U.S. Department of Transportation, Climate Change Center
Climate Strategies that Work

MICROMOBILITY DELIVERIES, MICROHUBS, AND LAST-MILE SOLUTIONS

Micromobility deliveries offer low-carbon, cost-effective last-mile solutions, reducing congestion and enhancing urban livability.

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OVERVIEW

Best Suited for:
Long Term & Short Term
Urban, Suburban, Rural & Tribal

Emissions from the last mile of delivery can account for up to 50% of total delivery carbon emissions and delivery trucks and vans contribute to congestion and safety issues. Micromobility deliveries offer a sustainable solution for the last-mile delivery challenge. They utilize compact vehicles like cargo bikes, drones, and delivery robots to efficiently transport goods over short distances, filling the gap between distribution centers and final destinations. **Micromobility devices can replace or supplement delivery trucks and vans in a range of cases**, from urban cores and downtown areas to rural communities.

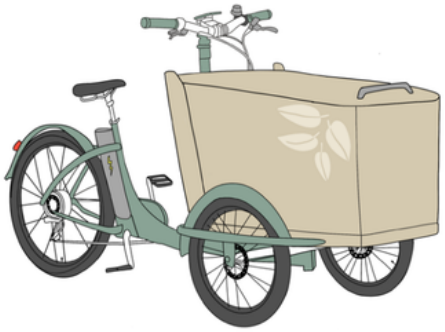
Micromobility deliveries can help to reduce noise and emissions from delivery trucks, mitigate congestion, and free up curb space. They can also expand access to delivery services in rural communities.

Use cases for micromobility deliveries span various sectors, including retail, food delivery, and healthcare. Micromobility deliveries can play a crucial role in urban resiliency planning, offering solutions for emergency response and disaster relief efforts. In light of recent disruptions like the COVID-19 pandemic, micromobility deliveries have demonstrated their resilience by providing essential services such as grocery and medicine delivery, ensuring continuity in supply chains and meeting the needs of vulnerable populations.

Did you know?

Research suggests that roughly 80% of a delivery driver's time is spent parked, with most deliveries completed on foot (Dalla Chiara et al., 2021). Cargo bikes can address this inefficiency by eliminating wasted time searching for parking and streamlining short-distance deliveries.

The effectiveness of micromobility delivery solutions is context-based, influenced by factors such as city density, urban form, existing infrastructure, and the nature of the delivery task. Tailoring micromobility solutions to specific environments and delivery requirements ensures optimal performance and integration within the broader transportation network, ultimately contributing to more sustainable and resilient cities.



Source: University of Washington, Urban Freight Lab

Elements of Micromobility Deliveries and supportive infrastructure may include:

Devices and Vehicles

- **(E-)Bikes and (E-)Cargo Bikes:** These versatile vehicles come in various configurations, offering significant payload capacities.
- **Electrified Dollies and Carts**: These emerging tools support on-foot deliveries, reaching doorsteps, stores, and lockers.

Worker Hubs, Success Story

Through a $1 million federal grant, NYC is transforming existing underutilized infrastructure, like vacant newsstands, to create critical street 'deliveristas hubs' that provide workers with charging stations, shelter, rest areas, and bike repair servicing. Read more, here.

