looking at floating car data, systemic trips, and Origin-Destination (O-D) data for hotspots in a city.
- Micromobility offers great potential for mobility-dependent populations to bridge first/last mile connections to transit services.
- The availability of user-generated data offers opportunities for micromobility planning, with future opportunities to integrate additional multimodal data.
- Municipalities can support network planning by requiring vendors to follow ordinances, operate with permits, follow safety regulations, and regulating pricing and use zones.

Effective Practices

- **Study short-distance trips** – A study of a city in southern Italian found that 22.2 percent of the car trips examined were round trips that were less than 5 km (3.1 miles) and under 20 minutes, making them suitable for micromobility.
- **Track multimodal trip planning** – The Minnesota Department of Transportation (MnDOT) is building a Federal Transit Administration Accelerating Innovative Mobility (AIM) grant-funded multi-modal planning application that will be able to track how people are planning and booking trips for different types of mobility, providing vital information for network planning.

- **Initiate pilot programs** – Raleigh, North Carolina implemented a pilot program that allowed for dockless scooters to operate in city right-of-way under an encroachment agreement while a RFP procurement process was undertaken to select the most advantageous e-scooter vendor(s) to operate for an extended period of time. This practice allowed time for effective planning.
- **Track micromobility usage to inform planning** – Charlotte, North Carolina implemented a dynamic pricing model for e-scooter vendors. Vendors pay based on which zone of the city the e-scooters were placed rather than a flat parking fee to encourage placement of the e-scooters in areas like transit stops where the next user may be a transit rider looking to pick-up an e-scooter to finish their trip. Charlotte tracks e-scooter usage and parking, informing the placement of scooter corrals for parking.

NCDOT ROLE

- Integration of micromobility considerations into statewide transportation planning.

IMD ROLE

- Provide technical assistance for communities planning a micromobility system.
- Provide access to data necessary to support and inform integration of micromobility into transportation network planning efforts.
- Pilot projects in communities planning a micromobility system.
- Coordinate with NCDOT Transportation Mobility and Safety Division to improve collection and comparison of micromobility usage and crash data.

Resources

- Developing Micromobility in Urban Areas: Network Planning Criteria for e-Scooters and Electric Micromobility Devices

D. How can NCDOT support the development of local micromobility ordinances?

Local ordinances may apply to micromobility users, service providers, or those who collect, manage, and share data. The concept of micromobility is constantly evolving as it is in its nascent stages of being recognized and made mainstream. With gaps in state legislation around micromobility, local ordinances allow for timely adoption of micromobility services in a jurisdiction before they may be formalized through statewide regulations.

Challenges

- Existing laws at times may not address the changing needs for the smooth functioning of a micromobility system and may require a new ordinance/legislation.
- Micromobility regulations among neighboring jurisdictions may differ.

Opportunities

- Promote the adoption of micromobility services by allowing for bike-and-ride facilities that make multimodal trips more seamless.
- Encourage early formation of good practices related to safety and device usage among micromobility users, such as education of users on safe riding and parking practices.

Effective Practices

- **Ensure safety of micromobility users and pedestrians** – Requiring e-scooters to be locked to bike racks ensures more parking compliance than sidewalk decals and in-app reminders.
- **Encourage adoption of micromobility services** – Limiting the number of park-and-ride facilities and increasing the number of bike-and-ride stations encourages transit users to use micromobility options to reach stations while being cost-effective and environmentally friendly (Oeschger et al., 2020).
- **Ensure uniformity in regulation through ordinances** – Regulations related to the usage of micromobility services and devices across neighboring jurisdictions can be harmonized to ensure users do not inadvertently break laws.
- **Enable early adoption by simplifying micromobility device classifications through ordinances** – In order to regulate micromobility devices, low-speed electric scooters and e-bikes can be considered bicycles and higher speed micromobility devices can be considered mopeds. All throttle-assist micromobility devices can be regulated and ensure that riders adhere to lower speeds (Corporate Partnership Board, 2020).
- **Encourage local regulation/ordinances** – MnDOT's preferred approach is to let local regulations take precedence over the state's, except in cases such as safety and security, with definitions of micromobility devices still being clarified at the state level.

NCDOT ROLES

- Ensure compliance with state laws and regulations.

IMD ROLES

- Assist in adopting uniform regulations across jurisdictions in a timely manner through ordinances.
- Provide guidelines on collection, management, and sharing of user and service data.

Resources

- National Association of City Transportation Officials (NACTO) Guidelines for Regulating Shared Micromobility
- NACTO Review of Cycling Laws

E. How can NCDOT facilitate safer micromobility?

In 2019, there were 18 documented e-scooter fatalities and two bikeshare fatalities in the U.S. (NACTO, 2019). Safety in micromobility is a topic that is still being fully understood, as it requires consistent, reliable data over time to identify trends and inform emerging safety issues. E-scooters and other emerging micromobility devices are less studied than bicycles.

Challenges

- Micromobility crash data reporting is inconsistent for micromobility across the state.
- Confusion and controversy over where micromobility devices can be ridden (sidewalk, roadway, etc.).
- E-scooters and dockless bicycles parked inappropriately on the sidewalk can cause safety issues for those with a mobility or vision impairment.
- Women feel less safe on e-scooters compared to men (Herbert, 2023).
- Non-white, particularly Black, communities are concerned over racial profiling and harassment while using micromobility (Dill et al., 2022).
- Crash data shows that the majority of micromobility crashes are a single device/vehicle crashes. Roadway surfaces and features, as well as inexperience on the rider's part, are major factors in these crashes.

