Exploring Cargo E-Bikes for Last-Mile Deliveries

BOSTON REGION MPO METROPOLITAN PLANNING ORGANIZATION

October 2025

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We would like to thank all the interviewees who participated in this study and generously shared their insights.

The preparation of this document was supported by Boston Region Metropolitan Planning Organization (MPO) through Unified Planning Work Program.

Central Transportation Planning Staff is directed by the Boston Region MPO. The MPO is composed of state and regional agencies and authorities, and local governments.

October 2025

Abstract

Cargo bikes are emerging as a promising sustainable alternative to traditional delivery vehicles, particularly for last-mile deliveries in dense urban areas. In this study, the Boston Region Metropolitan Planning Organization staff conducted a literature review, analyzed case studies from Europe and South America, and interviewed cargo bike experts from public agencies, operators, vendors, and researchers to understand the opportunities and barriers to cargo bike adoption. The study underscores that successful pilot programs require strong planning, coordination, and long-term adoption strategies. The findings informed a set of recommendations, best practices, and a checklist for municipalities to support cargo bike exploration through pilot programs and to integrate them into broader regional freight planning.

FIGURES

Executive Summary

This study, conducted through the Boston Region Metropolitan Planning Organization's (MPO) Unified Planning Work Program (UPWP), builds on regional interest in cargo bikes as a sustainable last-mile freight solution. Cargo bikes were highlighted as one of the freight decarbonization strategies in the FFY 2024 UPWP discrete study, Sustainability and Decarbonization in the Freight and Logistics Sector in the North Suffolk Area. Building on this, the MPO Board voted to pursue a dedicated study on cargo bikes in FFY 2025.

The purpose of this study is to identify best practices and develop recommendations for piloting and expanding cargo bike adoption in the Boston region. The study team reviewed existing literature, explored case studies from Europe (London and Berlin) and South America (Bogotá), and interviewed stakeholders including representatives from public agencies, operators, vendors, and researchers. These methods provided insights into operational challenges, infrastructure and policy needs, and lessons from other cargo bike programs.

Key findings highlight that cargo bikes can offer environmental, operational, and community benefits, particularly by potentially reducing last-mile truck trips, emissions, and congestion. However, challenges remain, including competition for curb space, regulatory uncertainty, infrastructure gaps, and safety concerns related to batteries and interactions between vulnerable road users and larger vehicles. Microhubs emerged as an important component of successful cargo bike operations, enabling efficient transfers of goods from trucks to cargo bikes.

The study recommends that municipalities interested in piloting cargo bike programs

- establish a clear goal and framework for their program with a plan for longer-term adoption;
- engage with partners and communities early in the process;
- plan for necessary infrastructure and logistics needs;
- support workforce development and training; and
- evaluate pilot program outcomes and leverage funding and incentives to support long-term adoption.

These findings and recommendations support the MPO's goals of advancing sustainability and promoting mode shift. The study also identifies opportunities for future research. At the regional level, the MPO can play an important role by identifying gaps through its active transportation planning, developing resources for municipalities, and coordinating research to address emerging challenges.

Background

This report presents the results of the Federal Fiscal Year (FFY) 2025 Unified Planning Work Program (UPWP) funded study 13821, Exploring the Potential of Cargo E-Bikes for First- and Last-Mile Freight Deliveries. In FFY 2024, the Boston Region Metropolitan Planning Organization (MPO) staff completed work on a UPWP discrete study, Sustainability and Decarbonization in the Freight and Logistics Sector in the North Suffolk Area, that gained interest from various stakeholders. As a follow up to the recommendations from this discrete study, the MPO board voted to pursue this discrete study on cargo e-bikes in FFY 2025. The work scope for this study was approved by the Boston Region MPO board on October 24, 2024.

The purpose of this study is to identify best practices and provide recommendations for adopting cargo e-bikes. The objectives of the study are

1. to conduct a literature review to summarize current research on cargo e-bike adoption;
2. to analyze case studies of cities and organizations that have implemented cargo e-bike programs;
3. to conduct interviews with key stakeholders to capture lessons learned and operational insights;
4. identify some past and ongoing cargo e-bike pilot programs across the country for takeaways from their efforts;
5. discuss the role of microhubs; and
6. to present study findings, best practices and recommendations for adopting cargo e-bikes.

1 Introduction

With the growing demand for sustainable transportation options, cargo e-bikes are emerging as an efficient and eco-friendly alternative for freight deliveries. Cargo e-bikes, also known as e-cargo e-bikes, freight bikes, or carrier cycles, come in various designs and wheel configurations and serve many purposes. These electric-powered bicycles are environmentally friendly, efficient for transporting goods, and used as an alternative to traditional delivery vehicles, particularly in urban areas where traditional delivery vehicles face challenges (e.g., limited parking). Cargo e-bikes are increasingly used for transporting packages, groceries, and prepared food and play a role in public services, such as postal services and waste collection in some areas. The term “cycle logistics” broadly refers to any form of pedal-powered bicycle used for transportation of goods. Many caregivers are also utilizing cargo e-bikes as a convenient mode of transport for dropping children off at daycare or school. Their versatility and low environmental impact make cargo e-bikes ideal for a variety of industries and personal use, helping to improve urban mobility while reducing emissions.

This study explores the potential for cargo e-bikes to enhance logistics operations, reduce carbon emissions, optimize last-mile delivery, and improve the overall efficiency of freight distribution. By conducting a literature review, researching case studies, and interviewing cargo e-bike experts and vendors, this study aims to provide valuable insights into the role of cargo e-bikes in shaping the future of urban freight transportation.

2 Exploring the Literature on Cargo E-Bikes

In the region, the City of Boston, in partnership with Net Zero Logistics, conducted a pilot program called Boston Delivers that supported local businesses in Allston and surrounding neighborhoods. In addition, the Metropolitan Area Planning Council recently published Strategies for Municipal Delivery Transition that focuses on identifying strategies for cargo e-bike adoption and expansion in the region. Building on these recent efforts, this study will explore the characteristics of cargo e-bikes and the potential for using them for the first- and last-mile deliveries across the region.

This section explores the growing body of research on cargo e-bikes, focusing on their typologies, applications, operational flows, the types of goods delivered, and their associated benefits and challenges. In addition, we explore the role of microhubs, including the activities carried out within them, their management structures, partnerships, key needs, and barriers.

Cargo E-bikes for First- and Last-Mile Delivery

Cargo e-bikes excel in first- and last-mile logistics, especially in dense urban environments where traditional delivery vehicles face challenges such as traffic congestion and limited parking. In Seattle, one study found that commercial vehicles cruising in search of parking represented 28 percent of total trip time on average (Chiara and Goodchild 2020). With the increasing competition for curbside space driven by a variety of uses such as parking for cars, e-scooters, and e-bikes; bike lanes; public transport bus stops; and outdoor dining, the management of street space for freight deliveries has become a topic of debate. In 2019, the Boston Region Metropolitan Planning Organization (MPO) conducted The Future of the Curb study, which examined the challenges and competing demands for curb space and identified strategies to prioritize, evaluate, and manage its use.

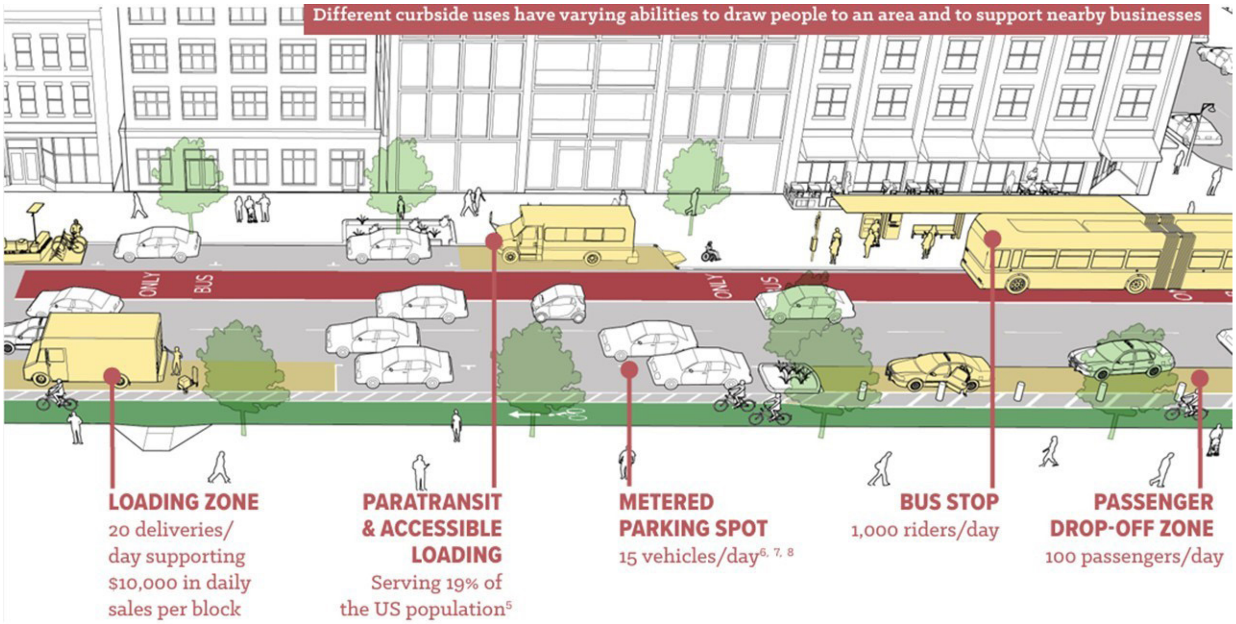

Figure 1. Reimagining the Curb.

Figure citations: a. (5) US Census. 2015; b. (6) San Francisco CTA. 2009; c. (7) Boston Transportation Department (n.d.); d. (8) Shoup, Donald C. 2011 Source: NACTO Curb Appeal.

In this context, cargo e-bikes could offer a viable solution for managing freight curbside needs (Castrellon and Sanchez-Diaz 2024). Their compact design allows them to navigate narrow streets and make frequent stops more efficiently than vans or trucks. For instance, a pilot program in Seattle demonstrated that cargo e-bikes reduced vehicle-miles traveled (VMT) and achieved faster delivery times in high-density neighborhoods compared to traditional delivery vans (Dalla Chiara et al 2023). Similarly, data from London shows that in congested areas cargo e-bikes completed deliveries 1.61 times faster than vans, further emphasizing their logistical advantages (Verlinghieri et al 2021).

Cargo e-bikes also minimize the need for curbside parking, which is often scarce in urban centers. This advantage not only reduces delays but also alleviates double parking, a safety hazard as well as a common source of urban congestion and emissions (Fried and Goodchild 2023). These benefits are particularly evident in microhub delivery models, where cargo e-bikes operate from localized hubs to efficiently handle short-distance routes (Gunes et al 2023).

2.2 Cargo E-Bike Applications, Goods Delivered, and Typologies

Cargo e-bikes are most effective in last-mile delivery contexts, where short distances and high delivery density favor their operational characteristics. Key use cases include

- **E-Commerce Deliveries**: Online retail platforms have increasingly adopted cargo e-bikes for delivering parcels, particularly in high-density urban centers where congestion poses challenges for traditional vehicles (Verlinghieri et al 2021).

- **Food and Grocery Delivery**: Cargo e-bikes are well suited for time-sensitive deliveries, such as takeout meals or fresh produce, due to their ability to quickly navigate traffic and reach customers faster than vans (Arnold et al 2017).

- **Municipal Services**: Cities have used cargo e-bikes for waste collection, mail delivery, and other municipal logistics, showcasing their versatility beyond private-sector applications (Nelson\Nygaard 2021).

The range of products delivered by cargo e-bikes depends largely on their size and capacity:

- **Small Parcels**: Packages from e-commerce retailers, such as books or clothing, are the most common goods transported by cargo e-bikes (Dalla Chiara et al 2023).

- **Perishables**: Temperature-controlled cargo e-bikes are increasingly used for delivering food and pharmaceuticals, highlighting their ability to handle specialized logistics needs (Llorca and Moeckel 2021).

- **Bulky Items**: Larger models, such as tricycles or longtail bikes, can accommodate bulkier items like furniture or home appliances in urban settings (Stout and Kaddoura 2021).

Cargo e-bikes come in multiple configurations, each designed to address specific operational needs. Some of the most common types include

- **Two-Wheeled "Dutch Box" Cargo E-Bikes**: Known for their agility, these are often used for smaller loads and deliveries requiring speed and flexibility in dense urban environments (Narayanan and Antoniou 2022).

- **Cargo Tricycles**: Offering greater stability and load capacity, tricycles are ideal for larger or heavier goods but may face limitations on narrower pathways or high-traffic areas (Gunes et al 2023).

- **Longtail Bikes**: With extended rear frames, these bikes strike a balance between agility and capacity, making them popular for grocery and small-scale e-commerce deliveries (Zimmermann and Palgan 2024).

