

ELECTRIC MICROMOBILITY IN NEW YORK CITY

EMERGING POLICIES
AND BEST PRACTICES



Acknowledgments

The white paper was commissioned by Uber Technologies, Inc. and produced by WXY architecture + urban design in 2022-2023. Many organizations and individuals contributed to the development of this work and the overall findings set forth here.

Uber Technologies, Inc.

WXY architecture + urban design

Table of Contents

4	Introduction
8	Background
14	Problem Definition
20	Best Practices & Recommendations
32	Conclusion
34	References

ॐ नमो भगवते वासुदेवाय ।

ॐ नमो भगवते वासुदेवाय ।

Introduction

ॐ नमो भगवते वासुदेवाय ।

Since being officially legalized in New York City (NYC) in 2020, electric micromobility vehicles, including electric bikes (e-bikes) and electric scooters (e-scooters), have soared in popularity among New York City residents. Working cyclists, commuters, and Citibike users have together fueled a sharp rise in e-bike sales (Sorenson, 2021; Surico, 2021) and e-bike use across the city, giving New Yorkers a fast, affordable, sustainable, and convenient way to move around the city.

While e-bikes provide many New Yorkers with greater access to reliable and convenient transportation for their livelihoods and daily needs, the rise in e-bikes on the city streets has been accompanied by a range of challenges and safety issues. Due to a combination of inadequate storage, poorly assembled and overused e-bikes, and non-certified lithium-ion batteries,

electric micromobility devices have been the cause of a rising number of dangerous and preventable battery fires. In 2022 alone, New York City saw over 200 fires caused by e-bikes (Chan, 2022). These fires have been concentrated in lower-income, working class neighborhoods in the Bronx and Queens where crowded living conditions, improper e-bike storage and charging, along with minimal oversight can create conditions where these types of fires are more likely to occur (City of New York, 2022). As e-bike-related safety issues have become more acute, NYC leaders have explored a range of policy and enforcement solutions. These potential solutions underscore the significant economic challenge of bringing affordable mobility solutions to lower-income New Yorkers, particularly the city's 100,000 working cyclists who rely on e-bikes and other micromobility vehicles for their livelihood.



© Jose A. Alvarado Jr./The New York Times

◀ **As New Yorkers have become more reliant upon deliveries for their daily goods, electric micromobility use has risen sharply on city streets.**

In light of these challenges and a lack of clear policy prescriptions, in Fall 2022, Uber commissioned WXY to develop a white paper that highlights best practices in e-bike and e-scooter policy, focusing on safety, certified vehicles, better solutions for charging and storage, and other pathways to legal use of micromobility vehicles. This white paper evolved through a combination of literature review, informal background interviews, dialogues with food delivery companies, and tracking of NYC Council hearings and legislative activities to more fully define the current problem and to understand key issues and challenges related to e-bikes in NYC and similar contexts. The literature review drew upon official government releases, national and international policies, academic articles, and reports by international organizations to inform the development of a roadmap to micromobility, with a particular focus on promoting safe e-bike usage and storage among lower-income individuals, including working cyclists.

The white paper provides a summary of current and emerging best practices related to electric micromobility, including mechanisms for financial assistance, e-bike access programs, and battery charging infrastructure. These best practices provide a strong foundation for future action intended to guide policymakers, planners, and transportation professionals in supporting safe and equitable policies that can expand micromobility access while prioritizing public safety.

In March 2023, New York City Mayor Eric Adams announced a slate of initiatives to accelerate the adoption of best practices in e-bike safety, charging, and micro-mobility use. Summarized in the "Charge Ride, Ride Safe" plan, the administration has set a clear agenda for making access to safe e-bikes and e-scooters more attainable for all New Yorkers (NYC Office of the Mayor, 2023).

E-mobility Policy Ecosystem ▶



**UL-CERTIFIED
E-BIKE REPAIRS**



**LOCAL BATTERY
SWAPPING
PARTNERSHIPS**



**EDUCATIONAL
CAMPAIGNS**



٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

٢٠٠٠

Background

Since the onset of the COVID-19 pandemic in March 2020, cities and regions globally have witnessed a significant increase in demand for micromobility vehicles, including e-bikes and e-scooters. According to the NPD Group, e-bike sales escalated worldwide by around 145% from 2019 to 2020 and around 240% from 2020 to 2021 (Sorenson, 2021; Surico, 2021). In 2023, about 40 million e-bikes are projected to be sold around the world, resulting in a 50% increase in the total number of e-bikes in circulation—both privately owned e-bikes and those accessible to the public via bike share systems—from 200 million in 2019 to 300 million (Deloitte, 2019; McCue, 2018). With advances in lithium-ion battery technology, lower pricing, and faster, more diverse, and powerful models, the e-bike market is further projected to reach \$80.6 billion by 2027 from an estimated \$49.7 billion in 2022 (Markets and Markets Research Private Ltd, 2022).

Surface transportation accounts for 15% of global carbon dioxide (CO₂) emissions with passenger road vehicles being the major contributor (IEA, 2022; Ritchie, 2020). The growth in e-bike use, in combination with other policy incentives for electric vehicles (EVs), including electric buses and trucks, can have profound environmental, economic, and social benefits, including reductions in traffic and pollution, improvements in public health, and enhanced accessibility for people of all ages, abilities, and backgrounds. In the face of growing urbanization and an accelerating demand for private vehicles, electric micromobility solutions can play a significant role in advancing sustainability goals in dense urban areas in the United States (US) and internationally.

In New York City, transportation accounts for nearly 25.4% of greenhouse gas (GHG) emissions (Inventory

of NYC GHG Emissions, 2020). The City has set an ambitious goal of reducing GHG emissions by 80% by 2050 (Office of NYC Comptroller, 2022). In addition to a recently passed New York State (NYS) law that requires all light-duty passenger vehicles sold or leased by 2035 to be electric (US Department of Energy, 2022; NYS Senate, 2022), the City has adopted a range of strategies to curb GHG emissions. The NYC Department of Transportation's (DOT) Green Wave plan offers a blueprint for making cycling in the city safer, more connected, and more accessible. Several initiatives aim to expand the City's off- and on-street EV charging network, including City Council legislation to increase the number of EV-ready parking spaces in New York City garages and new guidelines for siting electric vehicle charging infrastructure on-street, which were developed with NYS DOT and NYS Energy Research and Development Authority (NYSERDA) (Curb Enthusiasm, 2019).

In tandem with these policy initiatives and since the pandemic, e-bikes have soared in popularity among NYC commuters, especially among delivery workers and in lower-income neighborhoods where micromobility vehicles are an effective last-mile solution. The introduction of e-bikes into the CitiBike¹ bike share fleet beginning in 2019 and its expansion with a new fleet of 1,500 more powerful pedal-assist e-bikes in 2022, has further increased awareness of e-bikes as a mobility option for New Yorkers (Lyft, 2022).

In NYC's food delivery industry alone, more than 65,000 app-based delivery workers use e-bikes and mopeds (both registered and unregistered) (Figuroa et al., 2021). Although food delivery companies do not collect data on the specific types of e-bikes being

E-Bikes in New York City: A Timeline

4 DECEMBER 2002

HB727, 2002 law enacted by Congress, amends the Consumer Product Safety Commission (CPSC) definition of an e-bike to be considered as a "two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 h.p.), whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 MPH." The federal law permits e-bikes to be powered by the motor alone (a throttle-assist e-bike), or by a combination of motor and human power (a pedal-assist e-bike) (NCSL, 2021).

23 NOVEMBER 2004

NYC Council deems any motorized vehicle that cannot be registered with the New York State Department of Motor Vehicles (NYS DMV) illegal (New York Times, 2004).

15 MAY 2013

NYC Council approves legislation to enforce prohibitions against selling, possessing, and operating motorized scooters, including e-bikes (NYC Office of the Mayor, 2013).

19 OCTOBER 2017 - MARCH 2020

NYC Mayor Bill de Blasio and the NYC Police Department (NYPD) begin a crackdown on illegal e-bikes and motorized scooters, a 'war on e-bikes' that finally comes to an end in March 2020, after widespread confiscation and complaints by city delivery workers (NYC Office of the Mayor, 2017).

3 APRIL 2018

NYC Mayor Bill de Blasio announces NYC DOT's new framework to clarify that pedal-assist e-bikes as permissible, whereas throttle e-bikes, capable of travel at speeds over 20 MPH, cannot be legally operated on City streets under State law unless registered with the NYS DMV (NYC Office of the Mayor, 2018).

1 APRIL 2020

Under the NYS Fiscal Year 2021-2022 Executive Budget, the operation of a bicycle with electric assist is legalized on some streets and highways statewide (NYS DMV, 2020).

25 JUNE 2020

NYC Council votes to legalize the use of three classes (Class 1-3) of e-bikes with top speeds under 25 MPH and e-scooters with top speeds under 20 MPH throughout the city (NYC Office of the Mayor, 2020).

2 AUGUST 2020

New York State legalizes the operations of e-scooters with speed limits no greater than 30 MPH on some streets and highways statewide (NYS DMV, 2020).

20 MARCH 2023

Eric Adams Administration announces slate of policy initiatives to support access to safe e-bikes and e-charging infrastructure in "Charge Safe, Ride Safe" Action Plan (NYC Office of the Mayor, 2023).

used by delivery workers, a representative from Los Deliveristas Unidos (LDU), a NYC-based advocacy organization for delivery workers, asserted that almost “all of the e-bikes delivery workers in the city use come from the same factory in China” (Gordon, 2022). E-bikes ordered directly from factories in China or from online sites like Alibaba are often low-priced models of substandard quality built from an amalgamation of often incompatible or nonstandard materials.

Effective since 2020, the Underwriters' Laboratories (UL) 2849 certification is the standard that offers electrical and fire safety examination of an e-bike's entire electrical system, including the battery, motor, and charger, to ensure they are designed to work cohesively (UL Solutions, 2022). While UL certification is widely viewed as a barometer of a bike's battery safety, obtaining a certification for e-bikes and its concomitant parts is voluntary. With no restrictions on manufacturers and retailers regarding certification, the proportion of non-certified e-bikes on NYC streets continues to increase. This rise has been accompanied by a range of challenges and safety issues including an increase in fires caused by non-certified lithium-ion batteries and poorly assembled e-bikes. According to the NYC Fire Department (FDNY), the fire incidents caused by lightweight EVs doubled in 2021 compared to 2020, surpassing 100 incidents (Preston, 2022). As of November 15, 2022, FDNY had reported over 200 e-bike related fire incidents that caused more than 93 injuries and six deaths in 2022 (Chan, 2022). In August 2022, an e-bike related fire incident at a New York City Housing Authority (NYCHA) public housing complex in Harlem caused the death of a 5-year-old girl and 36-year-old woman, bringing the challenge of lower-quality lithium-ion battery, a lack of safe e-bike charging infrastructure, and minimal oversight into sharp relief (Zraick, 2022).