Supporting Infrastructure/Programs

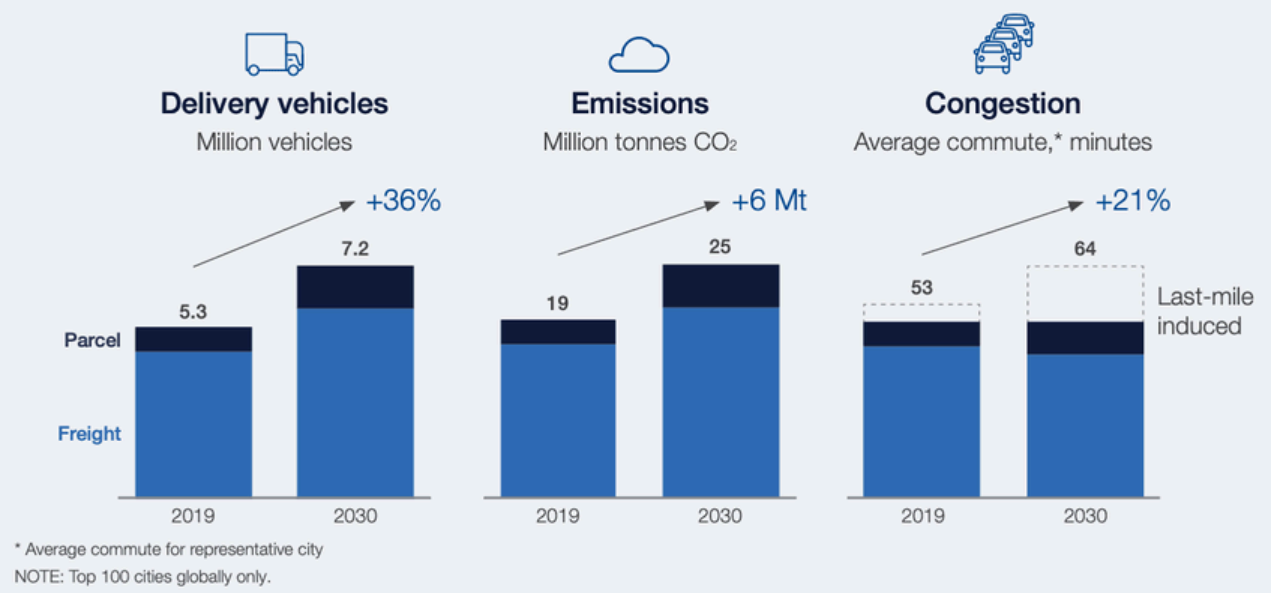
- **Microhubs:** These act as transfer points, facilitating the movement of goods from larger vehicles to smaller ones suitable for micromobility deliveries. They may also offer parcel lockers and serve as a midway point between Urban Consolidation Centers (UCCs) and final pick-up locations.
- **Wide Bike Lanes:** Dedicated lanes create a safe and efficient environment for micromobility deliveries.
- **Curb Management and Dedicated Parking:** Designated areas for loading and unloading optimize delivery workflows.
- **Delivery Lockers:** These lockers provide a secure location for package handoff, addressing the "Final Fifty Feet" challenge by completing the last stage of delivery.
- **Charging Infrastructure:** Convenient charging stations ensure smooth delivery operations for electric micromobility devices.
- **Secure Micromobility Storage**: Secure parking facilities address parking needs and deters theft.
- **Worker Hubs**: Dedicated spaces provide delivery personnel with important amenities, fostering a safer, more efficient work environment.
- **Rider Education:** Investing in workforce education empowers delivery personnel with the knowledge and skills to navigate urban environments safely and efficiently.

GHG REDUCTION POTENTIAL

This section provides an overview of GHG emission reductions associated with the strategy. It highlights key findings and relevant metrics from GHG modeling resources, peer-reviewed studies, and real-world applications.

MICROMOBILITY DELIVERIES IN CONTEXT OF URBAN FREIGHT

Current State of Urban Deliveries: In an "unguided adoption" scenario, where no interventions are made, the number of urban deliveries in the world's top 100 cities is projected to increase by 36% from 2019 to 2030. This surge is expected to result in 6 million tonnes of additional CO_2 (World Economic Forum, 2020).



Cities are facing increases in delivery vehicle activity, emissions, and congestion associated with deliveries. Between 2019 and 2030, the number of delivery vehicles on roads globally is expected to grow by 36% assuming no intervention taken. (Source: World Economic Forum, 2020)

Emissions from Urban Delivery Vehicles: Urban freight plays a significant role in transportation emissions. For instance:

- In Madrid, urban freight accounts to 10% of journeys but accounts for 20% of carbon emissions from transportation sources (Madrid 360, 2021).
- Last-mile delivery is responsible for approximately 30% of CO_2 emissions in the logistics sector (Kardinal, 2024).
- A model from NYU Tandon's C2SMARTER University Transportation Center indicates that residential parcel deliveries in NYC contributed to 0.05% of total daily vehicle-kilometers traveled (VKT), equating to 14.4 metric tons of carbon equivalent emissions per day (Yang et al., 2023).

CARGO BIKES AS A VIABLE SOLUTION

A report published in 2018 by cargo e-bike consulting group Transport for Quality of Life concluded that **10-30% of trips by delivery and service companies might be substitutable by (e-)cargo bikes** (Transport for Quality of Life, Ltd, 2019).

> ***Current Urban Delivery Vehicle Composition:*** *Freight trucks currently make up about two-thirds of urban delivery vehicles, with the remainder consisting of light commercial vehicles and passenger cars (World Economic Forum, 2020).*

The New York City Department of Transportation (NYCDOT) **estimates that two cargo bicycles can replace one delivery truck**, resulting in approximately 14 tons of CO_2 savings annually—equivalent to 30,872 passenger car miles (NYCDOT, 2023).

