Boston Delivers Cargo Bike Pilot Evaluation

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May 2025

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Contents

Executive Summary

Boston Delivers is a pilot project that promoted sustainable methods of making neighborhood deliveries for local businesses in Allston, Brighton, and the surrounding area. Instead of motor vehicles, packages were delivered by electric cargo bikes. The Boston Transportation Department (BTD) partnered with Net Zero Logistics (Net Zero) to carry out this delivery service. Net Zero Logistics provided electric cargo bikes, made deliveries, and coordinated delivery logistics. The Massachusetts Clean Energy Center (MassCEC) funded the pilot through their Accelerating Clean Transportation for All (ACT4All) Program. The pilot intended to test the policy implications of using right-sized delivery vehicles in urban environments, generate societal co-benefits from an efficient and sustainable mode for goods movement, and share learnings with a broad audience.

The city outlined four core goals as follows:

1. Support Local Businesses,
2. Reduce Urban Congestion,
3. Improve Street Safety, and
4. Reduce Pollution

Furthermore, the city created five learning objectives for the pilot program, as follows:

1. **Identify the policies, programs, and regulations** that need to change to allow for e-cargo bike delivery in the City of Boston;
2. **Test infrastructure changes** needed to accommodate e-cargo bike delivery, including but not limited to e-cargo bike delivery zones, staging and sorting areas, parcel lockers, and other last-mile logistical needs;
3. **Measure the benefits** of e-cargo bike delivery, including its impact on environmental, safety, and economic metrics;
4. **Understand the costs and feasibility** of e-cargo bike delivery for different types of businesses;
5. **Share findings** on e-cargo bike delivery and communicate to delivery service providers that the City of Boston is ready for e-cargo bikes to be used on a larger scale.

The 18-month pilot began in September 2023 and concluded in February 2025. The Boston team successfully recruited a logistics partner (Net Zero), onboarded and launched a new delivery service, and completed thousands of deliveries on behalf of underserved populations during the pilot period. Net Zero and BTD worked with four different clients who utilized the service:

- a private “meals on wheels” service provider (City Fresh Foods),
- a local restaurant (OliToki),
- a local non-profit (Allston Brighton Health Collaborative), and
- a catering service that fulfilled group food orders for corporate offices.

Between September 2023 and January 2025, **18,375 deliveries** were made (approximately **20,000 units**) with an estimated total of **5,881 cargo bicycle miles traveled** and an estimated savings of **2,352.5 - 3,193.5 of kg CO2e (carbon emissions) avoided**. By replacing larger vehicle trips, these outcomes directly contributed to the City’s goals of reducing neighborhood congestion and the chances for serious crashes, improving air quality through less tailpipe pollution, and showcasing new delivery methods that could benefit local businesses.

The pilot demonstrated that e-bike deliveries could be a feasible alternative to cars for specific delivery scenarios. **Critically, Boston created a strong pilot framework that referenced big picture agency goals but focused on measurable pilot learning objectives.** This approach allowed for a flexible and adaptive approach during pilot design and implementation, which made the pilot all the more successful. With an adaptive approach, the city was able to uncover important key learnings for future pilots.

While the critical elements of the pilot were achieved (launching a cargo bike operator, performing thousands of deliveries, and focusing on an underserved neighborhood), **key learnings for future sustainable delivery programs from the pilot included:**

- Flexibility in pilot design and implementation is critical during the execution of any pilot program and especially when working in close partnership with multiple organizations and companies.
- There is a need to coordinate and potentially partner with anchor clients or partners with significant volume ahead of launching a sustainable delivery program.
- For pilots or programs that require space for staging, identifying location(s) for these activities, and ensuring they can be launched expediently and permitted in a timely manner, is critical for success.
- When choosing a pilot geography, the use cases for e-bikes for last mile delivery should be evaluated in terms of existing neighborhood density, ease or lack thereof in making deliveries by large van or truck, and whether the neighborhood already has significant numbers of bike deliveries and a robust cycling culture.
- Organizers should understand the economics of programs that involve multiple non-governmental and private sector organizations, including the significant start up (capital) costs required, and the importance of achieving economies of scale in delivery volume to ensure long-term financial health of a program.
- Broader citywide goals and policies around safety, congestion relief, and decarbonization can help center urban delivery goals in broader contexts (potentially allowing for additional funding, programmatic support, communication, better unit economics, etc.).

Overall, the goal of this pilot evaluation is to reflect on the City of Boston's pilot experience and provide transparency about these learnings to a wide audience. We hope that the information below will provide real value for future City of Boston initiatives, delivery service providers and vendors, and cities nationwide as they continue to focus on ways to unlock greater efficiency in urban deliveries and realize a wide array of societal benefits.

Background and Introduction

Need for a Shift to Sustainable Delivery Travel Modes

The City of Boston has an ambitious goal of becoming carbon neutral by 2050. A key lever to achieve this goal is to decarbonize the transportation system, namely by reducing the number of trips taken by internal combustion engine (ICE) vehicles and transitioning those trips to more sustainable modes - such as walking, biking, and public transit, with any remaining vehicle trips being zero-emission (electric, for example). The City's **Climate Action Plan, Go Boston 2030**, and the **Zero Emission Vehicle Roadmap** provide details on the path Boston is taking; however, to date, these plans do not directly address the growing impact of freight, parcel, and on-demand delivery services.

Explosive growth in e-commerce and on-demand delivery services has led to growing pressures at the curb. With increasing competition for limited curb space, activity is spilling over into travel lanes as double parking, bus and bike lane blocking, and increased congestion. A report from the Metropolitan Area Planning Council (MAPC) entitled **'Hidden and in Plain Sight: Impacts of E-Commerce in Massachusetts,'** identifies the growing threat delivery vehicles pose to local climate goals and transportation networks. As detailed in the report, at the current pace of growth, the volume of delivery vehicles on streets will increase 36% by 2030, resulting in a 32% increase in vehicle emissions, and an average of 21 minutes added to commute times. To become carbon neutral, the City of Boston must make changes to the way goods are delivered.

Deliveries by smaller vehicles including e-bikes and e-cargo bikes are common in many European cities, with use only starting to grow in the US. These vehicles have the potential to solve many of the challenges posed by the increasing presence of delivery vehicles and provide for a more efficient means of completing last-mile deliveries. A pilot project by the University of Washington Urban Freight Lab found that e-cargo bikes traveled 50% fewer miles per package delivered than delivery trucks, and that one e-cargo bike mile could replace 1.4 truck miles, resulting in a 30% reduction in vehicle emissions per package delivered. When combined with a network of delivery hubs, carbon emissions reduction can be as much as 50% per package. A pilot program conducted by the New York City DOT found comparable results, with e-cargo bike delivery replacing vans or box trucks on a 2:1 or 1:1 basis, depending on the route.

Grant and Conception of Pilot

Boston Delivers was conceptualized as a pilot program to respond to the goals and increasing demands for curb space mentioned above. The program was funded through a $490,000 ACT4ALL grant from the Massachusetts Clean Energy Center (MassCEC) awarded in 2021, a state economic development agency dedicated to accelerating the growth of the clean energy

sector across Massachusetts. The ACT4All Program funds pilots that increase clean transportation access and decrease transportation existing burdens for underserved and overburdened communities across the Commonwealth. The grant provided to the City of Boston reflected MassCEC's focus on developing the next generation of clean energy technologies and innovators while promoting equity, a core goal of the ACT4ALL program.

With grant funding in hand, the city sought vendors who could provide a turnkey solution for e-cargo bike delivery services for the Allston Brighton neighborhood. The city looked for a vendor that could offer end-to-end support for businesses and their customers, and who could easily implement this program within current business operations.