Understanding the root cause and types of vehicles involved in fires has presented challenges for regulators and public agencies. E-bike is often loosely used as a catch-all term for all lightweight electric

vehicles when referencing their potential safety and fire hazards. New York City employs a tripartite classification scheme for e-bikes, ranging from Class One pedal-assist e-bikes, like those offered by CitiBike, to Class Three e-bikes with independent throttles and maximum speeds of 25 miles per hour (Rose, 2022). This situation is exacerbated by the difficulty of differentiating between a legal e-bike and an illegal e-scooter, a challenge that has been recognized by the NYPD Commissioner (Streetsblog, 2022). In November 2021, for instance, the NYPD stated that “e-bikes operators have been involved in 1,628 collisions, with 19 fatalities.” In addition to the lack of distinction made between whether e-bikes were involved in collisions or had caused them, many fires are caused by low-quality e-mopeds and e-motorcycles, many of which do not meet the legal standards of an e-bike in NYS and are not permitted on the city streets (Kuntzman, 2021).

In the past, certain policy and enforcement solutions related to e-bikes have proven counterproductive. In early 2020, the City confiscated hundreds of unregistered e-bikes under the mantle of its Vision Zero initiative, a policy that inequitably targeted delivery workers who were serving as frontline workers at the height of the COVID-19 pandemic. Between 2007 and 2017, data compiled by worker advocates illustrated that 92% of all tickets handed to delivery workers were given out in overwhelmingly white neighborhoods (Colon, 2020). Had NYCHA's e-bike ban passed, the policy would have imperiled the livelihood of city's working cyclists and stilted growth of affordable mobility options for lower-income New Yorkers (Weinberger et al., 2022). In March 2023, in parallel with the introduction of a new slate of e-mobility policies and initiatives, multiple city council bills were signed into law to safeguard New Yorkers against these risks. This included bills to prohibit easy access to uncertified e-bikes, prohibitions on the reassembly or reconditioning of lithium-ion batteries, and new educational programs related to fire safety.

Electric Micromobility Classification in New York City

	E-Bike Class 1 Pedal Assist	E-Bike Class 2 Throttle up to 20 MPH, Operable Pedals	E-Bike Class 3 Throttle up to 25 MPH, Operable Pedals
Maximum Speed	20 MPH	20 MPH	25 MPH
License Requirement	No	No	No
Registration Requirement	No	No	No
Permissible Spaces	Bike Lanes* and streets with speed limits no greater than 30 MPH	Bike Lanes* and streets with speed limits no greater than 30 MPH	Bike Lanes* and streets with speed limits no greater than 30 MPH
Helmet Requirement	Recommended for all, Required for 16-17 year olds and working cyclists	Recommended for all, Required for 16-17 year olds and working cyclists	Yes Required by law

* Including on bridges

** Including vehicle lanes on bridges

Moped Class C
 Limited Use Motorcycle,
 Low-speed, 2-3 Wheels

Moped Class B
 Limited Use Motorcycle,
 Low-speed, 2-3 Wheels

Moped Class A
 Limited Use Motorcycle,
 Low-speed, 2-3 Wheels

E-Scooter
 Electric/Human Power,
 Handlebar, Floorboard or
 Seat, less than 100 lbs



20 MPH

Yes
 Driver's License

Yes
 Must be registered with
 NYS DMV, must have
 license plates & VINs

Right lane and/or
 shoulder** (except
 when making a left turn)

Recommended

30 MPH

Yes
 Driver's License

Yes
 Must be registered with
 NYS DMV, must have
 license plates & VINs

Right lane and/or
 shoulder** (except
 when making a left turn)

Yes
 Required by law

40 MPH

Yes
 Driver's License
 Endorsement

Yes
 Must be registered with
 NYS DMV, must have
 license plates & VINs

Vehicular Lanes**

Yes
 Required by law

15 MPH

No

No

Bike Lanes* and streets
 with speed limits no
 greater than 30 MPH

Recommended
 for all, Required for
 16-17 year olds



Problem Definition

Based on contemporary literature review and informal interviews with key stakeholders, the white paper draws out and synthesizes the specific issues and challenges related to e-bike usage and adoption in New York City and similar contexts.

While policymakers and advocates recognize the potential benefits of e-bikes as an accessible transportation and environmentally friendly solution, the increasing frequency of fires caused by electric micromobility vehicles threatens to undermine their growing use among commuters and working cyclists. This section of the white paper attempts to more concretely define the current problem related to e-bike safety and to lay a foundation for sensible and proactive policy solutions.

1. The high costs of UL-certified e-bikes make them less accessible for lower-income communities, feeding an underground market of unsafe, cheaply made, e-bikes with incompatible or uncertified parts.

The cost of a commuter or leisure-style e-bike ranges from \$1,000 to \$5,500, averaging around \$2,600, while cargo-style e-bikes range from \$2,000 to \$9,000, averaging around \$5,000 (MacArthur et al., 2022). According to the 2022 DoorDash/Uber Delivery Worker Cost Study conducted by HR&A Advisors, the average cost of an e-bike, excluding modifications or maintenance, purchased by a working cyclist is \$1,400. Lower-end e-bikes with parts sourced from multiple manufacturers, including those off the black market, cost around \$1,000 (HR&A Advisors, 2022). Based on a 2021 survey conducted among 500 app-based food delivery

workers in NYC, along with worker focus groups and individual interviews, the Worker Institute at Cornell University's School of Industrial and Labor Relations (ILR) and the Workers Justice Project (WJP) found that delivery workers in NYC typically spend between \$1,000 to \$2,200 on e-bikes.

Additionally, an e-bike owner incurs an annual cost of around \$400 for maintenance, charging, and insurance, including battery replacements (MacArthur et al., 2022). However, a representative from Beyond² suggested that this maintenance cost is likely higher than that for a working cyclist based in NYC, as they either need an extra battery to commute back home or pay a monthly cost of around \$150 for overnight e-bike storage (Hubbard, 2022), making the cost of a certified e-bike prohibitive for many.

Delivery workers can work for restaurants or third party services full time, part time, or seasonally, and the varied income they take in can make large financial outlays challenging or impractical. As a result, working cyclists typically purchase lower-priced e-bikes that often do not comply with UL 2849 certification standards (UL, 2022). These less-expensive e-bike models are available for purchase online for as low as \$65 (Alibaba, 2022) and are often assembled incrementally from multiple sources, leading to safety and fire hazards. Repairs tend to be haphazard or performed without professional assistance and are further encumbered by overuse, riding/storage in inclement weather, and other factors that increase the risk of malfunction.

² Beyond, formerly known as Brooklyness, was founded in 2018 and is a NYC-based subscription service for e-bike and e-scooter rentals.

2. Improper use of lithium-ion batteries makes them susceptible to fire and safety hazards.

Fire safety concerns have stood at the center of the debate around e-bikes in NYC over the past year. While UL-certified batteries are typically considered safe and are rarely the cause of e-bike fires, non-UL certified batteries, improper storage, and overnight charging have together created a safety hazard that needs to be addressed through infrastructure, enforcement, and informed policymaking.

E-bikes average a speed of around 15 MPH, significantly faster than the average 9 MPH for a conventional bike. Up to twice as powerful and six times lighter for the same capacity than lead-acid batteries (Metaye, 2022), lithium-ion batteries are available in variants specifically designed for e-bike commuting (for fast acceleration at a low pedaling speed), cargo (for heavy loads), and mountain bikes (ideal for fast sprints and steep hills).

Depending on the quality, a premium 400-700 watt-hour (Wh) e-bike battery from Bosch retails for around \$500 to \$900, with similar versions from brands such as Samsung, Panasonic, or LG for about \$0.82 per Wh (Emma, 2022). In addition to a longer lifespan of over 3 years or around 500 charging cycles, with 30 to 60 miles per charging cycle as specified by a representative from Propel³ (NYC Council Hearing, 2022), these high-quality lithium-ion rechargeable batteries have a built-in battery management system (BMS) that prevents them from being overcharged (Barsukov, 2013). However, lower-priced off-brand batteries, typically manufactured in China (Emma, 2022), without BMS capability still seem cost advantageous to an e-bike user, particularly a working

cyclist with an average monthly mileage of 233 miles (HR&A Advisors, 2022).

Regardless of riding conditions and inclement weather, most delivery workers routinely work six days or more per week and over six hours on any day across multiple delivery apps to maximize their earnings (Cornell University and WJP, 2021). For a non-certified or refurbished battery already suffering from short battery life and other technical challenges, the overuse of e-bikes by working cyclists leads to frequent charging that strains the battery, causing overheating and damage making them more prone to fire and safety hazards. To ensure safe conditions for working cyclists and buildings where e-bikes and batteries are stored, it is critical that e-bike and battery charging and storage specifications are followed (Christopher, 2022; Sylvester, 2021; Preston, 2022).

This precarious situation has been exacerbated by minimal enforcement on e-bikes and batteries that do not comply with safety standards. As noted previously, the UL 2849 certification is voluntary for e-bike manufacturers and retailers. Few e-bike manufacturers buy and use components that have passed these safety standards (NYC Council Hearing, 2022), possibly due to the large amount of time (4-8 months) and costs (\$5,000-\$50,000) involved in obtaining a UL certification (Quintero, 2022), necessitating a coordinated policy effort among private and public actors.

.....

³ Propel, formerly known as Long Island Electric Bikes, was founded in 2011 and is an authorized e-bike dealer in the US with showrooms located in Brooklyn, New York, Long Beach, California, and Wilmington, Delaware.

E-Bike Battery Charging & Storage Specifications



Follow the manufacturer's instructions for charging and storage.



Use the manufacturer's cord and power adapter, or an exact replacement with the same specifications, made specifically for the respective e-bike.



Avoid use of extension cords as they change the level of electrical resistance.



Batteries should be kept in the middle of their capacity. Draining the battery to 0% or charging over 80% reduces the battery-life.



Wait for the battery to revert to room temperature before charging as it may get warm through regular use.



Battery should be completely dry before charging if the e-bike was used in the rain.



Store batteries and devices at room temperature and not in direct sunlight or below 32°F.



E-bikes should not be used in temperatures lower than -5°F.

3. E-bikes suffer from a lack of infrastructure for charging, battery swapping, and storage.

The demand for safe e-bike infrastructure has increased significantly over the past several years in parallel with the rising consumer demand for affordable e-bikes across the income spectrum. According to Beyond, each week in NYC, there are around 5,000 delivery app downloads with the intention of doing deliveries (Hubbard, 2022). For more than 100,000 delivery workers in the city, who are often immigrants and people of color (Cornell University and WJP, 2021), e-bikes have become a critical daily vehicle and a significant means of livelihood.

Unlike electric cars, e-bikes do not require the installation of specialized charging infrastructure. A regular household outlet is typically adequate for charging without any panel upgrades or permitting. However, most working cyclists opt for low-priced lithium-ion batteries that are produced using substandard materials, making them more susceptible to damage and hazardous to repair in case of improper use (Gordon, 2022). While conventional bicycle shops do not support e-bike repairs, most e-bike repair shops in NYC either refuse to repair models they don't sell or their services are

not affordable for low-income communities, leading delivery workers to rely on do-it-yourself (DIY) repairs or battery servicing and repairs that are rendered illegally.