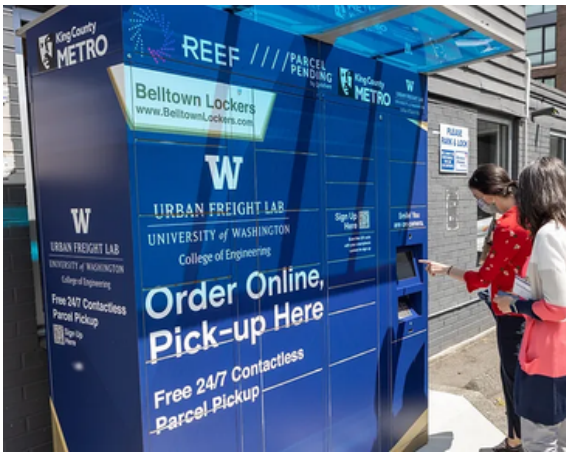
> I*mpact of Cargo Bikes in NYC*: In 2022, NYC cargo bikes completed over 130,000 trips, delivering more than 5 million packages and reducing CO_2 emissions by over 650,000 metric tons (NYCDOT, 2023).

Existing bike lane infrastructure in NYC can support a substitution of 17% of parcel deliveries by cargo bikes, leading to an 11% reduction in vehicle-kilometers traveled (VKT). Additionally, adding 3 km of bike lanes to connect Amazon facilities could increase this substitution benefit from 5% to 30% VKT reduction. A further expansion of 28 km of bike lanes could double the citywide substitution potential to 34%, saving an additional 2.3 metric tons of carbon equivalent per day (Yang et al., 2023).

Transport for London, which manages a metropolis similar in size to NYC, anticipates cargo bikes could replace up to 17% of van kilometers traveled in Central London by 2030 (Transport for London, 2023).

A pilot program in Seattle found that carrier lockers can reduce delivery truck curbside dwell time by as much as 33% and cut delivery times by as much as 78% (Ranjbari et al., 2023).

> The final 50 feet extends beyond the last mile of a trip and is often the most resource-intensive stage of the delivery process. Innovative solutions, such as delivery lockers, are being explored to enhance efficiency.



Source: University of Washington, Urban Freight Lab

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CO-BENEFITS

This section outlines the multiple co-benefits associated with the strategy, including safety benefits, local air quality improvements, and improved accessibility. Each co-benefit presents examples that demonstrate how the strategy enhances regional or community well-being while addressing emissions.

SAFETY

Micromobility deliveries contribute to safer streets by reducing the presence of large delivery vehicles in shared spaces, minimizing the risk of collisions with pedestrians, cyclists, elderly, and other vulnerable road users who are more susceptible to injury in accidents involving larger vehicles (AIANY, 2022).

Delivery vehicles often block lanes of street traffic, contributing to a larger pattern of traffic chaos and creating dangerous conditions for vulnerable road users. Distinct from congestion, traffic chaos refers to traffic patterns that create confusion and force drivers and other road users to make quick decisions (AIANY, 2022).

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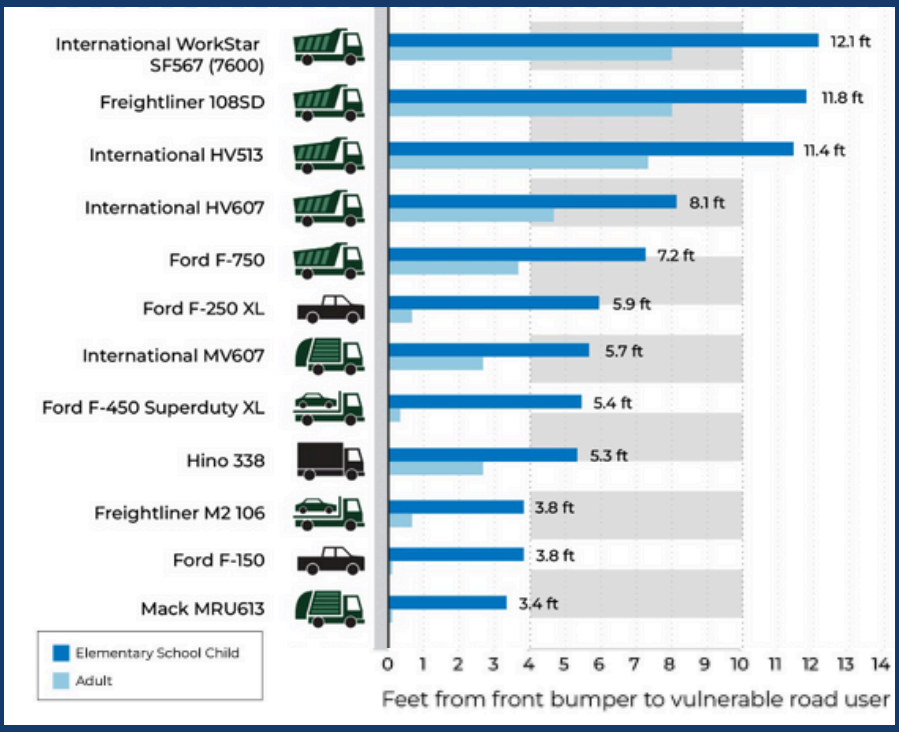
Large vehicles have poor sight lines.