Much of Allston consists of environmental justice populations[1]. Intentional efforts were made to reach these populations, including translating program materials into Spanish, Chinese, and Russian. Through the pilot program, the city explicitly aimed to support small and minority owned businesses in the Allston Brighton neighborhood.

Pilot Goals

The city outlined four goals for the pilot, as follows:

1. **Support Local Businesses,** including small and minority owned businesses: The City viewed a shift of existing deliveries to e-cargo bikes as a way to support the local business community in Allston and Brighton, which are neighborhoods with a diverse population that include historically marginalized populations.
2. **Reduce Urban Congestion:** Delivery trips create congestion on city streets, and many vehicles are oversized for their delivery use cases (for example, using a passenger car or SUV to deliver a single meal). A core goal for the City was to promote the "right-sizing" of delivery vehicles to fit the urban context.
3. **Improve Street Safety:** By shifting more delivery trips to e-bike, Boston sought a means to reduce the size, speed, and environmental impact of commercial delivery vehicles. Through a shift of delivery trips to right-sized travel modes, the City aimed to make progress on its Vision Zero Boston commitment to eliminate severe and fatal crashes on city streets by 2030.
4. **Reduce Pollution,** through reduced vehicle miles traveled and greenhouse gas emissions: By promoting delivery trips by sustainable and zero-emission e-bikes, the city aimed to reduce vehicle miles traveled by delivery car, van, or truck, and to replace those trips with e-cargo bike trips. Fewer motor vehicle miles would then result in an accompanying decline in greenhouse gas (GHG) emissions from vehicle tailpipes.

[1] https://www.mass.gov/info-details/environmental-justice-populations-in-massachusetts

As is the case with many climate-focused transportation initiatives, the City hoped that the benefit of pollution reduction could be paired with valuable co-benefits to social and community health indicators (such as traffic safety) along with economic benefits that provide local, neighborhood-level gains to small businesses and marginalized communities.

Pilot Learning Objectives

To support these broad goals, the city identified several learning objectives for the pilot program. These objectives form the basis of the "Pilot Learning Objectives and Outcomes" section of this report.

1. **Identify the policies, programs, and regulations** that need to change to allow for e-cargo bike delivery in the City of Boston;
2. **Test infrastructure changes** needed to accommodate e-cargo bike delivery, including but not limited to e-cargo bike delivery zones, staging and sorting areas, parcel lockers, and other last-mile logistical needs;
3. **Measure the benefits** of e-cargo bike delivery, including its impact on environmental, safety, and economic metrics;
4. **Understand the costs and feasibility** of e-cargo bike delivery for different types of businesses;
5. **Share findings** on e-cargo bike delivery and communicate to delivery service providers that the City of Boston is ready for e-cargo bikes to be used on a larger scale.

With the understanding that several of these objectives were intentionally written within the frame of a pilot program, an overall view of the City was the need for a flexible vendor partner who could iterate and be willing to test out different strategies so as to inform learnings for future, potentially permanent programming.

Pilot Overview and Key Program Components

This section briefly describes the pilot's conception and setup. Additional information can be found in Appendix B (Additional Details Around Pilot Design) in this report.

Conception and Pilot Funding

In the summer of 2020, the Boston Transportation Department (BTD) released a Request for Information (RFI) to better understand the potential for e-cargo bike delivery in Boston. The city received replies from vehicle manufacturers, logistics providers, planners, and data

evaluators. BTD researched e-cargo bike delivery models and interviewed more than two dozen large and small delivery companies, local community organizations, academic researchers, and neighborhood groups. This information was used to develop a program model focused on attracting a turnkey e-cargo bike fleet solutions operator and to concentrate efforts on supporting small and minority owned businesses. In the fall of 2021 BTD was notified of a grant award to fund the pilot program, via the Massachusetts Clean Energy Center. The State's additional contribution led to availability of $490,000 in funding for the pilot, which was to include labor hours, the hiring of a vendor to run the program, funds for local neighborhood groups (such as the Allston Village Main Streets Association), and subsidies for local business partners (clients of the service) who wished to participate in the program.

Procurement of Turnkey Logistics Operator

After a competitive selection process, Net Zero Logistics was selected to operate the program. The company markets itself as one of the largest final mile logistics companies in the tri-state (NY/NJ/CT) area. The company is an innovative urban e-commerce delivery company focused on reducing carbon footprints by offering sustainable green delivery solutions. Net Zero Logistics and its affiliates operate hundreds of cargo bikes in New York City, however the pilot program in Boston was the company's first exposure to the Boston market.

In addition to promising to make connections and provide delivery subsidies, the City of Boston, through BTD, pledged to assist local community organizations with support to on-board them into the new program and designated a full-time program manager to staff the pilot program.

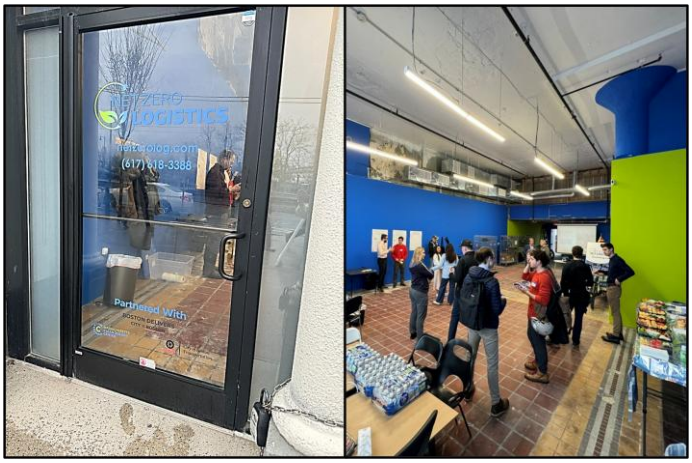
Operations Location, Hub Siting, and Start-Up

The pilot program area centered around the neighborhood of Allston and the Allston Village Main Streets district – an area identified as an environmental justice population. Allston is a fairly dense area, with 18,505 people per square mile, 50% greater than the city average. Allston has a significant immigrant population, hailing from South America, South Asia, and Eastern Europe, and they make up a large portion of the small business owners clustered around Brighton Avenue, Harvard Avenue, and Packard's Corner. These demographics reflected the City's desire to support small, local, and minority-owned businesses through sustainable solutions that reduce neighborhood traffic congestion and improve safety.

Map showing Allston and Brighton neighborhoods; Boston Delivers RFP

In order to find a suitable location for a logistics hub, the city and its selected operator, Net Zero Logistics, coordinated around needs to make the pilot operational. The city hoped to take a "scrappy" approach to staging and storage, such as using a shipping container on a surface parking lot (as used in a pilot conducted by the Urban Freight Lab in Seattle), namely to keep costs under control. The city believed using a city-owned parking lot could also help dramatically save on costs, like examples seen in Toronto and Europe. However, Net Zero noted that with more than one bike and rider in circulation at any given time, its base of operations would need to be more robust, requiring indoor battery charging availability. This dramatically changed potential options for a staging location, as an indoor location was deemed necessary for a centralized hub. The city eventually connected Net Zero to a vacant storefront near the pilot focus area. This storefront functioned as the main staging location during the pilot.

The city also installed a "No Parking" area and blocked off the space with bollards outside of the storefront location. This made the adjacent curb space inaccessible to motor vehicles and was used by Net Zero team members while they loaded and unloaded their cargo bikes. The city also installed an "Authorized Vehicles Only" zone adjacent to the No Parking area to facilitate transloading between motor vehicles and cargo bikes.