Due in part to a lack of regulated storage and parking space, e-bike thefts have become increasingly common. In NYC, about 15,000 bikes are reported stolen every year. This may only represent 20% of the actual number, indicating 75,000 bike thefts annually, with a recovery rate of less than 2% of the reported cases (Bicycle Habitat, 2022). According to the survey conducted by Cornell University and WJP, 54% delivery workers reported having experienced bike theft and about 30% were physically assaulted during the robbery (Cornell University and WJP, 2021).

The frequency and intensity of e-bike use, particularly among working cyclists, demands a unique approach to infrastructure development. During the course of a work day, many e-bike users drain their batteries, charge at home (often in crowded conditions with devices charging), or pay for bike storage and charging at an unregulated location. Lack of routine access to battery swapping infrastructure or safe storage contributes significantly to unsafe storage and charging practices across the city.



◀ **E-bike users and regular cyclists suffer from a lack of convenient and secure bike parking in New York City.**





Best Practices & Recommendations

With a focus on North America, the white paper explores a wide range of strategic approaches adopted by government agencies, non-profits organizations, and businesses around the world to manage and regulate micromobility vehicles, including e-bikes and e-scooters. The recommendations that follow offer a collection of potential policies, anchor partnerships, pilot programs, and educational campaigns curated based on the insights gathered from the international best practices to encourage the use of micromobility vehicles in achieving climate, sustainability, and mobility goals.

1. Financial assistance can help support the acquisition of safer, UL-certified E-bikes

Financial assistance, including subsidies or rebates, is one of the most common and most effective ways to encourage users to make changes in travel behavior by reducing barriers to entry for using EVs. In New York City, financial incentives can help bridge the gap that currently exists between e-bike commuters and working cyclists, creating greater access to safe, UL-certified E-bikes.

Since the enactment of the Energy Policy Act (EPA) of 2005, financial incentives to encourage the purchase of low emission vehicles have continually expanded (AFDC, 2022). In New York State, the EV models eligible for a rebate average \$40,000 (NYC DSA, 2021), indicating that EV incentive programs cater to higher income individuals capable of buying a substantially more expensive electric car. For less than 5% the cost of an electric car, e-bikes open up opportunities to redirect EV incentives to benefit a much larger swath of the population. Additionally, e-bikes used for daily commute generate higher carbon savings, making e-bike incentives more cost effective than those for electric cars (MacArthur et al., 2022).

Proposed as an expansion of the existing Drive Clean Rebate program for electric cars without additional funding requirements, the Ride Clean Rebate program for e-bikes was first introduced in the NYS Legislative Session in September 2020 and re-introduced in January 2021. With no limitations based on income level or area of residence, the bill directs NYSERDA to provide an immediate 50% rebate on

the purchase price of a new e-bike, capped at \$1,100 (Toll, 2022).

With additional incentive amounts for low-income communities, a majority of e-bike incentive programs worldwide fall in the range of \$200 to \$600 (MacArthur et al., 2022). There are several prominent examples that New York City can learn from.

- In April 2022, the City of Denver Climate Action Office launched the E-Bike and E-Cargo Bike Instant Rebate program offering up to \$400 rebate off a qualifying e-bike, with an additional \$500 rebate off the purchase of an e-cargo bike. Income-qualified residents are offered a \$1,200 rebate. The program does not specify a minimum or maximum purchase price of e-bikes, but the rebate voucher amount only covers the retail cost and does not cover taxes or shipping costs. As of October 24, 2022, a total of 4,401 e-bike vouchers have been redeemed, with 2,185 rebates provided to income-qualified residents (City and County of Denver, 2022).
- The 2021 Vermont Transportation Bill (Act 55) authorized \$50,000 in funding to establish a statewide e-bike incentive program. The State of Vermont Agency of Transportation has partnered with a local non-profit, Center for Sustainable Energy (CSE), to develop and administer the incentive programs. In addition, \$1.5 million has been authorized to a the Replace Your Ride Program, providing up to \$3,000 for residents to trade older, high-polluting vehicles for cleaner transportation options including e-bikes (Lewis, 2022).
- First introduced in 2021, the French government offers up to €4,000 towards an e-bike purchase for individuals trading in a car, with a full €4,000

**Identified E-bike Incentive Programs
in United States (as of April 2022)** ▶

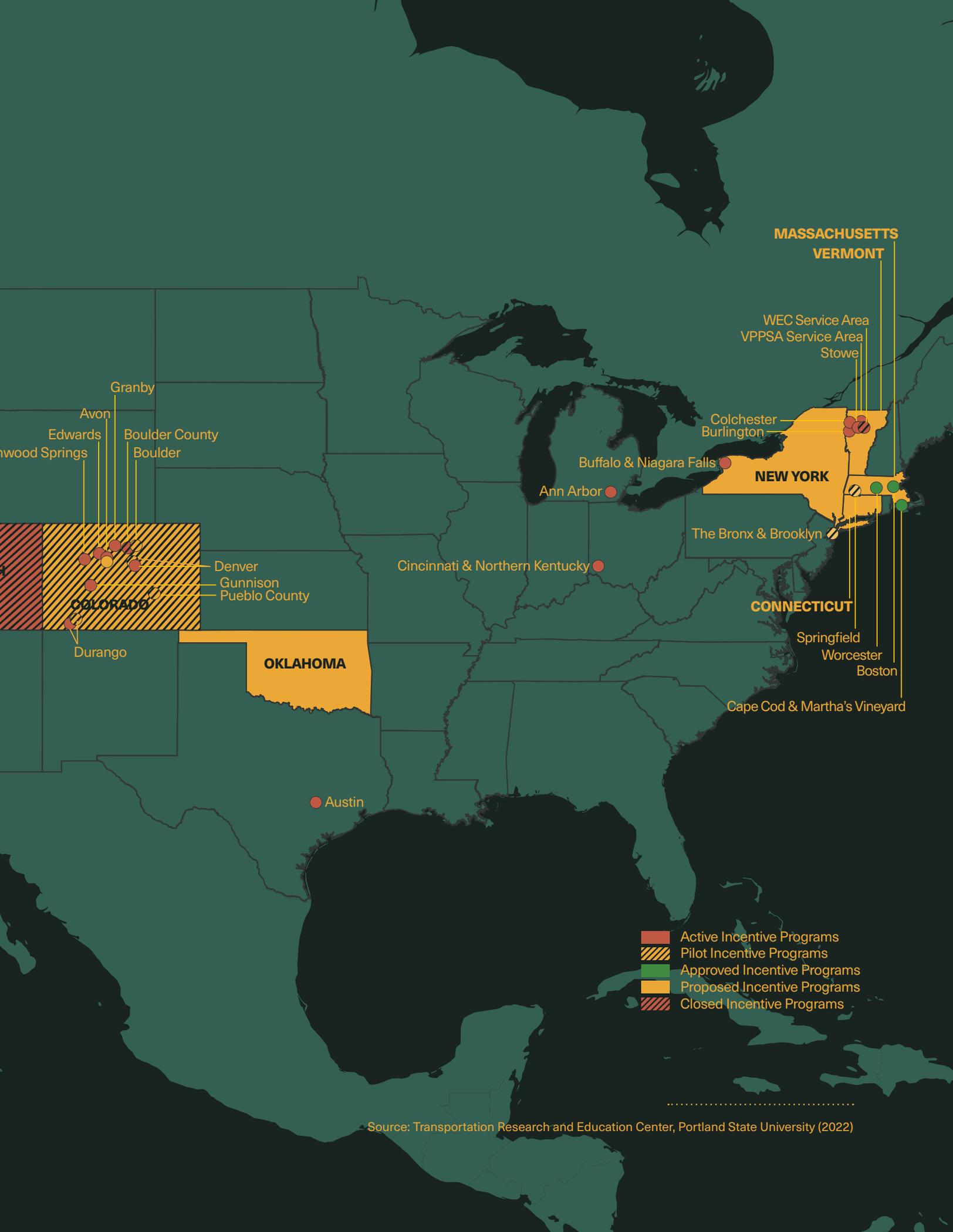
incentive awarded to low-income residents living in low-emissions urban zones. A subsidy of up to €400 is available to anyone buying a new e-bike. In addition, the Socialist-Green Council of Paris offers up to €500 towards the purchase of an e-bike or a folding pedal bike (Toll, 2022). The subsidy is intended to encourage over 9% residents nationwide to switch to e-bikes by 2024, compared to 3% in 2022 (Hawkins, 2022).

- In 2021, the UK’s £2 billion active travel package provided 500,000 vouchers of £50 each, redeemed at select e-bike retailers and repair stores, to those interested in fixing up their old bikes. The councils nationwide also offer free maintenance and training workshops (Hardinges, 2021).
- In Germany, company-vehicle privilege was expanded by lawmakers in 2012 to include bikes and since then, a three-year lease through employers with a pretax payroll deduction program has been offered to the public. This policy provides up to 40% savings on e-bike purchases (Gary, 2017).

Other rebate programs have emerged at a more grass roots level. Building off of the Bike Match programs led by New York City Economic Development Corporation (EDC) and Transportation Alternatives (TA), the Equitable Commute Project (ECP)⁴ is the first comprehensive e-bike equity program intended

.....
⁴ Equitable Commute Project (ECP) was initiated in 2022 as a consortium of New York City based NGOs, community development organizations, academics, and companies, including many who serve disadvantaged communities in the Bronx and Brooklyn. ECP is led by Transportation Alternatives (TA), with management support from Empire Clean Cities (ECC) and NYU Stern.





MASSACHUSETTS
VERMONT

WEC Service Area
VPPSA Service Area
Stowe

Colchester
Burlington

NEW YORK

The Bronx & Brooklyn

CONNECTICUT

Springfield
Worcester
Boston

Cape Cod & Martha's Vineyard

Granby

Avon

Edwards

Boulder County

Boulder

Wood Springs

Denver

Gunnison

Pueblo County

COLORADO

Durango

OKLAHOMA

Cincinnati & Northern Kentucky

Ann Arbor

Buffalo & Niagara Falls

Austin

- Active Incentive Programs
- Pilot Incentive Programs
- Approved Incentive Programs
- Proposed Incentive Programs
- Closed Incentive Programs

Source: Transportation Research and Education Center, Portland State University (2022)

to make 5,000 high quality e-bikes available to frontline and essential workers from low-income communities in Bronx and Brooklyn through a \$600 purchase subsidy and low-interest micromobility loans, including for individuals without credit. Offered through its organization partner, Spring Bank, the ECP has so far connected 17 frontline workers in NYC with subsidized e-bikes and accessible financing (ECP, 2022).

A low-cost, equitable, and efficient solution, financial assistance for both the purchase and servicing of e-bikes and other micromobility vehicles aimed at individuals from economically marginalized backgrounds, including working cyclists, can help enhance e-bike accessibility and encourage the use of UL-certified vehicles and regulated repair shops.