Figure 2. Cargo e-Bike Typologies
Clockwise from top left: Dutch Box Bike with a trailer, Cargo trike, Dutch Box Bike, and Three-wheeled e-trike.
Source: MPO Staff.

2.3 Challenges And Benefits

Challenges in Usage

Modal Challenges of Bicycles

While cargo e-bikes offer significant advantages, their usage is not without challenges. Limited payload capacities restrict the types of goods they can carry, particularly when compared to vans or trucks (Sheth et al 2019). In addition, their reliance on infrastructure such as bike lanes and staging areas can limit their effectiveness in cities with inadequate cycling infrastructure (Fried and Goodchild 2023).

Figure 3. Inadequate Infrastructure for Loading and Unloading Staging Area
Source: MPO Staff.

Thermal Runaway in Lithium-ion Batteries

A major challenge to broader adoption of cargo e-bikes is concern about the safety of lithium-ion batteries that are used in micromobility devices. Charging an e-bike battery is typically done one of two ways. Some have built-in batteries, which require the full vehicle to be at the charging site, while increasingly more e-bikes feature removable batteries. These have different implications: in situations where the e-bike has a built-in battery, the entire vehicle must be brought into a location with an electrical outlet, whereas removable batteries can be charged in an indoor environment without bringing the vehicle indoors. In spatially constrained urban environments, access to charging can be a barrier for individual delivery operators or small businesses that operate out of small spaces.

High-profile fires involving personal and shared e-bikes have raised alarm that have prompted safety agencies to declare a crisis. In fleet settings, simultaneous charging of many batteries introduces risks but also opportunities for better regulation and safety protocols compared to individual operators charging in constrained spaces like apartments. Effective safety regulations and standards have proven critical in reducing fire incidents, as seen in the contrast between New York City and London, where stricter rules in the United Kingdom have led to fewer e-bike fires and fatalities. Recent state-level legislation in New York and California further strengthens battery safety through sales restrictions and usage protections. New York City now mandates that e-bikes sold in the city meet the same Underwriters Laboratories (UL) safety standards as is mandated in both the United Kingdom and European Union (NYC Local Law 39, 2023). Leaving regulation to the municipal level can only have a limited impact on safety, however, as batteries with little to no safety certification can still be brought into the city from outside jurisdictions. This issue can be addressed at the state level, where New York State in 2024 adopted legislation prohibiting the sale of e-bike batteries that have not been tested by a lab certified by the International Organization for Standardization (New York S154, 2024). California adopted legislation that prohibits landlords from banning e-bikes if they conform with UL or European Union safety standards, encouraging safer bike adoption (California SB 712, 2023). The European Union is advancing comprehensive regulations (Regulation 2023/1542) that set performance, durability, and labeling standards for e-bike batteries. Alongside these laws, European standards address battery safety testing and hazardous substance limits. Although a unified EU charging standard is pending, national best practices such as Germany's fire-safe storage guidelines are currently shaping safer e-bike battery management across the continent. Appendix C has more detailed information on lithium-ion battery safety.

Safe Charging and Storage

Regulation of batteries is best applied at high levels of jurisdiction, such as state, national, or multinational bodies, where consistency can be enforced across broad areas. There are, however, strategies that municipalities can employ to mitigate fire risk and improve access to safe charging infrastructure. Chief among these are battery charging lockers and secure storage cabinets, which offer a practical intervention at the street or fleet level. These technologies provide a safe, centralized environment for charging lithium-ion batteries, reduce the risk of fires, and can help phase out unregulated or low-quality battery products often associated with third-party products.

One example of this approach is New York City's e-bike battery charging and swapping pilot, which launched in 2023 as part of the city's broader efforts to support delivery workers while improving fire safety. Designed primarily for app-based delivery drivers, the program created a network of battery swapping cabinets, allowing users to exchange depleted batteries for fully charged, UL-certified ones in a safe outdoor environment. The pilot has been embraced by the delivery community according to post-pilot reports and has reduced the number of unsafe charging practices in residential buildings. Building on this success, New York City is expanding the program and has adopted new rules in 2025 allowing property owners to install e-bike charging cabinets directly on sidewalks, further integrating this infrastructure into the streetscape (New York City DOT 2024; New York City DOT 2025).

Other cities in the United States are exploring similar strategies through federally supported demonstration projects. The proposed Integrated Electric Micromobility Powerhubs for Equitable Replication (I-EMPOWER) initiative, which included sites in Minneapolis, Minnesota, and Jersey City, New Jersey, aimed to deploy secure micromobility hubs with e-bike storage and charging infrastructure in traditionally underserved communities. Although the project's future is uncertain amidst changing federal priorities, it reflects growing interest in solutions that address both infrastructure gaps and public safety concerns (Drive Electric 2024).

Benefits of Cargo E-Bikes

Cargo e-bikes offer transformative potential for urban logistics. As cities grapple with the environmental, logistical, and social impacts of traditional delivery systems, cargo e-bikes have emerged as a sustainable alternative that can enhance efficiency while mitigating urban congestion and pollution.

Environmental Benefits

Cargo e-bikes significantly reduce greenhouse gas emissions and air pollutants compared to internal combustion engine delivery vehicles. In a pilot program conducted in London, replacing vans with cargo e-bikes resulted in a reduction of approximately 3,896 kilograms of carbon dioxide ($CO2$) emissions over a 98-day period (Verlinghieri et al 2021). Similar results were observed in Munich, where simulations demonstrated that cargo e-bikes reduced emissions of nitrogen oxides and particulate matter ($PM2.5$) during last-mile deliveries (Llorca and Moeckel 2021). Such reductions are vital for cities aiming to meet climate targets and address local air quality issues.

Alleviating Urban Congestion

By replacing larger vehicles, cargo e-bikes help reduce overall traffic volumes and improve road efficiency. Their ability to use bike lanes and access restricted areas makes them particularly effective in congested urban cores. A study in New York City highlighted that deploying cargo e-bikes for deliveries could significantly reduce the number of large delivery trucks, leading to fewer traffic bottlenecks and improved flow for all road users (Goldstein et al 2024). These changes not only benefit delivery operators but also contribute to broader urban mobility goals.

Social and Economic Impacts

Cargo e-bikes align with broader community goals, such as reducing noise pollution and enhancing the livability of urban spaces. Unlike internal combustion engine vehicles, they operate quietly, making them an ideal choice for deliveries in residential areas and during off-peak hours (Arnold et al 2017). Economically, cargo e-bikes offer cost savings for logistics operators through reduced fuel consumption and parking fees, as well as lower maintenance costs (Sheth et al 2019). These advantages are particularly appealing to small businesses and local couriers aiming to optimize their delivery models (Narayanan and Antoniou 2022).

Safety

Large commercial vehicles can pose safety risks to vulnerable road users, including pedestrians and bicyclists. Between 2018 and 2022, large vehicles accounted for 5.4 percent of total fatal and serious injury crashes in the Boston Region MPO. Within the same period, trucks were involved in 13 percent of pedestrian fatalities and 50 percent of bicyclist fatalities (MassDOT IMPACT portal). In urban areas, where deliveries often occur in dense environments, replacing trucks with smaller vehicles such as cargo e-bikes for last-mile deliveries could help mitigate these risks.

In addition, a study that examined scooter, bicycle, and motor vehicle parking habits in five major US cities found that ride-hail, taxi, delivery, and other commercial vehicles accounted for slightly less than one-quarter (23.8 percent) of all observed motor vehicles on the road but accounted for more than one-half (63.6 percent) of observed parking violations (Brown, Klein, Thigpen, and Williams 2020). By shifting deliveries into smaller vehicles such as cargo e-bikes, double-parking and blocking of bike lanes could be reduced, making the roads safer for all users.

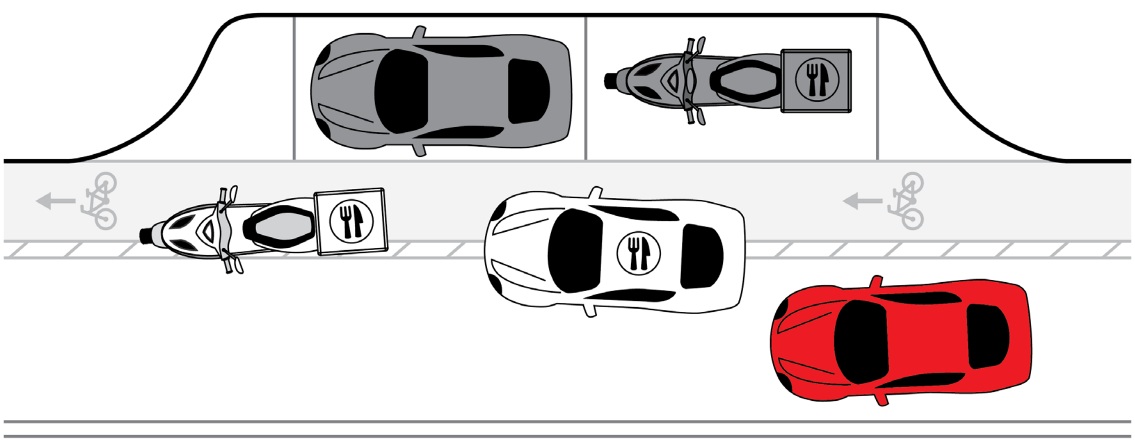

Figure 4. Double-parked Delivery Vehicles Blocking Bike and Travel
Source: MPO Staff.

2.4 Logistics and Hub Integration

The integration of cargo e-bikes into urban freight logistics relies heavily on effective hub-based models and innovative management structures. These systems optimize delivery operations by reducing the distance and congestion associated with traditional last-mile logistics.

The Role of Microhubs

Microhubs, also known as urban consolidation or transshipment centers, facilitate the redistribution of cargo from conventional vans to sustainable modes, such as cargo e-bikes. These hubs play a crucial role in the success of cargo e-bike logistics by serving as localized centers for sorting, organizing, and dispatching deliveries. They can be permanent or mobile and some also function as bike storage garages in addition to staging facilities. Microhubs bridge the gap between centralized distribution centers and delivery points, enabling cargo e-bikes to handle shorter routes with high delivery density (Vasiutina et al 2021; Gunes et al 2023).

Microhubs not only improve operational efficiency but also mitigate urban congestion by minimizing the need for large delivery vehicles in city centers. The City of Portland's Micro-Delivery Hub Feasibility study offers a framework for evaluating microhub location criteria, space requirements, and implementation challenges.

Activities at Hubs

Hubs perform a range of critical activities to support cargo e-bike logistics, including

- **Sorting and Consolidation**: Grouping parcels by delivery zones to streamline routes.
- **Charging and Maintenance**: Serving as stations for recharging cargo e-bike batteries and performing minor repairs.
- **Staging and Dispatching**: Organizing deliveries for efficient dispatch by cargo e-bike couriers (Gunes et al 2023).
- **Employee Amenities**: Providing restrooms, break rooms, water fountains, resting areas, and changing areas, ensuring the comfort and well-being of drivers and operators.

The proximity of hubs to delivery areas is a key factor in reducing operational delays and ensuring timely deliveries.

Management Structures

Effective management structures are essential for coordinating the logistics of cargo e-bikes and hubs. Common models include

- **Corporate-Owned Fleets**: Large logistics companies like UPS and DHL operate cargo e-bikes alongside traditional delivery vehicles, integrating them into existing supply chains (Sheth et al 2019).
- **Public-Private Partnerships**: Municipalities and private operators collaborate to establish microhubs and cargo e-bike fleets, as seen in initiatives such as Toronto's e-bike pilot (Stout and Kaddoura 2021).
- **Independent Operators**: Smaller businesses and cooperatives often lease or own their own bikes, offering tailored services to local markets (Zimmermann and Palgan 2024).

Partnerships and Stakeholder Engagement

Collaborative partnerships play a pivotal role in the success of cargo e-bike logistics. Engagement with stakeholders such as municipalities, logistics providers, and community organizations ensures alignment of goals and resources. For example,

- **Public Infrastructure Support**: Municipal governments often provide space for hubs or subsidies for pilot programs (Dalla Chiara et al 2023).
- **Private Sector Innovation**: Logistics companies contribute technological solutions to enhance efficiency such as advanced routing software and optimized cargo e-bike designs (Arnold et al 2017).

Challenges in Integration

Despite their advantages, the integration of hubs and cargo e-bikes faces challenges such as

- **Infrastructure Limitations**: A lack of suitable spaces for hubs and staging areas can hinder operations.
- **Coordination Issues**: Aligning multiple stakeholders with varying priorities can complicate implementation.
- **Cost Barriers**: Initial investments in hub construction and bike acquisition require financial backing, often beyond the capacity of smaller operators (Zimmermann and Palgan 2024).

2.5 Regulatory Framework

The regulatory environment plays a critical role in determining the feasibility and success of cargo e-bikes in first- and last-mile logistics. Variations in traffic laws, vehicle classifications, safety measures, and incentive programs across regions highlight the need for a cohesive and supportive framework to promote their adoption.