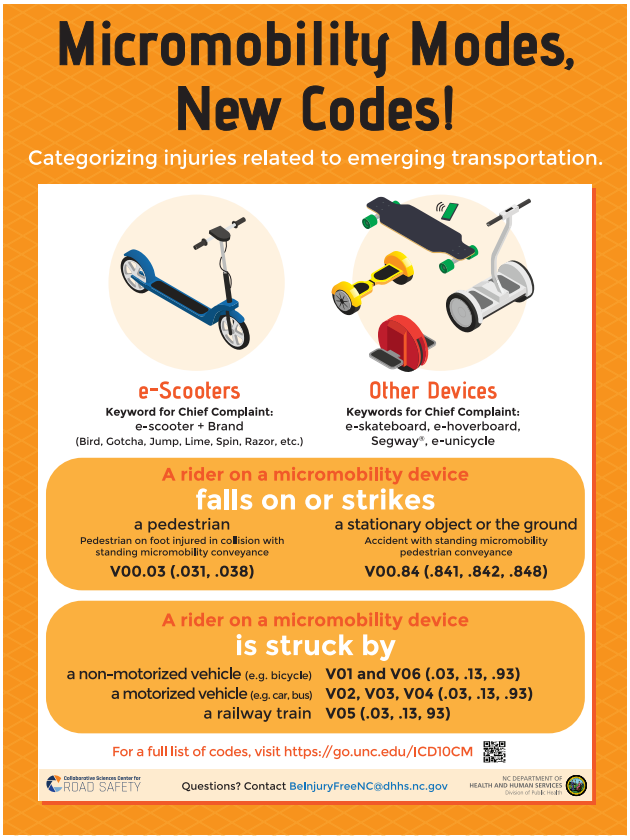
Opportunities

- Create policy to standardize crash data reports and train law enforcement in reporting.
- Boost funding and policies to encourage implementation of a robust network of interconnected multimodal facilities. In the meantime, educate on micromobility policies to users, drivers, and pedestrians.
- Form micromobility parking policies that provide clear, designated places to park and enforce these requirements.
- Engage with historically underserved communities to determine how to best implement micromobility in their communities.
- Provide designated, well-maintained areas for users to ride. Encourage users to take a "test run" of micromobility devices in an off-road, safe place and enforce speed limits on devices.

Effective Practices

- **Use technological solutions, particularly geofencing to regulate micromobility safety** – Geofencing creates a virtual geographic boundary that enables software to trigger an action (typically stopping) in the micromobility device. This is commonly used to control where micromobility devices can be operated and at what speed, both of which are crucial to safety (NASEM, 2022b).
- **Promote training and education for micromobility riders** – A study conducted by the Austin, Texas Public Health Department, with support from the Centers for Disease Control and Prevention (CDC), found that of a group of over 100 people with e-scooter crash-related injuries, 45 percent of the crashes involved head injuries, with 15 percent suffering traumatic brain injuries. Less than one percent of the riders were wearing a helmet. The study also found that 90 percent of injured e-scooter riders in Austin had ridden an e-scooter less than 10 times (Austin Public Health, 2019).
- **Allocate protected space for micromobility riding and parking to keep pedestrians safe** – Based on research from 12 large cities and 13 years of crash and street design data, cities with an abundance of protected bicycle facilities saw fatal crash rates decline by 44 percent and injury rates decline by 50 percent compared to cities with an average amount of protected bicycle facilities (Marshall & Ferenchak, 2019).

- **Support better collection of safety data by police officers and hospitals** – Police officers in Charlotte, North Carolina have received training on how to document the role of e-scooters in crash reports to help track micromobility crashes compared to other modes. Additionally, the North Carolina Department of Health and Human Services (DHHS) designed a poster for display in clinical and administrative settings where micromobility-related injuries are triaged, described, and coded.



Source: https://www.roadsafety.unc.edu/wp-content/uploads/2020/09/MicromobilityCoding_Poster_v2_FINAL.pdf

NCDOT ROLES

- Coordinate with NCDOT Transportation Mobility and Safety Division on crash data report standardization, track statewide micromobility data trends, and assist with safety decision-making.
- Coordinate with the North Carolina Governor's Highway Safety Program (GHSP) to support awareness and behavioral change campaigns targeted to communities with micromobility systems and to reduce impaired and reckless driving.

IMD ROLES

- Publicize safety data through visually engaging or interactive formats, such as spatially through the NCDOT GO! NC portal. This provides publicly accessible insights to local communities interested in deploying micromobility along particular corridors or within relevant street networks.
- Include micromobility into the NCDOT Complete Streets Policy and Implementation Guide so that design standards and project recommendations take micromobility into account.
- Coordinate with North Carolina communities on design standards that support adequate space for micromobility riders.
- Coordinate with other state or university researchers to disseminate locations and trends of micromobility related injuries with local planning partners.

Resources

- Understanding and Tackling Micromobility: Transportation's New Disruptor
- Safe Micromobility. International Transport Forum Corporate Partnership Board
- E-Scooter Safety: Issues and Solutions

F. How can NCDOT facilitate data collection and sharing?

Data collection and sharing varies widely across vendors and their public or institutional partners, making it a challenge for some municipalities and the research community to fully evaluate some micromobility programs (T4A, 2022a). Micromobility data sharing is important for municipalities to effectively integrate micromobility into their transportation network, create supportive policies, evaluate safety, and collaborate with state agencies and other municipalities. Micromobility data sharing is also crucial to MaaS which increasingly relies on cross-platform technology protocols which could ultimately provide seamless service across a variety of mobility enabled applications. Best practices include adopting clear data sharing agreements, data use standards, publishing clear policies, practicing data minimization, limiting data access, using third party data aggregators, and deleting raw data as soon as possible (Ride Report, 2020).

The primary two standardized systems for data sharing are General Bikeshare Feed Specification (GBFS) and Mobility Data Specification (MDS) (Li & Wang, 2022).

- GBFS is open source and provides information on a system at a current point in time, not vehicle-level information, such as traveler information or records of trips taken. GBFS is intended for public use and provides municipalities with a standardized way to understand, analyze, and compare data from micromobility service providers. GBFS defines a common format to share the real-time status of a shared mobility system.
- MDS is detailed, vehicle-level data. This data is considered non-public and intended for regulatory use only, allowing municipalities to have more control over monitoring and regulation of device operations within the public right-of-way (Ride Report, 2020). MDS allows cities to make decisions about safety, pricing, equity, and infrastructure improvements. If vendors collect and provide data in a standard format, stakeholders across all levels and sectors can more easily analyze and interpret results (Li & Wang, 2022).