Suggested financial incentive programs for e-bike users include:

- *Rebate programs and vouchers:* Individuals buying a new (or used) UL-certified e-bike and batteries should be eligible to file for a rebate. Approved in advance of the purchase, instant rebates and vouchers redeemable at authorized e-bike stores should be made available to low-income individuals, who are less likely to have funds to make purchase of a UL certified e-bike or battery at full cost and wait for a rebate check, encouraging them to avail the benefits. In addition, similar incentives could be offered on the purchase of e-bike accessories (including helmet, lock, panniers, and baskets) and repair services.
- *Cash-for-clunker programs:* Targeted at low-income essential workers, financial incentives could be offered to individuals for trading a low-quality e-bike for a new certified model that complies with UL 2849 safety standards.

E-bike retailers and repair service providers should be offered tax credits and other financial incentives to

encourage the sale and use of UL-certified products by their participation in:

- *Discounts:* Individuals will be able to avail a point-of-sale/service discount, particularly beneficial for low-income earners.
- *Lease or rent-to-own programs:* Individuals would have an opportunity to lease or rent e-bikes and batteries at low- or no-interest monthly payments toward ownership (Bennett et al., 2022).

To develop and administer effective incentive programs, public agencies should explore partnerships with local non-profit organizations, bicycle advocacy groups, and local e-bike retailers. While non-profit organizations and advocacy groups can assist with marketing and communications to targeted communities, e-bike retailers and repair service providers can advise on logistics to inform the program (PeopleForBikes, 2022). Additionally, delivery companies and other employers could help facilitate the disbursement of e-bike grants and incentives to working cyclists and further monitor the use of funds by delivery workers appropriately towards certified products.

WAGE-EARNING LEGISLATION

To complement financial assistance and incentive programs, many policymakers have focused on wage-earning legislation as a means of increasing access to safer e-bikes and increasing worker quality of life.

In accordance with Section 20-1522 of the NYC Administrative Code, the NYC Department of Consumer and Worker Protection (DCWP) studied the pay and working conditions of app-based food delivery workers in NYC and proposed rules to establish minimum pay rate (referred to as the Minimum Pay Law) in a report published in November 2022. The report findings drew upon data obtained from restaurant delivery apps; surveys distributed

to more than 123,000 delivery workers and 23,000 restaurants; testimony from a public hearing; interviews with stakeholders and other experts; and publicly available data on pay, benefits, and safety conditions.

A final rule is expected to be announced in February 2023, which will require a minimum earnings standard for delivery workers in NYC who work for third-party delivery or courier services. This standard

will increase take home pay for tens of thousands of workers in the industry. This rule will not apply to workers who are employed directly by restaurants or workers who connect to grocery delivery apps, but is a good first step in increasing wages for a large segment of the delivery industry in NYC, which in turn can help facilitate easier access for safer, certified equipment.

Delivery workers gathered at Sara D. Roosevelt Park on Manhattan's Lower East Side while waiting for delivery orders



2. E-bike access and education programs help make UL-certified bikes attainable at a lower level of investment

Equitable access to e-bikes is crucial, as low-income and historically disadvantaged communities can often benefit the most from their use as a low-cost micromobility solution. Policymakers should explore opportunities to leverage public and private funding for programs that can significantly expand e-bike access across the five boroughs of NYC, including subscription services, lending libraries, and try-out programs. These efforts can build upon existing partnerships and initiatives by non-profit organizations, tech startups, delivery companies, and law enforcement and public safety agencies. Shifting the responsibility of charging and maintenance away from the user, Beyond launched

the Cargo One e-scooter specifically designed for delivery workers in 2022 (Chen, 2020; Hubbard, 2022). The e-scooters will be available via weekly rental subscription for \$39 including maintenance to delivery workers in NYC from March 2023 (Bowden, 2022). While new start-ups are indicative of a growing market, weekly subscriptions may still be out of reach for many working cyclists.

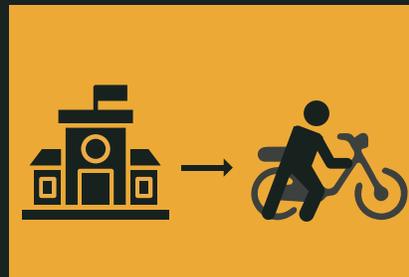
SAFETY EDUCATION

In addition to creating new pathways for e-bike access, safety education represents an important strategy for increasing awareness among the public and enforcement agencies. FDNY has conducted regular informational sessions and hands-on demonstrations for the public, targeting those from marginalized groups and socio-economic backgrounds, to disseminate information about the proper use and storage of e-bikes, including the dangers of overuse and misuse of rechargeable



SUBSCRIPTION SERVICES

Instead of buying outright, which can be a challenge for low-income earners with limited funds, e-bikes can be made available via subscription for a fixed rate, including coverage of necessary adjustments, insurance, and repairs, typically with a minimum contract period of 6 to 12 months.



LENDING LIBRARIES

Income-qualified individuals could be granted the use of e-bikes for low cost (or free) from a few days to a month at a time.



TRY-OUT PROGRAMS

In support of educational campaigns, try-out programs aimed at potential e-bike buyers would provide longer trials from a few days to three months, compared to around the block test rides offered by e-bike retailers and would likely be paired with safe rider training.

lithium-ion batteries (NYC Council Hearing, 2022). These initiatives provide hands-on workshop and training sessions for staff members and volunteers of public safety and law enforcement agencies to impart most up-to-date information about e-bikes and other micromobility vehicles, such as e-mopeds and e-scooters. They also help agencies ensure that fire incidents are not haphazardly reported under the umbrella of e-bikes and specific details (about the classification of micromobility vehicle, battery type, certification status, usage and storage condition among others) are shared with the public to avoid exaggerate fears about certified e-bikes (Bicycle Retailer, 2022).

Detailed under FC 309, the 2022 New York City Fire Code also recommends the adoption of below standards to address the charging and storage of e-bikes, scooters, and other powered micromobility devices (FDNY, 2022).

- Adoption of UL standards for charging equipment.
- Fire safety regulations for rooms in which 6 or more powered mobility devices are being charged. Exemption for up to 5 powered mobility devices in a residential dwelling unit.
- Fire safety regulations in which 6 or more powered mobility devices are being stored but not charged.

More broadly the, e-bike and battery manufacturing industry can make strides to enhance accessibility for certification itself (Gauthier, 2021). Manufacturers should be mandated to receive certification from a nationally recognized testing laboratory or approved organization, such as UL. This coordinated approach could aid enforcement efforts in curbing unsafe practices by encouraging the sale and use of e-bikes and batteries that comply with safety standards (NYC Council Hearing, 2022).

Potential E-bike Access Programs ▼



IN-STORE AND ONLINE SERVICE PROVIDERS

Including options for both in-store and online e-bike retailers and service providers allows program participants to choose from the widest range of bikes to meet their needs.



EMPLOYER-MANAGED FLEETS

Government agencies should work with delivery companies and tech startups to explore the viability of employer managed fleets of certified e-bikes offered to frontline and essential workers, including app-based delivery workers (Amazon, 2022).



EDUCATIONAL CAMPAIGNS

In addition to disseminating information about the latent benefits of e-bikes, educational campaigns can be organized to increase awareness among users about the financial incentives available when opting for UL 2849 certified products.

3. Infrastructure, including battery swapping and storage, can support e-bike safety and expansion.

While many policies strive to increase access to UL-certified e-bikes through financial incentives and educational partnerships, battery swapping and storage infrastructure have a critical role to play in expanding access to e-bikes for routine cyclists. Especially for lower-income individuals living in overcrowded situations or those prone to overusing or overcharging their bike, finding a secure place to charge and store e-bikes and batteries can be burdensome.

Battery swapping service providers worldwide now offer safe and cost-effective options for e-bike users, including delivery workers, to allow battery charging at regular intervals throughout the day, rather than once overnight, to prevent overcharging. A few notable initiatives include:

- Launched in 2011, GoGoRo developed a battery-swapping refueling platform for electric two-wheeled scooters, mopeds, and motorcycles. With the largest operating network of nearly 11,000 in Taiwan and 250 in China, GoStations allow users to exchange a discharged battery for a charged one as an alternative to plugging the vehicle into a charging station (Gogoro, 2022).
- Founded in 2016, the Berlin-based Swobbee offers a decentralized charging and swapping network for batteries from different manufacturers. Optimizing operations at reduced costs, the battery exchange stations can host 8 different battery types to suit a range of micromobility vehicles (Swobbee, 2022).
- In India, SUN Mobility offers a pay-as-you-go battery subscription service for three-wheeled auto-rickshaw drivers to swap discharged batteries at one of the 50 dedicated swapping stations across 14 cities (Masterson, 2021).
- In 2020, the Berlin-based TIER Mobility added 200 scooters with swappable batteries to its existing fleet in Paris. The energy network places



◀ **GoStation for e-scooter riders to swap depleted batteries for charged ones**



▲
**TIER Mobility rider swaps
 batteries at a local retail store**

battery charging stations in retail stores across its coverage area (Tier, 2022). In addition to riders earning free credit for swapping batteries at the end of their ride, the retail stores are incentivised to host the charging station because of the additional footfall it brings into the store at no extra infrastructure cost (Bellan, 2021).

In October 2022, New York City announced a pilot program to renovate and transform underutilized infrastructure like vacant city newsstands, into Street Deliveristas Hubs through a \$1 million federal grant secured for the WJP. The hubs will be designed by secure bicycle parking designer Oonee⁵ and the architecture firm Fantastica. These hubs are intended to provide NYC's delivery workers with e-bike charging stations, shelter, rest areas, and bike repair services (City of New York, 2022). In March 2023, as part of the Adams' administration's e-bike policy announcements, the City committed to advancing and evaluating innovative public-facing charging solutions through a "Studio Challenge" that will invite

startups to propose and deploy their products as a demonstration project (NYC Office of the Mayor, 2023).

Beyond this initial pilot, New York City has a unique opportunity to take advantage of city streets and parking lots for e-charging infrastructure. Since 2020, New York City has developed a robust set of curbside management tools, exemplified by the City's popular Open Restaurants Program, which has more than 11,800 restaurants enrolled across five boroughs (Krader, 2021). By partnering with restaurants who are phasing out of the program, the city could create a mechanism to convert open restaurants being retired from the program into regulated e-bike hubs networked together to offer assortment of secure on-street services including parking, storage, and/or charging for e-bike users, including delivery workers, before the spaces are reverted to car parking (BikeHub, 2022; City of New York, 2022; LDU, 2022). Similar to ongoing pilots for waste and freight consolidation on street, the city could release an Request for Expressions of Interest (RFEI) for curbside charging vendors to help develop a battery swapping prototype for New York City.

Beyond expanding access to infrastructure, NYC policymakers should explore ways of obtaining access to more complete data around e-bike usage, types, and patterns. While registration and licensing of e-bikes is discouraged due to the risk of criminalizing those from marginalized backgrounds and creating barriers to entry for many working cyclists (Poon, 2021), government agencies could work with third party delivery and courier companies to develop a data collection strategy to better understand current and future trends in NYC.

