Biking the Goods

How North American Cities Can Prepare for and Promote Large-Scale Adoption of **Cargo e-Bikes**

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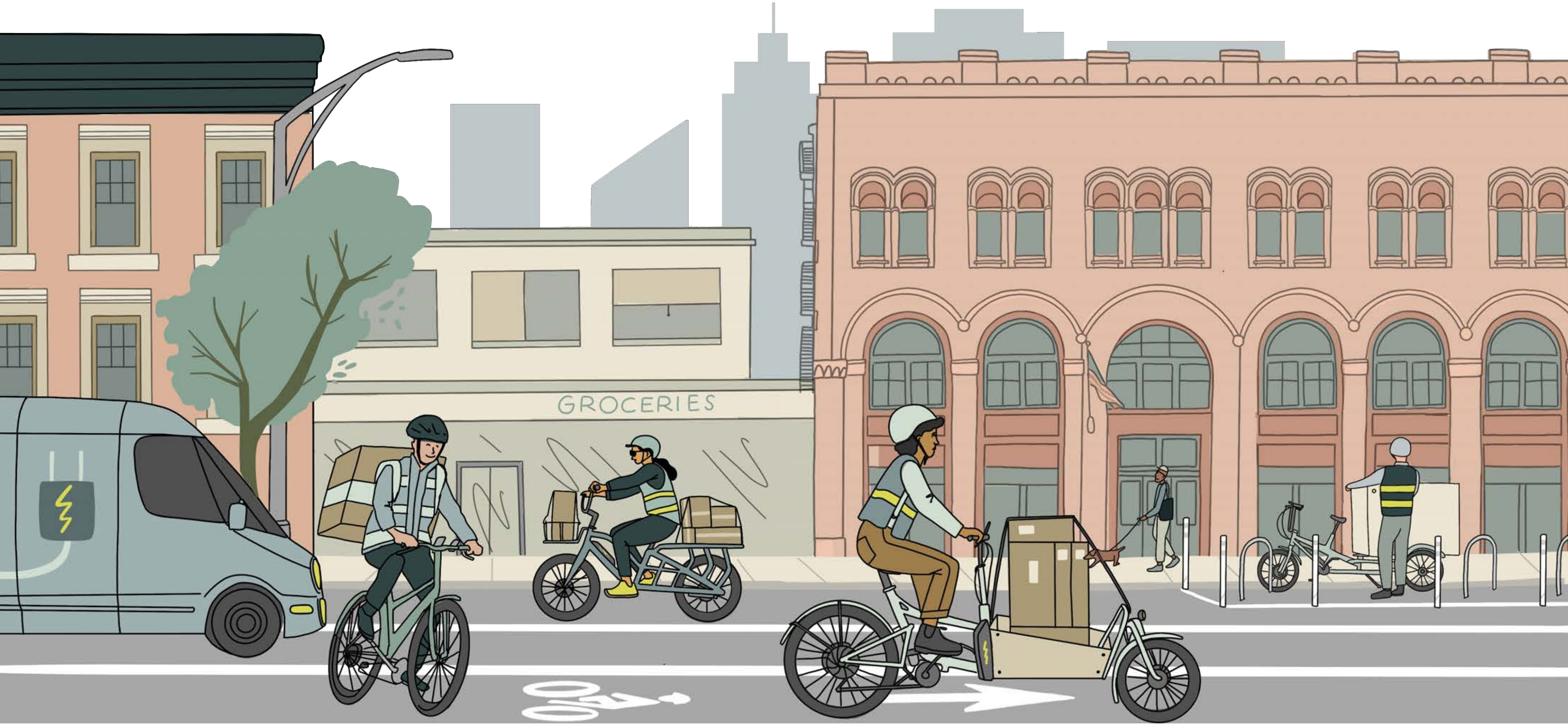

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Conventionally, the **distribution of goods and services** in North American cities have mainly relied on diesel-powered internal combustion engine (ICE) vehicles. The recent developments in **electromobility** have provided an opportunity to reduce some of the negative externalities generated by urban logistics systems.

Cargo e-bikes—electric cycles specially designed for cargo transportation—represent an alternative environmentally friendly and safer mode for delivering goods and services in urban areas. However, lack of infrastructure, legal uncertainties, and a cultural and economic attachment to motorized vehicles has hindered their adoption. **Cities play a crucial role** in reducing these barriers and creating a leveled playing field where cargo e-bikes can be essential to urban logistics systems.

This paper aims to inform urban planners about what cargo e-bikes are, how they have been successfully deployed in North America to replace ICE vehicles and identify actionable strategies cities can take to encourage their adoption while guaranteeing safety for all road users.

Gathering data and opinions from key public and private sector stakeholders and building on the expertise of the Urban Freight Lab, this paper identifies nine recommendations and 21 actions for urban planners across four main thematic areas:

1. **Infrastructure**
   Cycling, parking infrastructure, and urban logistics hubs
2. **Policy and regulation**
   E-bike laws, safety regulations, and policies de-prioritizing vehicles
3. **Incentives**
   Purchase rebates and business subsidies
4. **Culture and education**
   Labor force training, educational programs, and community-driven adoption

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Forward

City planners, policymakers, and climate activists increasingly recognize the immense potential of electric bicycles (e-bikes) to alleviate urban congestion, improve health outcomes, and reduce greenhouse gas emissions. Over the last few years, e-bike sales have grown dramatically, and riders of all ages, abilities, and interests are embracing the many joys and benefits of riding an e-bike. The average distance Americans drive in a single car trip is less than six miles, and thanks to an electric boost making it easier to tackle hills and ride further with less effort, e-bikes are proven to be a great option for getting people out of cars and using active transportation. Across the country, young families take their kids to school on a cargo e-bike instead of in the family minivan.

If the United States can scale the use of e-bikes with commercial e-cargo, the implications for air quality improvements and greenhouse gas emission reductions can be monumental. As with every great new idea, logistical, social, and political hurdles exist before this new transportation technology can truly take hold. In this paper, authors explore pilot projects from across the globe that highlight the benefits and challenges of introducing e-cargo to existing infrastructure. One of the biggest challenges is the historical and ongoing prioritization of automobiles and trucks in urban spaces. To address this challenge, cities are utilizing innovative solutions, such as "zero-emission zones," which shift that priority to e-bikes and electric vehicles. Based on lessons learned from these pilot projects, the authors created a list of recommendations to expedite the introduction of e-cargo in the U.S.

Bicycle riders, whether riding traditional bicycles, e-bikes, or commercial cargo e-bikes, need safe, connected, and protected infrastructure. Protected bike lanes make roads safer for all users, including people driving, and U.S. cities need more of them. To help grow the potential of e-cargo in the U.S., the authors provide clear and actionable recommendations for city planners, policymakers, and advocates to accelerate the construction of local bike infrastructure. For example, by giving designated parking spaces for deliveries and improving existing infrastructure to support efficient cargo e-bike operations, cities can reduce barriers to commercial e-cargo adoption.