Under the new federal Bipartisan Infrastructure Law, crash data must differentiate between e-scooters and bicycles, which will improve industry understanding of safety (Destinie, 2022). However, most police-reported crash data currently require involvement of a motor vehicle and property damage, so police-reported crashes fail to capture most e-scooter injuries—most of which involve falling from the e-scooter or colliding with a person or object other than a motor vehicle (NASEM, 2022b). Crash reporting involving micromobility devices could follow a universal model to ensure data collected is reliable and accurate, including training police officers and hospital staff to use consistent standards for micromobility crash reporting (Fischer, 2020).

Data privacy is another key aspect of micromobility data. Micromobility service providers and data aggregators could have protocols for collection, protection, and sharing of information, including user data (MITRE, 2022). It can also be considered that, apart from local, state, and federal laws, additional laws, such as guidelines for Personally Identifiable Information (PII) like the California Consumer Privacy Act, may have to be followed for data management (NACTO & International Municipal Lawyers Association, 2019).

Challenges

- Providing access to data on how people move on micromobility while ensuring individual privacy.
- Evolving data standards linked to industry trends and technology driven by private goals/objectives are not conducive for analysis.
- Data security breaches compromise private financial information and impact user confidence in pay-as-you-go mobility.

Opportunities

- Opportunity to utilize micromobility data to understand and implement plans and policies that support positive outcomes for mobility, health, equity, and more.
- Opportunity to partner with private vendors and communities to set up protocols and procedures for data sharing that benefit all parties.
- Opportunity to identify safety protocols and response plans to resolve breaches as part of vendor and community contracts.

Effective Practices

- **Create consistent data collection and management standards for micromobility** – Develop consistent micromobility data standards across business units and leverage data collection opportunities at different stages of planning and project development.
- **Ensure data policies and practices are routinely updated** – Refresh guidance and training of documented policies to keep current with security risks and response measures.
- **Require shared micromobility vendors release an open, public GBFS feed** – As of 2019, 56 percent of cities in North America required shared micromobility operators to release an open, public GBFS feed (NABSA, 2021).
- **Explore arrangements which require micromobility service providers to share their trip level data with third parties for security audits and improved planning analysis for communities.**

NCDOT ROLE

- Ensure compliance with state laws and regulations regarding data access and availability.
- Coordinate review of data agreements with the North Carolina Department of Justice specifically to ensure compliance consistency where appropriate.

IMD ROLE

- Assist municipalities with understanding federal and state privacy laws that affect micromobility data collection and storage.
- Assist municipalities by reviewing data agreements with micromobility vendors to ensure in what format data will be made available. If appropriate, IMD could provide a micromobility data agreement template to interested public agencies statewide.

Resources

- What is the Mobility Data Specification and What Do Micromobility Operators Need to Know About It?
- Managing Mobility Data
- Data Good Practices for Municipalities
- Shared Micromobility Playbook: Data

G. What's next for micromobility?

While micromobility as a mode of transportation evolves over time, the sector is encountering new challenges which will require innovation and collaboration to develop solutions to address them. Some of the emerging and future considerations are listed below.

- **Integration with MaaS:** Deep integration of micromobility services into a community's transit system will enable more usage by locals and visitors, either as subscription or ad-hoc business models. Users will have access to various transportation options, including micromobility, through a single app, making it easier to plan and pay for their journeys.
- **Equity and Accessibility:** Ensuring equitable access includes addressing issues such as affordability, accessibility for people with disabilities, and availability of micromobility options in underserved communities. Partnerships between public and private entities along with innovative pricing models will be crucial. Discounts for specific user groups and uniform ticketing systems will help promote equity and user-friendliness (Oeschger et al., 2020).
- **Regulatory Frameworks:** Many cities are not yet equipped to handle the growing number of micromobility users, leading to conflicts between modes of transportation and safety hazards. Lack of regulations may lead to confusion. Local agencies should draw from existing regulatory frameworks to develop and promulgate rules which oversee e-scooters, dockless shared bicycles, and other diverse, emerging micromobility devices (Oeschger et al., 2020).
- **Unit Caps:** Unit or fleet caps are an emerging method used by local authorities to regulate and control micromobility services in the street network. Implementation of caps allows users to become accustomed to and adapt to the presence of devices in targeted locations and helps control poor parking behavior and public space disorder. However fewer vehicles can lead to decreased service causing some private mobility providers to avoid cities with caps due to financially unsustainable operating costs. More research is required to understand how communities can use caps to balance service and safety without sacrificing free market opportunities for vendors. (Gauquelin, 2020).
- **Data Security:** In order to address data security and privacy issues arising out of app-based micromobility services, measures can be implemented to ensure the security of micromobility devices before rental to prevent breach of data. Such measures may include installation of sensors to determine if a vehicle has been tampered with or the adoption of anti-spoofing and anti-jamming solutions (Marques & Coelho, 2022).
- **Safety:** Crash data regarding micromobility devices is scarce and makes it difficult to make extensive crash characterizations. In a 2018 study undertaken in Indianapolis, there were 92 injuries reported by e-scooter users in a span of 61 days (Marques & Coelho, 2022). The safety of pedestrians must also be considered while planning for micromobility services in a municipality.

Recommendations

IMD has the opportunity to take actions and develop strategies to provide specific micromobility program support. Recommended actions include:

A **Program Integration**
Work to integrate micromobility into NCDOT policies and initiatives, ongoing state-led stakeholder coordination, and feasibility analyses.

- **A1** ***NCDOT policies and initiatives***
- **A2** ***Stakeholder coordination***
- **A3** ***Feasibility analysis***

B **Education**
Provide educational resources about micromobility issues.

C **Emerging Practice Areas**
Develop research and guidance to address key practice areas and topics as early as possible.

- **C1** ***Increasing equity***
- **C2** ***Micromobility as an element of Mobility-as-a-Service (MaaS)***
- **C3** ***Micromobility in tourist communities***

D **Pilot Projects**
Develop pilot programs and support pilot projects.

A. How can NCDOT integrate micromobility into ongoing efforts?

Micromobility will be most effective if it is fully integrated into the statewide multimodal transportation system. Key areas for integration include:

A1

NCDOT policies and initiatives – NCDOT can start with an understanding of how micromobility supports existing statewide efforts to inform the future incorporation of micromobility as new initiatives are developed.