A study by the Boston Blind Zone Safety Initiative details the first distance point at which a vehicle can see an adult and elementary school child in a crosswalk (Brodeur et al. 2023).

Nearest point at which an adult and child are visible to a driver in a standard crosswalk. The number listed in feet corresponds to the distance from the vehicle bumper to a child in the crosswalk. (Source: Brodeur et al. 2023)

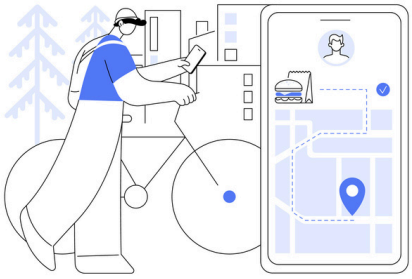


ACCESSIBILITY AND EQUITY

Cargo e-bikes have a significantly lower environmental footprint compared to traditional delivery vehicles. Studies show they generate just 12% of the total *social and environmental cost* of a diesel van and 14% of an electric van (Just Economics, 2022).

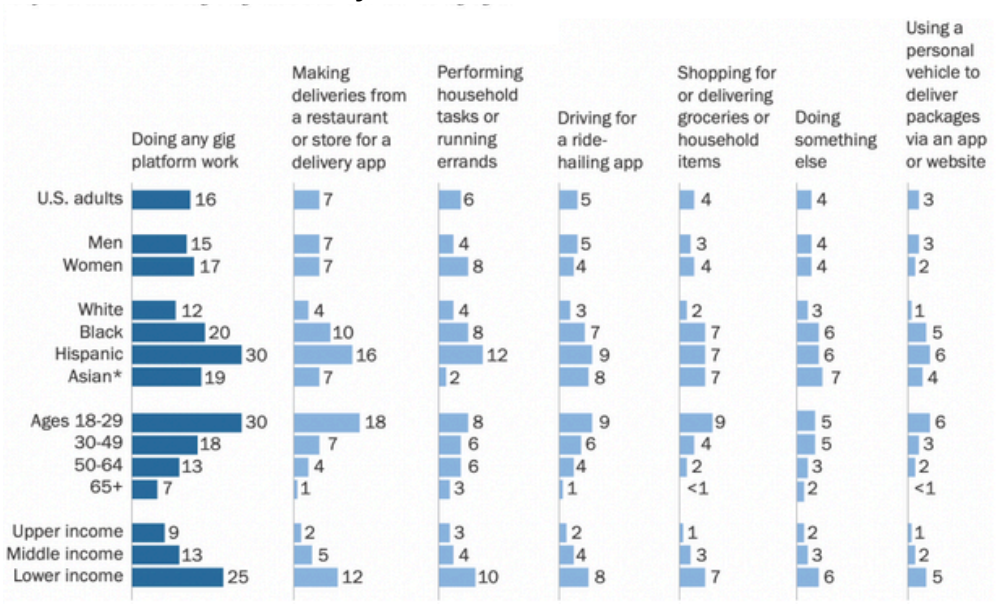
Social and environmental costs are the negative externalities that are not reflected in the prices of goods and services. In the context of delivery, social and environmental costs include things like air pollution, noise pollution, and climate change.

Micromobility's lower barrier to entry, i.e., not requiring a car or commercial driver's license, could create more equitable access to job opportunities. Micromobility deliveries can also offer flexible work schedules that cater to individuals with childcare responsibilities, those seeking part-time work, or students.