⁵ Oonee was founded in 2017 and is a Brooklyn-based architecture firm that partners with public and private agencies to develop scaled networks of modular bicycle parking infrastructure. Since the first public pilot in Lower Manhattan in 2018, Oonee has partnered with Metropolitan Transportation Authority (MTA), NYC DOT, and Port Authority of New York and New Jersey (PANYNJ) to make secure curbside bike parking stations accessible.

ELECTRIC MICROMOBILITY POLICY ECOSYSTEM

Creating a safer, more convenient, and accessible electric micromobility ecosystem will require a combination of infrastructure tools, like battery swapping and charging stations and policy tools, like financial assistance and educational campaigns. New York City is in a position to emerge as an e-bike leader, combining these approaches with other sustainable transportation and micromobility strategies.

E-Mobility Hubs

Leverage NYC's curbside management tools and the Open Restaurant Program to explore the conversion of retired open restaurants into **regulated e-bike hubs**. Hubs can be networked to offer an assortment of services, including parking, storage, charging, repairs, and comfort stations.

Reuse underutilized city infrastructure like vacant newsstands into a scaled networks of charging **hubs for working cyclists**, offering parking and storage, rest areas, charging stations, and repair services.

Education

Organize **educational campaigns** to disseminate up-to-date information about electric micromobility vehicles, fire safety guidance, and the incentives offered to the public.





Battery Swapping

Explore partnerships with convenience stores and other retail businesses to offer **battery charging and swapping** kiosks.

UL-Certified

Explore partnerships with e-bike retailers and repair service providers for individuals to avail **point-of-sale/service discount** on UL certified products.

Financial Incentives

Develop **financial incentive programs**, including rebates and vouchers, aimed at economically marginalized individuals for both purchase and servicing of UL-certified electric micromobility vehicles.

Micromobility Infrastructure

Support the creation of **wider bike lanes and protected bikeways** that allow for passing where feasible to reduce near-miss conflicts between bicycles and e-bikes.

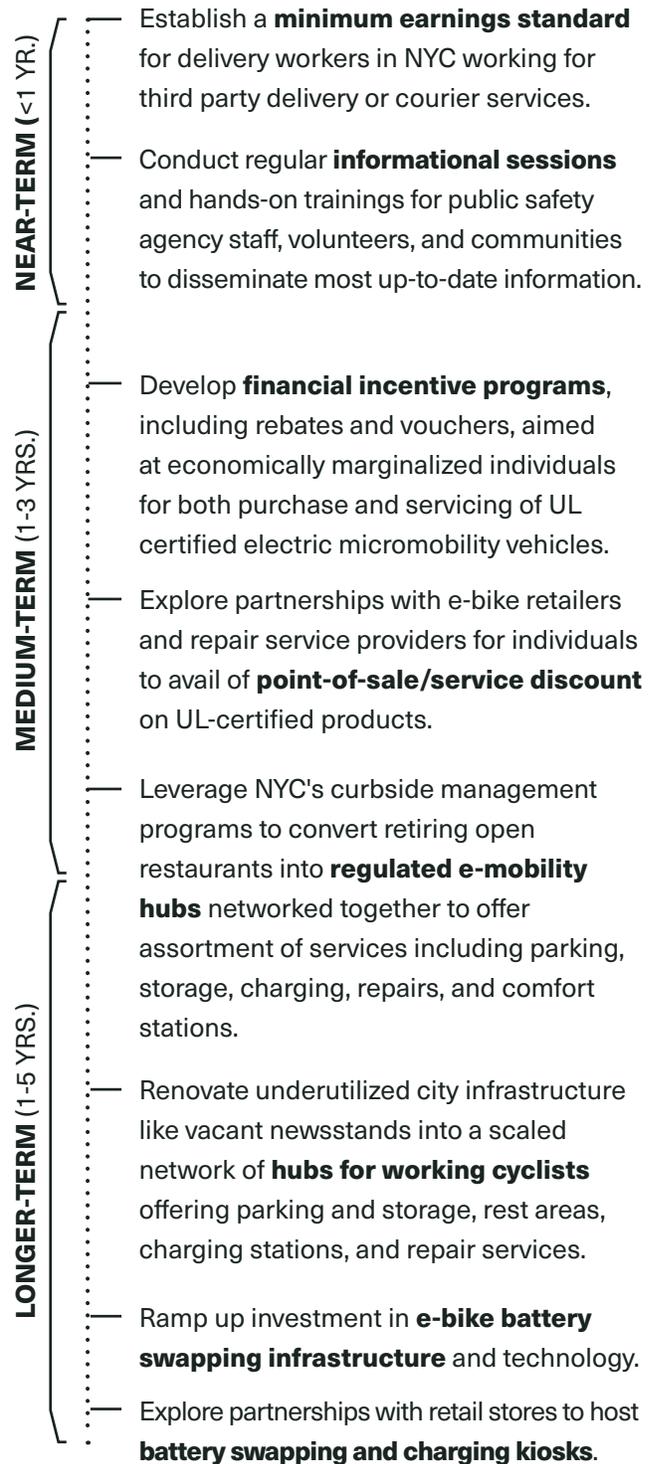
ॐ नमो भगवते वासुदेवाय ।

Conclusion

Advancing access to electric micromobility could play an integral role in shaping more equitable communities and reducing GHG emissions in the transportation sector, which, at 25.4%, is one of the largest contributors to NYC's CO₂ emissions among all economic sectors (Inventory of NYC GHG Emissions, 2020). However, to fully harness its potential, policymakers, planners, and transportation professionals must first overcome policy and behavioral challenges that threaten the industry's growth.

With app-based deliveries projected to increase by 35% by 2025 (DCWP, 2022), there is an urgent need to both facilitate and accelerate the adoption of UL certified e-bikes with safer lithium-ion batteries. Given the conditions in which many working cyclists operate, the City should continue to explore potential strategies for curbside charging infrastructure and networked battery swapping infrastructure with smaller retailers. Building out a robust and easily accessed charging network is key to making e-bikes safer for everyone. Infrastructure campaigns can complement other financial assistance programs, partnerships, educational campaigns, and pilots currently being undertaken by the City and the State.

NYC has a unique opportunity to learn from incremental approaches and leverage existing programs and partnerships to serve more people and fill existing gaps. With an innovative regulatory framework in place, the City is to implement forward-thinking electric micromobility policies and initiatives that can foster sustainable and equitable urban mobility, while protecting public safety.



References

- Ackerman, Gwen. "Tel Aviv's Tech Worker Boom Also Brings Micromobility." Bloomberg.com, Bloomberg, 28 Apr. 2022, <https://www.bloomberg.com/news/features/2022-04-28/tel-aviv-s-tech-worker-boom-also-brings-micromobility>.
- AIANY. "Delivering the Goods: NYC Urban Freight in the Age of e-Commerce - Calendar - AIA New York / Center for Architecture." Calendar, AIANY, 12 Sept. 2022, <https://calendar.aiany.org/2022/09/12/delivering-the-goods-nyc-urban-freight-in-the-age-of-e-commerce/>.
- AIANY. "Delivering the Goods: NYC Urban Freight in the Age of e-Commerce." Delivering the Goods, AIA New York, 30 Nov. 2022, <https://www.aiany.org/membership/special-projects/project/delivering-the-goods-nyc-urban-freight-in-the-age-of-e-commerce/>.
- Alibaba. "Alibaba: E-Bike Search Results." Ebike Manufacturers, Suppliers and Exporters on Alibaba.com Electric Hybrid Bike, Alibaba.com, 2 Dec. 2022, https://www.alibaba.com/trade/search?fsb=y&IndexArea=product_en&CatId=&tab=all&SearchText=ebike.
- Alibaba. "Cheape Bike 21/27 Speed Hot Selling 36v 10ah Battery 250W/350W/500W Electric Bicycle Electric Mountain Bike." Alibaba.com, Alibaba, 9 Dec. 2022, https://www.alibaba.com/product-detail/Cheap-e-bike-21-27-speed_1600442137357.html?spm=a2700.galleryofferlist.normal_offer_d_title.aee05003tqpK98%29.
- Amazon. "Transportation." Sustainability (US), Sustainability (US), 2021, <https://sustainability.aboutamazon.com/environment/transportation>.
- Aponte, Claudia Irizarry, and Josefa Velasquez. "NYC Food Delivery Workers Band to Demand Better Treatment. Will New York Listen to Los Deliveristas Unidos?" The City, The City, 7 Dec. 2020, <https://www.thecity.nyc/work/2020/12/6/22157730/nyc-food-delivery-workers-demand-better-treatment>.
- Aponte, Claudia Irizarry. "Delivery Workers Cheer \$23.82 Proposed Minimum Pay Standards, but Not Everyone's Happy." The City, The City, 21 Nov. 2022, <https://www.thecity.nyc/work/2022/11/21/23471329/delivery-workers-cheer-23-82-proposed-minimum-pay-standards-but-not-everyones-happy#:~:text=Deliverista%20Antonio%20Solis%20speaks%20outside,%242-3.82%20by%20April%201%2C%202025>.
- Barone, Richard, and Emily Roach. "Why Goods Movement Matters." Regional Plan Association, RPA.org, n.d., <https://rpa.org/work/reports/why-goods-movement-matters>.
- Barsukov, Yevgen, and Jinrong Qian. Battery Power Management for Portable Devices. Artech House, 2013.
- Batteries International. "China Could Move to Ban Lead Batteries for e-Bikes." Batteries International, Batteries International, 5 Nov. 2021, <https://www.batteriesinternational.com/2021/11/05/china-could-move-to-ban-lead-batteries-for-e-bikes/>.
- Bennett, Cameron, and John MacArthur. "Using E-Bike Purchase Incentive Programs to Expand the Market - North American Trends and Recommended Practices." Transportation Research and Education Center, May 2022.
- Bevilacqua, Matt. "Six Months after Crackdown, New York City Will Legalize Some E-Bikes." Bicycling, Bicycling, 3 Apr. 2018, <https://www.bicycling.com/news/a19674987/nyc-legalizes-pedal-assist-ebikes/>.
- Beyond. "Beyond Scooters - the Best Commuter Electric Scooter in New York City." Beyond, RideBeyond.com, 2022, <https://www.ridebeyond.com/>.
- Bicycle Habitat. "Security." Bicycle Habitat, Bicycle Habitat, 2022, <https://www.bicyclehabitat.com/articles/security-pg80.htm>.
- Bicycle Retailer. "Approximately None of the Recent 'E-Bike Fires' in New York Involved an e-Bike." Industry News, Bicycle Retailer and Industry News, 26 Apr. 2022, <https://www.bicycleretailer.com/industry-news/2022/04/26/approximately-none-recent-e-bike-fires-new-york-involved-e-bike#.Y5lADnbMJAT>.