Picture of the Net Zero Logistics Hub on Commonwealth Ave, Photo courtesy of Net Zero Logistics

Business and Community Outreach

In parallel to the activities to prepare the hub location, the City and Net Zero Logistics set out to identify potential local business partners as well as community organizations that might be able to use the program and/or share information with local businesses. Several community organizations had initially promoted Allston as a neighborhood that would benefit from e-cargo bike delivery due to its high concentration of small, minority-owned businesses, along with the need to reduce pollution and safety concerns that have risen as the number of motor vehicle delivery trips have grown. These organizations either expressed support for the pilot and/or supported direct outreach to businesses and the public in the Allston Brighton community. They included Allston Village Main Streets, the Allston Brighton Health Collaborative, A Better City, Boston Cyclists Union, and CommonWheels.

BTD and Net Zero collectively took many approaches to community engagement and client recruitment. The team tabled at neighborhood events and festivals in Allston Brighton, presented at community meetings and found door-to-door canvassing more effective than emails and calls to small and local businesses and restaurants. The team also organized a presentation and cargo bike demo at the Longwood Collective, a non-profit that coordinates supportive services like transportation and childcare in the Longwood Medical and Academic Area of Boston. This event garnered over forty attendees.

The pilot team held an official launch event and open house at the Net Zero Logistics Hub in April 2024. The event was open to the public and organizers encouraged the local business and advocacy community to attend. The event consisted of a short presentation followed by live demonstrations of two e-cargo bike models with the Net Zero team. An activity was provided in which guests could share their own visions for making deliveries more sustainable. The event attracted about forty attendees and included a variety of advocates, local businesses, other

transportation and logistics professionals, and the State Senator for the area, William Brownsberger.

Photo of Open House in April 2024; Photo courtesy of Net Zero Logistics

Program Participants

Following site selection, contracting, and permitting, the Boston Delivers program formally launched in September 2023. At launch, two organizations had agreed to operate in the program. They were OliToki (a local restaurant) and Allston Brighton Health Collaborative's (ABHC) Community Supported Agriculture (CSA) program. ABHC's program provided boxes of fresh fruits and vegetables to food insecure populations in the neighborhood. In November, an additional organization (an office catering company that preferred to remain anonymous) began working with Net Zero but chose not to receive any subsidy from BTD and pay market rate for deliveries. Their platform allows companies to "batch" lunch orders for delivery to office workers. Finally, in April of 2024, Net Zero began completing deliveries for a local "Meals on Wheels" private contractor, City Fresh Foods (City Fresh), that sources and delivers government-subsidized meals to homes and apartments. Net Zero supported delivery of kosher meals to residents in the Allston Brighton area.

To manage the deliveries for the program launch, Net Zero Logistics hired two couriers (also referred to as "Delivery Associates" or "DAs") to carry out deliveries and one operations manager to oversee dispatch and the fleet. DA's received training on road safety and equipment/battery management. The overall logistics of the program was managed remotely by Net Zero's Operations team with the help of their logistics management software, Xcelerator. Three e-cargo bike form factors were deployed for the program: a Coaster Cycle

trike with a trailer, a Tern E-bike, and a Fulpra cargo trike. An additional vendor, Nemo, was brought on by Net Zero to provide on-demand maintenance for the bikes.

Photo of Net Zero Logistics bikes: First photo is the Fulpra cargo trike. The second photo is the Coaster Cycles trike. The third photo is the Coaster Cycles trike with trailer. Photos courtesy of Net Zero Logistics.

More details on each of the key program participants and experiences are detailed in Appendix A (Key Project Partners).

Pilot Learning Objectives and Outcomes

This section details the various learning objectives for Boston Delivers and evaluates the pilot's outcomes for each (see learning objectives on page 7 above). Overall, the Boston Delivers pilot delivered results for all the learning objectives set out at the onset of this project, with some producing higher yield learnings than others.

1. Policies, Programs, and Regulations

From a policy and regulatory perspective, the pilot was unimpeded by a lack of existing policy around light electric vehicles. The State of Massachusetts and the City of Boston do not have clear definitions and classifications for electric cargo bikes. However, this did not interfere with the pilot's progress or ability to launch and implement a program of this small scale.

During the duration of the pilot, the city also did not have an adopted definition of curbside use for e-cargo bike loading and unloading activities. However, due to the relatively small nature of the pilot, this was not reported as an issue by Net Zero Logistics or participating businesses. If e-cargo bike delivery grows more common in Boston, the designation of curb space for this specific activity may be warranted.

A significant effort was needed to determine proper permitting for the logistics hub that was established using a rented storefront space in the City of Brookline. If the location had been found in the City of Boston, it is likely similar permitting challenges would have arisen. The pilot showed that there is a need for more specific permitting schemes to facilitate the indoor charging of e-bike batteries and the allowance of multi-use purpose of commercial space.

2. Infrastructure Utilized and Required

From a hard infrastructure perspective, the primary need for the pilot was an indoor hub location to stage bikes and riders, charge batteries between trips, and dispatch riders out for pickups and deliveries. As noted elsewhere, it was challenging to find a suitable (and affordable) location for this purpose. Battery safety emerged as a critical concern during the program's implementation. With the growing use of lithium-ion batteries in e-bikes and e-scooters, ensuring safe charging practices was important to the City and Net Zero. Efforts to establish secure staging locations and adopt best practices for battery management not only enhanced operational safety but also contributed to broader discussions on regulatory frameworks for small electric vehicles. This highlighted the importance of developing robust guidelines to support the safe deployment of electric cargo bikes in urban environments.

The Allston-Brighton neighborhood did provide access to segregated bike lanes which did enable smooth operations, but neighborhoods like Roxbury, Dorchester, Jamaica Plain, and Mattapan still face significant safety concerns due to car traffic and lack of access to bicycle infrastructure.

While staging and charging considerations would be an issue with any e-bike pilot, the focus on food delivery resulted in specific challenges around the technological infrastructure used by end-consumers to make food delivery orders from restaurants. With an established ecosystem of companies like UberEats, Doordash and Grubhub, attracting interested restaurants to work with Net Zero Logistics, a turnkey logistics operator, was a challenge. Integration would require them to either set up new systems for ordering or use a more manual “self-delivery” option within these established apps. Despite multiple conversations with app representatives and restaurant owners, integration proved complex: a participating restaurant would have to take an “all or nothing” approach, meaning that if they wanted to deliver any orders by cargo bike with the pilot, they would have to manually manage all delivery requests through a separate process, removing some of the benefits of their arrangements with the app companies to manage an ecosystem of deliveries.

This experience underscored the need to understand the user experience from the client perspective- in this example, from the local restaurant perspective. Because of the difficulty in managing deliveries “in-house” or removing themselves from these major app platforms which drive significant demand, most local restaurants were unable to participate in the pilot and take advantage of the delivery subsidies that were provided. This digital integration issue is a good

learning to share with the app delivery providers and if addressed, might allow for more experimentation in delivery modes.