Traffic Laws and Vehicle Classifications

Cargo e-bikes occupy a unique space in the regulatory landscape, often falling between traditional bicycles and motorized vehicles. In many jurisdictions, their classification depends on attributes such as weight, speed limits, and power output. In the United States, most states regulate e-bikes using a consistent three class model based on PeopleForBikes' model legislation (PeopleForBikes 2023). In Europe, regulations limit electric assist to 250 watts and speeds of 25 km/h (15.5 mph) for e-bikes to be treated as bicycles (Arnold et al 2017). However, these regulations make no distinction between a regular e-bike and a cargo e-bike.

In the United States, classifications and associated rights-of-way vary by jurisdiction, with some regions requiring additional licensing or restricting access to certain roadways (Narayanan and Antoniou 2022). In New York City, for example, commercial bikes are defined separately from regular bicycles based on use and are governed by a different set of thresholds under which they may continue to be counted and regulated as a type of bicycle (RCNY 2025, § 4-01). In neighboring Yonkers, a dense urban environment with a population over 200,000, there are no such regulations, meaning one could acquire a cargo e-bike that they wouldn't be able to use in neighboring New York City. These regulatory variations can limit the pool of eligible drivers and vehicles, discourage the participation of part-time drivers, increase operational costs, result in service deserts due to restricted access, and hinder the experimentation and scalability of newer models. In addition, these inconsistencies complicate the standardization of delivery practices across regions.

Safety and Operational Standards

The integration of cargo e-bikes into urban logistics requires adherence to safety standards tailored to their operational characteristics. These include lighting, braking systems, and load stability measures. For example, Toronto's cargo e-bike pilot revealed gaps in driver training and operational safety protocols, prompting calls for standardized guidelines (Stout and Kaddoura 2021). In addition, infrastructure design plays a critical role in ensuring safety, with protected bike lanes and appropriate staging areas reducing conflicts with other road users (Llorca and Moeckel 2021).

Incentives and Promotion Programs

Incentives and promotion programs can accelerate the adoption of cargo e-bikes, particularly for small businesses and logistics operators. Programs in cities like Vienna and Paris provide subsidies for commercial cargo e-bike purchases and infrastructure development, lowering the financial barriers to entry (Zimmermann and Palgan 2024). In the United States, Boston has explored similar models, offering grants to pilot projects and partnerships with logistics providers to test cargo e-bikes for specific delivery routes (Nelson\Nygaard 2021).

Municipal Support for Microhubs

Municipalities have increasingly supported the establishment of microhubs to reduce reliance on larger delivery vehicles in congested urban areas. For instance,

- **Seattle's Microhub Pilot**: Supported by local government and private stakeholders, the pilot demonstrated significant reductions in VMT and emissions, improved efficiency through fewer trips and stops, and provided a convenient site for cargo e-bike delivery pickups (Gunes et al 2023).

- **Boston's Approach**: Initially, the city considered repurposing municipal parking lots as microhub sites. The approach was later reframed to an indoor microhub to provide facilities for cargo bike drivers, space to stage bikes, charge batteries between trips, and provide a safe rest area for cargo bike drivers. Battery safety concerns further reinforced the need for a secure indoor facility (City of Boston 2025).

- **Brussels' Mobile Depot (MD)**: The city introduced a custom-designed trailer equipped with a loading and unloading dock, sorting center, office space, and a lift for cargo e-bike access to parcels. Trucks transport the MD to a location where cargo e-bikes manage the last-mile deliveries. Although costs doubled compared to diesel vans and on-time performance decreased by seven percent, this system achieved significant environmental benefits, reducing CO2 emissions by 24 percent and PM2.5 emissions by up to 99 percent (Verlinde et al 2014).

Figure 5. Mobile Depot in Brussels
Source:ResearchGate

These examples highlight the role of local governments in addressing infrastructure and logistical barriers, which could pave the way for broader adoption of cargo e-bike systems.

Gaps and Challenges

Despite the progress in some regions, gaps remain in regulatory frameworks. A lack of consistency in vehicle definitions across jurisdictions creates confusion for operators, while inadequate enforcement of bike lane protections limits their utility in dense urban areas (Fried and Goodchild 2023). Policies often fail to account for the unique needs of cargo e-bikes, such as defining the legality of cargo bikes utilizing bike lanes or designated loading zones, which are essential for scaling their use in logistics (Gunes et al 2023).

2.6 Operational and Infrastructure Challenges

While cargo e-bikes offer significant benefits for first- and last-mile logistics, their adoption faces operational and infrastructure challenges. Overcoming these hurdles is crucial for expanding their role in urban freight systems. To increase adoption, a mix of regulatory measures (e.g., vehicle restrictions), incentives (e.g., subsidies), soft benefits (e.g., improved health), and enhanced infrastructure are needed. Trial programs and promotional campaigns can help overcome resistance, further facilitating cargo e-bike integration (Narayanan et al 2022).

Operational Constraints

Cargo e-bikes are subject to several limitations that impact their efficiency and feasibility for widespread adoption:

- **Limited Payload Capacity**: Compared to vans and trucks, cargo e-bikes have smaller load capacities, making them less suited for high-volume deliveries. This limitation is particularly acute in areas with low delivery density, where fewer stops per route reduce their cost-effectiveness (Sheth et al 2019).

- **Range and Battery Life**: Electric-assist cargo e-bikes rely on battery power, which can restrict their range, especially in hilly terrain or when carrying heavy loads. Frequent recharging may disrupt delivery schedules, highlighting the need for strategically located charging stations (Narayanan and Antoniou 2022).

- **Weather**: Key factors affecting cargo e-bike performance in inclement weather include road maintenance, bike design, and rider preparedness. Timely snow removal, proper tires, and rider training are crucial for safety. These measures can improve cargo e-bike reliability year-round (Dybdalen and Ryeng 2022).

- **Driver Training and Safety**: Operating a cargo e-bike requires specific skills to navigate urban traffic safely while managing heavy or bulky loads. Toronto's pilot program identified a lack of standardized training as a key barrier to adoption (Stout and Kaddoura 2021).

Infrastructure Needs

The success of cargo e-bikes in urban logistics is heavily dependent on supportive infrastructure, which can include

- **Protected Bike Lanes**: Protected bike lanes can facilitate efficient goods movement and enhance safety, as people bicycling for commercial delivery make up a disproportionate share of those injured on bicycles due to obstructed lanes (Basch, Ethan, Fera, et al 2023). Wider bike lanes are particularly crucial for accommodating larger cargo e-bike models. A lack of dedicated cycling infrastructure can force cargo e-bikes to share roads with motorized vehicles, increasing safety risks and slowing delivery times (Fried and Goodchild 2023).

- **Staging Areas and Loading Zones**: Cargo e-bikes require accessible areas for loading and unloading goods. In many cities, the absence of designated loading zones near delivery hubs or customer locations creates bottlenecks and inefficiencies (Zimmermann and Palgan 2024).

- **Microhub Integration**: Insufficient availability of strategically located microhubs limits the reach of cargo e-bikes and increases operational delays. Municipal investment in hub infrastructure is critical to addressing this challenge (Gunes et al 2023).

Regulatory and Policy Barriers

Inconsistent policies across jurisdictions further complicate cargo e-bike operations:

- **Vehicle Definitions**: Variability in how cargo e-bikes are classified affects their access to bike lanes, parking zones, and other critical infrastructure (Narayanan and Antoniou 2022).

- **Parking and Right-of-Way**: Many cities lack clear regulations on where cargo e-bikes can park or operate, leading to conflicts with other road users and enforcement issues (Arnold et al 2017).

Financial Barriers

The cost of acquiring and maintaining cargo e-bikes remains a significant obstacle, particularly for smaller operators:

- **High Initial Investment**: Electric-assist cargo e-bikes and the associated infrastructure, such as charging stations and secure storage, require substantial upfront costs (Sheth et al 2019).

- **Ongoing Maintenanc**e: Frequent use in urban conditions results in wear and tear, necessitating regular maintenance and increasing operational expenses (Zimmermann and Palgan 2024).

Scalability Challenges

Scaling cargo e-bike operations across diverse urban contexts is another critical hurdle:

- **Urban Density and Layout**: Cargo e-bikes are most effective in high-density areas with short delivery distances. In suburban or sprawling urban environments, their efficiency decreases due to longer travel times and fewer delivery stops (Llorca and Moeckel 2021).

- **Integration with Existing Systems**: Incorporating cargo e-bikes into traditional logistics networks requires significant reorganization of supply chains, particularly for companies heavily reliant on centralized distribution models (Dalla Chiara et al 2023).

Collaborative efforts between municipalities, private operators, and logistics companies will be essential to overcoming these hurdles and realizing the full potential of cargo e-bikes.

3 Spotlight of Selected Case Studies

3.1 City of London, United Kingdom

Historical Context

Cargo bikes have long been part of London's transport landscape. In the late 19th century, tradespeople pedaled their wares through narrow streets on some of the earliest known designs for cargo e-bikes. The cargo e-bike's modern role in urban logistics began to take form in the early 2010s, as questions about climate change, air quality, and congestion began converging in the public discourse.

Figure 6. 1910 Cargo e-Bike Design
Source: International Cargo Bike Festival

One of the earliest innovators was Gnewt Cargo, launched in 2008. While best known for pioneering the use of electric vans, Gnewt was also involved in alternative last-mile modes, helping to provide proof of concept that logistics in a dense city need not be reliant on diesel-powered step vans. Around the same time, local cycling advocates and researchers began quietly laying the groundwork for a more visible shift. City initiatives backed by advocates and spanning across both Labour and Conservative administrations advanced a network of bicycle "superhighways" connecting the inner core of London with far-flung boroughs and installed thousands of bicycle parking facilities across the city between the launch of Gnewt and 2016 (TTaylor 2008; Usborne

2013). Despite being intended to support bicycling for personal transportation, these investments set the stage for Pedal Me, a company co-founded in 2017 by transport planner Benjamin Knowles. Pedal Me's model offered both pedal-taxi service that competed with rideshare operators, as well as urban freight delivery (Pedal Me 2025).

Figure 7. PedalMe/Gnewt, Side by Side

Source: PedalMe/Gnewt

Programs like the Mini-Hollands initiative, begun in 2014, boroughs on the outer edge of London received substantial investment, about £100 million in total, to upgrade cycling infrastructure (Greater London Authority, 2014). While not focused solely on freight, this initiative normalized the idea that street design could be reshaped to accommodate more human-scale transport. Still, cargo e-bikes were largely on the fringe of transport planning conversations with private operators leading the experimentation.

That dynamic shifted in 2020, when the COVID-19 pandemic reordered urban life. Lockdowns created surging demand for home deliveries and cargo e-bikes stepped into the gap. Companies like Pedal Me pivoted from a mix of passenger and parcel services to almost exclusively logistics, delivering food, medical supplies, and care packages. In partnership with Lambeth Council, Pedal Me delivered more than 10,000 care packages to residents (Bowden 2021). These types of collaborations marked a turning point as cargo e-bikes shifted from being a novelty to nimble and scalable assets.

At the same time, Transport for London (TfL), the city's integrated transport authority, responded to the broader surge in cycling by installing temporary bike lanes and reallocating road space. These actions, while not designed intentionally for freight, benefited cargo e-bike operators and allowed the spatial and political visibility of cargo e-bikes to grow during this period.

The experience of the pandemic, combined with mounting public urgency around climate and the city's Ultra Low Emission Zone (ULEZ) expansion in 2023, led to a new level of institutional commitment. That same year, TfL published its first Cargo Bike Action Plan, a comprehensive strategy aimed at embedding cargo e-bikes into the city's freight system. It recognized not only the benefits of environmental and congestion, but also the operational advantages in dense urban areas, where vans have difficulty in finding parking, maneuvering, or accessing curb space (Transport for London 2023).