- BikeHub. "BikeHub Homepage." Easier Bicycle Commuting, BikeHub, n.d., <https://www.bikehub.com/>.
- Blanco, Sebastian. "Bay Area Grant Program Offers \$9500 to Trade Your Gasoline Car for an EV." Car and Driver, Car and Driver, 9 Oct. 2021, <https://www.caranddriver.com/news/a37916152/bay-area-grant-program-trade-ice-for-ev/>.
- Boffey, David. "Dutch Government Pilots Technology to Cut E-Bike Road Deaths." The Guardian, Guardian News and Media, 6 Nov. 2020, <https://www.theguardian.com/world/2020/nov/06/dutch-government-pilots-technology-to-cut-e-bike-road-deaths>.
- Bolton Jr., O. "Electric Bicycle." Patent No. 552271, 31 Dec. 1895, <https://patentimages.storage.googleapis.com/de/f7/f4/37a9e8ed9f4873/US552271.pdf>.
- Bothra, Nilesh. "E-Bike Sales Worldwide." Medium, Calamus, 25 Mar. 2019, <https://medium.com/calamus/e-bike-sales-worldwide-91c1df5da89a>.
- Boudway, Ira. "Oonee Is Building Bike-Parking Pods to Help Prevent Bike Theft." Bloomberg.com, Bloomberg, 11 Feb. 2021, <https://www.bloomberg.com/news/features/2021-02-11/oonee-is-building-bike-parking-pods-to-help-prevent-bike-theft>.
- Bowden, Alex. "Cargo e-Scooter for Delivery Workers Launched by New York Micromobility Subscription Service." Ebiketips, Ebiketips, 29 Sept. 2022, <https://ebiketips.road.cc/content/news/cargo-e-scooter-for-delivery-workers-launched-by-new-york-micromobility-subscription>.
- Bubbers, Matt. "Vancouver and Montreal Named among World's Most Bike-Friendly Cities; Toronto 'Not Close'." The Globe and Mail, The Globe and Mail, 27 June 2019, <https://www.theglobeandmail.com/drive/mobility/article-vancouver-and-montreal-named-among-worlds-most-bike-friendly-cities/>.
- CBS New York. "Mayor Bloomberg Expected to Sign E-Bike Ban." CBS News, CBS Interactive, 26 Apr. 2013, <https://www.cbsnews.com/newyork/news/mayor-bloomberg-expected-to-sign-e-bike-ban/>.
- Chan, Wilfred. "E-Bike Batteries Have Caused 200 Fires in New York: 'Everyone's Scared'." The Guardian, Guardian News and Media, 15 Nov. 2022, www.theguardian.com/us-news/2022/nov/14/new-york-e-bike-batteries-fires-delivery-workers.
- Chan, Wilfred. "How Delivery Workers Won Their First Charging Hub." Curbed New York, Curbed, 7 Oct. 2022, <https://www.curbed.com/2022/10/delivery-workers-won-first-charging-hub-newsstand.html#:~:text=Creating%20delivery-worker%20hubs%20had%20become%20a%20major%20goal,said%20Hildalyn%20CoI%C3%B3n%20Hern%C3%A1ndez%2C%20Deliveristas%20Unidos%E2%80%99s%20policy%20director>.
- Chen, I-Chun. "Beyond Gets \$1.8M Funding, Chosen by New York's MTA for e-Scooter Trial." Bizjournals.com, New York Business Journal, 15 Dec. 2022, <https://www.bizjournals.com/newyork/news/2020/12/15/beyond-funding-chosen-for-new-york-mta-scooter.html>.
- Christopher, Justin. "Best Practices for Ebike Battery Charging." Bike.com, Bike.com, 17 Jan. 2022, <https://bike.com/blogs/ebikes/best-practices-for-ebike-battery-charging>.
- City of New York. "Mayor Adams Announces First-in-Nation Street Deliveristas Hubs to Serve NYC's Food Delivery Workers." The Official Website of the City of New York, NYC.org, 3 Oct. 2022, <https://www.nyc.gov/office-of-the-mayor/news/715-22/mayor-adams-majority-leader-schumer-first-in-nation-street-deliveristas-hubs-serve#/0>.
- City of New York. "NYC Delivers First-Ever City Plan to Meet the Goals of the Paris Climate Agreement." The Official Website of the City of New York, NYC.gov, 3 Oct. 2017, <https://www.nyc.gov/office-of-the-mayor/news/634-17/nyc-delivers-first-ever-city-plan-meet-goals-the-paris-climate-agreement>.
- ClimateAction Center. "E-Bike-Programs." E-Bike Incentive Programs, ClimateAction Center, 2 Dec. 2022, <https://www.climateaction.center/e-bike-programs>.
- Colon, Dave, and David Meyer. "Justice Delivered: E-Bikes Legalized Statewide in Budget Bill." Streetsblog New York City, Streetsblog New York City, 2 Apr. 2020, <https://nyc.streetsblog.org/2020/04/01/justice-delivered-e-bikes-legalized-statewide-in-budget-bill/>.
- Considerable Staff. "The Popularity of Electric Bikes Is Skyrocketing among Older Riders." Wellness, Hella Health, 20 July 2022, <https://www.hellahealth.com/blog/wellness/popularity-electric-bikes/>.

- Coulon, Jessica. "It's Now Legal to Ride e-Bikes with Top Speeds of under 25mph in NYC." *Bicycling*, Bicycling, 26 June 2020, <https://www.bicycling.com/news/a32984364/nyc-legalizes-e-bikes/>.
- Cunningham, Emma. "How Much Does an Electric Bike Battery Cost?" *Electric Biking*, Electric Biking, 21 May 2021, <https://electric-biking.com/battery-cost/>.
- Denver Gov. "Electric Bikes (e-Bikes)." City and County of Denver, Denver Gov, 2022, <https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/Sustainable-Transportation/Electric-Bikes-E-Bikes-Rebates#:~:text=Denver%27s%20e%2Dbike%20rebate%20program,please%20subscribe%20to%20our%20newsletter.>
- Dillet, Romain. "Dott to Expand beyond e-Scooters with Bike-Sharing Service." *TechCrunch Startups*, TechCrunch, 15 Dec. 2020, <https://techcrunch.com/2020/12/14/dott-to-expand-beyond-e-scooters-with-bike-sharing-service/>.
- DuBois, Gretchen, and Doug Shinkle. "State Electric Bicycle Laws: A Legislative Primer." *State Electric Bicycle Laws | A Legislative Primer*, National Conference of State Legislatures, 24 Feb. 2021, <https://www.ncsl.org/research/transportation/state-electric-bicycle-laws-a-legislative-primer.aspx>.
- Ebike Portal. "Ogden Bolton Jr and His 1895 Hub Motor Ebike." *OGDEN BOLTON JR AND HIS 1895 HUB MOTOR EBIKE*, Ebike Portal, 13 Feb. 2015, <http://www.ebikeportal.com/history/ogden-bolton-jr-and-his-1895-hub-motor-ebike>.
- ECP. *Equitable Commute Project*, Equitable Commute Project, n.d., <https://equitablecommuteproject.carrd.co/>.
- ELBC. "Lead Batteries Continue to Power e-Bikes in China." *ELBC*, ELBC Expo, 25 May 2022, <https://www.elbcexpo.org/2022/05/25/lead-batteries-continue-to-power-e-bikes-in-china/>.
- FDNY. "New York City Fire Department Fire Code Revision Project." *New York City Fire Code*, NYC.gov, 15 Apr. 2022, <https://www1.nyc.gov/assets/fdny/downloads/pdf/codes/fire-code-highlight-summary.pdf>.
- Figuroa, Maria, Ligia Gualpa, Hildalyn Colon-Hernandez, Glendy Tsitouras and Andrew Wolf. "Essential but Unprotected: App-based Food Couriers in New York City." *Workers' Justice Project/ Los Deliveristas, The Worker Institute at Cornell*, 13 Sept. 2021, 09142021CHARTSLos Deliveristas Unidos-v02.pdf (wsimg.com).
- Fischbach, Nick. "Denver e-Bike Rebate Funds Exhausted for 2022." *FOX31 Denver*, FOX31 Denver, 25 Oct. 2022, <https://kdvr.com/news/local/denver-e-bike-rebate-funds-exhausted-for-2022/>.
- Frank, John. "Coloradans Now Paying More for Uber, Amazon and Doordash." *Axios Denver*, Axios, 1 July 2022, <https://www.axios.com/local/denver/2022/07/01/coloradans-tax-uber-amazon-doordash>.
- Frothingham, Steve. "E-Bike Regulation Discussion an 'Eye-Opener' for Industry." *Bicycle Retailer and Industry News*, Bicycle Retailer, 20 May 2022, <https://www.bicycleretailer.com/industry-news/2022/05/20/e-bike-regulation-discussion-%E2%80%98eye-opener%E2%80%99-industry#.Y4oZsMvMJaS>.
- Gilbert, Ben. "We Got inside New York City's First Amazon Fulfillment Center, Where Thousands of People Work in a Building Large Enough for 18 Football Fields." *Business Insider*, Business Insider, 2 Sept. 2019, <https://www.businessinsider.com/amazon-new-york-city-fulfillment-center-tour-photos-2019-8>.
- Gliemann, Jennifer. "200th Anniversary: How the Bicycle Changed Society." *Bikecitizens*, Bikecitizens, 21 Mar. 2017, <https://magazine.bikecitizens.net/200th-anniversary-bicycle-changed-society/>.
- Gogoro. "Gogoro Global." *Gogoro*, Gogoro, 2022, <https://www.gogoro.com/>.
- Gouk, Annie. "Cambridge Is the UK's Cycling Capital - but It's on the Decline." *Cambridge News*, CambridgeshireLive, 1 Sept. 2018, <https://www.cambridge-news.co.uk/news/cambridge-news/cycling-cambridge-greenways-cam-cycle-15095519>.
- Hamer, Lars James. "Register Your E-Bike or It Might Get Seized!" *That's Online*, Thatsmag.com, 4 Aug. 2022, <https://www.thatsmags.com/china/post/34828/register-your-e-bike-or-it-might-get-seized>.