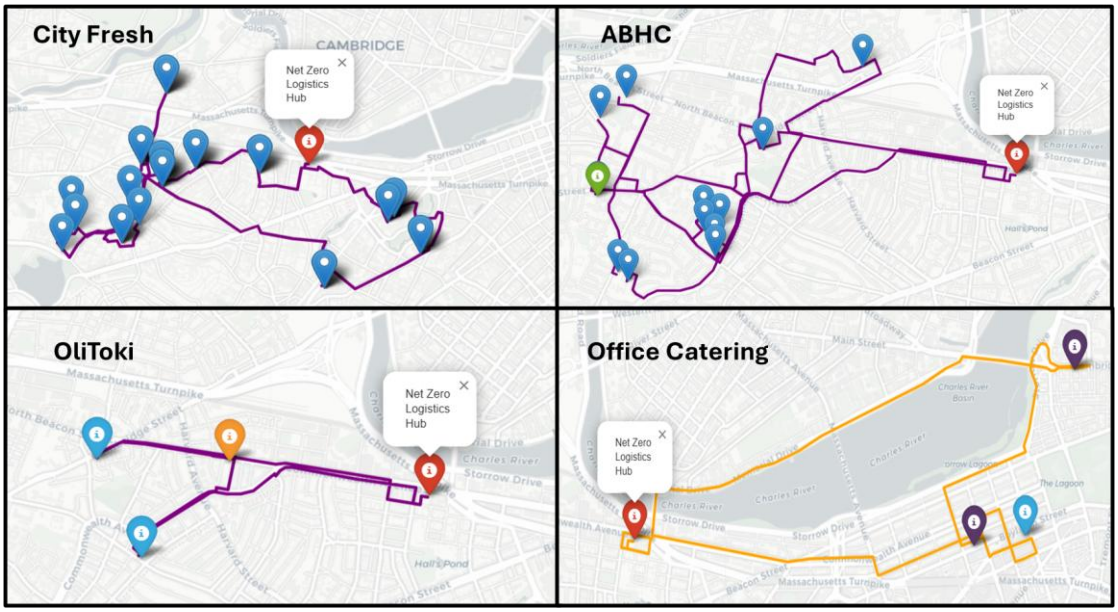
3. Impacts and Benefits

Over the course of the Boston Delivers pilot, delivery routing and volume data was collected. With deliveries that would have otherwise been in motor vehicles such as passenger cars, vans, or light trucks, every delivery made by e-bike is assumed to have resulted in pollution reduction, safer streets, and reduced congestion. These benefits varied based on the operations and routing of the different end clients in the pilot, which are detailed below before the summary statistics on pilot performance, which follow in the tables thereafter.

Delivery Patterns by Organization

All organizations that participated in the pilot centered around food or meal deliveries- with the majority of deliveries to underserved, low-income populations via City Fresh. Each organization operated on a slightly different delivery pattern as detailed below:

- **OliToki**: Involves one-to-one deliveries, where a delivery person handles one meal per trip. Operated from September - November 2023.
- **ABHC**: Deliveries involve one-to-many (tour), where a delivery person picks up multiple meals from ABHC and delivers them to various customers. Operated September - November 2023.
- **Office Catering**: This company's delivery model involves either one-to-many or many-to-many deliveries, where a delivery person picks up meals from various restaurants and delivers them to multiple customers. Operated November 2023 - October 2024.
- **City Fresh Foods**: Operates a one-to-many model (tour) like ABHC, but the delivery person collects meals directly from the Net Zero hub and delivers them to multiple customers, returning to the hub afterward. City Fresh meals were delivered to the Net Zero hub and delivered in two routes/day. Operated April 2024 - January 2025.



Representative route examples for each client.

Summary Statistics

Please find a detailed methodology in Appendix C (Data Analysis Methodology).

SUMMARY OF CARGO BIKE DELIVERIES AND ROUTES

September 2023 - January 2025

Company/Organization Name	Type of Organization	Months of Participation	Total Routes	Total Deliveries/Units
OliToki	Local Restaurant	3	10	14
Allston Brighton Health Collaborative (ABHC)	Local Non-Profit	3	6	60
Anonymous	Office Catering	13	255	467
City Fresh Foods	Private “Meals on Wheels” Delivery Provider	10	402	17,834 / 19,208

SUMMARY OF VMT AND CO2 REDUCTION IMPACTS

September 2023 - January 2025

Organization	Total VMT[2]	VMT /Route	VMT /Delivery	CO2 Reduction Compared to Passenger Car (kg)	CO2 Reduction Compared to Light Truck (kg)
OliToki, ABHC, and Office Catering	2126.3	7.93	3.93	850.5	1154.6
City Fresh	3754.9	9.34	0.21	1502	2038.9

Between September 2023 and December 2024, OliToki, ABHC, and the office catering app collectively operated on 173 delivery dates, averaging 12.4 days per month. The total number of routes during this period was 268, with an average of 19.1 per month. There were 541 deliveries in total, corresponding to an average of 38.6 deliveries per month. The total delivery VMT for these three companies was 2,126.3 miles, averaging 151.9 miles per month and 7.93 miles per route. These operations are estimated to have prevented the emission of 850.5 kg of CO2 when compared to passenger cars, and 1,154.6 kg of CO2 when compared to light-duty trucks.

For City Fresh, which only operated from April 2024 to January 2025 there were 201 total delivery dates, averaging 20 days per month. The number of deliveries during this period was significantly higher at 17,834, with an average of 1,920.8 deliveries per month. The total VMT amounted to 3,754.9 miles, with an average of 375.5 miles per month, and a notably low average of 0.21 miles per delivery, reflecting the high volume of deliveries per trip. This operation is estimated to have eliminated 1,502 kg of CO2 compared to passenger cars and 2,038.9 kg of CO2 compared to light-duty trucks.

Customer Satisfaction, Equity and Labor

All client organizations reported positive experiences overall with Boston staff, Net Zero staff and drivers, and the deliveries themselves. Two of the client organizations were equity and food access-related, focused on providing meals or fresh foods to underserved and vulnerable populations in the Allston Brighton neighborhood. For City Fresh, which provided kosher meals to low-income seniors, the direct recipients reported high satisfaction levels, particularly

[2] Please see details of route creation and VMT calculations in Appendix C, Data Analysis Methodology. Detailed route data was not available for Boston Delivers and VMT calculations should be assumed to be best estimates using the available data provided by companies.

regarding wellness checks and timely deliveries. See more details in Appendix A (Key Project Partners).

An additional benefit of the pilot was the jobs that were created to perform the deliveries themselves. Net Zero Logistics hired 8 Delivery Associates over the course of the pilot to staff two open courier positions. They also hired one manager to support dispatch and operations management from the hub location. These jobs were filled by local residents of the area, provided the benefit of a healthy and enjoyable form of travel via e-bike, and further contributed to the pilot's goal of supporting the local neighborhood economy and well-being of Allston Brighton.

4. Costs and Feasibility

Despite the benefits shown above, one of the major learnings from this pilot is that there must be a significant volume of deliveries to create a sustainable financial operation. Despite providing subsidy to the logistics provider, it was still challenging to find clients and create a viable operating market for an e-bike logistics company- a lofty goal. With the pilot ending and subsidies to local businesses no longer available, this made retention of clients or expansion to other clients even more challenging for the operator. As a result, the operator will depart the Boston market for the time being to return their focus to their existing clients in the New York City market.

The pilot program expenditures consisted of:

- Build out/improvement costs to prepare the hub for use
- Space rental costs for the indoor hub
- Delivery subsidies to local businesses and organizations
- Equipment
- Additional labor costs
- Outreach and marketing
- Pilot evaluation and best practices

A summary of actual grant expenditures is listed below although these costs do not include additional (and proprietary) expenses that Net Zero contributed to overhead, labor, marketing and sales, and operations management or the cost share match that BTD contributed to the pilot:

SUMMARY OF ACTUAL GRANT EXPENDITURES	
Cost Category	**Grant Expenditure**
Build out/improvements	$31,000
Rent	$110,000
Equipment	$28,000
Delivery subsidies	$110,500
Outreach/marketing	$57,000
Additional staff time	$28,500
TOTAL Subcontractor	**$365,000**
Pilot evaluation	$125,000
Overall Grant Total	**$490,000**

Build out, Rent, and Equipment

Operational costs were far higher than originally budgeted. As noted earlier in this report, finding a suitable indoor hub location was more costly than relying on government-owned space or outdoor staging. Funds that had been allocated to support City labor hours were moved into these two categories (Build out and Rent) to cover these unplanned costs. Of this amount, $110,000 went toward the rental of storefront space, and $31,000 was used to build out the space to specifications that the operator required for operations. Net Zero Logistics contributed approximately $15,000 of its own funds to complete the retrofits before launch.