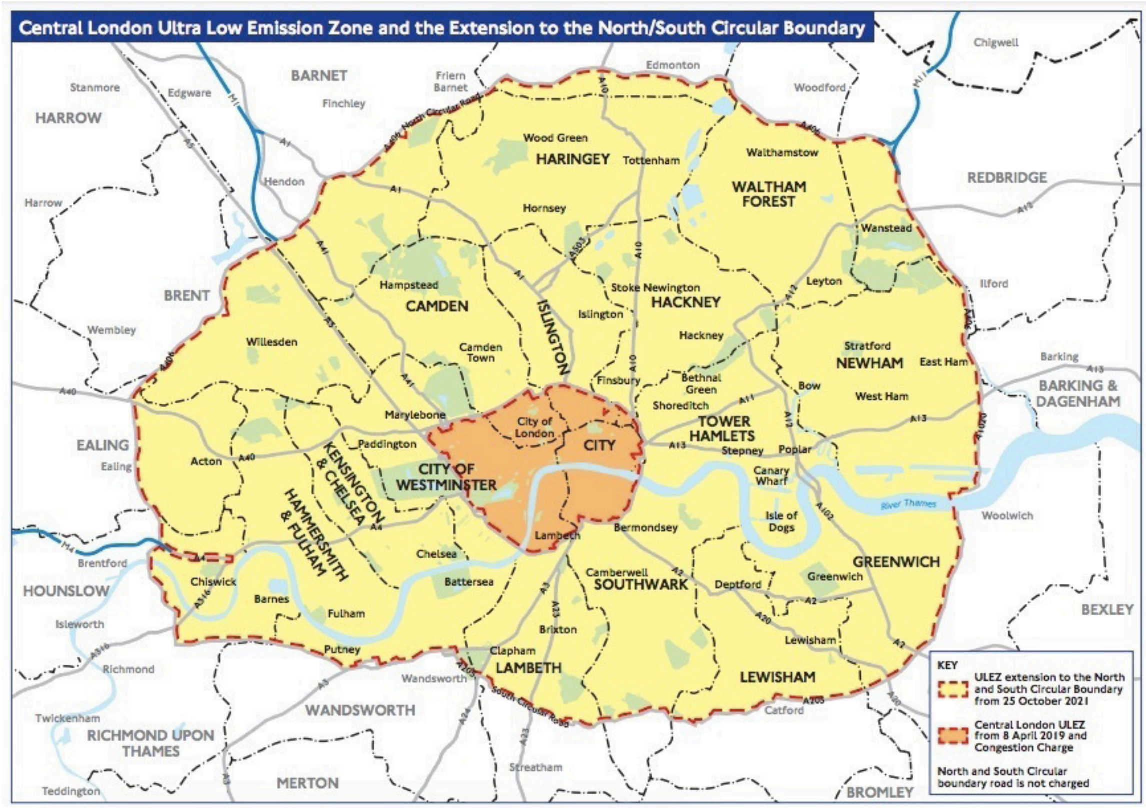

Figure 8. Map of ULEZ

Source: City of London

This trajectory continues in 2025 with the release of the London Cargo Bike Safety Standard, designed to guide operators, manufacturers, and regulators on issues ranging from vehicle dimensions to braking and visibility. The document marked London's emergence as a global leader in formalizing and professionalizing the cargo e-bike sector (Transport for London 2025).

Policy and Regulatory Environment

As cargo e-bikes began gaining traction in London, their integration into public policy was neither immediate nor inevitable. In the early days, their rise was driven more by grassroots innovation and entrepreneurial experimentation than by government-led interventions. Over time, as their operational benefits became more visible and their presence more normalized on city streets, policymakers began to adapt. What followed was a process of formalizing cargo e-bikes within London's regulatory and strategic frameworks.

Early on, policy attention focused more broadly on last-mile logistics and emissions reduction. The 2007 London Freight Plan and subsequent freight strategies dating back to the mid-2010s emphasized consolidation centers, off-peak deliveries, and low-emission zones, and cargo bikes were mentioned only as an emerging alternative. This changed over the next several years, especially as TfL worked to align freight with cycling strategies and as cities across Europe began investing directly in cargo e-bike solutions.

By the time TfL released the 2023 Cargo Bike Action Plan, the city had put cargo e-bikes at the center of its sustainable freight strategy. The plan laid out a comprehensive policy framework to identify and support the development of microhubs; provide guidance to boroughs and developers on planning and land use; standardize safety requirements; and develop tools for monitoring and evaluating performance. Policy had caught up to what was happening on the ground, affirming that cargo e-bikes were not just permitted, but actively encouraged, stating: “Our goal is to promote and enable the growth of cargo e-bikes to make them a leading option for last-mile freight and service trips” (Transport for London 2023). The plan emphasizes collaboration and acknowledges the fragmented regulatory environment across London’s 32 boroughs, proposing standardizing approaches to curb access. This is especially critical when issues such as illegal parking can undermine even the best-laid mobility strategies (Transport for London 2023).

On the regulatory side, TfL took a measured but proactive stance. Recognizing the diversity of vehicle types and operator models, it avoided rigid licensing requirements, opting instead to develop voluntary design and safety standards. These were later formalized with the 2025 release of the London Cargo Bike Safety Standard. Though not legally binding, the standard is valuable guidance for large logistics firms, for whom alignment with TfL guidelines is key to gaining access to public contracts and street space (Transport for London 2025).

The London Plan, the city’s overarching spatial development framework, was revised in 2021 and incorporated freight needs more explicitly by encouraging developers to allocate space in high-density areas and town centers for last-mile delivery facilities, including cargo e-bike depots. The University College of London’s Centre for Transport Studies also issued supplementary planning guidance to help local authorities and developers accommodate microhubs in new developments.

Despite these advances, policy consistency continues to be a challenge as borough-level regulation is still inconsistent and limited data on freight movements continues to make planning difficult. In spite of these challenges, cargo bikes are an increasingly normalized element of London’s logistics ecosystem.

Infrastructure and Logistics Integration

The potential of cargo e-bikes could not be fully realized without a complementary network of infrastructure to support them, as demonstrated by the slow rate of adoption between Gnewt's launch in 2008 to the larger boom in 2020 and beyond. Central to this has been the development of microhubs. Without these types of facilities, deliveries are only viable when the point-to-point shipment is within a few miles.

London's earliest microhubs were ad hoc, such as converted garages, temporarily leased storefronts, or underused spaces tucked into rail arches or car parks. Public authorities responded to these uses and the Cross River Partnership, a public-private collaboration hosted by Westminster City Council, became an early champion of consolidation strategies. Through pilot programs such as the London Light Freight Project, they worked with boroughs and logistics firms to test various hub configurations. Some were hosted on private land, others on publicly owned curbside or off-street spaces (Cross River Partnership 2023).

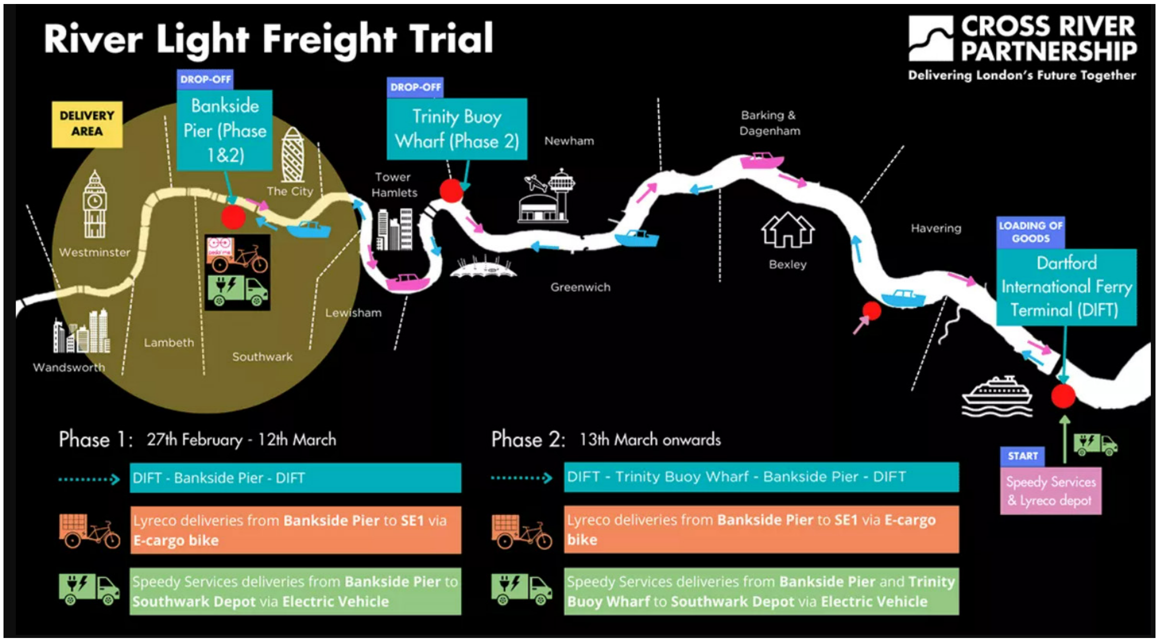

Figure 9. Cross River Partnership

Source: Cross River Partnership

Land availability remains a limiting factor. Central London real estate is scarce and expensive, and freight is often not a popular use compared to housing, retail, or public space. This tension has led to creative partnerships. In some boroughs, Business Improvement Districts stepped in to help broker deals between logistics operators and landlords. Elsewhere, TfL itself has explored repurposing parts of its real estate as temporary or rotating hub sites.

The private sector has also innovated in this space. As an example, Zedify operates with a "hub-and-spoke" model where packages are received at peripheral depots and sorted at inner-city microhubs (Baker 2022) with an emphasis on consolidated, timed deliveries to neighborhoods. This has enabled them to operate competitively even in the context of Amazon-scale expectations. Other operators such as Pedal Me have used flexible hub strategies, relying on partnerships with retailers and working directly with councils for space access.

Infrastructure integration has not just been about physical sites, but also about enabling access for cargo e-bikes. Some boroughs have introduced dedicated delivery bays for cargo e-bikes, while TfL has worked to ensure new cycling infrastructure can accommodate wider or longer cargo configurations, as called for in the Cargo Bike Action Plan.

Collectively, these efforts have created a logistical sub-ecosystem within London where goods can be transferred, stored, sorted, and dispatched within a low-emission, human-scale framework. However, the system is still in progress. Most hubs operate under short-term leases or informal agreements. There is no single zoning designation for urban logistics, and many cargo e-bike firms grapple with long-term spatial security.

Key Outcomes and Lessons

London's experience with cargo e-bike logistics offers a compelling glimpse into what is possible when policy vision, private initiative, and political will converge. While the system is still maturing, the city has already seen meaningful shifts. In areas with strong microhub support and well-integrated cycling infrastructure, such as Camden, Hackney, and parts of Westminster, cargo e-bikes have captured a growing share of deliveries. Companies report not just environmental benefits but also operational gains: faster delivery times in traffic-congested zones, reduced missed deliveries, and lower costs in dense neighborhoods where parking violations and delays are costly.

From a public policy standpoint, the most striking outcome is not mode shift, it's mindset shift. What began as a fringe movement is now anchored in formal planning documents, design standards, and infrastructure investments. Boroughs that once struggled to envision freight without trucks are now hosting active pilots and incorporating logistics into land use planning. At the same time, the private sector has gained confidence that the city will support, and not penalize, low-emission delivery models. Though still uneven across boroughs, these actions are helping to de-risk long-term investment in cargo e-bike fleets and microhub infrastructure.

The London case also reveals critical lessons for other cities. First, the success of cargo e-bikes depends as much on space governance as on technology. Without secure, well-located microhubs and curb access policies that reflect the realities of cargo e-bike logistics, the model will struggle to scale. Second, data and monitoring remain underdeveloped. While anecdotal and pilot-level data are promising, London, like many cities, still lacks a robust freight performance framework tailored to cargo e-bike operations. Finally, timing matters. The acceleration seen during the COVID-19 pandemic shows how quickly perception and policy can shift when a city is forced to innovate, but also how important it is to institutionalize those gains.

3.2 City of Berlin, Germany

Historical Context

Driven by congestion concerns and a desire to mitigate the contribution of freight to carbon emissions, Berlin turned to the cargo e-bike as an answer to last-mile logistics.

In the 2010s, Berlin witnessed the emergence of community-driven cargo e-bike sharing programs. The Allgemeiner Deutscher Fahrrad-Club (ADFC) launched "fLotte Berlin" in 2018, offering residents free access to cargo e-bikes for up to three days. This initiative aimed to promote sustainable urban mobility and reduce car dependency. The program's success led to its expansion through "fLotte kommunal," also free of charge, and this time in collaboration with local authorities, further embedding cargo e-bikes into the city's transportation fabric (Becker and Rudolph 2018) (Urban Sustainability Exchange 2025).

Simultaneously, private startups like Avocargo, founded in early 2021, entered the scene, providing app-based cargo e-bike rentals. These ventures demonstrated the commercial viability of cargo e-bikes and their potential to address urban logistics challenges, though they also showed the limitations in a status quo environment as many of these startups, including Avocargo, which folded in 2023, did not survive (Avocargo 2025).

Recognizing the potential benefits, Berlin's government introduced subsidies to encourage cargo e-bike adoption. In 2018, a €90,000 fund aimed at individual buyers was exhausted within a day, highlighting the public's enthusiasm. Part of the subsidy's success can be attributed to its lack of means testing, reducing a friction point where prospective users would have to file paperwork and proof of income, making it easy to apply (Schmitt 2018). Further support came through pilot projects like KoMoDo, which advanced the integration of cargo e-bikes into last-mile delivery services by providing a microhub for multicarrier use. The pilot project resulted in reduced noise and emissions, as well as fewer double-parked vans in the 3km (1.9 miles) radius around the hub (Zhen 2021).

Policy and Regulatory Environment

Berlin's policy and regulatory framework for cargo e-bikes is anchored in the city's commitment to sustainable urban mobility, as exemplified by the Berlin Mobility Act (Mobilitätsgesetz). Enacted in 2018, this legislation combines Vision Zero goals with climate measures with the resulting elements being supportive of active modes of transportation for both people and goods. Immediate measures include the development of safe bicycle lanes along identified main roads and the redesign of intersections to improve safety for people bicycling. This act also sets rules for how transportation planning processes must transpire, resulting in planning decisions that prioritize modes of transport that help to advance the climate and safety goals over the speed and convenience of people driving motorized vehicles into the city (City of Berlin 2018).