A2

Stakeholder coordination – NCDOT can build on its existing stakeholder relationships to raise awareness of micromobility considerations and ensure they are incorporated into transportation planning, programs, and projects as appropriate.

A3

Feasibility analysis – NCDOT can provide guidance and support for developing micromobility feasibility analyses.

A1. How can micromobility be integrated into key NCDOT policies and initiatives?

Multimodal planning and policies can incorporate micromobility as a specific mode choice in the future. Because it is a relatively new mode, not all existing multimodal planning incorporates micromobility. However, micromobility already supports key NCDOT initiatives, including:

- **Complete Streets Policy** – Directs the department to consider and incorporate several modes of transportation when building new projects or making improvements to existing infrastructure.
- **NC MOVES 2050 Plan** – Supports multimodal transportation that promotes safe and inclusive transportation, as well as North Carolina's economy and quality of life.
- **NC Clean Transportation Plan** – Defines strategies and recommendations to advance the state's clean transportation transition.

Challenges

- Micromobility may not be fully integrated in current multimodal planning efforts.

Opportunities

- Consider micromobility as a mode choice for future planning and policy efforts.
- Develop specific strategies related to micromobility.
- Identify where micromobility supports or aligns with existing strategic efforts.

Effective Practices

- **Align micromobility initiatives with policy goals and strategies for existing programs** – A review of key NCDOT initiatives revealed how micromobility can support many of the department's adopted policy goals and plan strategies, as shown in Table 5. These plans and policies are intended to be considered in tandem with each other as well as other state and NCDOT policies, plans, and initiatives. IMD can most effectively support micromobility by aligning goals with these existing efforts.

Table 5: Existing NCDOT Strategies and Policy Goals Related to Micromobility

Strategy or Policy Goal	How Micromobility Can Support?
NCDOT Complete Streets Policy	
Provide an efficient multi-modal transportation network making it easier for people to get where they need to go and diversify the transportation options	Micromobilty accommodation and access should be considered in the design of transit-intensive infrastructure decisions and facility recommendations under the Complete Streets policy. Greater opportunity for micromobility inclusion in the early stages of planning can foster more efficient, accessible, and multimodal transportation mobility in corridors and networks. Electric-assisted micromobility devices operating in such robust corridors and networks offer a competitive travel time advantage compared to walking, biking, and in some cases automobiles depending on local travel conditions and network connectivity.
Promote sustainable communities	Environmental impacts of micromobility vary based on the device and calculation of greenhouse gas reduction. Human-powered devices have the least impact and produce no tailpipe emissions. Electric-powered devices also produce no tailpipe emissions but contribute to emissions via the power plant supporting the electric grid. Longer term impacts such as disposal of tires and electronic components in landfills are emerging considerations which will require further research. Currently infrastructure networks for micromobility require a smaller footprint compared to rail or automobile networks thereby reducing potential negative impacts to historic and natural resources. Overall, micromobility trips reduce carbon footprint significantly compared to automobile trips.
Enhanced connectivity	Micromobility can be more integrated within NCDOT planning and design processes through the review of greater inclusion and recognition of micromobility service within roadway designs and local street networks. This review can be informed by emerging national practice and research to facilitate integration that benefits NCDOT goals and community context.
NC MOVES 2050 Plan	
Improve quality of life and multimodal access to regional jobs and services	Micromobility can provide access to transportation for disadvantaged households, increase access to transit, and help facilitate higher density land use patterns. These benefits can improve quality of life for all community members, not just those using micromobility, while increasing overall access to jobs and services.
Connect communities to statewide opportunities	IMD has already taken the initial steps to lay the groundwork for connecting communities to opportunities by gathering interest, needs, and lessons learned through the survey conducted as a part of this report. Collaboration between communities, vendors, policy makers, and others leads to the most beneficial micromobility outcomes.
Enable smart and innovative statewide technology solutions	Micromobility in its current state is a very new mode of transportation, representing a great opportunity for innovation. Micromobility devices in docked and dockless systems are almost universally accessed via a smartphone app, and vendors are able to collect detailed data on rides.
Promote more multimodal safety and behavioral-based programs, policies, and tools	Promotion of multimodal safety and behavioral-based programs, policies, and tools can include consideration of micromobility. These efforts can help address unsafe behaviors by users, one of the biggest challenges associated with micromobility.

Strategy or Policy Goal	How Micromobility Can Support?
NC Clean Transportation Plan	
Align statewide policy through an interagency task force	Effective implementation of micromobility requires coordination between a variety of stakeholders with diverse backgrounds and expertise. IMD can support this goal and micromobility by participating in the interagency task force and aligning micromobility goals with the efforts of other agencies and departments.
Increase equitable outcomes in transportation planning projects	Thoughtfully planned and deployed micromobility has the potential to increase equity by providing a low-cost mode of transportation which can benefit transit-dependent and zero-car households. Micromobility best supports equity when combined with demographic analysis to ensure Black, Indigenous, and people of color (BIPOC) populations have access to devices and stations, as well as rebate programs, free or reduced rides for low-income riders and job seekers, and additional payment options. Accessible devices such as sit-down scooters can provide a transportation option for persons with disabilities or older populations with some mobility challenges.
Ensure access and affordability to clean transportation	Human and electric powered micromobility devices are the cleanest form of transportation other than walking. By promoting micromobility, especially in tandem with initiatives that support equity, access to affordable and clean transportation is increased.
Maximize existing funding and evaluate and apply for new funding to support clean transportation outcomes	Many communities interested in micromobility reported in the survey conducted as a part of this report that finding and securing funding was a key challenge. IMD can provide research and technical assistance to these communities to leverage existing funding sources and apply for new grants and programs that support micromobility, and in doing so, support clean transportation outcomes.
Expand transportation demand management strategies	Transportation demand management refers to a broad set of programs and strategies that seek to reduce automobile vehicle miles traveled (VMT). Micromobility trips can replace automobile trips and complement transit trips, thereby decreasing automobile VMT.
Establish a coordinated clean transportation communication strategy	This recommendation aims to support a coordinated communication strategy for NCDOT to advance clean transportation. IMD can support this effort while promoting other micromobility goals such as providing clearer definitions for micromobility devices and regulations, creating consistent data collection and management standards, and promoting micromobility awareness and education.