The recommendations shared in this paper are tailored to ensure all road users' safety while promoting the adoption of cargo e-bikes as an alternative mode for transporting goods and services. As the trade association for the U.S. bicycle industry, PeopleForBikes is invested in the future of e-cargo. We know e-bikes can play a critical role in solving many challenges facing urban communities today. We look forward to working with policymakers, city planners, and advocates to help implement the recommendations shared in this paper in cities nationwide.

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Electric Bicycle Policy & Campaign Director
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Source: NetZero Logistics

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Status quo

Cities are major generators of freight trips. In North America, **80 percent** of all goods traded start and end their life cycles in metropolitan areas[1].

With an increasing urban population (83 percent of North American people live in cities[2]), urban freight transportation—often referred to as the last mile--is bound to become increasingly relevant for the national economy and everyday urban life.

The last mile has also profoundly changed in the past decade as more urban dwellers shop online and request just-in-time direct-to-home deliveries. These trips are primarily fulfilled by Diesel-powered Internal Combustion Engine (ICE) vehicles—semi-trailers, box trucks, vans, and pick-up trucks--picking up goods at warehouses located in commercial districts and delivering them to residential and commercial urban areas.

While efficiently utilizing the current extensive road infrastructure, this commercial fleet brings several challenges. From a *climate perspective*, the tailpipe emissions of these vehicles make up a significant portion of greenhouse gas (GHG) emissions from the transportation sector while also affecting air quality in urban areas. Urban delivery vehicles contribute to 28 percent of GHG emissions and are expected to increase worldwide up to 37 percent by 2050[3]. From a *safety perspective*, heavier vehicles are associated with an increased likelihood of fatality in vehicle accidents. Moreover, 60 percent of vehicle accidents occur in urban areas. Being hit by a 1,000-pound heavier vehicle is associated with a 47 percent increase in the probability of fatality[4]. From an *operational perspective*, congestion of roads and curb parking spaces reduced the agility of commercial vehicles in delivery in urban areas. Consequently, about 80 percent of a delivery driver's time is spent parked on the curb, and most of the delivery takes place on foot, carrying goods by hand[5].

ICE vehicles play and will continue to play a vital role in the last mile. However, with the emergence of new technology, there is now a chance to find a more sustainable path to distribute goods and services in cities.

Source: Giacomo Dalla Chiara

An alternative future

Bicycles are sustainable, efficient, and affordable modes of passenger transportation in urban areas. Bicycle ridership has increased in recent years, mainly due to the rising popularity of electric bicycles, also known as *e-bikes*. The electrification of bicycles has also enabled their use for transporting goods. Though cargo bikes—specially designed for cargo transportation—have existed for many years, electric cargo bikes, hereafter called *cargo e-bikes*, allow the transportation of heavier loads for longer distances. Cargo e-bikes can carry people and goods while retaining most of the flexibility and agility of a bicycle.

Especially in **urban areas**, cargo e-bikes are faster than motorized vehicles, able to park closer to their delivery destination, use bike lanes and pedestrianized roads, and avoid traffic congestion[6].

Cargo e-bikes are more affordable, as their total ownership costs are about 40 percent of the cost of a conventional delivery van. They are zero-emission, with an estimated total social and environmental cost of 12 percent of that of a diesel van and 14 percent of that of an electric van[7].

Compared to delivery vans, cargo e-bikes have several disadvantages; some of these are intrinsic to the nature of the cargo e-bike itself. Their payload and carrying volumes are smaller than those of delivery vehicles. Moreover, while cargo e-bikes have proven to be faster on urban roads, vehicles can cover more expansive areas and ride on highways and multi-lane roads. However, other disadvantages that cargo e-bikes experience are "artificial." Decades of investment in infrastructure that supports vehicle travel will continue to ensure the dominance of vehicles over any other modes. Vehicle-centric cities also shape vehicle-centric logistics systems, with established carriers fully optimized to use vehicles supported by an extensive network of facilities in suburban and rural areas.

A more sustainable future for urban freight is a multi-modal one, where cargo e-bikes will replace vehicle miles traveled while coexisting with vehicles carrying consolidated loads over socially optimized routes. A change from a vehicle-centric system to a multi-modal system is needed.

The role of cities

Cargo e-bike adoption faces several challenges and barriers to entry: infrastructure that supports their usage may be limited, regulation may be unclear or hostile, and they may be seen as a financial risk by individuals or businesses investing in cargo e-bike fleets in the early stages of their adoption.

Cites play a central role in *promoting* cargo e-bike use, smoothing these barriers, and creating a level playing field where cargo e-bikes can be financially efficient for delivering goods and services in urban areas.

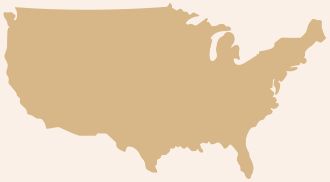
Cities also play a crucial role in *preparing* for this transition to a multimodal urban freight system. As a new technology, they are still finding their place within the urban transportation systems, a process that can quicklyencounter hiccups. Cargo e-bikes are flexible in the use of urban infrastructure: they can ride on travel lanes, bikeways, and also on pathways reserved for pedestrians, such as sidewalks and closed and pedestrianized streets. This advantage comes with a higher chance of interacting with different modes. Cities play a central role in ensuring all road users' safety, ensuring that cargo e-bikes are safe without hindering their competitive advantages.

Several cities in North America have already taken this path. In a recent scan of planning documents from the 46 most populous and fastest-growing cities in the U.S., 17 of them (37 percent) mention cargo e-bikes as a key sustainability strategy to reduce urban freight vehicle emissions[8]. However, in evaluating the maturity and concreteness of these plans, they only contain anecdotal references or general guidelines, with only six cities (13 percent) providing concrete policies and actions to promote cargo e-bike adoption. Several use cases of North American communities, organizations, and companies adopting and operating cargo e-bikes at different scales exist, and several are highlighted in this paper. However, adoption has progressed slower than in sister cities across the oceans.

This white paper, together with several recent reports released in the past two years, is timely in calling public stakeholders to act. This paper aims to inform urban planners on the following.

1

What are **cargo e-bikes**?



What are existing cargo e-bikes use cases in **North America**?

2

3

What **strategies** can cities take to promote cargo e-bike use while **guaranteeing the safety** of all road users?

What is a cargo e-bike?

A cargo e-bike is an electric **bicycle** that is primarily used to **transport cargo** to deliver/pick up goods or perform a service.

While the term bicycle generally refers to the conventional two-wheeled human-powered single-occupancy vehicle, its formal definition varies across regulatory agencies to include electric bikes and cycles with more than two wheels. The United States Consumer Product Safety Commission (CPCS) defines a bicycle 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"[9]

This definition excludes 4-wheel bikes, though they are not excluded in the definitions of bicycles provided by the regulatory authorities of the European Union[10] and the United Kingdom[11]. More than two-wheeled cargo e-bikes can generally carry larger loads and provide increased stability while they have a larger footprint within the local cycling infrastructure.