- Hardinges, Nick. "How to Claim Your Free £50 Bike Repair Voucher as 150,000 More Are Released." LBC, Leading Britain's Conversation, 30 Mar. 2021, <https://www.lbc.co.uk/news/explained/how-to-claim-your-free-50-bike-repair-voucher-150000-more-released-government/>.
- Herbert, Kiran. "What Makes a Good Electric Bike Incentive Program?" PeopleForBikes, PeopleForBikes, 7 Mar. 2022, <https://www.peopleforbikes.org/news/what-makes-a-good-electric-bike-incentive-program>.
- Hiar, Corbin. "Why Biden Might Be the e-Bike President." Climate Wire, E&E News, 3 Nov. 2021, <https://www.eenews.net/articles/why-biden-might-be-the-e-bike-president/#:~:text=The%20near-final%20textof%20the%20%22Build%20Back%20Better%22%20bill,commuter%20benefit%20from%20%2420%20per%20month%20to%20%2481>
- Hu, Winnie. "City Council Overrides Veto of Bill on Motorized Scooters." The New York Times, The New York Times, 24 Nov. 2004, <https://www.nytimes.com/2004/11/24/hyregion/city-council-overrides-veto-of-bill-on-motorized-scooters.html>.
- Hubbard, Ben. "Beyond Launches 'Cargo One' e-Scooter for Delivery Workers." Zag Daily, Zag Daily, 14 Sept. 2022, <https://zagdaily.com/tech/beyond-launches-cargo-one-e-scooter-for-delivery-workers/>.
- Hurford, Molly. "NYPD Initiates e-Bike Crackdown, and Cyclists Are Outraged." Bicycling, Bicycling, 27 Mar. 2017, <https://www.bicycling.com/news/a20030315/nypd-initiates-e-bike-crackdown-and-cyclists-are-outraged/>.
- IEA. "Transport Sector CO2 Emissions by Mode in the Sustainable Development Scenario, 2000-2030 – Charts – Data & Statistics." IEA, International Energy Association, 26 Oct. 2022, <https://www.iea.org/data-and-statistics/charts/transport-sector-co2-emissions-by-mode-in-the-sustainable-development-scenario-2000-2030>.
- Invictus Active. "Wheelchair Electric Bike Attachment." Invictus Active, Invictus Active Lifestyle Solutions, 22 Mar. 2022, <https://www.invictusactive.com/solutions/wheelchair-electric-bike-attachment/>.
- Jancer, Matt. "What Are Ebike 'Classes' and What Do They Mean?" Wired, Wired, 4 Oct. 2020, <https://www.wired.com/story/guide-to-ebike-classes/>.
- JOCO. "Home." JOCO, RideJoco.com, 2022, <https://ridejoco.com/aboutus>.
- Julianto, Ary. "Electric Battery Exchange Easier to Apply for E-Bike and E-Scooter, Here's Why!" VOI, VOI.ID, 25 Mar. 2022, <https://voi.id/en/technology/149696/electric-battery-exchange-easier-to-apply-for-e-bike-and-e-scooter-heres-why>.
- Krader, Kate. "Restaurant Owners Fear Losing \$25,000 Outdoor Dining Sheds." Bloomberg.com, Bloomberg, 21 Sept. 2021, <https://www.bloomberg.com/news/articles/2021-09-21/restaurant-owners-fear-losing-25-000-outdoor-dining-sheds?leadSource=uverify+wall>.
- Kuntzman, Gersh, and David Meyer. "NYPD Seizes Illegal Mopeds - Then Disseminates Misinformation, Lies and Anti-Cycling Propaganda." Streetsblog New York City, Streetsblog New York City, 30 Nov. 2021, <https://nyc.streetsblog.org/2021/11/29/nypd-seizes-illegal-mopeds-then-disseminates-misinformation-lies-and-anti-cycling-propaganda/>.
- Lee, Do J. "Delivering Justice: Food Delivery Cyclists in New York City." CUNY Academic Works, City University of New York (CUNY), Sept. 2018, https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=3854&context=gc_etds.
- Lee, Paul, Jeff Loucks, Duncan Stewart, David Jarvis, and Chris Arkenberg. "TMT Predictions 2020 How Has Covid-19 Changed Expectations?" Deloitte Insights, Deloitte, 9 Dec. 2019, <https://www.deloitte.com/au/insights/industry/transport-logistics/tmt-predictions-2020-how-has-covid-19-changed-expectations> (deloitte.com).
- Lewis, Michelle. "Vermont Launches the First State e-Bike Incentive Program in the US, plus Other EV Programs." Electrek, Electrek, 3 May 2022, <https://electrek.co/2022/05/03/vermont-launches-the-first-state-e-bike-incentive-program-in-the-us-plus-other-ev-programs/>.
- MacArthur, John, and Cameron Bennett. "Using e-Bike Incentive Programs to Expand the Market." Portland State University, PDX Scholar, 6 May 2022, https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1223&context=trec_seminar.
- Masterson, Victoria. "How Swappable Battery Tech Is Keeping India's Electric Rickshaws on the Road." World Economic Forum, 8 Jan. 2021, <https://www.weforum.org/agenda/2021/01/sun-mobility-ev-battery-swap-stations/>.

- Mays, Jeffery C. "New York Passes Sweeping Bills to Improve Conditions for Delivery Workers." *The New York Times*, *The New York Times*, 23 Sept. 2021, <https://www.nytimes.com/2021/09/23/nyregion/nyc-food-delivery-workers.html>.
- McCue, TJ. "Global Electric Bike Market Is Still Moving Fast - Sondors E-Bike Offers Glimpse." *Forbes*, *Forbes Magazine*, 12 Apr. 2018, <https://www.forbes.com/sites/tjmccue/2018/04/12/the-global-electric-bike-market-is-still-moving-fast-sondors-e-bike-offers-glimpse/?sh=53e3676531ff>.
- Metaye, Romain. "Lead-Acid vs Lithium-Ion (10 Key Differences)." *Climatebiz*, *Climatebiz*, 24 May 2022, <https://climatebiz.com/lead-acid-vs-lithium-ion/>.
- Mierjeski, Alex. "First They Came for the Electric Bikes..." *VICE*, *Vice*, 20 Jan. 2014, <https://www.vice.com/en/article/9bzb3e/first-they-came-for-the-electric-bikes-0000195-v21n1>.
- Mohl, Bruce. "Legislature Proposes New Uber, Lyft Fees." *CommonWealth Magazine*, *CommonWealth Magazine*, 6 Jan. 2021, <https://commonwealthmagazine.org/transportation/legislature-proposes-new-uber-lyft-fees/#:~:text=The%20legislation%20also%20creates%20a,encompassing%2014%20Greater%20Boston%20communities>.
- New York City Council. "Council Votes to Legalize the Use of e-Bikes and Scooters." *Press*, *New York City Council*, 25 June 2020, <https://council.nyc.gov/press/2020/06/25/1997/>.
- New York Metropolitan Transportation Council Followthis publisher. "NYMTC's Regional Transportation Plan - Plan 2045." *Issuu*, *NYMTC*, 27 June 2018, https://issuu.com/newyorkmtc/docs/full_main_plan_2045_r_6-27-17?utm_medium=referral&utm_source=www.nymtc.org.
- NYC Commission on Human Rights. "Salary Transparency in Job Advertisements." *Salary Transparency in Job Advertisements*, *NYC Human Rights*, 1 Nov. 2022, <https://www.nyc.gov/site/cchr/media/pay-transparency.page>.
- NYC Commission on Human Rights. "Salary Transparency in Job Advertisements - New York City." *Salary Transparency in Job Advertisements*, *NYC Human Rights*, 12 May 2022, <https://www1.nyc.gov/assets/cchr/downloads/pdf/publications/Salary-Transparency-Factsheet.pdf>.
- NYC Department of Consumer and Worker Protection. "A Minimum Pay Rate for App-Based Restaurant Delivery Workers in NYC." *NYC DCWP*, *NYC DCWP*, 16 Nov. 2022, <https://www.nyc.gov/assets/dca/downloads/pdf/workers/Delivery-Worker-Study-November-2022.pdf>.
- NYC Department of Consumer and Worker Protection. "Delivery Workers." *Delivery-Workers*, *NYC DCWP*, 16 Nov. 2022, <https://www.nyc.gov/site/dca/workers/workersrights/Delivery-Workers.page>.
- NYC Department of Consumer and Worker Protection. "New York City Proposes Nation's First Minimum Pay Rate Specific to App-Based Restaurant Delivery Workers." *NYC DCWP*, *NYC DCWP*, 16 Nov. 2022, <https://www.nyc.gov/site/dca/media/pr111622-NYC-Proposes-Minimum-Pay-Rate-for-App-Based-Delivery-Workers.page>.
- NYC DOT. "Electric Bicycles & More." *NYC DOT - Electric Bicycles & More*, *NYC Department of Transportation*, 23 Nov. 2020, <https://www.nyc.gov/html/dot/html/bicyclists/ebikes.shtml>.
- NYC Mayor's Office of Sustainability. "GHG Inventory." *GHG Inventory*-*NYC Mayor's Office of Sustainability*, *INVENTORY OF NEW YORK CITY GREENHOUSE GAS EMISSIONS, 2020*, <https://nyc-ghg-inventory.cusp.nyu.edu/>.
- NYC Office of the Mayor. "Mayor Adams Announces Plan to Combat Lithium-Ion Battery Fires, Promote Safe Electric Micromobility Usage." *The Official Website of the City of New York, NYC*, 20 Mar. 2023, <https://www.nyc.gov/office-of-the-mayor/news/195-23/mayor-adams-plan-combat-lithium-ion-battery-fires-promote-safe-electric-micromobility#/0>.
- NYC Office of the Mayor. "Mayor Adams Announces First-in-Nation Street Deliveristas Hubs to Serve NYC's Food Delivery Workers." *The Official Website of the City of New York, NYC*, 3 Oct. 2022, <https://www.nyc.gov/office-of-the-mayor/news/715-22/mayor-adams-majority-leader-schumer-first-in-nation-street-deliveristas-hubs-serve#/0>.
- NYC Office of the Mayor. "Mayor Bloomberg Signs Legislation Increasing Enforcement of Motorized Scooters." *The Official Website of the City of New York, NYC*, 15 May 2013, <https://www.nyc.gov/office-of-the-mayor/news/165-13/mayor-bloomberg-signs-legislation-increasing-enforcement-motorized-scooters>.