NCDOT ROLE

- Establish internal and external partnerships to support integration of micromobility into plans and department initiatives.

IMD ROLE

- Provide resources to help communities identify technical support, funding, and other assistance available to implement NCDOT plans and policies.

A2. How can NCDOT lead the integration of micromobility in coordination with external stakeholders?

In addition to coordination that directly supports planning and implementation for micromobility systems in specific communities, NCDOT can lead statewide efforts to fully integrate micromobility into the statewide transportation network in coordination with external stakeholders. As micromobility systems mature, implementation support may evolve into a statewide micromobility program.

Challenges

- Ad hoc implementation of micromobility systems by individual communities may lead to inconsistency or system gaps.
- Knowledge about micromobility system planning and implemenation varies among communities.

Opportunities

- Develop programmatic approaches for integrating micromobility into statewide transportation planning.
- Establish opportunities for information exchange.

Effective Practices

- **Create opportunities for information exchange** – Consider hosting forums, conferences, or establishing newsletters to keep communities informed of new developments and initiatives related to micromobility.
- **Establish programs to address statewide micromobility needs** – When micromobility is more fully integrated into statewide planning, consider developing programs to support statewide priorities, such as targeted grant programs or consolidated delivery models to reduce administrative burden for small communities implementing micromobility systems.

- **Develop statewide program efforts to support micromobility coordination** – The Statewide Transit Visioning Workshops previously conducted by IMD for small systems are an example of a similar program effort.
- **Cultivate collaborative, action-oriented projects with diverse stakeholders** – Raleigh, North Carolina worked with other municipalities and micromobility vendors to build a research portfolio for their micromobility program. IMD can emulate this process when assisting other communities.

NCDOT ROLE

- Establish statewide priorities around micromobility and develop programs to address them.

IMD ROLE

- Convene communities and micromobility practitioners.
- Disseminate micromobility information and facilitate knowledge exchange.

A3. How can NCDOT provide guidance and support for micromobility feasibility analyses?

Before implementing a micromobility program, many municipalities conduct a feasibility analysis to inform decision-making about micromobility in a community. A feasibility analysis may determine what form of micromobility service best fits local context, needs, and scale of use. Feasibility analyses may be a standalone effort or part of a larger transportation study, and often inform recommendations on system size, docked versus dockless systems, and whether to expand existing systems or to bring in new vendors, if applicable (Foursquare ITP, 2021).

Challenges

- A standard approach to micromobility feasibility analysis has not yet been established.

Opportunities

- Case studies and peer examples are available for review.

Effective Practices

- **Engage community leaders and citizen advisory groups early in the process to understand public perceptions of micromobility** – Use community input to define, clarify, and communicate challenges and opportunities that support the implementation of a successful micromobility program.
- **Feasibility analyses could have one or more of the following components:**
  - **Demand or market analysis** can include factors that are considered to make micromobility programs successful, such as population, employment, age, infrastructure, density, transit availability, and tourist destinations (C/CAG, 2022 & Sheng, 2020). A heat map of popular routes and destinations is an effective way to visualize this demand and identify where micromobility programs have the highest potential utilization and success.
  - **Barrier analysis** is a geographic-based component which shows areas where a micromobility program may not be successful. Such barriers can include level of traffic stress, clusters of auto-focused businesses, rail lines, highways, and grades greater than 10 percent.
  - **Program opportunity and resource analysis** considers factors such as management capability, vendor availability, and funding capacity (C/CAG, 2022).
  - **Equity analysis** may consider income, race/ethnicity, and crash history in the context of community infrastructure and available vehicles (C/CAG, 2022 & Sheng, 2020).

NCDOT ROLE

- Provide resources to help communities identify technical support, funding, and other assistance available to conduct micromobility feasibility analyses.

IMD ROLE

- Create a feasibility study template for municipalities who want to evaluate and incorporate micromobility
- Serve as a technical resource to municipalities to provide feedback on micromobility demand, market assessments, or program management feasibility.
- Offer technical assistance to municipalities exploring vendor-based feasibility assessments and projected micromobility benefits of program implementation.

B. What educational resources can NCDOT provide to support micromobility?

Since micromobility services are relatively new, communities and transportation partners may need educational resources to support introducing micromobility and integrating it into the transportation network. NCDOT may provide resources such as:

- Identification of funding opportunities, like those listed in Table 4: Micromobility Federal Funding Opportunities
- Direct support for grant applications and administration
- Educational and awareness campaign materials and similar resources for dissemination
- Reviews of local policies related to micromobility
- Training on planning for and adoption of micromobility

Challenges

- Due to micromobility being relatively new, communities may lack the knowledge to effectively plan for and implement micromobility services.
- Communities and potential users may not be familiar with the benefits of micromobility or its role in transportation.

Opportunities

- Resources can be developed to educate communities on the benefits of micromobility, planning and policy considerations, infrastructure needs, and methods for effective implementation.
- Awareness, education, and outreach campaigns can support a broader understanding of micromobility.

Effective Practices

- **Promote micromobility awareness and education** – Facilitate an annual "Micromobility Awareness Week" or similar events to educate public and private stakeholders about NCDOT's role and responsibility related to micromobility and to promote IMD's technical resources and guidance. Incorporate findings from national and state research within promotional opportunities including sharing emerging industry trends and changes in micromobility implementation. Seek opportunities to recruit national subject matter experts to present at North Carolina transportation conferences to reach a wider audience of stakeholders.
- **Provide training to help smooth adoption** – Provide training for the usage of the micromobility devices including riding, parking, and docking in order to address concerns such as poor riding skills and lack of experience (Oeschger et al., 2020).
- **Require service providers to have statutory and on-demand instruction** – Technical assistance must be available to the users of such micromobility devices either through in-app customer service or at locations where the micromobility devices may be rented at parking areas or docking stations.

Effective Practices (continued)

- **Enable increased adoption of micromobility** – Educational campaigns may be undertaken to raise awareness on the environmental benefits of adopting micromobility services and to promote modal shifts from private motorized vehicles. Handouts, fact sheets, and ad campaigns may be used to share this knowledge with the public (Oeschger et al., 2020).