In addition to infrastructural commitments, Berlin has implemented financial incentives to encourage the adoption of cargo e-bikes. Companies and independent contractors can apply for subsidies up to €2,500 from the city when purchasing a cargo e-bike. At the federal level, Germany's subsidy program offers grants covering 25 percent of the purchase cost, up to a maximum of an additional €2,500 per cargo e-bike or trailer, provided the vehicle is used for commercial purposes (Pembina Institute 2021). These subsidies are part of broader efforts to integrate low-emission vehicles into urban logistics and reduce reliance on fossil fuels.

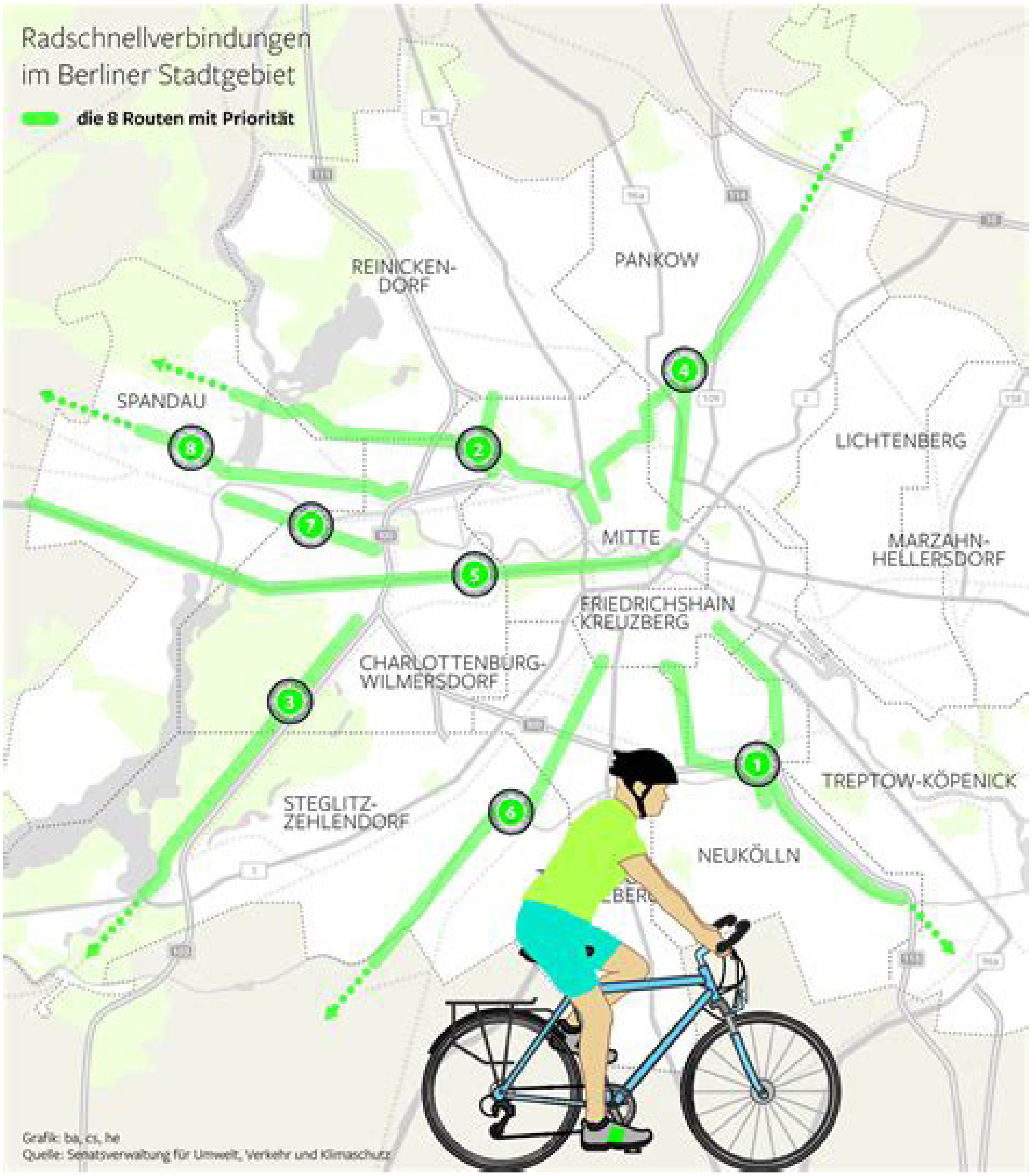

Figure 10. Berlin Priority Routes Connecting Outskirts with Last-mile Destinations

Source: FixMyBerlin

Berlin has not issued any regulations defining cargo e-bikes, allowing innovation in models and design. However, they are under the jurisdiction of the European Union's standards for safety specifications and testing methods that cover all e-bikes. These regulations help prevent some of the issues discussed in our interviews related to lower quality cargo e-bikes, including the potential of battery fires (Pembina Institute 2021).

Recently, Berlin has also focused on the development of microhubs to facilitate efficient last-mile deliveries. The establishment of such hubs required regulatory changes, including the allocation of urban space and the adaptation of zoning laws to accommodate these facilities as well as convincing residents that this is a valuable prioritization of limited urban space (City of Berlin 2019) (Gruber, Heldt, and Seidel 2023).

Infrastructure and Logistics Integration

Building on the success seen in the KoMoDo pilot, Berlin has worked with private carriers and landowners to expand its microhub network to more than 70 locations around the city, with a mix of public and private operation models (Zhen 2021). Within this cluster is the Te-Damm microhub, launched in 2020 near Tempelhof, which has specialized space for local producers to drop off their goods for delivery, showing an example where microhubs need not serve only one direction in terms of the flow of goods (Gruber, Heldt, and Seidel 2023). This network does have some remaining limitations. Approximately 86 percent of Berlin's microhubs are utilized by only a single carrier, which can minimize the utility of valuable urban land (Zhen 2021).

Berlin is also leveraging digital solutions to optimize cargo e-bike logistics. The UNCHAIN project, for instance, integrates real-time traffic data and microhub availability, enabling cargo e-bike operators to plan efficient and safe delivery routes. This data-driven approach aids policymakers and planners in making informed decisions about microhub placements and urban logistics strategies (POLIS Network 2023).

Key Outcomes and Lessons

One of the most instructive elements is the way Berlin embedded cargo e-bikes into its broader mobility policy through the 2018 Mobility Act. The Act prioritized cycling and public transport system-wide, mandating new protected cycling infrastructure that could accommodate larger vehicles like cargo e-bikes. This legal and planning foundation allowed subsequent interventions, like microhubs and delivery regulations, to fit into a coherent multimodal strategy. From an infrastructure standpoint, Berlin's cycling network expansion has included not only more kilometers of lanes but also changes in design typology to accommodate larger bikes, turning radii, and loading zones. This reflects a shift in mindset that is more important than any one given project or regulation.

Figure 11. Bike Parking Designed with Cargo in Mind

Source: Cargobike.jetzt

Another key takeaway is Berlin's deployment of shared microhubs through projects like KoMoDo. This model offers a template for reducing curbside conflicts and emissions without requiring each operator to develop their own depot real estate footprint. The success of this project depended on city-led facilitation, access to strategically located urban land, and a willingness to coordinate among otherwise competing firms, all of which must be addressed explicitly in policy design elsewhere if it is to succeed on a scale larger than Berlin has thus far accomplished. A city may, for example, make municipal properties in strategic locations available for use as a microhub with a requirement that multiple carriers be able to use the space. Alternatively, zoning codes, under which microhubs are typically considered an industrial use, can be leveraged to make hubs easier to site if they allow for multiple carriers. This latter option can be particularly effective if the microhub is not being directly owned and operated by the logistics firms making the deliveries, as was observed in Montréal.

Berlin also demonstrated that direct financial subsidies can rapidly accelerate adoption. The city's cargo e-bike incentive program was not only popular, selling out immediately, but also provided evidence of strong latent demand among both commercial and individual users when cost barriers are removed.

3.3 Bogotá, Colombia

Historical Context

Bogotá's transformation into a cycling-friendly city began in 1974 with the inception of Ciclovía, a weekly event where major roads are closed to motor vehicles every Sunday, allowing more than 1.5 million residents to engage in cycling, walking, and other recreational activities (Taylor 2024). This initiative was instrumental in shifting public perception towards cycling, setting up the public and political will necessary to further push the frontiers of bicycle culture in the western hemisphere over the next several decades.

As Ciclovía's popularity grew over the 1980s and '90s, political leaders such as Mayor Enrique Peñalosa leveraged the visibility of the popularity of the event to promote a cultural shift towards bicycling for everyday transportation, not just for recreational Sunday rides. At the start of Peñalosa's term in 1998, the city had a bicycle mode share of 0.58 percent. The mayor launched a campaign of building out high-quality bicycle facilities based on a simple yet empowering understanding of their purpose: "A protected bike way achieves two things," he says. "One, it protects the cyclist. But second, it raises the social status of the cyclist. It shows that a citizen on a $30 bicycle is equally important to a $30,000 car" (Helme 2021). By the end of Mayor Peñalosa's second term in 2019, the city had reached a bicycle mode share of nine percent, exceeding any other major city in the western hemisphere (Copenhagenize 2019).

Figure 12. Ciclovía
Source: City of Bogotát

As part of this cycling revolution, in 2016 the city introduced Plan Bici, a four-year strategy to double the mode share of cycling to 10 percent of all trips by 2020. The plan included the construction of at least 120 km (74.5miles) of new cycling paths and maintenance of an additional 100 km (62 miles) of existing paths. As of 2022, an extensive network of bike paths known as Ciclorrutas spanned over 564 kilometers (350 miles), making it one of the most comprehensive in Latin America (Balaguera 2022). Like other cities that have seen significant penetration by cargo e-bikes, these route networks were developed with the goal of improving mobility for people or improving connections to transit but have proved to be vital groundwork for enabling freight mode shift.

The emergence of cargo e-bikes in Bogotá can be traced back to small-scale initiatives aimed at addressing the common urban challenges such as traffic congestion and pollution. A notable example is Bogbi, a Colombian-Norwegian collaboration that began in 2016 producing handmade cargo e-bikes designed for urban logistics and family transportation. The founders, Eduardo Moreno and Sigurd Kihl, envisioned cargo e-bikes as a practical solution for navigating the city's dense traffic while promoting sustainable mobility (Parr 2018).

Building upon these efforts, in 2020 the city launched the Bicicarga program, a pilot initiative aimed at integrating electric cargo e-bikes into last-mile delivery logistics. The program tested collaborative distribution models between private sector stakeholders through a cross-docking platform where electric trucks bring the products and consolidate them into the cargo e-bikes for last-mile delivery. During the pilot's first phase, the partnership replaced two trucks and four motorcycles with eight electric cargo e-bikes, avoiding 1.97 tons of CO2. Due to this success, a second phase was developed and launched in December 2021. During the second phase, four additional cargo e-bikes, including one that carries refrigerated cargo, replaced two trucks, saving 1.62 tons of CO2. Through efficiencies, BiciCarga also reduced 2.3 hours of daily working hours of drivers. As operators are paid a salary or on a per-delivery commission, as opposed to an hourly wage, this time savings is accrued to the operator without cutting into their wage. It also increased the number of deliveries made per hour by 67 percent and the number of deliveries per kilometer by 63 percent (P4G 2022; Urbano, 2023a).

Figure 13. Refrigerated Cargo Containers Improve Food Delivery
Source: Despacio

Policy and Regulatory Environment

Prepared by earlier experience to recognize the potential of cargo e-bikes, the Bogotá
Prepared by earlier experience to recognize the potential of cargo e-bikes, the Bogotá
city government was quick to encourage their adoption. In 2016, Colombia enacted Law 1811 providing incentives for bicycle use, including provisions that support cargo e-bike utilization for both personal and commercial purposes (Boxer-Macomber 2017). For example, it mandates the inclusion of bicycle parking spaces in all car parking lots and offers benefits such as a half-day off work and a free public transport trip for every 30 bicycle commutes to work.

In February 2021, the city's Secretary of Mobility formalized the Política Pública de la Bicicleta (Public Policy of the Bicycle), aiming to improve conditions for cyclists and promote cycling as a viable mode of transportation (ITDP 2023). This policy aims to improve the physical and cultural conditions of Bogotá to make the city more hospitable to cyclists, with a focus on gender inclusion and making it safer for women to cycle. This priority was reflected in the structure of the Bicicargo pilot program, which had a heavy emphasis on understanding the barriers women face in cargo e-bike delivery. One of the early emerging interventions from the results of this pilot, which identified safety as the biggest barrier to more women taking positions in cycle-logistics, is development of women specific professional associations, trainings, and support meetings (Urbano 2023b).