A Pew Research Center survey found that 16% of US adults reported earning money through an app-based platform in 2021, the majority of whom were people of color (Anderson et al., 2021).

The increasing number of women in delivery roles (44% in 2021 compared to 36% in 2019 according to Garin et al., 2023) suggests a trend towards a more inclusive workforce in the delivery sector.



*Asian adults were interviewed in English only.
Note: Gig platform work refers to earning money by using a mobile app or website to find jobs that directly connect workers with people who want to hire them, or by using a personal vehicle to deliver packages to others. White, Black and Asian adults include those who report being only one race and are not Hispanic. Hispanics are of any race. Family income tiers are based on adjusted 2020 earnings. Those who did not give an answer are not shown.
Source: Survey of U.S. adults conducted Aug. 23-29, 2021.
"The State of Gig Work in 2021"

Percent of U.S. adults who have earned money by different gig jobs. (Source: Pew Research Center)

16% of Americans have earned money via an online gig platform; adults under 30, Hispanic adults, and those with lower incomes especially likely to do this jobs.

AIR QUALITY AND HEALTH

By shifting deliveries to smaller, more maneuverable vehicles like bicycles and electric scooters, micromobility deliveries reduce the number of emissions-emitting vehicles on the road (especially in densely populated areas).

Using bicycles and electric scooters for deliveries has the potential to reduce urban noise pollution (Farooqui et al., 2020).

Micromobility deliveries provide flexible access to fresh food options, particularly for people with limited mobility, car dependence, residence in a food desert, or underlying health concerns who have limited access to fresh food or may benefit from minimized exposure in crowded grocery stores. This convenience and reduced risk were especially valuable during the COVID-19 pandemic, ensuring continued access to essential goods.

ECONOMIC GROWTH

Micromobility deliveries can foster a more human-scaled street experience, potentially increasing foot traffic and local business activity. To incentivize the adoption of cargo e-bike deliveries, State and local governments have successfully established green loading zones and zero emissions delivery zones and added bike lanes or bike parking in downtown areas. *See the City of Portland, which is piloting a Zero-Emission Delivery Zone.*

Micromobility deliveries can support the growing demand of e-commerce by completing last-mile deliveries to end users. In 2020, e-commerce accounted for 20% of all sales in the United States (U.S. Census, 2021).

The shift to online shopping requires new ways to address increasing delivery demands and associated increases in delivery-related GHG emissions, especially with sellers offering next-day delivery options and free shipping (SANDAG, 2021).

Boston Delivers, an e-cargo bike delivery pilot program focuses on carrying out final mile deliveries for businesses and organizations dedicated to expanding access to healthy and affordable food in two Boston neighborhoods, Allston & Brighton (City of Boston 2023).

Denver Food Rescue uses e-cargo bikes to save surplus fresh food from local markets and grocery stores and deliver it to No Cost Grocery Programs, reducing food waste and providing nutritious options to underserved communities.

COST SAVINGS

Micromobility allows for quicker and more agile navigation through traffic-dense areas, potentially reducing delivery times and costs.

A cost modelling and simulation of last-mile characteristics demonstrates that the cost for last mile cargo bike delivery in densely populated areas in European cities is €1.60 (2015 U.S. $1.78) per unit, while the standard delivery within a city, with motorized vehicles is €2.91 (2015 U.S. $3.23). These results indicate a possible cost reduction of up to 45% in urban areas if cargo bikes are used for deliveries (Wrighton & Reiter, 2015).

Micromobility deliveries have the potential to alleviate congestion and the associated time costs by reducing the number of delivery vehicles during peak hours.

In an "unguided adoption" scenario, meaning no intervention, growth in urban deliveries could increase average commute time by 21% (purely last mile delivery induced), equaling an additional 11 minutes of commute time for each passenger every day by 2030 (World Economic Forum, 2020).

A study in NYC found a single double-parked delivery truck on average affects 43 cars, and totals over $240 million lost a year in time and pollution (Goldstein et al., n.d.)

RURAL COMMUNITIES

Micromobility deliveries can fill gaps in health care service by offering fast and efficient transportation of essential medical supplies, prescriptions, and even diagnostic samples.

Upstate Medical University's Outpatient Pharmacy introduced a drone-delivered prescription pilot service for direct home patient delivery in November 2023 (Upstate Medical University, 2023).