NCDOT ROLE

- Provide funding to develop education and training programs for adoption of micromobility.

IMD ROLE

- Develop/continue to develop training and educational materials for micromobility.

Resources

- City of Durham Frequently Asked Questions on E-Scooters and E-Bikes

C. What emerging practice areas could NCDOT prioritize?

Micromobility is relatively new, but some key topics have already been identified that could be addressed strategically. NCDOT could develop strategies to support the following practice areas:

C1

Increasing equity – Micromobility has great potential as an equitable mode of transportation, but current users are not particularly diverse, creating opportunities to increase equity.

C2

Micromobility as an element of MaaS – MaaS is another emerging transportation service. Micromobility has the opportunity to be integrated in the early stages of MaaS development.

C3

Micromobility in tourist communities – Communities with high levels of tourism face unique transportation challenges and micromobility can play a role in addressing these unique needs.

C1. What strategies could improve equity of micromobility?

Although national trends continue to show most micromobility users are disproportionately white, male, and young with higher income levels, micromobility has the potential to increase equity by providing increased transportation options and access for low-income individuals, minorities, and persons with disabilities (Aman et. al, 2021 Dill & McNeil 2020; Washburn, 2020). In order to achieve equity goals, thoughtful and intentional strategies are needed.

IMD can directly implement strategies to increase equity in micromobility, such as through demographic analysis and research efforts. IMD can also encourage communities, vendors, and other stakeholders to employ other strategies. For example, when aiding communities as they negotiate with micromobility vendors, IMD can recommend that vendors agree to practices such as free and reduced fares for low-income individuals or incentivizing vehicle deployment in equity zones.

Challenges

- Micromobility devices left on sidewalks present a barrier to those with a mobility or vision impairment.
- Micromobility users are disproportionately white, male, young, and higher income.
- Stations and devices tend to be located in white and high-income areas, while transit dependent, low-income, and minority communities may have little to no access to stations and micromobility devices.
- Payment for micromobility rentals typically requires a smartphone and a credit card, so unbanked users may be excluded from using the service.
- Compared to equity issues on race/ethnicity, age, income, and physical ability, research on gender equity and micromobility is fairly limited.

Opportunities

- Continued innovation and advancement in accessible micromobility device designs for persons with disabilities.
- Incentives and other strategies can be used to make micromobilty devices more accessible to low-income individuals, such as offering free or reduced fares for those who qualify.
- Programs and policies exist that can increase micromobility device deployment in low-income and minority communities.
- Ticketing kiosks can be used to allow cash payment for micromobility services.
- Support further research that identifies key issues around gender equity and informs micromobility program strategies.

Effective Practices

- **Demographic and geospatial analysis** – Demographic information can be obtained from the U.S. Census Bureau to identify neighborhoods where disadvantaged populations are located. Combining demographics with vendor ridership data helps evaluate how equitably devices are being distributed and whether they are servicing transit dependent communities – some municipalities have performed

such analysis to identify "equity zones", and require vendors to deploy a minimum percentage of their fleet in these zones (Johnston et al., 2020). NCDOT is using Environmental Justice (EJ) and Transportation Disadvantaged Index (TDI) tools to identify, understand, and assess the needs of low-income and racial/ethnic minority communities and project impacts on transportation disadvantaged communities. Combining demographic information from these analyses with crash data can point to safety concerns that should be addressed via infrastructure, education, enforcement, or some other intervention.

- **Free or reduced payment for low-income individuals** – Strategies supporting low-income riders have been implemented by municipalities, non-profit organizations, and vendors themselves. After Uber's popular bikeshare system was removed in New Orleans in response to the COVID-19 pandemic, a non-profit was formed to secure funding to continue operating the bikeshare system (Aoun Angueira, 2023). Lime has a service called Lime Able, providing accessible devices, and Spin has rented scooters at half the price to job seekers (Marlen LNU, SkedGo Pty Ltd., 2022). Some municipalities have supported individuals purchasing their own personal micromobility devices. Raleigh, North Carolina is preparing to launch a pilot program to provide e-bike vouchers, with half of the vouchers reserved for people making 80 percent or less of area median income (Patterson, 2023). Denver, Colorado provides a $1,200 rebate for low- to moderate-income residents who purchase their own electric micromobility devices (Brasch, 2022).
- **Alternative payment options** – Most commonly, users of micromobility systems are required to use a smartphone application to access and pay for use of devices. This practice presents a barrier to those who lack a smartphone and/or credit card for payment. Alternative payment options, such as allowing users to access the system via text message or allowing users to purchase rides with cash via a terminal, can overcome this barrier.
- **Accessible vehicle types** – While micromobility is often seen as inaccessible to the older populations and persons with disabilities, it can in fact provide greater access and transportation options to these populations provided their needs are taken into account. Sit-down scooters can accommodate wheelchair users while modified e-bike designs such as recumbent bicycles and tricycles can accommodate other users. In 2022, Helbiz, an e-scooter company, introduced wheelchair attachment and sit-down scooter options in Charlotte, North Carolina (WSCOTV.com News Staff, 2022).