Our research into Bogotá did not uncover many of the regulations present in the North American and European cities we examined, such as definitions and restrictions on what constitutes a cargo e-bike, where it can operate, or land use reforms to encourage the development of microhubs. This could be attributed to a regulatory environment that is, on average, less restrictive as a starting point than other cities examined (Pinilla and Rodriguez Vitta 2018).

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Infrastructure and Logistics Integration

The city has not yet developed a publicly coordinated microhub network to support cargo e-bike logistics at scale. Bogotá's efforts have largely focused on expanding the general cycling network through projects like Ciclorrutas rather than building logistics-specific infrastructure such as microhubs.

This lack of formal, public infrastructure tailored to urban logistics has not stopped the integration of cargo e-bikes into the city's delivery networks among private sector actors. Beyond Bicicarga, major delivery and logistics firms, alongside smaller enterprises, have adapted to the existing urban form. Bogotá's dense, mixed-use land patterns and permissive street-level commercial activity allow for relatively seamless deployment of cargo e-bikes without the need for formal microhubs. Companies have relied on informal consolidation points, private warehouses, and in some cases, modified storefronts to stage goods for cargo e-bike distribution (ICLEI 2022).

Key Outcomes and Lessons

Bogotá's experience with cargo e-bikes offers a different model from the approaches seen in most North American and European cities. Rather than being driven by top-down planning, planners have provided the canvas upon which private actors are able to thrive in implementing a pedal-powered freight program. In doing so, Bogotá demonstrates that progress in sustainable urban logistics does not always require high-cost interventions if the broader foundation for mode shift is already underway. As they have been moving in that direction since the 1970s, conditions were more aligned for adoption to happen organically in comparison to most North American cities.

A defining characteristic of Bogotá's model is its ability to leverage informality and mixed-use density as assets rather than liabilities. While European cities often depend on carefully planned microhubs, restricted access zones, and curb management regimes, Bogotá's logistics operations have evolved within a permissive environment where small-scale commercial uses are embedded throughout the city. This enables e-bike couriers and cargo e-bikes to operate effectively without the need for centrally planned consolidation and staging points. For North American cities, where rigid zoning and separated land uses are common barriers to last-mile efficiency, as came up in many of our interviews, Bogotá's example demonstrates the possibilities of flexible zoning.

Another important lesson is Bogotá's use of public policy to signal support for cycling. Initiatives like the Bicicarga pilot, the Política Pública de la Bicicleta, and the country's national Ley Probici provide enabling frameworks without overly burdening the sector with rules on speed, size, or operational zones. This light-touch approach has allowed experimentation and localized adaptation. In contrast, cities like New York or London often wrestle with highly specific regulatory constraints that can inadvertently stifle innovation. Bogotá's regulatory restraint has fostered a spirit of entrepreneurial experimentation that can be difficult to cultivate under heavier regulatory frameworks.

Bogotá's model is not without limitations. The absence of public investment in logistics-specific infrastructure, such as microhubs or managed curb space, may hinder long-term scalability. Moreover, without systematic incentives or funding mechanisms, the transition to cargo e-bikes remains largely dependent on external partners or motivated private actors. In this sense, while Bogotá's example is instructive for its flexibility and adaptability, it also highlights the importance of eventually formalizing and supporting these operations to achieve broader system-level impacts.

4 Peer Interviews in North America and Canada

To explore the commercial cargo e-bike last-mile delivery operations in North America, we met with industry experts to learn about their experiences developing pilot programs and operating cargo e-bikes. While our primary focus for this study is on commercial delivery applications, we also spoke with a range of businesses that cater to consumer use to gain a broader perspective.

We connected with 15 organizations across the United States and Canada. The interviewees included representatives from the public sector—such as departments of transportation, municipalities, and a transit agency—as well as community-based organizations, research organizations, cargo e-bike operators, and vendors offering a range of services. The participating vendors represented a range of innovative services, from a brick and mortar bike shop that tailors to the consumer cargo e-bike market, to commercial cargo e-bike logistics and last-mile delivery operators, to on-demand roadside bike repair services such as NEMO's mobile maintenance units and CargoB. The list of organizations interviewed can be found in Appendix A and a sample questionnaire from interviews can be found in Appendix B.

Participants shared a range of motivations to explore and implement cargo e-bike solutions in urban logistics. These motivations included a desire to decarbonize freight activity, comply with policy mandates to reduce emissions, experiment with smaller, slower and safer modes for last-mile delivery, improve urban livability, and respond to funding-driven urgency. Many public agencies saw cargo e-bikes as a tool for congestion mitigation, a low-emission alternative to step vans for last-mile delivery, and a way to improve delivery efficiency, particularly in dense urban areas where traditional trucks are often stuck in traffic while trying to reach destinations in downtown commercial districts. In areas where loading zones are limited or occupied, using cargo e-bikes can also help reduce double-parking due to their compact size and ease of parking, addressing a common issue that contributes to traffic congestion, delays emergency response vehicles, and compromises overall road safety.

In many cases, cargo e-bike pilots were initiated with a mindset geared toward experimenting with creative urban logistics solutions, whether through city-sponsored logistics hubs, public procurement programs, or startup partnerships, with a willingness to embrace risk as a foundation for early adoption. Some pilots emerged from municipal testing programs, such as city maintenance crews piloting the use of cargo e-bikes. On the personal and entrepreneurial side, user-driven motivations emerged from lived experience with bikes, lack of service-oriented retail in their immediate surroundings, and a desire to support sustainable mode shift that led to exploring business ideas to support the community. Interviewees often advanced their interest through local pilot programs, observed last-mile delivery challenges, or broader visions for sustainable and efficient transportation alternatives.

Through these interviews, five central themes emerged, each offering overlapping yet distinct insights into what it takes to deploy, scale, and sustain cargo e-bike programs.

4.1 Pilot Implementation Challenges

Interviewees described a wide range of challenges encountered during the implementation of cargo e-bike pilot programs. Microhubs emerged as a cornerstone of operational viability, yet their deployment was often hindered by unclear permitting processes and difficulties aligning physical space with operational and maintenance needs, such as electrical and plumbing. One of the most consistent barriers mentioned was site selection and facility procurement, as high urban land costs and zoning constraints made it difficult to deploy microhubs in locations that are in proximity to highways as well as final last-mile delivery destinations. .

> *"We expected to find a location for the mini hub within six months, but it ended up taking us 14 to 17 months to find the right place. Our initial plan was to open five hubs, but by then, we knew we wouldn't be able to open all five within three years. If we could open one, that would be a success."*
> *—A representative from Coop Carbone*

Interviewees also noted a mismatch between cargo e-bike needs and existing infrastructure, citing safety and maneuverability concerns, particularly in shared environments not designed to minimize conflicts between users.

Design and planning processes of the pilot programs were often constrained by rushed timelines tied to funding deadlines, limited internal scoping opportunities, and unclear definitions of success in early stages. Several participants shared their experience of launching pilots without adequate time to identify an anchor client or test pilot site suitability, which led to implementation breakdowns and difficulty maintaining continuity post-pilot.

> *"I think the program design process should include identifying the anchor client, the operator and/or the staging location. Only then should the program be launched and contracts executed."*
> *—Harper Mills, City of Boston (Boston Delivers)*

Interviewees emphasized that successful cargo e-bike delivery systems depend heavily on well-structured, mission-aligned partnerships between public agencies, private operators, and community organizations. When asked about how success was defined, public sector participants often noted that simply launching a pilot was considered an achievement, given the numerous challenges encountered during planning and implementation. Some also highlighted long-term adoption and measurable delivery replacement as key indicators of success. While emissions reduction was viewed as an important outcome, it was not always the primary metric used to evaluate program success.

On the other hand, private sector participants emphasized operational performance and viability, pointing to consistent delivery volumes, client retention, and cost efficiency as key indicators. Additional shared measures of success included the formation of strategic partnerships, strong interest from anchor clients and delivery operators, and observable behavioral changes such as increased cargo e-bike purchases or usage for short-distance trips.

Despite these setbacks, pilot programs served as valuable testbeds for exploring microhub strategies, partnership models, and evidence-based regulatory approaches, providing critical lessons for longer-term cargo e-bike integration. For instance, in Seattle, several pilot projects were conducted not only to demonstrate feasibility, but also better understand challenges before scaling up. In Vancouver, a shared microhub pilot that was unable to take off revealed key planning gaps around interdepartmental coordination and maintenance responsibilities. In Montréal, the Colibri project piloted a city-supported, NGO-managed mini hub model where private delivery companies operated as clients of a neutral third party.

4.2 Policy and Regulation

Interviewees shared how certain policies, such as cargo e-bike classifications or zoning constraints created barriers to cargo e-bike implementation, while others such as flexible permitting processes and pilot-friendly regulations could enable cargo e-bike adoption. They identified a broad and evolving set of policy and regulatory considerations shaping the adoption of cargo e-bikes. Interviewees emphasized the need for regulatory flexibility, suggesting that reframing cargo e-bikes as a functional extension of e-bikes would help avoid overregulation..

> *"I think many cities tend to focus policies on regulatory criteria and restrictions, and not enough on the incentives and subsidies to encourage private sector participation." — Kelly Rula, University of Washington Urban Freight Lab*

There was widespread concern about the lack of clear and consistent definitions for cargo e-bikes, especially as vehicle types evolve beyond conventional two- and three-wheeled formats, with different jurisdictions basing their definitions on number of wheels, weight, width, or speed.

Participants discussed the importance of incremental regulation through permitting frameworks, vehicle eligibility rules (such as fleet size limits or speed restrictions), and curb access policies that could accommodate cargo e-bikes. Key regulatory challenges included zoning as a barrier for microhub siting, lack of standardized infrastructure compatibility, and insurance gaps related to battery safety. Battery safety and quality certification also emerged as pressing concerns, particularly in light of growing fire incidents. However, some participants also highlighted the growing safety standards and technologies that are helping to mitigate these risks.

Another concern raised by interviewees was the lack of protected bike lanes. While cargo e-bike deliveries could operate without them, interviewees emphasized that the absence of dedicated, safe infrastructure limits scalability and raises safety concerns. Interviewees emphasized that regulation should encourage rather than stifle innovation, especially in the early stages of cargo e-bike adoption.

> *"I think many cities tend to focus policies on regulatory criteria and restrictions, and not enough on the incentives and subsidies to encourage private sector participation." — Kelly Rula, University of Washington Urban Freight Lab*

Interviewees recommended prioritizing learning over enforcement during pilot phases to ensure that policy remains adaptive to on-the-ground realities.

4.3 Operational Barriers

Interviewees underscored that while cargo e-bikes offer a promising alternative to traditional urban freight vehicles, their deployment faces a range of operational barriers. These challenges were identified across a variety of geographies and stakeholder types. One major operational barrier frequently cited was infrastructure, including the limited network of protected bike lanes (particularly for rider safety among newer or less experienced cargo e-bike riders), suitable microhub staging areas, dedicated transloading zones and safe storage facilities. As discussed in the Pilot Implementation Challenges section, difficulties in microhub site selection due to high costs, limited availability of space for microhubs, and zoning constraints often persisted into the operational phase, limiting the ability to maintain efficient, proximity-based delivery routes.

Operators reported maintenance burdens unique to cargo e-bikes, including terrain-induced wear and tear, challenges with battery performance in extreme temperatures, and the importance of access to trained bike repair professionals. While weather was not considered a major operational barrier, its impact varied by geography. The following perspectives from our interviewees illustrate these differences:

"You would expect that the weather would impact the cycling company. The reality is it doesn't, at least in Portland."
—Franklin Jones, B-Line Urban Delivery

"The battery over the winter would not charge very well. Overnight, the temperature can be minus 15 Fahrenheit, if not worse. At that temperature, you're not going to be able to charge the battery very efficiently."
—Omar Choudhry, City of Ottawa

In response to such challenges, the courier company in Ottawa secured a climate-controlled garage where batteries could be charged and packages sorted. One interviewee noted that during severe snowstorms or heavy rain, operations temporarily reverted to traditional vehicle delivery to ensure service continuity. However, the Ottawa courier experienced no service disruptions from snowstorms or heavy rains during its first year of operations.

Logistics partners, operators, and vendors described how the limitations in cargo capacity, trip ranges, and battery life require careful planning of delivery routes and schedules. An example of cargo capacity limitations comes from the City of Portland's Parks and Recreation department, which experimented using cargo e-bikes along the Springwater Corridor Trail for trash removal. While cargo e-bikes were initially seen as a promising option for accessing the trail, they realized over time that it wasn't the right tool for the job due to the limited carrying capacity. However, they noted that cargo e-bikes can be a great tool when matched with the right application. To address these constraints, operators emphasized the importance of right-sizing vehicles (such as using trikes and quads) to maximize payload without compromising maneuverability.
Others shared that access to insurance, secure parking, union and non-union labor dynamics (in shared microhubs), and bike repair support systems were critical but often overlooked components of long-term operations. Cities and vendors alike emphasized that without addressing these pain points, cargo e-bikes risk becoming a symbolic solution rather than a scalable one.