While we define cargo e-bikes here by their primary use and purpose, it is essential to note that their design departs from conventional bicycles in mainly one aspect: they include built-in modifications in their frames to host cargo compartments. These cargo compartments can take several sizes and shapes, including open baskets, containerized boxes, heavy-duty panniers, and attached trailers. Because cargo bikes are designed to carry cargo, they generally have a higher maximum payload capacity than conventional bikes.

Moreover, while there exist fully human-powered cargo bikes, most contemporary models are equipped with an electric motor to assist the rider while pedaling. Although a pedal-assist cargo e-bike has an electric motor, it is not considered an electric motor vehicle if it meets the CPSC definition of a bicycle.

Anatomy of a cargo e-bike

While there are different models of cargo e-bikes varying in size, shape, and design, they share two main features:

- They are fully or partially human-powered (this characteristic is necessary to be defined as bicycles) and
- They have a built-in cargo compartment or a method to attach a cargo trailer.

Partially human-powered cargo bikes are equipped with an electric motor that assists the rider in pedaling, and they are often referred to as cargo e-bikes or pedal-assisted cargo bikes.

The table on the following page introduces and defines key components that characterize cargo bikes.

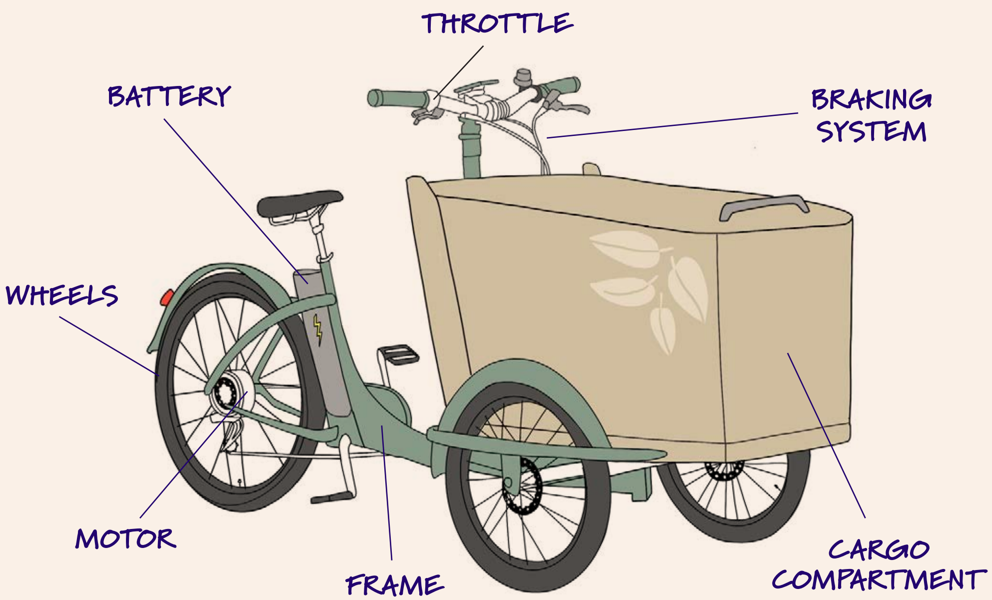
Anatomy of a cargo e-bike

Cargo compartment / A space designed to carry loads, characterized by a given *volume and payload*, which measures the weight a cargo e-bike can safely carry. The payload is not only related to the motor's power but also to the strength of the bicycle *frame*, the capabilities of its *braking system*, and the durability and quality of various components, including *wheels and tires*. Cargo compartment designs include open baskets, containerized boxes, heavy-duty panniers, and attached trailers.

Wheels / Cargo e-bikes can have two or more wheels (note that 4-wheel cargo bikes are not formally included in the U.S. CSPC definition of bicycle). Being one of the components of the bike that is the most exposed to wear and tear during heavy usage, wheel maintenance can be a significant expense. New developments in airless tires can eliminate the risk of punctures, though these have not yet been widely adopted[12].

Battery / The source of electric energy that powers the motor. Cargo bikes' batteries are typically rechargeable lithium-ion batteries. Depending on terrain and cargo weight, these batteries can power cargo bikes for anywhere between 20 and 100 miles. The amount of stored energy is usually measured in Watt-hours, and a typical e-bike battery may store between 500 and 1000 Watt-hours.

Throttle / E-bikes provide electric assistance while pedaling. Some e-bikes also offer a throttle that enables the motor to propel the e-bike with no simultaneous pedaling. Throttles are typically mounted on the handlebars and may be engaged by twisting the grip or pressing down a thumb lever or a button.



Motor / An electric motor converts electrical energy from the battery into mechanical energy that supports the rider's pedaling effort. The amount of support is measured either in power (expressed in Watts "W") or torque (a measurement of the turning force applied to the wheel, expressed in pound-foot "lb.-ft" or newton-meter "Nm"). For a given power level, a motor system may trade off a lower maximum speed for a higher torque output, allowing a heavier payload to be moved.

Braking system / A system of components that can reduce the speed of a cargo e-bike or prevent it from moving. Disc brakes have replaced rim brakes for most new high-performance cargo e-bikes and are mounted on the front and/or rear axles. Two types of disc braking systems may be used: mechanical and hydraulic. Hydraulic brakes are more expensive but require less grip force by the driver, offer improved stopping power, and may need less maintenance overall as they are sealed components.