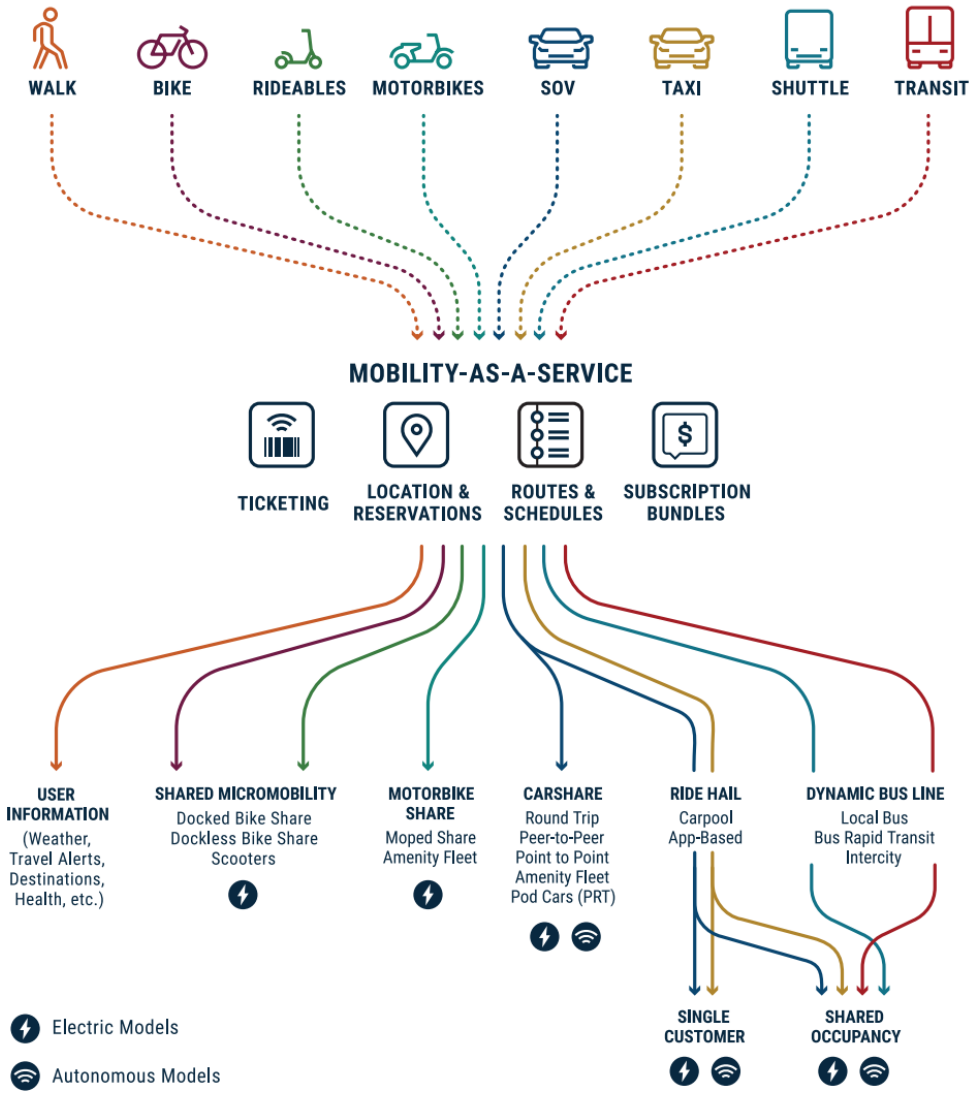
IMD ROLE

- Advance demographic and geospatial research efforts to measure equitable access to micromobility devices.
- Undertake research to examine equity issues around micromobility and gender.
- When providing technical assistance to communities and/or aiding communities as they broker deals with vendors, encourage the vendors to agree to use equitable practices such as free or reduced payment programs and the use of accessible device designs.

C2. How can micromobility be integrated into MaaS platforms?

Integration of micromobility services with a city's existing transit system will enable more usage by locals and visitors. Users can plan, book, and pay for their journeys through a single app with access to various transportation options, including micromobility. Figure 7 illustrates how MaaS integrates multiple travel modes.

Figure 7: The Mobility-as-a-Service Model



Source: Crowther, 2018.

Challenges

- Adoption of MaaS is limited in many population groups, with the age group of 18–34 years old most likely to adopt (Zhang & Kamargianni, 2022).

Opportunities

- An increase in the use of MaaS is predicted due to rising global fuel costs.
- Integration of micromobility services into a community's transit system will enable more usage by locals and visitors.

NCDOT ROLE

- Invest in infrastructure and technology that enable the development and deployment of MaaS solutions.

IMD ROLE

- Create policies that support the integration of DOT terminology and services, such as common standards, data sharing, and payment systems into MaaS.

Resources

- The Role of Micromobility in MaaS
- Drivers and Enablers of Micromobility and MaaS
- Move PGH Mid-Pilot Report

C3. How can micromobility support the needs of tourist communities?

Micromobility can support tourist communities by providing a clean, sustainable transportation option for tourists who might otherwise have to rent an automobile or take a rideshare or taxi. Utilizing micromobility also lowers demands on automobile parking which is often limited in downtowns, small tourist towns, and beachfront communities (Davies, Blazejewski & Sherriff, 2020). In one case study, micromobility tourism platform, GoGiro, partnered with a multinational hotel chain to create successful tourism tours on e-scooters (Hubbard, 2022).

Challenges

- Tourists may lack the knowledge to safely use micromobility services.
- All tourist destinations may not be accessible using micromobility services.
- Separate phone apps and sign-up processes for each service may deter tourists seeking to only use the system for a short period of time.

Opportunities

- Micromobility devices allow tourists to travel more quickly than walking, reaching additional destinations and, thereby, supporting the local economy.
- Micromobility services such as bikeshare and e-scooters are popular ways for tourists to explore a new city as they are faster than walking and allow users more interaction with their local environments than a car trip.

Effective Practices

- **Consider tourist destinations in planning micromobility service areas.**
- **Seek partnerships to support tourism-related micromobility** – Micromobility services have in some cases partnered with hotel chains to create successful micromobility tours. Tourism-oriented businesses, chambers of commerce, and other organizations may offer partnership opportunities.

IMD ROLE

- Promote micromobility in tourist communities (that have the appropriate density and infrastructure) to increase transportation options.

Resources

- The Rise of Micromobility at Tourism Destinations

D. How can NCDOT support pilot projects?

Pilot projects are an effective way for North Carolina communities to test new or expand existing micromobility systems. Thirty-one respondents to the micromobility survey conducted as a part of this report provided their contact information for a follow-up to discuss working with IMD on a micromobility pilot program. Interest ranges from respondents that do not currently have an idea or plan for a pilot project to those that have full pilot projects in mind, as listed in Table 6.

NCDOT occasionally may receive or set aside funding to support micromobility pilot projects. IMD can work with communities on pilot projects as an extension of the technical support it provides for implementing micromobility. The criteria for choosing pilot projects may include local staff support for the pilot project as well as political and public interest in the topic, geographic distribution across the state, and representativeness of locality types (large urban, suburb, small urban, rural, tourist town, beach town, university town, etc.).