Delivery Subsidies

To collaborate with local community organizations and encourage participation by local businesses in the pilot program, $111,000 was allocated for delivery subsidies. Program staff made numerous pivots throughout the pilot duration to determine how to best package the subsidies to maximize participation for delivery clients and reimburse Net Zero at a fair rate. BTD ultimately allocated the subsidy on a first-come, first-serve and as-needed basis using a loaded hourly rate that was agreed upon with Net Zero (as opposed to a per delivery rate). This resulted in one organization receiving the lion's share of subsidy overall. If a more distributed subsidy is a goal in a future pilot, cities could consider capping the number of deliveries/month eligible for subsidy or other means.

For OliToki, the low volume restaurant orders required that Net Zero staff delivery windows to stay at the restaurant and wait for orders to come in. ABHC and City Fresh both operated one-to-many routes in a small geographic area allowing more flexibility and greater efficiency in routing and costs. City Fresh reported that e-bike deliveries were significantly more expensive than car-based deliveries, even when scaled to 6-8 routes. This cost differential presents challenges for low-margin, community-serving businesses like City Fresh Foods.

Labor Cost Structure

With unpredictable and variable levels of end-user demand and delivery volume, it was difficult for the vendor to keep up with fair labor wages and materials costs (bikes and their maintenance). For labor, Net Zero hired full-time, W-2 receiving workers. This is desirable from a labor fairness and equity perspective and provides efficiencies via a "turnkey" set up with insurance and benefits covered, easy data extraction, and streamlined top-down communication from the City and Net Zero. However, paying full-time workers under a W-2 arrangement is at odds with the current economics of players in the food delivery space, where workers are usually contractors and are paid by the delivery, rather than at a fixed hourly rate. It was a challenge to have this type of disconnect between businesses with variable demand throughout the day and labor that is paid for in a more fixed, traditional approach.

Outreach and Staffing

The City of Boston, through the Boston Transportation Department, dedicated a program manager (65% of time over 3 years) to staff Boston Delivers as part of the cost-share element of the grant. This staff time was used to provide coordination among all parties, assist with outreach, and manage the grant and report on progress to the Massachusetts Clean Energy Center. In the long-term, even if e-bike delivery becomes more common and profitable, eliminating the need for this type of pilot programming, the City would likely still need to dedicate some level of staffing hours to manage a formal e-bike program, monitor for compliance with any regulations, and review and issue permits associated with operations. Net Zero received some reimbursement ($28,500) for staff time spent in pilot design and project management throughout the duration of the pilot, however, the amount provided was allocated after contracting and did not fully compensate for the staff time needed for this type of engagement.

Pilot Evaluation

BTD allocated over 25% of the grant budget to both Metropolitan Area Planning Council (MAPC) and the University of Washington's Urban Freight Lab (UFL) to complete pilot evaluations and in the case of MAPC a webpage with resources of best practices for other municipalities. This allowed the project team to assess the future feasibility of pilots of this nature.

Impact of Costs on Future Feasibility

Last-mile delivery in any vehicle is costly. Of the total budget expenditures above, Net Zero received $365,000 in reimbursement subsidy to cover costs of rent, equipment, and delivery labor line items. While funding was identified early on for a logistics provider, no anchor client was identified at the start of the project. Larger clients and distributors can provide consistency, higher volumes, and more predictable delivery schedules, while small businesses require more customized approaches that result in resource-intensive onboarding processes.

Effectively, the focus on underserved populations in an equity neighborhood during the pilot period made it harder to stimulate a new market for e-bike based delivery. Initial outreach found that most small businesses that did not already have delivery operations were more likely to see the service as a potential administrative or operational burden. And many were uninterested in utilizing a service that cost money long-term, notwithstanding the City's offer to subsidize during the pilot. For businesses already making deliveries, a universal concern was how the new cargo bike delivery service would integrate into their current operations and ordering systems and processes.

Finally, while all clients reported satisfaction with the service and were supportive of the goals of the pilot, e-bike delivery (without subsidy) was more expensive than vehicle-based delivery. Food is a point to point service, which provides limited "batching" opportunity- meaning that typically there is only one (or few) deliveries made to a given address at any given time. So while food being delivered on an e-bike makes sense in terms of the size of the "package", it may be best suited for independent/gig drivers that may be willing to switch to a personally-owned bike rather than logistics companies that rely on higher batching and longer routes to drive profitability.

5. Sharing Findings

The city and funders at MassCEC hoped to use the pilot as a means of sharing findings throughout the State of Massachusetts and nationally to support localities interested in integrating e-cargo bike deliveries into their logistics ecosystem. To that end, both BTD and Net Zero have spoken at numerous events and conferences nationally to share early learnings from the pilot. Those include local events in the City of Boston, national conferences like Micromobility America, and virtual webinars hosted by C40 and FHWA's Talking Freight. BTD also launched a dedicated program page early in the project to track developments: https://www.boston.gov/departments/transportation/boston-delivers. This report itself is a comprehensive assessment of the findings of the entire project which shows the benefits accrued while also covering the costs faced (expected and unexpected). It highlights how an iterative approach was and will continue to be needed to make advances in the e-bike market share for last mile deliveries. The City is hopeful that sharing these findings openly, with transparency around logistics and costs, is helpful for other cities who are considering similar programs and policies.

Recommendations for Future Cargo Bike Delivery Pilots

Boston Delivers showed that it is possible to create a supportive environment for the introduction of electric cargo bikes for commercial purposes in a new market by remaining flexible and adaptable throughout the pilot period. Their use can provide benefits in addressing concerns about urban congestion and environmental impacts, while resulting in good-paying jobs in underserved neighborhoods.

Nonetheless, there were several key learnings that can inform future pilots like this, and future growth of e-bike trips for delivery purposes.

1) **Pilots Require Maximum Flexibility:** Pilots are experiments that require the project managers and program participants to be creative, flexible, and persistent.
2) **Sequencing of the Pilot Program:** There is a need to coordinate and potentially partner with anchor clients or partners with significant volume ahead of launching a sustainable delivery program.
3) **Staging Hubs for E-Bikes:** For future pilots or programs that require space for staging, identifying location(s) for these activities, and ensuring they can be launched expediently and permitted in a timely manner, is critical for success.
4) **Use Cases for E-Bikes:** Density of a neighborhood, length of typical trips, and existing culture of making deliveries by bicycle will all play a role in the ultimate success of any given e-bike pilot.
5) **Economics and Costs:** All participants must better understand the economics of such a program, including the significant start up (capital) costs required, and the resultant need to achieve economies of scale in delivery volume to ensure long-term financial health of a program.
6) **Policy Alignment:** A deeper integration with broader citywide goals around safety, congestion relief, and decarbonization, which could help center urban delivery goals in broader contexts (potentially allowing for additional funding, programmatic support, communication, etc.)

Each of the six key learnings is examined in more detail below.

Pilots Require Maximum Flexibility

Pilots are experiments: cities should be creative and flexible to improve the odds of success. A broad lesson learned through all phases of the Boston Delivers pilot was that all participants had to embrace flexibility and adjustments in the approach and pilot delivery to achieve successful outcomes. For example, finding the right program partners that saw value in the use

case of delivering goods by e-bike required many conversations and different methods of outreach. Ultimately, several partners were found, and even then they had different needs. Organizers at BTD, alongside the logistics partners at Net Zero, had to successfully engage in constant coordination in order to launch operations and ensure the program would succeed. When managing relationships with multiple partners, including local non-profits who are often understaffed with their own budgetary constraints, and private sector companies who may be very cost conscious, the recognition that running a pilot will involve constant evolution and flexibility is critical for its success.