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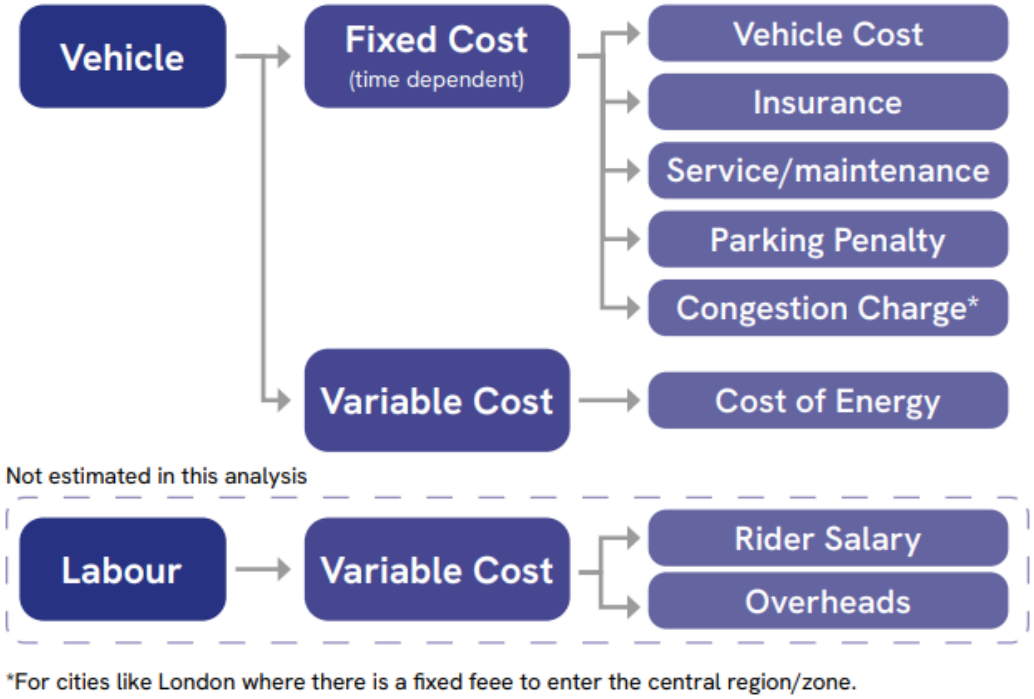
COST CONSIDERATIONS

COST OF IMPLEMENTATION

A report evaluating cargo bike delivery performance in Brussels found electric cargo bikes are over ten times cheaper to operate than a van in urban areas (Kale, 2023).

Adding fixed and variable costs, total yearly expenses are €2,066 per e-cargo bike, €10,782 for the Ford Transit van, and €10,296 for the Citroen e-van. Despite the same 20,200 parcels delivered, e-cargo bikes cost 1/5 the amount per parcel (€0.10) as the vans (€1.05-€1.10).

Considering a 2 km beeline service radius, drones costs €1.44 per shipment and the sidewalk robots delivery costs €1.13 per shipment (Li & Kunze, 2023).



Cost estimation structure for full delivery cost. (Source: Kale, 2023)

COST EFFECTIVENESS

Micromobility deliveries offer significant cost-saving advantages for logistics companies, particularly when considering the last-mile challenge.

For logistics companies, the last mile is the most complex part of the journey, representing over half the overall cost (Dolan, 2022). Micromobility's agility in congested urban areas can significantly reduce delivery times and associated labor costs.

> *Studies show busy city streets can consume 9-15 minutes just finding parking for traditional delivery vehicles (Sheth et al., 2019). Micromobility eliminates this wasted time and associated parking fees. Although this research does not focus solely on delivery trucks, it serves as a revealing proxy for parking challenges that trucks experience.*

E-cargo bikes are more cost effective than delivery trucks for deliveries in close proximity to the distribution center (less than 2 miles for the observed delivery route with 50 parcels per stop and less than 6 miles for the hypothetical delivery route with 10 parcels per stop) and at which there is a high density of residential units and low delivery volumes per stop (Sheth et al., 2019).

FUNDING OPPORTUNITIES

USDOT's **Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program** provides grants to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems in order to improve transportation efficiency and safety. Delivery/logistics is included as a technology area for eligible projects.

The Joint Office of Energy and Transportation's **Communities Taking Charge Accelerator** Program funds projects that will expand community e-mobility access and provide clean reliable energy. Funding opportunities for FY24 include Expanding E-Mobility Solutions through Electrified Micro, Light and Medium-Duty Fleets.