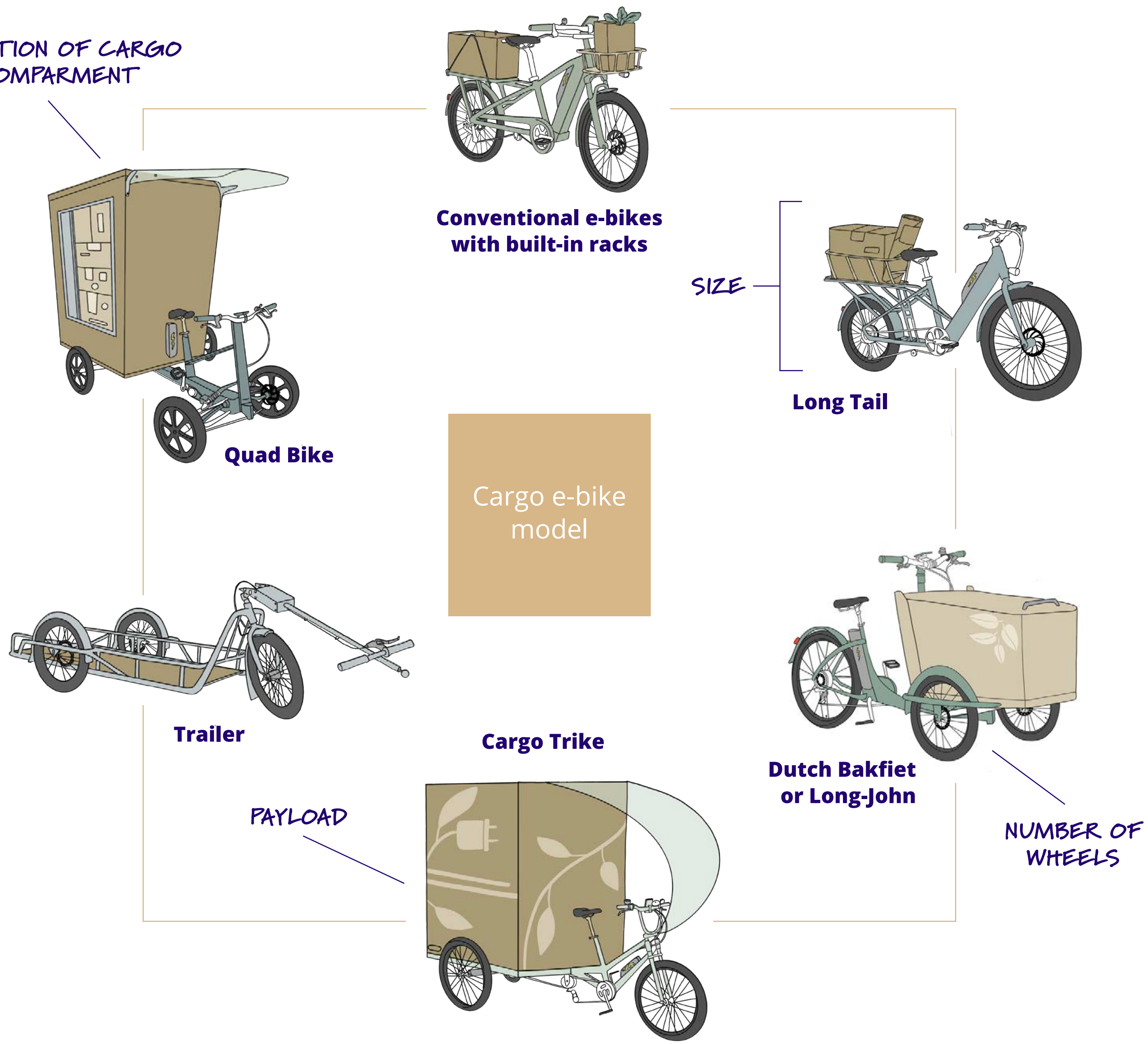
Frame / . Hollow metal tube sections form the structure of the cargo bike, connecting the front and rear wheel axles. Several cargo bike models are characterized by an extended frame to host a cargo compartment, compared to a conventional bicycle.

Cargo e-bike models

Since cargo e-bikes are bicycles designed to transport goods and/or perform services, their structural characteristics, size, and shape deviate from conventional bicycles. The types of loads that cargo e-bikes can transport vary greatly, ranging from paper letters to parcels and even construction materials. Similarly, cargo e-bikes support diverse services, from vehicle maintenance to parking enforcement. It is, therefore, not surprising that there is a wide variety of cargo bike models in the market, reflecting the variety of uses, the heterogeneity of goods that can be carried, and the services that can be performed.

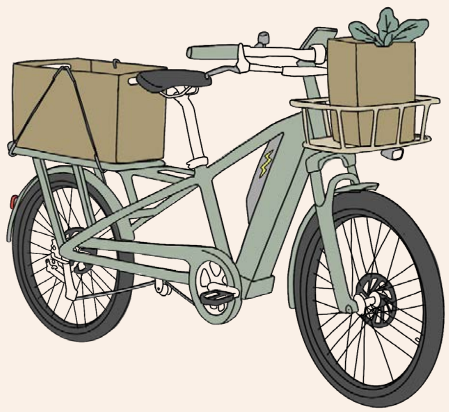
The following six categories of cargo bikes models vary mostly in:

- Number of wheels
- Location of the cargo compartment
- Size
- Payload



1

Conventional e-bikes with built-in racks



WHEELS
2 wheels

LOADING
Front or rear-loaded

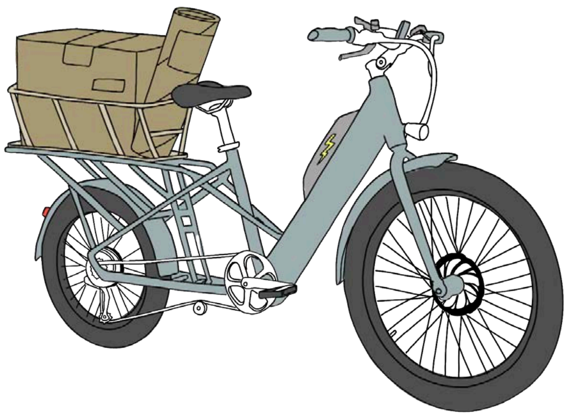
SIZE
Legnth: 5ft- 6.5 ft
Width: 1.5-2.5ft
Height: 3.5-4ft

PAYLOAD
50-100 lbs

Conventional e-bikes can carry some cargo by relying on add-on features such as baskets, racks, backpacks, saddlebags, or panniers. While many e-bike models also come with built-in cargo compartments, their braking systems, frames, and components may not be able to sustain as heavy loads as other cargo e-bike models. These models are more suitable for individual use and offer an excellent opportunity for cities to substitute vehicle miles traveled if used for shopping purposes.

2

Long Tail



WHEELS
2 wheels

LOADING
Rear-loaded

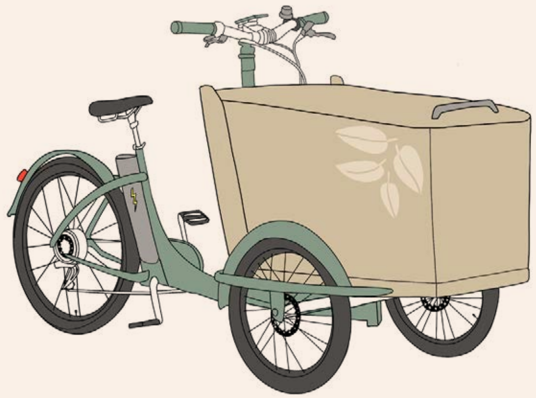
SIZE
Length: 6ft- 7.5 ft
Width: 2-3ft
Height: 3.5-4ft

PAYLOAD
300- 550 lbs

The long-tail is a 2-wheel cargo e-bike with a built-in extended rear deck. They are designed for hauling cargo or passengers (usually children). While they maintain the familiar look and riding style of conventional e-bikes, they have additional features, such as wider tires, hydraulic braking systems, and a low center of gravity, that can support heavier loads than conventional e-bikes. Wheels are sometimes smaller than conventional bicycles to allow easier acceleration with heavier payloads. Long-tail cargo e-bikes are a good choice for individuals and families who want to commute and haul cargo easily. They might also be suitable for commercial use when paired with trailers.

3

Dutch Bakfiet
(or Long-John)



WHEELS
2 or 3 wheels

LOADING
Front-loaded

SIZE
Length: 6.5t- 8.5ft
Width: 3-5ft
Height: 3.5-4ft

PAYLOAD
400-800 lbs

The "Dutch Bakfiet" or "Long-John" is a front-loaded cargo e-bike. Its extended frame between the seat and the front wheel can haul a basket, platform, or bin, which can be used for carrying cargo. Since the cargo compartment is front-loaded, its height is lower than back-loaded cargo e-bikes not to obstruct the rider's vision and to keep a lower center of gravity. This model is highly versatile, carrying anything from parcels to food stands. Front-loaded cargo e-bikes can have either two or three wheels. Two-wheel models are easier to maneuver and have a similar riding style to conventional bicycles. Three-wheel models are more stable at a standstill and suitable for heavier payloads.