- NYC Office of the Mayor. "Mayor De Blasio Announces New Framework to Clarify Legality of Pedal-Assist Bicycles." The Official Website of the City of New York, NYC, 3 Apr. 2018, <https://www.nyc.gov/office-of-the-mayor/news/165-18/mayor-de-blasio-new-framework-clarify-legality-pedal-assist-bicycles>.
- NYC Office of the Mayor. "Mayor de Blasio and NYPD Announce Plans to Crack Down on Improper Use of Electric Bikes." The Official Website of the City of New York, NYC, 19 Oct. 2017, <https://www.nyc.gov/office-of-the-mayor/news/666-17/mayor-de-blasio-nypd-plans-crack-down-improper-use-electric-bikes/#/0>
- NYMTC. "Freight Planning: Programs and Projects." Freight Planning: Programs and Projects, NYMTC, 4 Apr. 2022, <https://www.nymtc.org/Regional-Planning-Activities/Freight-Planning/Freight-Planning-Program-and-Projects>.
- NYS. "Electric Scooters and Bicycles and Other Unregistered Vehicles." New York DMV, Department of Motor Vehicles, 18 Aug. 2022, <https://dmv.ny.gov/registration/electric-scooters-and-bicycles-and-other-unregistered-vehicles>.
- NYSERDA. "Climate Act." Our Progress, NYSERDA, 2022, <https://climate.ny.gov/Our-Progress#:~:text=New%20York%27s%20Nation-Leading%20Climate%20Targets%201%2085%25%20Reduction,of%20Carbon%20Reduction%20through%20Energy%20Efficiency%20and%20Electrification>.
- NYSERDA. "Weekly Average Motor Gasoline Prices." NYSERDA, NYS, 29 Nov. 2022, <https://www.nyserda.ny.gov/Researchers-and-Policymakers/Energy-Prices/Motor-Gasoline/Weekly-Average-Motor-Gasoline-Prices>.
- Office of New York City Comptroller Brad Lander. "NYC Climate Dashboard." Comptroller.nyc.gov, New York City Comptroller Brad Lander, 2022, <https://comptroller.nyc.gov/services/for-the-public/nyc-climate-dashboard/emissions/>.
- Oonee. "Oonee." Homepage, Oonee, 2022, <https://www.oonee.us/>.
- O'Sullivan, Feargus. "How Paris Hopes to Build an E-Bike Boom." Bloomberg.com, Bloomberg, 24 Sept. 2019, <https://www.bloomberg.com/news/articles/2019-09-24/how-paris-helps-people-ride-and-buy-e-bikes>.
- O'Sullivan, Feargus. "Norway Will Spend Almost \$1 Billion on New Bike Highways." Bloomberg.com, Bloomberg, 3 Mar. 2016, <https://www.bloomberg.com/news/articles/2016-03-03/norway-s-national-transit-plan-will-spend-almost-1-billion-on-new-bike-highways>.
- O'Sullivan, Feargus. "Oslo Offers Citizens \$1,200 to Buy an E-Bike." Bloomberg.com, Bloomberg, 31 Jan. 2017, <https://www.bloomberg.com/news/articles/2017-01-31/oslo-offers-free-money-to-buy-electric-cargo-bikes>.
- Philippe Gauthier. "Material Challenges of Bicycle Manufacturing in a Post-Growth World (Translated From French)." Resilience, Resilience, 9 Feb. 2021, <https://www.resilience.org/stories/2021-02-09/material-challenges-of-bicycle-manufacturing-in-a-post-growth-world/>.
- Poon, Linda. "CityLab Daily: The Profiling Problem with Bike Registration Laws." Bloomberg.com, Bloomberg, 23 Apr. 2021, <https://www.bloomberg.com/news/newsletters/2021-04-23/citylab-daily-the-profiling-problem-with-bike-registration-laws>.
- Preston, Benjamin. "How to Prevent an Electric-Bike Fire." Consumer Reports, Consumer Reports, 27 Oct. 2021, <https://www.consumerreports.org/electric-bikes/how-to-prevent-e-bike-fires-a2493889574/>.
- Quintero, Eulises. "UL Certification - Do You Need One or Can You Avoid It?" Titoma, Titoma, 15 Apr. 2022, <https://titoma.com/blog/ul-certification#>.
- Rahmanan, Anna. "NYC Is Turning Empty Newsstands into Hubs for Food Delivery Workers." Time Out New York, Time Out, 4 Oct. 2022, <https://www.timeout.com/newyork/news/nyc-is-turning-empty-newsstands-into-hubs-for-food-delivery-workers-100422>.
- Research and Markets Ltd., Research and Markets. "E-Bike Market by Class (Class-I, Class-II, Class-III), Speed (up to 25km/h, 25-45 Km/h), Battery Type (Lithium-Ion, Lithium-Ion Polymer, Lead Acid), Motor Type, Mode (Pedal Assist, Throttle), Component, Usage, Ownership and Region - Forecast to 2027." Market Research Reports - Welcome, Research and Markets, June 2022, https://www.researchandmarkets.com/reports/5455970/e-bike-market-by-class-class-i-class-ii-class?utm_source=GNOM&utm_medium=PressRelease&utm_code=tm3brl&utm_

- campaign=1723419%2B-%2BE-Bike%2BMarket%2BGlobal%2BReport%2B2022-2027%3AGovernment%2BSupport%2Band%2BInitiatives%2Bto%2BIncrease%2BE-Bike%2BSales&utm_exec=como322prd.
- Reynolds, Pete. "Are Electric Bikes More Likely to Get Stolen? [Statistics]." *Discerning Cyclist*, Discerning Cyclist, 18 June 2022, <https://discerningcyclist.com/are-electric-bikes-more-likely-to-get-stolen/>.
- Ritchie, Hannah. "Cars, Planes, Trains: Where Do CO2 Emissions from Transport Come from?" *Our World in Data*, Our World in Data, 6 Oct. 2020, <https://ourworldindata.org/co2-emissions-from-transport#:~:text=Transport%20accounts%20for%20around%20one,CO%20emissions%20from%20energy%5D.&text=Road%20travel%20accounts%20for%20three,buses%20%2E%80%93%20which%20contribute%2045.1%25>.
- Rose, William. "The 'War on e-Bikes' Rides on: Exploring the Hudson River Greenway E-Bike Ban." *Environmental Law Review Syndicate*, NYU Environmental Law Journal, 24 Feb. 2022, <https://www.nyuelj.org/2022/02/the-war-on-e-bikes-rides-on-exploring-the-hudson-river-greenway-e-bike-ban/#:~:text=Introduction,bikes%20in%20New%20York%20City>.
- Ryssdal, Kai, and Anais Amin. "E-Bikes Are Soaring in Popularity, but Some Still Have Reservations ." *Marketplace*, Marketplace, 14 Oct. 2022, <https://www.marketplace.org/2022/10/14/e-bikes-are-soaring-in-popularity-but-some-still-have-reservations/>.
- Shenk, Henry, Gersh Kuntzman, and Vince DiMiceli. "Field Guide to the Micro Mobility of New York City." *Streetsblog*, Streetsblog.org, 2022, <https://nyc.streetsblog.org/wp-content/uploads/2021/11/Streetsblog-MicroMobility-Field-Guide-FINE-FINAL.pdf>.
- Sorenson, Dirk. "The Cycling Market Pedals Ahead in 2021." *The NPD Group*, NPD, 10 Feb. 2022, <https://www.npd.com/news/blog/2021/the-cycling-market-pedals-ahead-in-2021/>.
- Sun Mobility. "Sun Mobility." Sun Mobility Homepage, Sun Mobility, n.d., <https://www.sunmobility.co.in/>.
- Surico, John. "The Popularity of e-Bikes Isn't Slowing Down." *The New York Times*, The New York Times, 8 Nov. 2021, <https://www.nytimes.com/2021/11/08/business/e-bikes-urban-transit.html>.
- Swobbee. "Swobbee ." Swobbee: The Multimodal Battery Swapping Station for Micromobility, Swobbee, 24 Nov. 2022, <https://swobbee.de/en/>.
- Sylvester, Lisa. "How Cold Weather Affects Electric Bikes (Problems and Solutions)." *EBiking Today*, EBiking Today, 13 Sept. 2022, <https://www.ebikingtoday.com/how-cold-weather-affects-electric-bikes-problems-and-solutions/>.
- Toll, Micah. "New York's Proposed E-Bike Rebate Could Slash Electric Bike and Scooter Prices by 50%." *Electrek*, Electrek.co, 31 Aug. 2022, <https://electrek.co/2022/08/31/new-york-e-bike-rebate/>.
- Toll, Micah. "This Country Is Paying Car Drivers Nearly \$4,000 to Switch to an Electric Bike." *Electrek*, Electrek, 22 Aug. 2022, <https://electrek.co/2022/08/22/france-paying-car-drivers-switch-electric-bike/>.
- Troutman, Matt. "NYC's Vacant Newsstands Will Become Hubs for Food App Delivery Workers." *MSN*, MSN, 3 Oct. 2022, <https://www.msn.com/en-us/news/us/nyc-s-vacant-newsstands-will-become-hubs-for-food-app-delivery-workers/ar-AA12xSzT>
- U.S. Department of Energy. "Key Federal Legislation." *Alternative Fuels Data Center: Key Federal Legislation*, Energy Efficiency and Renewable Energy, n.d., https://afdc.energy.gov/laws/key_legislation#epact05.
- UL Solutions. "E-Bikes Certification: Testing to UL 2849." *UL Solutions*, UL, n.d., <https://www.ul.com/services/e-bikes-certification-testing-ul-2849>.
- United Nations. "Around 2.5 Billion More People Will Be Living in Cities by 2050, Projects New UN Report ." *United Nations*, UN Department of Economic and Social Affairs, 16 May 2018, <https://www.un.org/development/desa/en/news/population/2018-world-urbanization-prospects.html#:~:text=Around%202.5%20billion%20more%20people%20will%20be%20living,for%20more%20sustainable%20urban%20planning%20and%20public%20services>.
- Weinberger, Rachel, and Melinda Hanson. "Opinion: We Need E-Bike Incentives, Not Bans." *City Limits*, City Limits, 5 Oct. 2022, <https://citylimits.com>.

org/2022/10/05/opinion-we-need-e-bike-incentives-not-bans/.

Zipper, David. "Why E-Bikes Could Change Everything." Sierra Club, Sierra Club, 1 Oct. 2022, <https://www.sierraclub.org/sierra/2022-3-fall/material-world/why-e-bikes-could-change-everything>.

Zraick, Karen and Matthew Sedacca. "2 Die in Harlem Fire as Warnings Mount About Scooter Battery Hazards." The New York Times, 3 August 2022, [nytimes.com/2022/08/03/nyregion/new-york-electric-scooter-battery-fire-deaths.html](https://www.nytimes.com/2022/08/03/nyregion/new-york-electric-scooter-battery-fire-deaths.html).

Oonee's advanced bike parking kiosk envisioned at Times Square ▶





Hello Oonee, Welcome to Times Square

Times Square

1	Downtown	1 min
2	Downtown	2 min
3	Downtown	3 min
4	Downtown	4 min
5	Downtown	5 min
6	Downtown	6 min
7	Downtown	7 min
8	Downtown	8 min

ASH

THE PRIDE RETURNS
SEPT 14
THE LION KING

DAVIDS
GREAT AMERICAN
BUTLER, author of Shogun Loveless

MCBS

ORANGE

Glossary

BMS	Battery management system		Legislatures
CO2	Carbon dioxide	NGO	Non-governmental organization
CPSC	Consumer Product Safety Commission	NHTSA	National Highway Transportation Safety Administration
CSE	Center for Sustainable Energy	NYC	New York City
DIY	Do-it-yourself	NYCHA	New York City Housing Authority
DMV	Department of Motor Vehicles	NYPD	City of New York Police Department
DOT	Department of Transportation	NYS	New York State
E-bike	Electric bicycle	NYSERDA	New York State Energy Research and Development Authority
E-mobility	Electric mobility	NYU	New York University
E-scooter	Electric scooter	PANYNJ	Port Authority of New York and New Jersey
ECC	Empire Clean Cities		
ECP	Equitable Commute Project	TA	Transportation Alternatives
EDC	Economic Development Corporation	TREC	Transportation Research & Education Center
EPAAct	Energy Policy Act		
EV	Electric vehicle	UK	United Kingdom
F	Fahrenheit	UL	Underwriters' Laboratories
FDNY	New York City Fire Department	USD	United States dollar
GHG	Greenhouse gas	Wh	Watt-hour
IEA	International Energy Agency	WJP	Work Justice Project
ILR	Industrial and labor relations		
Km	Kilometer		
Kmph	Kilometer per hour		
LDU	Los Deliveristas Unidos		
MPH	Miles per hour		
MTA	Metropolitan Transportation Authority		
NCSL	National Conference of State		