COMPLEMENTARY STRATEGIES

Micromobility delivery services rely on the infrastructure established within active transportation networks. Leveraging bicycles and scooters for last-mile deliveries, these services contribute to the efficient movement of goods while complementing efforts to reduce traffic congestion and emissions in urban areas.

Freight digitalization strategies, such as GPS tracking and eco-routing, streamline dispatch and route optimization, enabling micromobility deliveries to efficiently navigate congested urban areas.

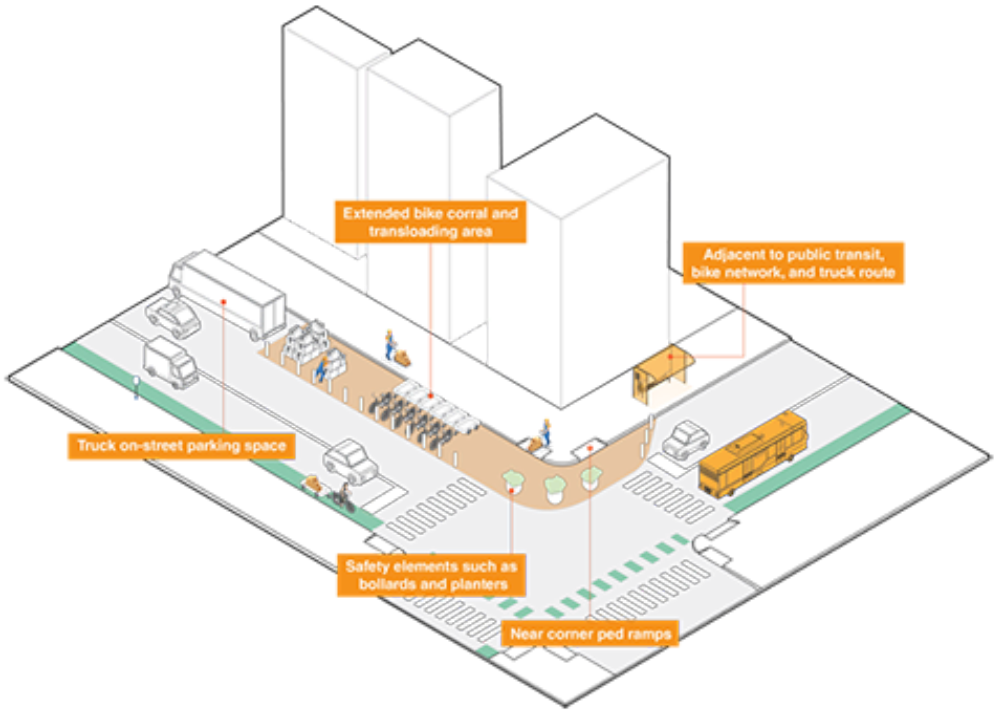
Integrating micromobility deliveries with off-peak delivery can enhance the overall effectiveness of freight movement and help reduce GHG emissions. Off-peak delivery times can alleviate congestion and improve efficiency for micromobility deliveries. Conversely, micromobility delivery can provide flexible and efficient last-mile solutions during off-peak times.

There are synergies between intermodal freight and micromobility deliveries in last-mile delivery optimization, where micromobility can complement intermodal freight by facilitating efficient distribution within urban areas, reducing GHG emissions.

View All Strategies

CASE STUDIES

NYC LOCAL DELIVERY HUB PILOT



Source: NYC DOT

New York City DOT is set to launch a new microhub pilot program in Summer 2024, aiming to transform the city's delivery landscape. The pilot introduces microhubs, local delivery points which will facilitate the shift from large trucks to more sustainable transportation options for the final delivery stretch. In response to the growing e-commerce demand, these microhubs are expected to reduce traffic congestion, enhance air quality, and improve public safety. With up to 20 hub sites in the pilot, NYC DOT plans to monitor operations and collect data, paving the way for a permanent local delivery hub program. The move aligns with the city's broader strategy to rethink curb space and prioritize sustainability in urban logistics.