4

Cargo Trike

WHEELS
3 wheels

LOADING
Rear-loaded

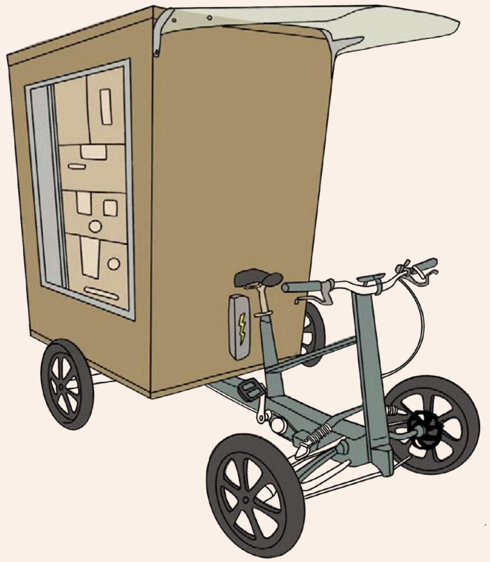
SIZE
Length: 6.5ft- 10ft
Width: 3-5ft
Height: 3.5-5ft

PAYLOAD
400-700lbs

Cargo tricycles or "trikes" are three-wheel rear-loaded cargo e-bikes, with two wheels set across from each other in the rear. The space between the rear wheels allows for a wider cargo compartment. Compared to front-loaded cargo e-bikes, trikes can haul a higher cargo compartment. Still, load height must be managed to reduce the risk of a tip-over when turning at higher speeds. The trike model generally has a larger carrying volume and payload and ensures stability with larger payloads. They are usually well suited for commercial activities requiring heavier loads and can feature windshields for weather protection.

5

Quad Bike



WHEELS
4 wheels

LOADING
Rear-loaded

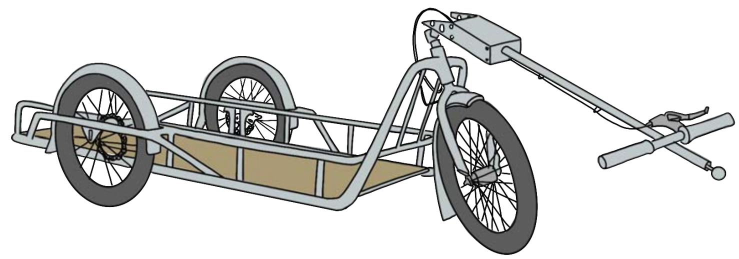
SIZE
Length: 9-11ft
Width: 3-5 ft
Height: 5-7 ft

PAYLOAD
400-600 lbs

Quad bikes are four-wheel rear-loaded vehicles, though they include human pedaling as part of their power source. These models have been used by major shipping companies such as UPS and Amazon Logistics as a way to replace motorized vehicles in urban areas. They often feature windshields and covered cabins. Due to the definition of bicycle in the US CPCS regulations, quad bikes are not formally considered bicycles in the US, while they have seen wider adoption in Europe and the UK.

6

Trailer



WHEELS
2, 3 or 4 wheels

LOADING
Rear-loaded

SIZE
Length: 1-6ft

PAYLOAD
40-350lbs

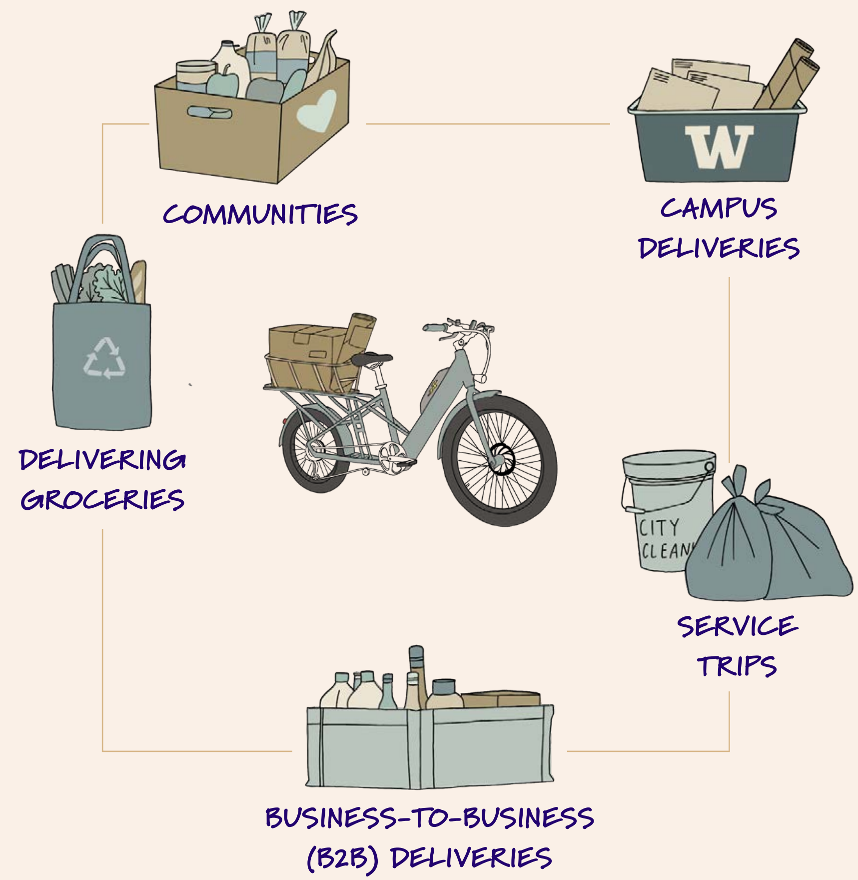
Trailers attach to a cycle to expand their carrying capacity, allowing cargo to be towed behind. The same weight on a trailer may offer better handling characteristics for the rider than having that same load on the cargo e-bike itself. Consumer-level trailers for small cargo and children can usually be acquired for under $500. In contrast, higher-end trailers can cost over $3,000 but offer more safety features and an improved towing experience. Trailers have the versatility of being able to be attached and detached as necessary to different cycles within a fleet, increasing modularity and ease of storage. Their main downside is their added length, necessitating extra caution and balance while turning, interacting with traffic, or accessing bicycle infrastructure.

Use cases

Cargo e-bikes are incredibly versatile in the types of cargo they can carry and the services they can support. This section provides five case studies of how cargo e-bikes have been successfully used across North America in a wide variety of scenarios. From grocery deliveries in Manhattan to bulky business-to-business deliveries in Portland to upkeep the streets and serve the food-insecure communities in Seattle, these use cases show the variety of communities, individuals, and businesses cargo e-bikes can serve.

Beyond the uses of cargo e-bikes, it is paramount for cities to understand how cargo e-bike drivers interact with the urban transport infrastructure. In the second part of this section, data from different cargo bike pilots and carriers delivering parcels in downtown Seattle was used to analyze the riding and parking behaviors of cargo e-bike drivers.