Sequencing of the Pilot Program

Get ahead on stakeholder outreach and understanding the market: It is never too early. Setting up a pilot program for success is critical regardless of the type of pilot. Talking to established players and understanding the existing market during the initial design and conception, can help pilot organizers better tailor their offering to solve challenges and needs. For urban deliveries, these players include retailers, receivers, carriers, and local government players and regulators. On the retail side, a client that can fill the role of an anchor tenant is incredibly important if the goal of the pilot is also to work with small businesses who operate on much lower volumes. For Boston Delivers, if an early anchor tenant had been identified before the pilot began, this may have provided sufficient demand to give the logistics company runway to gain traction and build a local client base with smaller businesses. The pilot organizers also faced challenges in finding leads outside the food delivery space, leaving them with operational challenges of a low-margin, point-to-point service. When designing a sustainable delivery pilot, the clients are critically important. Thus, it may be more strategic to source an anchor client and garner interest from small and local businesses citywide and then determine the geography or neighborhood to focus as opposed to selecting the geography or neighborhood first and clients second.

Staging Hubs for E-Bikes

Cargo bikes need the right location and facilities to perform. An extension of the lesson above around sequencing is also to launch with physical hub space(s) already identified and, ideally, fully funded. If a pilot owner anticipates operating out of city-owned property, it would be important to identify that property as early as possible once operator requirements are clear. Alternatively, a city could more heavily weigh which vendors already have staging locations identified, available, and ready for buildout during the RFP process, and/or which vendors would need the city's support in finding and paying for one.

Additionally, clearer permitting frameworks from municipalities would also be helpful as the use cases for staging hubs for light electric vehicles (e-bikes, trikes, or others) becomes more apparent. This area continues to evolve with battery technology and vehicle type.

E-bike based logistics hubs are a new concept in the United States and often require the repurposing of existing space in urban areas that have never accommodated this use type before. Heavy vehicles generally follow a simple model: they are loaded once and then dispatched out to make deliveries for the entirety of a driver's shift. E-cargo bikes and other small, light electric vehicles have limited capacity and require more than one loading event per day, sometimes at different hub locations. These hub locations must be much closer to the end customer than heavy vehicle hubs and therefore the real estate/space may be quite expensive. As a result, precise loading planning and routing is critical for success to achieve efficiency in deliveries and to maximize economies of scale.

Use Cases for E-Bikes

Cities and partners must find the "sweet spot" for what can and should be delivered by e-cargo bike. By their nature, e-bikes do not hold as much product (size or weight) as large vans or trucks and generally cannot travel as great of a distance at speed (for example, from a large distribution facility at a regional port into several outlying neighborhoods of a city). They can compete most effectively with large vehicles on shorter trips in very dense places, especially areas that have heavy vehicle congestion where operations are hampered with stop-and-go traffic and challenges finding available curbspace. Very dense central business districts, like in New York, have existing challenges for large vehicles that boost e-bikes as an inherently workable solution; in less dense areas, the right incentives and regulations are needed to make e-bikes compete successfully with legacy delivery strategies.

By leading with an equity lens and selecting the neighborhood of Allston Brighton first, the use case for e-bikes as a last mile delivery solution were limited in part by a small pilot area, making it challenging to identify situations where goods were being purchased and delivered within its 1-2 mile radius. If the pilot had been conducted in a more densely populated area with a greater number and diversity of potential delivery clients (Fenway, Back Bay, Downtown, Chinatown, Seaport) the results may have been quite different.

Economics and Costs

Cities and partners need a plan to overcome high start-up costs and thin margins that can be barriers to success. A throughline of the learnings listed above is the need to understand market economics and long-term financial pathways for delivery pilots. Cities and the public sector must do research to understand the significant start up (capital) costs required, and the resultant need to achieve economies of scale in delivery volume to ensure breakeven unit economics and long-term financial health of a program.

The Boston Delivers pilot aimed to help subsidize the start-up costs for cargo bike delivery with the assumption that the logistics operator would be able to profitably continue after the pilot ended and the subsidies were no longer available. While the subsidies did provide offsets to defray the transition costs incurred when entering a new market, the 18-month pilot period was not enough time to achieve the level of growth and client base needed to continue operations after the pilot was complete. Cities should anticipate that they will need to play a supportive role (either via direct operational subsidy, equipment subsidy, real estate subsidy or via other means) to provide a longer runway for this new type of logistics service to take hold. To prioritize equity, delivery subsidies were available only to Women and Minority Owned businesses in Allston-Brighton. Future grants and pilots might consider making equity-oriented subsidies available to a wider range of business types and sizes so long as they are delivering in Environmental Justice Communities. More flexibility in subsidy allocation may help to attract anchor clients with larger delivery volumes.

Policy Alignment

Cities should see e-cargo bikes as one tool in a toolbox to advance policies for equity, safety, and sustainability. For cities considering the evolution of delivery and urban goods movement, Boston Delivers shows both the promise of the shift and the challenges in connecting success with other planning and policy efforts. Broad city-wide goals around safety, congestion relief, and decarbonization can help center urban delivery goals in broader contexts if the effort is made to launch and promote e-bike deliveries alongside other "big moves." This includes Boston's recent safety ordinance requiring food delivery apps to maintain umbrella liability insurance for all workers utilizing their platforms and sharing data back to the City. BTD will require data about the types of vehicles used to complete deliveries in Boston, which restaurants experience the highest number of orders, and where and how quickly trips are completed. This information will give the City more details about how third-party delivery affects Boston's streets, which will be useful to inform future sustainable delivery policy that is localized to Boston.

In Boston, and most North American cities, there is still not enough of an economic disincentive to driving (as opposed to biking) to account for the differential in cost and time for bicycle delivery trips vis-a-vis driving delivery trips. This gap is shrinking in some cities who explore mobility management solutions (such as road pricing, e-bike incentives, or curb space restrictions for vehicles) as they look to manage driving trips in urban areas and reduce overall vehicle miles traveled. Supportive city investment around traffic calming and vision zero investment will also make the shift from delivering goods by vehicle to e-cargo bike more appealing. Some cities have begun to explore explicit plans for the Zero Emission freight movement, (NYC's Delivering Green) while others are considering a potential freight delivery fee attached to fossil-fuel vehicle delivery trips (within Seattle's Climate Change Response

Framework). Taken collectively, a policy framework with related investments and action that makes it easier and more efficient to bike relative to driving in urban areas will help make pilots like Boston Delivers more and more successful, as the market sees the advantages of sustainable urban delivery from an economic and time efficiency perspective.

ACKNOWLEDGEMENTS, APPENDICES, AND REFERENCES

Acknowledgements

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MassCEC: Elijah Sinclair, Soumya Atnoor, Jasmine Li

Additionally, thanks to representatives from OliToki, Allston Brighton Health Collaborative, City Fresh Foods, and NEMO for their feedback on the pilot.

Recommended Citation:
Rula, K., Rosenblatt, B., Mills, H., Chu, Y, Dalla Chiara, G., Warfield, M., Goodchild, A. (2025). Boston Delivers Cargo Bike Pilot Evaluation. Urban Freight Lab, University of Washington.

Appendices

Appendix A: Key Project Partners

Funder

The Massachusetts Clean Energy Center (MassCEC) is a state economic development agency dedicated to accelerating the growth of the clean energy sector across the Commonwealth to spur job creation, deliver statewide environmental benefits and to secure long-term economic growth for the people of Massachusetts. This program was funded through MassCEC's Accelerating Clean Transportation for All (ACT4All) Program. ACT4All funds equity-focused transportation pilots and programs that increase clean transportation access and decrease existing transportation burdens for underserved and overburdened communities across the Commonwealth.

Project Manager

The Boston Transportation Department oversees the transportation system in the City of Boston and includes functions around long-term planning, policy, design guidelines and standards, street operations, and permitting. Within BTD, the New Mobility team makes policy and tests innovative ideas. It manages transportation programs that are technology driven, on-demand, and shared. The New Mobility team managed the Boston Delivers pilot for BTD and the City of Boston.