"The insurance environment in the United States for doing repairs on e-bikes is very difficult. It's very expensive to pay for insurance to do work on e-bikes and as a result electric cargo e-bikes."
—Worth Smith, NEMO Bike Repair Services

Overall, stakeholders stressed the importance of integrating infrastructure planning, maintenance ecosystems, and policy reform to unlock the full potential of cargo e-bikes as a reliable and scalable delivery mode.

4.4 Urban Logistics Transformation

Cargo e-bikes are broadly seen as an important tool for facilitating freight mode shift, especially for short-trip and last-mile deliveries. Interviewees shared that shifting from vans or trucks to bikes was attractive for both environmental and operational reasons. Still, the feasibility of this shift was highly dependent on context. Since traditional logistics systems are built around large, centralized operations, shifting to decentralized models like cargo e-bike delivery hubs can be challenging due to institutional resistance and entrenched workflows. Interviewees consistently pointed to urban form and land use as factors shaping the feasibility, efficiency, and scalability of cargo e-bike delivery systems. Densely built environments with high commercial density and short-trip lengths were described as ideal conditions for cargo e-bike operations, offering logistical efficiency.

Cities and vendors highlighted the growing use of smart logistics platforms such as app-based fleet tracking and IoT integration for route planning. For example, B-Line Urban Delivery, a cargo e-bike operator noted that “IoT devices on our vehicles are linked in and processed data is packaged and sent to the city,” enabling municipalities to access real-time insights on cyclo-logistics activity and better understand how these systems function in practice. This data-driven coordination reflects the shift from viewing cargo e-bikes as just vehicles to seeing them as part of a broader logistics ecosystem. Interviewees underscored that shifting from vans to bikes requires more than just new vehicles. It demands rethinking and restructuring logistics systems, building out microhub networks, and reimagining urban design to enable efficient bike-based routing.

Government actors are considered instrumental in enabling modal shift, not just as regulators or funders, but as strategic conveners, ecosystem builders, and enablers of innovation. Their role encompasses targeted subsidies, inclusive program design, and integrated infrastructure planning to support long-term mode shift.

> *“As city staff, our best role is to at least encourage uptake in cargo e-bikes—to continue to build an environment that’s more bike-friendly and people-friendly, making these alternative modes more attractive than driving.” — Mike Zipf, City of Vancouver*

Interviewees reflected optimism that cargo e-bikes can serve as both a proof-of-concept and an on-ramp to broader decarbonization strategies when integrated into long-term freight planning efforts..

4.5 People-First Freight Solutions

Access and community inclusion emerged as recurring priorities throughout interviews, with stakeholders raising questions about who benefits from cargo e-bike adoption and who may be left out. Interviewees highlighted that expanding access to cargo e-bike delivery programs requires deliberate, multifaceted strategies to address structural, geographic, and informational barriers. Many cited the importance of inclusive program design, noting that small businesses and lower-income users face significant challenges due to limited incentives, retail availability, and a lack of awareness of cargo e-bike options. In Seattle, Katherine Rice at the Seattle Department of Transportation described how they engaged community organizations, business district groups, and small to medium businesses throughout the program design process to ensure the initiative would be responsive to local needs. They also emphasized the importance of creating open channels to hear public concerns and questions at every stage.

Some interviewees raised concerns about the impacts of rebate programs, noting that while financial incentives are essential to lowering adoption barriers, the incentive was often too modest to encourage meaningful uptake. They also emphasized the need for better targeted outreach, simplified application processes, financing options, and safeguards against low-quality equipment that can undermine trust among first-time cargo e-bike adopters.

The comfort and convenience of modern cargo e-bikes, particularly “bucket” models, received praise for enabling riders of varying experience levels, further reinforcing their potential to serve a broad demographic beyond seasoned cyclists. For example, Dorothy Fennell of CargoB On-demand Bike Share—the first bike share system in North America to offer on-demand public access to cargo e-bikes—shared that they partnered with the City of Boston’s Open Streets Series to create an opportunity for community members to meet the team, experience a cargo e-bike firsthand, and even take a short test ride.

Programs such as community-based microhubs, vehicle demo events for new, interested, or exploratory riders of cargo e-bikes, and on-demand bike share models (like cargo e-bike sharing platforms similar to bike and car sharing) were highlighted as promising strategies. Ultimately, participants called for bottom-up adoption strategies that center community voices, local service capacity, and shared governance to ensure cargo e-bike delivery is not just innovative, but also accessible across diverse user groups and neighborhoods.

The map below highlights all the cities examined through our literature review, case studies, and stakeholder interviews, summarizing the geographic scope of our research.

Figure 14. Geographic Distribution of Cities Examined in this Study
Source: MPO Staff.

5 Current Regulations and Practices in Massachusetts

In Massachusetts, legislation defining e-bike classifications was signed into law in 2022. The state recognizes two categories of e-bikes, Class 1 and Class 2, defined as electric bicycles with motors up to 750 watts and a maximum assisted speed of 20 miles per hour. These classes are legally distinct from motorized bicycles and do not require a license, registration, or insurance to operate them. Riders are permitted to use Class 1 and 2 e-bikes on bike lanes and roadways, though sidewalk riding is prohibited statewide (MassBike 2023).

Cargo bikes or cargo e-bikes are not defined as separate vehicle classes under Massachusetts Law and are instead treated the same as standard bicycles or e-bikes respectively. Cargo bike configurations such as trikes and longtails are included under Class 1 or 2 designations as long as they meet the same wattage and speed limitations. There is no statewide minimum age requirement for operating Class 1 or 2 e-bikes, though riders under age 16 must wear a helmet. All users of motorized bicycles must be at least 16 years old and wear helmets (MassBike 2023). E-bikes must also comply with all traffic laws applicable to vehicles, including obeying traffic signals, stop signs, and lane markings (LetricGo).

Although Massachusetts does not have statewide safety regulations specific to e-bike batteries, municipalities such as Cambridge have adopted best practices, recommending UL 2849 or EN 15194 certified batteries, and encouraging professional repairs to reduce fire risk (City of Cambridge 2024).

6 Recommendations and Best Practices

The following recommendations and best practices from this study are intended to guide the planning, implementation, and scaling of cargo e-bike delivery pilot programs.

Program's visioning and planning

- Define a clear purpose, goals, and success metrics for the cargo e-bike pilot program to assess cargo e-bike suitability for community needs.
- Allow adequate time for planning, scoping, and designing the pilot with built-in learning objectives to gather insights and feedback throughout the program.
- Establish a framework for collecting quantitative and qualitative data to support evidence-based decision-making, iterative adjustments, and comprehensive program evaluation.
- Facilitate internal coordination among relevant departments to assess feasibility, identify challenges, align interdepartmental needs, and address any gaps before the launch of the pilot. Consider all potentially involved parties, including transportation, land use, code enforcement, economic development, and others.

Policy and regulatory frameworks

- Define cargo e-bikes in local ordinances using clear eligibility criteria, (range of dimensions, cargo weight, and/or electric versus manual classification) while maintaining flexibility to avoid overregulation. Instead, adopt phased or incremental regulations and policies that can evolve the mode scales in operation. Flexibility in allowable cargo e-bike models is essential to explore the growing variety of designs and operational needs.
- Clarify and provide clear signage indicating where cargo e-bikes (including electric-assist models) are permitted to ride, load and unload, and park (e.g., sidewalks, bike lanes, multi-use paths, trails, on-street parking). Collaboration with neighboring municipalities, regional and/or state entities can help ensure consistency across jurisdictions.
- Address any intermunicipal policy restrictions that affect overall cargo e-bike operations.
- Explore curb management policies for diverse curbside space allocation and vehicle eligibility requirements to support consistent operations across jurisdictions.

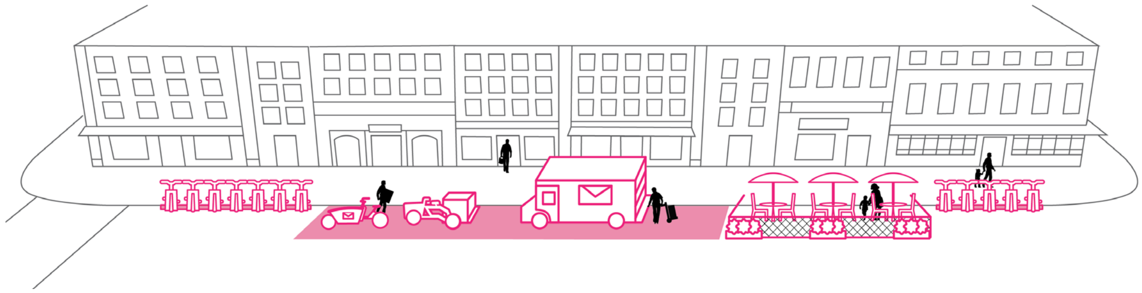

Figure 15. Reimaging Curb Spaces.
Source: MPO Staff.

- Update curb management policies to support cargo e-bike loading and unloading zones, especially near microhubs and designated delivery areas. Some examples of interventions may include
    - ◊ Zero-emission only loading zones.
    - ◊ Smart loading zones that allow pre-reservation.
    - ◊ Cargo bike accommodative parking racks.
    - ◊ Automated enforcement of loading zones.
    - ◊ Legalize cargo bike parking in on-street public parking spaces.
- When deciding delivery zones and routes, consider battery range, cargo capacity, and topography.
- Promote the use of cargo e-bikes with certified batteries to minimize fire risks and educate the public on the usage of cargo e-bikes with these batteries.
- Review zoning regulations to ensure microhubs are permitted in appropriate land use areas (e.g., industrial and mixed-use zones).
- Encourage repurposing underutilized spaces and support mixed-use zoning that enables decentralized deliveries.
- Include cargo e-bikes as a recognized mode of transportation and assess and revise traffic laws to support their use, including classification, lane access, parking, and roadway operations.
- Position cargo e-bike pilot programs within broader decarbonization efforts.

- If a municipality wants to keep track of active cargo e-bikes, they can establish a registration process for cargo e-bikes, especially for commercial use. An expansion of this process could include requiring rider orientation and training and/or registration of riders for commercial cargo e-bike uses.

Partnerships and community engagement

- Engage partners early in the planning process—even before launching the pilot—while defining program model, delivery needs, operational boundaries, and necessary service models such as maintenance, bike repairs, and shared cargo e-bike rentals. Partners could include anchor clients, operators, vendors, service providers, etc.
- Conduct proactive, inclusive community outreach and public engagement, either directly or through community-based organizations to educate residents and build public support.
- Communicate and develop educational materials on the benefits and use cases of cargo e-bikes, and address safety concerns or barriers raised by the community.
- Convene public safety officials for education and collaboration on e-bike battery safety risks, myths, and best practices.

Infrastructure and logistics planning

- Identify appropriate sites for microhubs, considering staging needs, safe storage, procurement timelines, infrastructure requirements (e.g., electricity and plumbing), and proximity to highway and delivery zones.
- Explore different microhub models (mobile, permanent, or repurposed spaces) to identify the most suitable model based on program goals and site-specific needs.
- Ensure basic amenities for operators (restrooms, charging, personal belongings storage, etc.) in all microhub models.
- Consider publicly owned spaces for microhubs to enable multiple operators and support wider adoption in areas with limited available land.
- Expand the bike network to support cargo e-bike operations through dedicated facilities on known delivery routes.

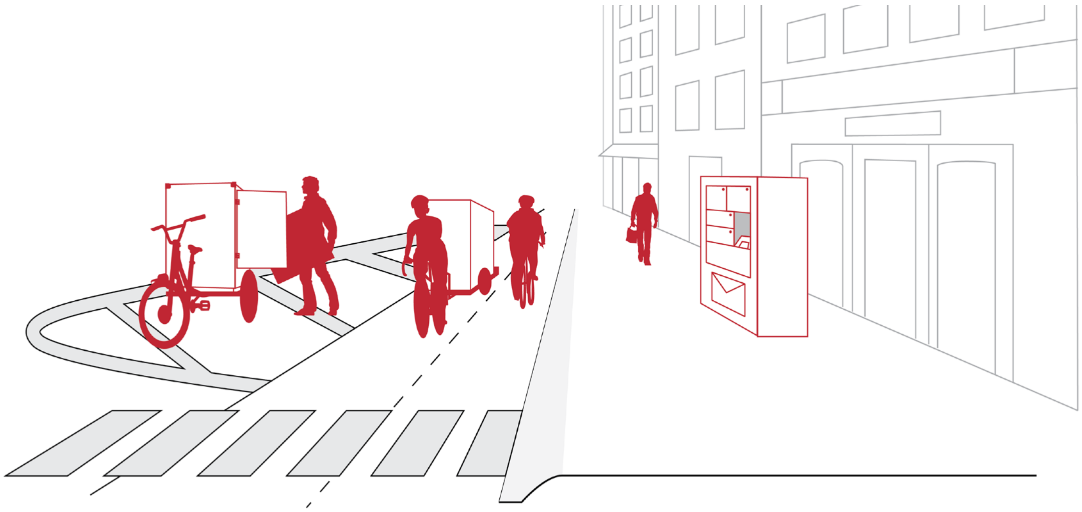

Figure 16. Cargo e-Bike Operations.
Source: MPO Staff.