From grocery deliveries in Manhattan to serve the food-insecure communities in Seattle, these use cases show how cargo e-bikes have be successfully adopted in a variety of sectors



Delivering Groceries

In the past decade, many households have been turning to online e-commerce channels to source groceries and deliver them to their doorstep.

Grocery delivery trips are short and frequent, must often be performed quickly, and their destinations are residential areas. Due to these characteristics, cargo bikes have been successfully used to perform urban grocery deliveries, reducing the number of motorized vehicle trips in urban residential areas.

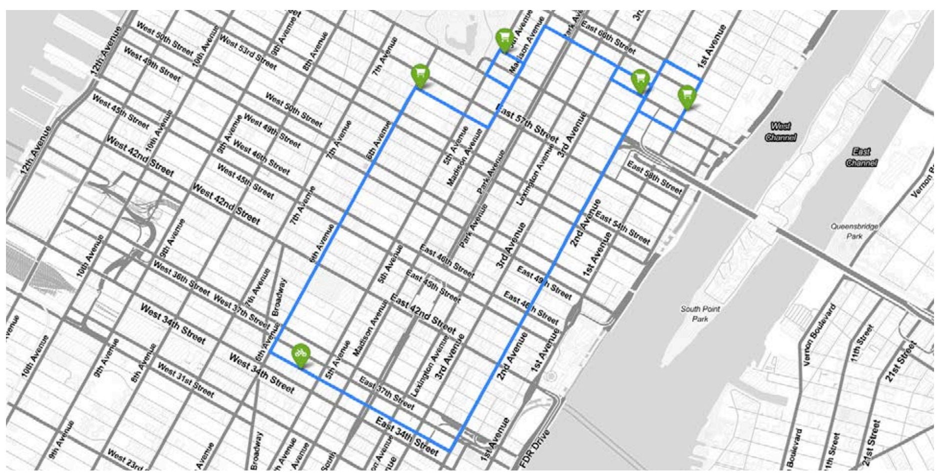
One use case for grocery deliveries using cargo bikes can be found on Manhattan Island in New York City. The island is one of the most densely populated areas of the US, with approximately 73 thousand residents per square mile. Since 2019, Cornucopia Logistics, a US-based final mile logistics company, has been using cargo e-bikes to deliver groceries on the island. Today, the company operates about 200 cargo e-bikes, mostly e-bikes (with attached cargo trailers) and trikes, providing groceries to 10 to 15 thousand customers weekly.

Source: NetZero Logistics

Use Case:

CORNUCOPIA LOGISTICS
Manhattan Island
New York City

10-15 thousand
customers served weekly



A typical day for a grocery delivery driver in Manhattan, New York City, involves riding approximately 8 to 10 miles over four delivery routes. In the displayed route, the driver used an e-bike with a cargo trailer to deliver 25 grocery bags to five customers, carrying approximately 300 pounds of groceries. It took the driver about 2 hours to ride 4.8 miles.

Campus Deliveries

Campuses and large buildings are generally enclosed areas where vehicle traffic is restricted, encouraging pedestrian and light vehicle movements. Examples are schools, universities, company campuses, shopping malls, and airports. Campus logistics operations include food catering, mail and parcel deliveries, utility maintenance, and garbage collection.

Campus operations are ideal use cases for cargo e-bikes. One example is the University of Washington (UW) Mailing Services, based in Seattle, Washington State. The main campus is located northeast of the city and comprises 500 buildings over 1.1 square miles of land, hosting more than 80 thousand people daily among students, faculty, staff, and visitors.

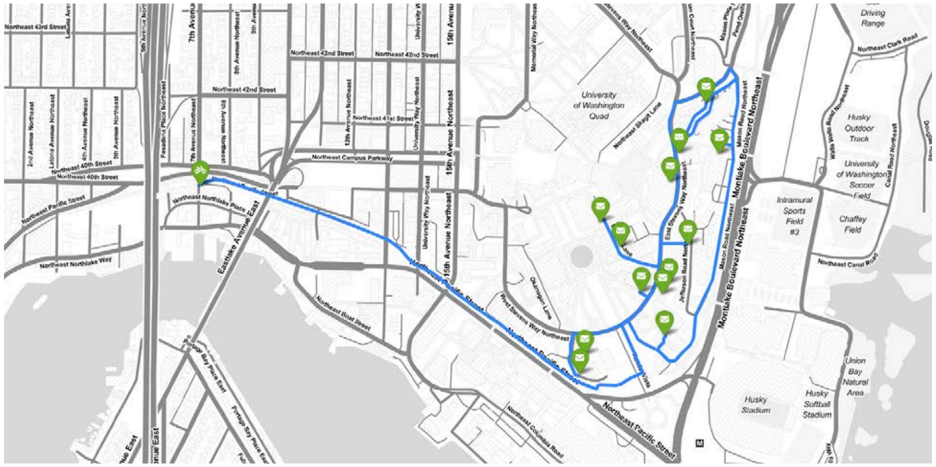
The US Postal Service deliveries on campus were initially carried out using 12 delivery vans. Since 2017, three delivery vans have been retired, and eight cargo e-bikes are used to deliver mail, parcels, and printed material on campus.

Source: Rishi Verma

Use Case:

UW, MAILING SERVICES
Seattle, Washington

8 cargo bikes and 9 delivery vans are used to make deliveries to 80 thousand people on campus.



A UW mailing service driver performs two daily routes. In the displayed route, the driver rode for 4.5 miles, making 13 stops and visiting 18 campus buildings. The driver delivered four cubic feet of parcels and mail in one hour.

B2B Deliveries

Business-to-business (B2B) deliveries are conventionally performed using heavy motorized vehicles due to the larger volumes and lower shipment frequency than business-to-consumer deliveries. However, when supported by urban logistics facilities close to the delivery customers, cargo bikes can be efficiently used to perform last-mile and only-mile B2B deliveries in urban areas; one such case study is B-line, a last-mile delivery company operating in Portland, Oregon State.

Founded in 2009, B-line operates a fleet of 12 cargo trikes out of a20,000-square-foot-meter hub, hosting a warehouse with 2,000 square feet and cold storage 1.5 miles from downtown Portland. Each trike carries a cargo box of 1.58 cubic meters volume and a payload of 272 kg.