Logistics Operator

Net Zero Logistics is one of the largest final mile logistics companies servicing the tri-state area (NY, NJ, and CT). Their participation in Boston Delivers was their first exposure to the Boston market. They have a vast knowledge of all service areas including on-demand, micromobility, and final mile solutions. They utilize dock-high trucks, vans, E- bikes, and foot couriers. They currently have roughly 300 E-Bike messengers, 150 foot messengers, and 350 drivers throughout New York, New Jersey, and Connecticut.

Maintenance Contractor

NEMO is an on-demand bicycle service company that was contracted by Net Zero to provide on-call maintenance for the bike fleet over the pilot duration.

Organizational Partners in Boston Delivers

Four different organizations participated in the pilot, all centered around food or meal deliveries. Most deliveries made were to underserved, low-income populations. The organizations were OliToki, the Allston Brighton Health Collaborative, City Fresh Foods, and an office catering company that chose to remain anonymous. Each organization is described in detail below.

Partner #1: A Local Restaurant

OliToki is a successful local restaurant offering Korean Mexican fusion cuisine that grew significantly with its delivery volume during and following the pandemic. The restaurant was recruited and found conversations with the City of Boston and Net Zero Logistics to be straightforward. They were interested in the pilot because they understood the mission to test innovative and sustainable delivery options, and this goal resonated with ownership. A major challenge, however, was determining how to allow Net Zero Logistics to oversee a portion of their online deliveries. OliToki had previously grown their online delivery presence via multiple apps such as UberEats, Doordash, Grubhub, Hungry Panda and Fantuan. However, they were unable to figure out how to syphon the app-based restaurant's orders to Net Zero. OliToki ended up creating a new order pipeline through a web-based service (Chownow), but this system still required them to forward any orders that came in from Chownow to the Net Zero Logistics team. As a result of this, the Net Zero team dedicated a bike courier from 4 to 9pm every Thursday to Saturday to OliToki. It remained challenging to direct orders to the Chownow platform, and delivery volumes were very low through the duration of their participation. The pilot did subsidize each order, but there was still not enough volume to support a dedicated bike courier to wait for OliToki orders during this long time window- thus requiring OliToki to pay an additional amount for each hour to cover the gap. Despite these challenges, the restaurant saw promise in the concept and suggested that integration into a dominant platform like UberEats, in conjunction with other restaurants in the immediate area, would be more useful for future exploration into sustainable deliveries. They remain supporters of the concept and hope that technological changes enable better integration in the future.

> *"If enough restaurants inquired or talked about this option, they might think about it more. The platforms [UberEats, Doordash, Grubhub] want to keep restaurants happy. For example, if a restaurant on a crowded street [has] deliveries getting backed up and drivers who can't find parking or are canceling orders, customers will blame the restaurant, not the drivers. [It would be beneficial] to partner with the platforms on this."*
> *-- John Kim, Owner and GM, OliToki*

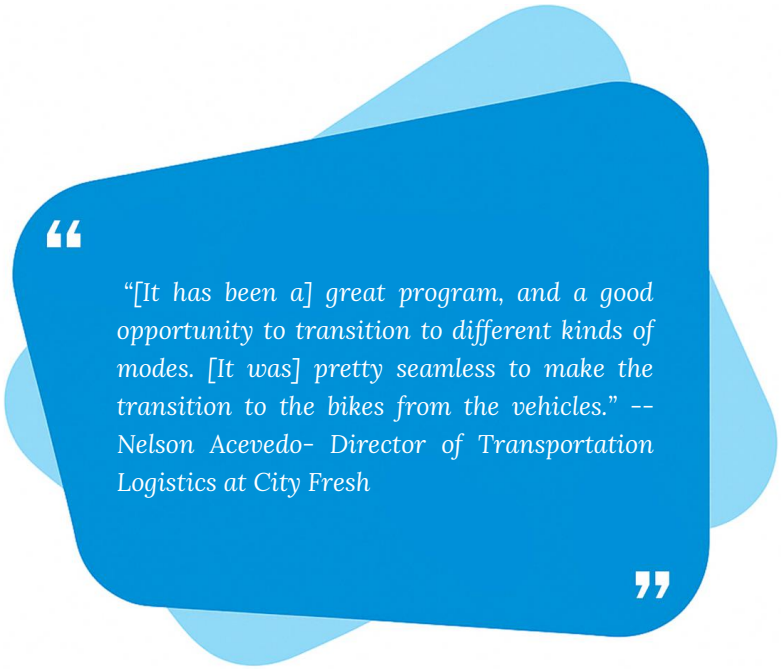
Partner #2: A Neighborhood Non-Profit

The Allston Brighton Health Collaborative participated in Boston Delivers to distribute food to under-resourced households. Dispatching from a church - where people would come to pick up food - was a simple solution as the e-bikes were able to load food at that location and then deliver to households unable to pick up the food from the church. The full subsidy was critical in allowing ABHC, a local non-profit, to make these deliveries to about 10 or 15 households who subscribed to ABHC's Community Supported Agriculture (CSA) through the Supplemental Nutrition Assistance Program (SNAP). ABHC participated for only 3 months, as the CSA season ended, and the program was not renewed the subsequent year.

Partner #3: A Private Contractor Serving Government-Funded Meal Recipients

City Fresh Foods (City Fresh) took the best advantage of Boston Delivers out of all the participants, using the program for the highest delivery volume. As a private "meals on wheels" contractor, City Fresh had set routes and known delivery patterns, making them an ideal participant. With route certainty, operational challenges of delivering by bike could be anticipated in ways that were challenging for a restaurant like OliToki. City Fresh delivered over one hundred kosher meals per day to recipients in the Allston and Brighton neighborhoods. While the company does not have explicit goals around sustainability, its management was interested in upgrading their fleet to zero-emissions, cleaner options. City Fresh participated in the program for 10 months, and deliveries were fully subsidized by the Boston Delivers pilot funds. This was a sizable portion of subsidy funds available, but City Fresh was seen as a strong use case with higher delivery volumes than local businesses and the benefit of serving food insecure residents in the priority neighborhoods. However, there were issues connecting the online system used by City Fresh to track and assign deliveries and it did not easily integrate

into Net Zero Logistics' tracking system. Additionally, due to HIPAA restrictions and personal data sensitivity, detailed customer data could not be shared in full. Paper route sheets were used every morning with each batch of meals. Originally, these sheets were not organized by address so the couriers would often find themselves jumping back and forth between the same apartment complexes instead of batching the orders for each address. City Fresh was eventually able to work with the kitchen which produces these sheets to better organize the routes. Ideally, everything would have been electronically linked to Net Zero Logistics system for assigning bike trips. While City Fresh enjoyed the pilot during the subsidy phase, the unit economics did not allow for a long-term, non-subsidized relationship to continue.



Partner #4: Non-subsidized office meal delivery platform

In their efforts to establish additional client partners, Net Zero forged a deal with an office meal delivery platform that caters to large office buildings and employers. They preferred to remain anonymous in this report. Office managers were able to batch breakfast and lunch orders via this platform, and Net Zero, on behalf of the company, picked up and delivered these orders. Net Zero performed deliveries for this company Monday-Friday 10am-2pm between October 2023 and November 2024. This company, however, declined to participate in the pilot as a formal participant and declined the subsidy reimbursement, instead paying out of pocket for the Net Zero bike deliveries.

Appendix B: Additional Details Around Pilot Design

This appendix provides further detail than is provided in the body of the report on how certain aspects of Boston Delivers pilot were designed and delivered. Other cities or organizations interested in launching or expanding sustainable last mile delivery programs may find this background useful as they explore their options. Further discussion is welcome with teams at the Boston Transportation Department, Urban Freight Lab, and Net Zero Logistics.