- Provide safe, secure, and accessible cargo e-bike parking spaces to support reliable operations and long-term adoption.
- Review bicycle facility design guidelines for ability to facilitate cargo e-bike use.
- Ensure year-round maintenance of cargo e-bike routes, including snow removal, to support continuous operation.
- Incorporate freight considerations into complete streets and urban mobility planning.

Training and workforce development

- Design inclusive pilot programs that benefit small and medium-sized businesses and low-income communities.
- Simplify application process and avoid means testing to encourage participation and reduce barriers.
- Provide rider training workshops and promote flexible ownership or rental models for cargo e-bikes.
- Invest in local workforce development and create training programs for cargo e-bike operators and cargo e-bike repair experts, with a focus to increase participation among women and underrepresented groups to support diverse participation.

- Host inclusive demo sessions, such as test rides, open streets activations, or ride-along.
- Promote adaptive cargo e-bike models and ensure outreach includes accessibility considerations.
- Consider requiring basic training or certification for commercial riders, including guidance on age requirements and helmet use.

Pilot program evaluation

- Collaboratively define success metrics based on program goals, such as successful pilot launch, long-term cargo bike adoption, truck delivery volume replacement, vehicle-miles traveled and emissions reductions, client retention, cost-efficiency, strategic partnerships and observable behavioral changes.
- Incorporate data collection efforts into the pilot design and work with operators to identify relevant performance metrics early in the process.
- Conduct post-pilot evaluations and use lessons learned to refine the program and to scale up when possible.

Funding-related

- Establish state- or federally supported grant programs for businesses, similar to existing grant programs targeting individuals such as those operated by the Massachusetts Clean Energy Commission, to fund pilot initiatives, including vehicle procurement, microhub facility permitting and acquisition, community outreach, and data processing and analysis. Pilot projects should focus on the needs of the target businesses that may include
    - ◊ Independent contractors in the gig economy, making ad hoc deliveries.
    - ◊ Small operators and businesses with specific and predictable clients.
    - ◊ Large logistics firms with robust supply chains and high delivery volumes.

- Provide targeted support for service businesses that offer cargo e-bike maintenance and repair services.
- Offer targeted financial incentives to the public to support cargo e-bike adoption and to reduce cost barriers for cargo e-bike adoption.
- Explore the role of tax incentives and subsidies in encouraging cargo e-bike adoption and expansion by businesses, ensuring these benefits reach those who need them most.

7 Conclusion and Areas for Further Study

This study confirms that cargo e-bikes can deliver substantial environmental, operational, and safety benefits when integrated into urban freight systems particularly in dense, mixed-use areas. Realizing these benefits at scale depends on a range of enabling conditions, including access to appropriately sited microhubs, clear and flexible regulatory frameworks, and infrastructure to accommodate safe bicycle travel. Operational challenges must also be considered. Successful programs typically combine supportive infrastructure such as protected bike lanes, well-located microhubs, flexible regulations, and strong public-private partnerships. Pilots have proven to be valuable learning platforms, revealing the importance of right-sized vehicle selection, safe battery charging and storage, and logistics models tailored to local land use and curb access conditions. Regulatory flexibility has allowed for innovation, while targeted incentives and subsidies have accelerated adoption.

Certain topics surfaced during the study that required additional exploration due to a lack of definitive consensus or sufficient evidence supporting a clear recommendation. For example, while wider bike lanes were suggested as a potential infrastructure upgrade to support the operations of cargo e-bikes, there is a concern that emphasizing lane width could generate additional pushback against bike lane implementation overall. Existing bike facility design guidelines generally accommodate cargo e-bikes adequately, making network expansion and connectivity a higher priority for operational safety and viability.

Similarly, the question of whether cargo e-bikes should be allowed on existing bike lanes involves considerations around safety, allowable speed, weight, and how cargo e-bikes coexist with other users. These factors may vary depending on the specific cargo e-bike model, speed, dimensions, and rider comfort. Therefore, it remains unclear whether standardized regulations would be effective or if local discretion is preferable.

Another area of uncertainty that emerged is the lack of tailored insurance frameworks for commercial cargo e-bike operations. Stakeholders expressed concerns about safety of riders and liability. While this issue is complex and often shaped at that industry or state level, it remains a potential risk in adoption.

To address these gaps, future research could include developing a comprehensive Cargo Bike Action Plan to guide strategic planning, implementation, and scaling of cargo e-bikes in the region. In addition, the Boston Region Metropolitan Planning Organization's (MPO) Active Transportation Program's Bike Network Gap Analysis effort findings could help identify key infrastructure deserts in the region to support cargo e-bike integration. A region-wide microhub site selection study could be a follow-up study that focuses on identifying locations with proximity to high-volume freight delivery areas and opportunities to support last-mile decarbonization. In addition, the MPO's Active Transportation Program's Bike Network Gap Analysis effort findings could help identify key infrastructure deserts in the region to support cargo e-bike integration. These initiatives would help provide the evidence base needed for further guidance and policy development.

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Appendix A

LIST OF STAKEHOLDERS INTERVIEWED

MPO staff conducted interviews for this study with the following stakeholders. We would like to thank them for their time and we appreciate their insights.

Stakeholder	Category
Seattle Department of Transportation	Public Sector
University of Washington Urban Freight Lab	Research Organization
Portland Bureau of Transportation	Public Sector
B-Line Urban Delivery	Operator
City of Portland (via email)	Public Sector
City of Ottawa	Public Sector
COOP Carbone	Non-Profit Cooperative
Translink / City of Vancouver	Public Sector
City of Montreal	Public Sector
New York City Department of Transportation (NYCDOT)	Public Sector
CargoB On-Demand Electric Cargo Bike Share	Bike Share Operator
City of Boston – Boston Delivers	Public Sector
Net Zero Logistics	Operator
NEMO Bike Repair Services	Repair Service Provider
Mission Electric Bike Shop	Vendor

Appendix B

SAMPLE INTERVIEWEES QUESTIONNAIRES

This study involved semi-structured interviews with stakeholders from public agencies, cargo bike operators, service providers, and researchers. While the main questions remained consistent, the interview questionnaire was tailored to each interviewee's background, expertise and role. Below is a sample questionnaire.

Sample Questions: Public Sector/Researchers

- Can you please provide an overview of your agency's efforts to integrate cargo e-bikes into urban delivery systems?
- What motivated you to explore and support cargo e-bikes as a logistics solution?
- What incentives, if any, did you provide to encourage private-sector adoption of cargo e-bikes, and how did this collaboration shape the initiative?
- What infrastructure changes, if any, were necessary to support cargo e-bike operations (e.g., bike lanes, loading zones, parking)?
- Were there any regulatory or policy adjustments required to accommodate cargo e-bikes?
- What were the biggest challenges (and/or unexpected obstacles) in implementing cargo e-bike initiatives and how were they addressed?
- What metrics have you used to evaluate the success of cargo e-bike initiatives (e.g., emissions reduction, delivery times, cost savings)?
- How did you address concerns or challenges raised by businesses, such as cost, operational constraints, or logistical feasibility?
- What is the key lesson learned from your experience with cargo e-bikes?
- Are there any specific best practices or recommendations you would share with other cities or regions looking to implement similar programs?

Sample Questions: Operators

- Can you tell us about your organization's mission?
- How do cargo e-bikes compare to traditional delivery trucks in terms of cost efficiency and environmental impact?
- How do you efficiently plan the trips and deliveries?
- What are some of the logistical challenges you've encountered with cargo e-bike deliveries?
- How do you monitor the battery levels and maintenance needs of your e-bikes?
- How do you handle weather conditions or other external factors that may affect the use of cargo e-bikes for deliveries?
- How do you monitor cargo capacity and ensure that deliveries are balanced and optimized for each e-bike?
- Do you collect any data from your cargo e-bikes?
- Are there any new technologies or improvements to cargo e-bikes that you're particularly excited about?

Sample Questions on cargo bike integration and pilot program

- Could you share your overall experience developing the pilot program and establishing partnerships?
- What steps were involved in establishing a contract and launching the pilot, and what preparations were required?
- What were the pilot program's goals, and how was success measured?
- Did you receive any feedback from community members or businesses about the program?
- What key lessons were learned from the pilot?
- What are some considerations related to cargo e-bike fleet maintenance? Has wear and tear led to frequent maintenance needs and downtime for the cargo e-bike fleet?

- How important is including bike repair support as part of a pilot?
- What types of data collection have been most helpful in refining the program?
- What are the key considerations when running a pilot with limited funding? How to plan for the post-pilot phase?

Wrap up question

- Would you recommend getting in touch with anyone else with expertise in cargo e-bikes who might be interested in speaking with us?

Appendix C

Lithium-Ion Battery Safety

High-profile incidents in which a battery sparks an intense fire have drawn national attention, with the United States Consumer Product Safety Commission declaring in 2022 that “Destructive and deadly fires from lithium-ion batteries in e-bikes have reached a crisis level.” (Trumka 2022). These incidents are not limited to personal e-bikes, with major bikeshare operators such as Lyft and Lime having to recall bikes or halt operations due to battery fires (Rodriguez 2019).

These types of fires, created by a chemical process called “thermal runaway,” are particularly concerning due to the nature of how they burn. A lithium-ion battery ignites in a rapid and intense explosion, and once the fire starts, it is incredibly difficult to extinguish, with best practice often being to let the battery fire burn itself out (Fleishmann, et al 2025). This poses a serious risk if the fire ignites inside of a residential building. Because many multifamily housing units are in dense, urban environments where e-bikes are more common, these housing units lack safe and secure outdoor storage for bicycles, resulting in e-bikes frequently stored indoors and often blocking points egress, where many of these fires occur.

In a fleet setting, as opposed to individuals who are responsible for charging their own battery, many bikes or batteries may be charged at the same place at the same time. While this may sound like a recipe for larger and more dangerous fires, in practice a business is easier to regulate than an individuals operating out of their own apartments. Hazardous practices such as blocking an egress with a charging bike are easier to prevent while preventive safety measures can be put in place prior to the beginning of operations.

However, strong safety regulations around the manufacture, transport, maintenance, storage, and disposal of these batteries has been shown to be effective. Safety standards in the United Kingdom, for example, have contributed to the City of London having 55 percent of the e-bike fires and 17 percent of the related fatalities as New York City in 2023, where regulations were much looser (New York City Mayor’s Office 2024; (Ungoed-Thomas 2024). New York City has since mandated that e-bikes sold in the city meet the same Underwriters Laboratories (UL) safety standards as is mandated in both the United Kingdom and European Union (NYC Local Law 39 2023). Leaving regulation to the municipal level can only have a limited impact on safety, however, as batteries with little to no safety certification can still be brought into the city from outside jurisdictions. This issue can be addressed at the state level, where New York State in 2024 adopted legislation prohibiting the sale of e-bike batteries that have not been tested by a lab certified by the International Organization for Standardization (IOS) (New York S154 2024). Elsewhere in the United States, California adopted legislation that prohibits landlords from banning e-bikes if they conform with UL or European Union safety standards, encouraging safer bike adoption (California SB 712 2023).

The European Union's regulatory landscape for e-bike batteries is undergoing a significant transformation with the introduction of Regulation 2023/1542 on Batteries and Waste Batteries, which came into effect in February 2024 and replaces the earlier Battery Directive 2006/66/EC (Regulation [EU] 2023/1542 2023). This new regulation establishes comprehensive lifecycle requirements for all battery types, including those used in light means of transport (LMT) such as e-bikes. It mandates performance and durability standards, substance restrictions, labelling requirements, including QR-coded battery passports, and an implementation roadmap extending to 2027. For example, beginning August of 2024, LMT batteries must include detailed performance documentation, with digital battery passports required for batteries exceeding 2 kWh by 2027.

Battery safety is also governed through European standards, which are agency-issued regulations rather than the legislatively passed Regulation 2023/2642. EN 15194 is the principal standard for e-bikes and incorporates requirements for electrical systems, including references to EN 62133-2, which specifies safety testing for lithium-ion batteries. These standards address risks related to overcharging, short-circuiting, thermal stability, and mechanical abuse, key concerns in both transport and storage of e-bike batteries. The Low Voltage Directive (2014/35/EU) and the Restriction of Hazardous Substances Directive also apply, ensuring electrical safety and limiting hazardous substances such as lead, cadmium, and mercury in battery components (Malloci 2024).

While no EU-wide charging standard for e-bikes currently exists, Regulation 2023/1542 requires the European Commission to assess the feasibility of standardizing charging interfaces by the end of 2025. In the meantime, best practices and national level safety guidance, such as Germany's VDMA 24994 standard for fire-safe battery storage cabinets, are shaping local policies (Verband Deutscher Maschinen- und Anlagenbau 2024).

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