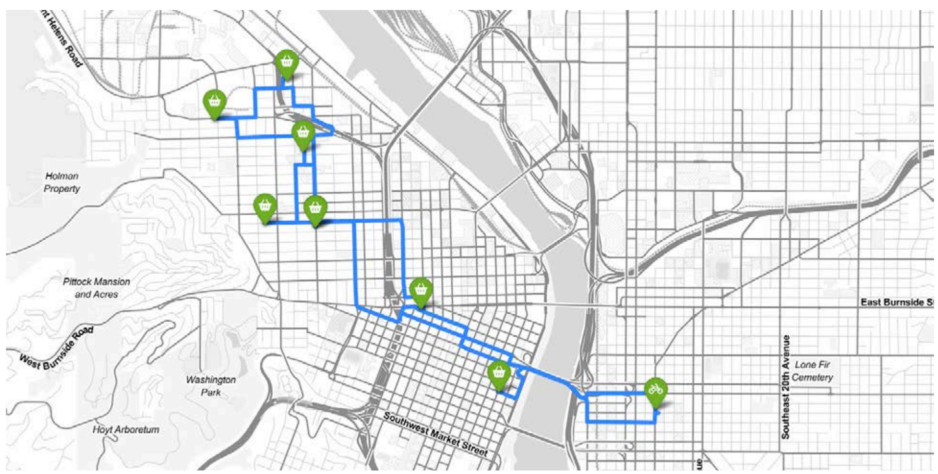
B-line works across multiple sectors, delivering food, groceries, beverages, and office supplies. A cargo trike's average daily travel distance is 8.3 miles, serving four to six customers per hour (delivery amount varies by customer and type of goods delivered).

Source: B-line

Use Case:

B-LINE
Portland, Oregon

B-line delivers food, groceries, beverages, and office supplies with their fleet of 12 cargo trikes.



In Portland, Oregon, the rider left the B-line warehouse at 7 am on a cargo trike and crossed the Willamette River heading west into downtown. They made eight delivery stops, primarily restocking cafes and restaurants. The rider traveled 5.2 miles in 40 minutes and spent 55 minutes loading and unloading operations.

Service Trips

In the US, 55 percent of urban establishments operate in service-intensive sectors. Service trips include maintenance, repair, cleaning, and medical services. They often involve technicians carrying equipment using small motorized vehicles.

Cargo e-bikes can be used to perform service trips in cities due to their agility in navigating crowded and congested urban environments. In Seattle, the Downtown Ambassadors—funded by the business association of downtown property owners--provide cleaning, safety, and hospitality services in a 300 square-blocks area of Seattle downtown. Originally, each ambassador patrolled designated routes throughout the day either walking and carrying their equipment using a cart, or driving pick-up trucks. Since 2022, many of the walking routes were upgraded by adopting a fleet of 45 cargo trikes, carrying a garbage bin and cleaning equipment, and ten other larger trikes were used to carry pressure washers for heavy-duty cleaning, substituting five pick-up trucks.

Source: Giacomo Dalla Chiara

Use Case:

DOWNTOWN SEATTLE ASSOCIATION

Seattle, Washington

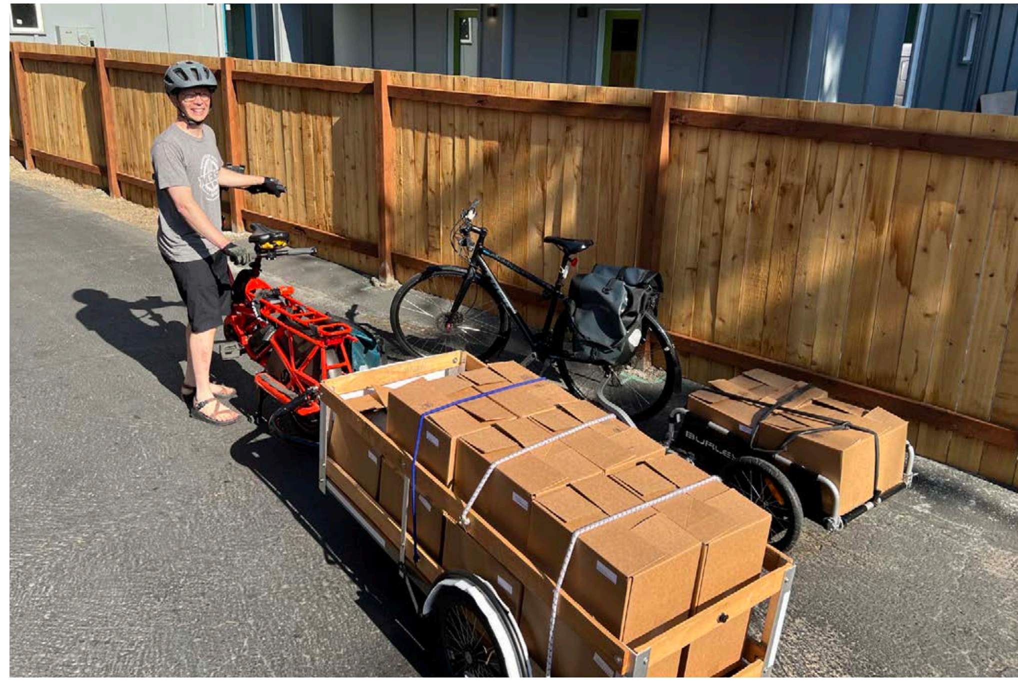
25 block faces were cleaned in 3 hours on a morning patrol route

On a weekday, the downtown ambassador covered 25 block faces on their route in Downtown Seattle using a trike equipped with a garbage bin and cleaning material. During the route, the driver picked up 30 cubic feet of trash by cleaning the curb gutters, cleaned six graffiti, and called in three alley cleanup jobs. It took them three hours to ride approximately seven miles.

Communities

Cargo e-bikes represent an alternative mode of goods transportation not only for businesses but also for local communities and non-profit organizations, which often rely on a lower budget and volunteers' support. Examples include community groups, churches, afterschool organizations, neighborhood and business associations, and food banks.

One example of a community organization supported by cargo bikes is the Seattle Pedaling Relief Project (PRP). In 2020, the Cascade Bicycle Club, a Seattle-based bicycling non-profit, started the PRP, a volunteer-based program supporting local food banks in rescuing and delivering food to residents using cargo bikes. In Spring 2023, the program reached a milestone of 1 million pounds of food delivered to local households since its conception[9].



Source: Giacomo Dalla Chiara

Use Case:

SEATTLE PEDALING RELIEF PROJECT (PRP)
Seattle, Washington

Since 2020, PRP has delivered 1 million pounds of food.

On a Seattle summer day, several Pedaling Relief Project volunteers met at the Byrd Barr Place food bank in the Central District of Seattle, Washington State, equipped with bikes, e-bikes, and cargo e-bikes. In one route, two volunteers used a longtail e-bike with an attached trailer and an e-bike to deliver 110 kg of groceries to 18 households. It took the two volunteers 45 minutes to ride a total of 5.5 km.

Cargo e-bikes and the urban infrastructure: a Seattle case study

It is crucial to understand how cargo e-bikes interact with the existing transport infrastructure. Cargo e-bikes are nimbler and more agile than motorized vehicles, being able to ride on travel and bike lanes and areas closed to vehicle traffic, such as trails and pedestrianized streets. They can also leverage more infrastructure than just curb lanes to park, including bike corrals and sidewalks.

The following table provides an overview of observed driving and parking behaviors of cargo e-bike vs. delivery van drivers delivering parcels in Seattle downtown.[5, 6, 13]

Parking

While delivery vans spend 80 percent of their time parked at the curb, cargo e-bike drivers are parked only 60 percent of their time. One reason is that cargo e-bikes parked closer to their delivery destinations (about 105 feet), while delivery vans parked on average 174 feet away. They also performed fewer deliveries per stop, while performing more stops per route. Consequently, the parking dwell time of cargo e-bikes is lower than delivery vans', 4.3 minutes vs. 17.6 minutes.