Based on survey responses and research, NCDOT may consider supporting a wide range of pilot project types.

Challenges

- Pilot projects may face hurdles in relation to unit caps on micromobility devices, business area restrictions, parking, and fees.

Opportunities

- Pilot projects would benefit the state by expanding innovative micromobility practices that a municipality and IMD can learn from and disseminate findings with other interested municipalities through peer exchanges.
- Based on the responses in the survey, IMD has a variety of localities and institutions interested in partnering for a micromobility pilot project.

Effective Practices

- Implement a new micromobility program.
- Expand micromobility programs in response to changing and diverse needs such as offering retrofits of existing devices or new designed devices which support mobility challenged riders.
- Conduct equity analyses and undertake incentive programs.
- Establish partnerships with employers.
- Encourage integration with local transit.
- Undertake data collection exercises.
- Craft regulations that enable the demarcation of low-speed zones and establishment of parking solutions such as parking zones using geofencing or requiring devices be locked to certain infrastructure.
- Test deployment and/or no deployment zones.
- Explore service area requirements for vendors.

IMD ROLE

- Oversee, deploy, and pilot micromobility projects across diverse urban and rural communities to test equity, sustainability, administrative, safety, and operational concerns.
- Engage a growing community of micromobility users and advocates to promote pilot projects.
- Use stakeholder feedback to refine and strengthen state, local, and public-private coordination protocols, policies, and practices and to launch future pilot projects.
- Host peer exchanges which allow participating communities to learn from each other.

Table 6: Potential Micromobility Pilot Projects

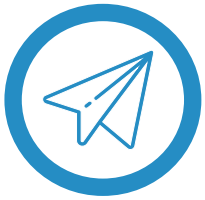
Organization	Context	Type of Program		Mode(s)				Assistance Requested								
		New	Expand Existing	Bikeshare	E-bike	E-scooter	Unknown	Connect Key Destinations	Community Interest	Contracting or Solicitation	Access to Jobs	Transit Connection or First/Last Mile	Infrastructure/ Docking	Data Collection	Program Management	Funding
Wake Technical Community College – Southern Wake Campus	Campus	x		x												
Southwestern RPO – Western Carolina University area	Campus	x			x		x	x								
University of North Carolina at Wilmington	Campus		x		x	x										
Foothills RPO	Rural	x							x							
Kerr Tar RPO	Rural	x							x							
Northwest Piedmont RPO	Rural	x							x							
High County RPO	Rural	x							x							
Mid-East RPO	Rural	x							x							
Peanut Belt RPO	Rural	x							x							
Down East RPO	Tourist	x					x	x								
Town of Mooresville	Suburban	x					x	x			x					
City of Greensboro	Small Urban		x				x			x						
Greensboro Urban Area MPO	Small Urban		x				x				x	x	x			
City of Durham	Large Urban								x					x	x	x

Conclusions

As micromobility systems continue to grow across North Carolina, IMD is well-positioned to provide resources and technical assistance to communities across the state. Additionally, IMD will continue to have strategic opportunities to serve as an internal resource and point of contact to NCDOT divisions to promote data sharing and analysis related to micromobility considerations. The cross section of strategies and considerations outlined in this report are a starting point to understand and clarify IMD and NCDOT roles that support and advance effective and equitable integration of micromobility into local transportation networks. These roles will evolve as micromobility is continuously shaped by social, economic, and environmental considerations and by regulation and emerging technology. The following summarizes IMD and NCDOT roles and actions focused in three key areas – statewide policy, local implementation, and program recommendations. Actions presented here can cut across each area and together encapsulate a path forward for further review and implementation.

Policy

IMD can provide statewide leadership and policy direction in response to proposed state legislation and compliance issues. This can occur through promoting a clear definition of micromobility, an understanding of how micromobility devices are categorized in North Carolina, and supporting broader context and understanding of regulatory and compliance issues at federal, state, and local levels. IMD can promote and establish data standards which facilitate consistent reporting and communication of micromobility use and activity as it relates to NCDOT's role in providing safe, reliable, and well connected travel on state-maintained infrastructure. IMD can promote and monitor compliance to data standards as more guidance is issued and in response to future federal or state requirements which impact compliance. These steps can help IMD promote opportunities to set standards and work proactively with policy makers to address regulatory goals and/or provide more clarity for NCDOT planning partners and stakeholders interested in micromobility services.



Implementation

IMD can coordinate closely with local partners interested in implementing micromobility or expanding current systems to provide specific resources and enable technical assistance that also involves and leverages the expertise of other NCDOT divisions. This joint technical and resource assistance can support, better coordinate, and integrate micromobility in local transportation networks. IMD can help identify funding opportunities through a variety of federal grant programs; establish models with communities to adopt appropriate ordinances for effective and consistent statewide micromobility deployment; and publicize safety information and promote standardization of safety data consistent with NCDOT practices and to comply with local safety ordinances. IMD can facilitate data sharing and governance practices which improve the understanding of data security between communities and vendors and review and/or provide templates for communities interested in data agreements with vendors.

Recommendations

IMD can identify actions and strategies which deepen and extend micromobility program support within NCDOT and to external stakeholders. IMD can take a proactive role to implement these actions to stay current with national practice and local partner needs and leverage expertise that benefits both the department and local communities. IMD can facilitate internal and external partnerships to support micromobility integration within plans and department initiatives, including a review of NCDOT Complete Streets guidance. This internal integration would be consistent with advancing goals outlined in recent statewide plans such as NC Moves 2050 and the NC Clean Transportation Plan. Externally IMD can leverage NCDOT resources to offer feasibility analysis assessments to communities interested in micromobility implementation. IMD can combine these actions with opportunities to serve as a resource clearinghouse to disseminate educational materials, research findings, and training which increases awareness of micromobility adoption. Based on survey findings in this report a variety of North Carolina communities are interested in pilot studies. IMD can build on this interest to partner with local agencies to develop, deploy, and pilot micromobility projects which test equity, sustainability, administrative, safety, and operational concerns across diverse urban and rural communities.

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