SEATTLE ZERO-EMISSIONS DELIVERY ZONE

The Seattle Neighborhood Delivery Hub is part of the Zero Emissions Last Mile Delivery Pilot in Seattle developed through collaboration between the University of Washington Urban Freight Lab, the Seattle DOT, and private companies. The Delivery Hub is one of the country's first zero-emissions last-mile delivery pilots and is expected to help consolidate freight vehicle trips and reduce congestion and emissions associated with last-mile delivery. The program consists of microhubs or central drop-off/pick-up locations and integrates eco-friendly vehicles and transport modes like cargo bikes or walking. Delivery Hubs will also utilize common carrier parcel locker systems allowing carriers to transport multiple packages during a single stop and reducing idle time. The hubs are an important part of Seattle's Transportation Electrification Blueprint, including the goal of transitioning 30% of goods delivery to zero emissions by 2030.

Benefits of a Microhub
Source: University of Washington, Urban Freight Lab

SAN FRANCISCO, CA: E-BIKE DELIVERY PILOT

With funding from DOE's Vehicle Technologies Office, the San Francisco Environment Department carried out a pilot program in collaboration with app-based food delivery companies to shift deliveries from vehicles to e-bikes. The pilot will gather data to better understand impacts on delivery efficiency, safety, worker income, congestion, and emissions.

IMPLEMENTING MICROMOBILITY DELIVERIES, MICROHUBS, AND LAST-MILE SOLUTIONS : **WHAT TO READ NEXT**

Collaboration, thoughtful policy, and a focus on safety and equity are crucial for successful implementation of micromobility deliveries. Key considerations include:

Building a Collaborative Ecosystem: Micromobility delivery programs necessitate a well-coordinated effort.
Stakeholders may include:

- City Officials: Responsible for establishing regulations, infrastructure development, and safety protocols.
- Fleet Managers: Manage the micromobility delivery vehicles, ensuring proper maintenance and efficient operations.
- Departments of Transportation & Public Works: Oversee infrastructure planning and modifications to accommodate micromobility deliveries.
- Departments of Consumer & Worker Protection: Implement regulations to ensure fair treatment of delivery workers and consumer safety.

The Environmental Defense Fund developed a guide on freight stakeholder engagement. The report provides guidance on developing an engagement strategy, along with insight into some of the best practices used to develop productive stakeholder partnerships for improving freight movement. The report can be accessed here.

New York City's recent establishment of the Department of Sustainable Delivery offers a real-world example. This department aims to regulate the booming e-bike delivery sector, prioritizing safety, worker well-being, and environmental benefits. Read more, here.

- **Rethinking Payment Structures for Worker Safety and Equity:** Current payment structures in app-based delivery services often incentivize speed over safety. This can lead to reckless driving, putting both delivery workers and pedestrians at risk. Additionally, low wages can create challenges for worker well-being.

- **Optimizing Curb Management:** A diverse array of curb needs necessitates policies to guide which uses get prioritized. While cargo bikes require less space than traditional delivery vehicles, efficient curb management is crucial. Designated pick-up and drop-off zones ensure safer deliveries and minimize disruption to traffic flow.

The Institute of Transportation Engineers developed a Curbside Management Practitioners Guide that provides guidance on best practices curb space allocation. Available here.

The Urban Freight Lab is a public-private partnership housed at the University of Washington. The Lab explores urban freight research topics in a collaborative setting with the goals of reducing GHG emissions from urban freight transportation and increasing urban freight efficiency. Current focus areas include sustainable last-mile solutions and curb management using autonomous delivery vehicles, cargo bikes, and drones. Learn more about their research here.

RESOURCES

GENERAL RESOURCES

University of Washington, Urban Freight Lab: This resource focuses on improving urban freight systems through innovation and collaboration, with a particular interest in sustainable solutions like cargo e-bikes.

MIT Urban Mobility Lab: This resource investigates various aspects of urban mobility, including the role of new technologies and logistics models in optimizing last-mile deliveries.

Biking the Goods: How North American Cities Can Prepare for and Promote Large-Scale Adoption of Cargo e-Bikes. Urban Freight Lab, University of Washington: This white paper explores the potential of cargo e-bikes for last-mile deliveries in North American cities, outlining challenges, opportunities, and strategies for large-scale adoption.

The Future of the Last-Mile Ecosystem, World Economic Forum, 2020: This report from the World Economic Forum examines trends and innovations shaping the final leg of delivery journeys, including the rise of sustainable options like cargo bikes.

TOOLKITS AND MODELLING APPROACHES

RMI's E-Bike Impact Calculator Tool for Local Governments: The e-bike calculator estimates the impact of e-bikes as a substitute for short vehicle trips, based on a city-wide e-bikes goal; it also estimates the impact of an e-bike incentive program. Impacts are provided in terms of GHG emissions and VMT reductions, as well as cost savings.

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