Hypotheses for the Pilot

The Boston team took measures to approach their pilot with a research mindset, including the creation of pilot objectives referenced throughout the body of the report. By creating a set of hypotheses at the outset of the pilot, these could be referenced and validated or refuted during the pilot. The pilot program model was conceived with the following assumptions in mind:

- E-cargo bike delivery is best suited for last mile deliveries such as groceries, meal kits, and small- to medium-sized packages;
- E-cargo bike delivery could be used for sending goods between a business and a customer, a business and a business, and a supplier and a business;
- The most efficient business model for e-cargo bike delivery is to consolidate delivery operations by using delivery hubs, parcel lockers, dedicated loading zones, and coordinated pick-ups. Regular scheduling of trip origin and destination points and trip times can make best use of cargo capacity;
- BTD's role was to be a convener, making connections between delivery service providers and community members, local businesses, and neighborhood organizations;
- BTD would use its resources to support the program with staffing, financial subsidies, and infrastructure and policy interventions;
- This model is not specific to a geographic region and has the potential to scale to other areas.

RFP Terms

Once the grant was secured and the pilot could be funded, the City issued a Request for Proposal (RFP) for a full-service, turnkey operator to manage e-cargo bike operations for the Boston Delivers pilot. This service needed to include the operations and maintenance of delivery bikes, point-to-point delivery logistics, and the ability to attract additional customers outside the scope of this pilot program. The operator was responsible for training delivery drivers and establishing a customer and business side training for using their services. The selected vendor also needed to understand the nature of the pilot program and be a willing partner in helping to achieve the program goals and objectives defined above.

City of Boston Commitments

On the City side, BTD committed to supporting the selected Vendor by providing space to establish loading zones and vehicle staging and storage areas. Funding was available to support some infrastructure costs, including the purchase or leasing of shipping containers, tents, and other non-permanent structures for sorting and distribution operations; however, ultimately, a more secure space in a rented retail space was needed to effectively run operations. BTD also pledged to procure and install certain infrastructure the Vendor identifies, including cargo containers, on-street e-cargo bike loading zones, and other identified needs. BTD would subsidize the cost of operations for the Vendor, and alongside community partners, would support the Vender in marketing their services, and generating business.

Community Connections and Outreach

Partnering with community organizations such as Allston Village Main Streets and the Allston Brighton Health Collaborative helped the pilot team facilitate introductions. These connections produced most of the successful partnerships in the pilot; however, leads from these organizations were eventually exhausted. Certain restaurants that initially expressed interest later fell away from the recruitment process. As is common with working in local communities, the community partner connections were highly valuable but do not represent a catch-all solution for local engagement. When collaborating with local partners, it is important to be specific about the breadth of their local networks, and their capacities to engage in on-the-ground engagement.

Logistics Hub Site

Site selection, procurement, and permitting of the location proved to be a challenge with no City-owned facilities identified. The location selected, at 830 Commonwealth Ave (in nearby Brookline, MA), was centrally adjacent to the pilot area, had the right amount of space, and ground level access. However, as the use of indoor space was unexpected; the project team did not anticipate having any rental costs of staging space to launch the project. The final rental cost of the staging hub was $110,000. This outlay consisted of 20% of the grant funding available, thereby reducing monies that could be used for delivery subsidies, outreach, staff, and equipment. In order to launch the hub, additional money and time was needed to secure the necessary permitting and contractor services, to ensure compliance with local fire code in the context of bike battery charging, and to make small improvements to the space ($31,000 total).

APPENDIX C: DATA ANALYSIS METHODOLOGY

The Urban Freight Lab (UFL) research team conducted analysis and VMT simulations using Python 3 in Jupyter Lab. The simulations utilized the OpenRouteService (a route planning API tool) to calculate optimized routes and corresponding VMT, based on the simplified assumption that e-cargo bikes follow the same routes as passenger cars. The VMT data was integral for estimating CO2 reductions when comparing e-cargo bikes to passenger cars and light-duty trucks.

Definitions

UFL defined the deliveries, delivery dates, trips, and routes as follows:

- **Deliveries:** Each unique company-customer pair represents a delivery, corresponding to a row in the original dataset. Deliveries may share the same trips and routes if they involve deliveries to the same location, such as apartments or commercial buildings.
- **Delivery Dates:** Refers to specific dates on which deliveries occur. Multiple companies can have deliveries on the same dates.
- **Trips:** Defined as the movement from an origin (location A) to a destination (location B), irrespective of the location types.
- **Routes:** Comprise multiple trips performed by a delivery person on a delivery date. These may include round trips from a hub to companies, restaurants, and customers.

Company-Specific Delivery Patterns

- **OliToki:** Involves one-to-one deliveries, where a delivery person handles one meal per trip.
- **ABHC:** Deliveries here are one-to-many (a tour), where a delivery person picks up multiple meals at once from ABHC and delivers them to various customers.
- **Office Catering:** This company's delivery model involves either one-to-many or many-to-many deliveries, where a delivery person picks up meals from various restaurants and delivers them to multiple customers.

These three companies sometimes shared the same delivery personnel on the same delivery dates. In such cases, their deliveries are considered to be part of the same route. Consequently, some routes may involve delivery activities from two or three of the companies. For example, a delivery person starting at the hub might first deliver for the office catering company. After completing this delivery, the delivery person could either return to the hub or continue with additional deliveries for OliToki or ABHC.

- **CityFresh:** Operates a one-to-many model like ABHC, but the delivery person collects meals directly from the hub and delivers them to multiple customers, returning to the hub afterward. It only involved two routes on a delivery date and did not share the routes with the other three companies.

VMT Simulation

UFL began by geocoding to convert addresses into latitude and longitude coordinates. Using OpenStreetMap, a customizable and performant routing service that provides global spatial services, UFL then assigned the shortest path for all routes and calculated estimated VMT for each[3]. In this analysis, it was assumed that e-cargo bikes utilized the same routes as passenger cars.

For OliToki, ABHC, and the office catering company, UFL organized the routes based on the delivery dates, delivery person, actual pick-up times, and delivery times. Any delivery trips sharing the same delivery date and delivery person were organized into the same route, including trips to and from the hub. The arrangement of trips and the order of locations within a route were determined by the actual pick-up and delivery times.

For CityFresh, UFL organized the routes based on delivery dates due to limited information about delivery times, delivery personnel, and precise addresses. Given the limited address data in the original dataset, addresses were first aggregated before simulating the routes. UFL assumed that the delivery person always went to one address on a street, which was determined by the highest number of households using the delivery service on that street. Due to the lack of detailed delivery time information, the routes were simulated using optimized route scenarios.

CO2 Reduction Estimation

UFL estimated CO2 emissions reductions by comparing the VMT of e-cargo bikes, which were assumed to have zero tailpipe emissions, to those of passenger cars and light trucks. Emission rates were sourced from official data: 400 grams of CO2 per mile for gasoline-powered passenger cars and 543 grams per mile for gasoline-powered light trucks[4], according to the United States Environmental Protection Agency[5] and the USDOT Bureau of Transportation Statistics[6].

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[3] GIScience. (n.d.). Openrouteservice. GitHub. Retrieved March 3, 2025 from https://github.com/GIScience/openrouteservice

[4] According to the USDOT Bureau of Transportation Statistics, the average emission rates of gasoline-fueled light-duty trucks produced from 2000 to 2024 were estimated to be 543 grams of CO2 per mile for light-duty trucks, and the average CO2 emission rates for gasoline-powered passenger cars from the same period were 400 grams per mile.

[5] United States Environmental Protection Agency. (n.d.). *Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Retrieved March 3, 2025 from Greenhouse Gas Emissions from a Typical Passenger Vehicle | US EPA.

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