Driving

The observed cargo bike drivers were faster than delivery drivers, with an average speed of 13.6 km/h. One explanation is the ability of cargo bike drivers to use a broader range of infrastructure to ride on. Whenever a bike lane was available, the cargo bike drivers were observed choosing the bike lane 46 percent of the time, followed by a preference for sidewalks (37 percent) and travel lanes (17 percent).

The following table compares a cargo bike driver with a delivery van driver.

Performance metric	Cargo bike	Parcel van
Percentage of time spent:		
Driving	40 %	20%
Parking	60 %	80%
Median parking dwell time	4.3 minutes	17.6 minutes
Percentage of parking stops with		
1 delivery made	73 %	33%
2+ deliveries made	27 %	67%
Average walking distance	32 meters	53.3 meters
Percentage of time spent driving on		
Travel lane	17%	98%
Bike lane	46%	0%
Sidewalk	37%	0%
Others	/	2%
*Considering only road segments with bike lane		
Mean speed	13.6 km/h	7.7 km/h

* Considering only road segments with bike lane

Table adapted from Dalla Chiara et al. (2023)[6]

Recommended actions

The following sections contain recommendations and action steps that cities and states can take to support the widespread and safe adoption of cargo bicycles **for individual and commercial usage**.

Infrastructure

Policy and regulation

Incentives

Culture and education

Infrastructure

RECOMMENDATION NO. 1

Build and improve cycling infrastructure to support cargo e-bike operations while reducing interactions with other road users

Action 1.1

Expand the network of bike lanes to minimize conflicts with pedestrians on sidewalks

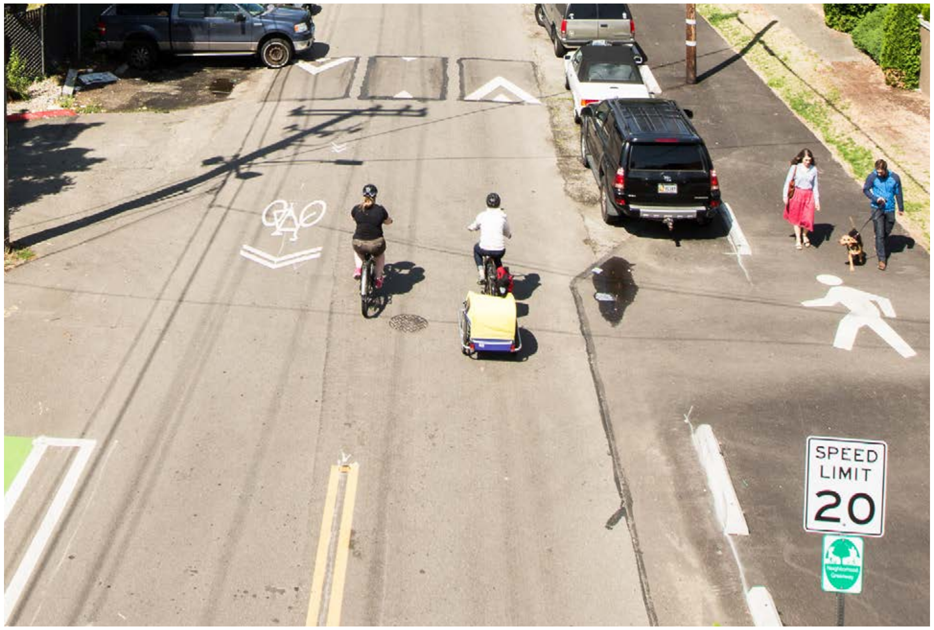
Cargo e-bikes use a wider variety of infrastructure than conventional delivery vehicles. They can share the travel lane with vehicles, utilize bike lanes and trails with other micro-mobility devices, and access pedestrian infrastructure, including sidewalks and pedestrianized streets.

While this versatility makes them more agile and often faster than delivery vehicles in navigating urban roads and traffic, it also increases the likelihood of conflicts with other road users. In particular, cargo e-bike riders may ride on sidewalks before reaching their delivery destinations to access their customers' buildings.

However, cargo e-bike riders prefer riding in bike lanes over sidewalks and travel lanes whenever provided (according to data from the Seattle cargo e-bike pilot[6]). Therefore, by providing bike lanes, it is possible to reduce the likelihood of cargo e-bikes riding on sidewalks, reducing the probability of conflicts with pedestrians.

Providing more bike lanes might also have the long-term effect of inducing more demand for cargo e-bikes and micro-mobility devices. In a recent study using data from Copenhagen (Denmark), the authors found that the existing bike lane network induced demand for bicycle km traveled to increase by 90 percent[14].

Source: Giacomo Dalla Chiara



A bike boulevard in Seattle, WA

Action 1.2
Provide wider bike lanes and intersection accommodations

Cargo e-bikes might also conflict with other micro-mobility devices on the bike lane network. They are wider than e-bikes and travel at different speeds than non-electric bicycles. Moreover, backloaded trikes and four-wheel cargo e-bikes might reduce sight lines for other users attempting to pass them. Some cargo e-bike models are also longer, especially if equipped with trailers, requiring a wider turn radius.

To improve safety and reduce conflicts, cities should plan for adequate bike lane dimensions that accommodate safe passing, wider turn radius, and provide enough queuing space for longer trailers at red lights. The white paper “Designing for Small Things with Wheels,” released in February 2023, updates the existing National Association of City Transportation Officials (NACTO) guidelines to better plan for cargo e-bikes[15]. NACTO identifies a comfortable riding space for cargo e-bikes as 7.5 to 8.5 feet to enable safe passing for other small-wheeled devices, an increase from the typical 5 to 6 feet recommended for a typical bike lane design.

Intersections are another infrastructure feature where cargo e-bikes need accommodation. The NACTO guidelines recommend that cargo e-bikes have an inner turn radius of 5 feet and a sweeping radius of at least 9 feet. Some considerations that will make it safer for micro-mobility devices approaching the intersection in turn lanes are: sufficient queue space for people to wait at intersections, protected corners to allow safe turning outside vehicle turn paths, and gradual tapers of the lane to allow turning at appropriate speeds.

There are instances where wider bike lanes are not always desirable. Wider bike lanes can lead to more double parking or vehicles parked in the bike lane. Therefore, where possible, protected bike lanes should be considered to limit vehicle encroachment into the bikeway.

Finally, though wider bike lanes may better accommodate cargo e-bikes, they may not always be feasible. Vehicle parking could be repurposed into bike lanes, vehicle lanes could be reconfigured via road diets or be narrowed. Where roadway space cannot be gained, the bike lane widths can be narrowed one to two feet from the recommended widths above, with the understanding that certain situations will be impeded, like bikes not being able to pass as easily.

Action 1.3
Prioritize bicycles over vehicles in “Bicycle boulevards”

A bicycle boulevard (also known as a greenway or a neighborhood parkway) is a “low-stress shared roadway bicycle facility, designed to offer priority for bicyclists operating within a roadway shared with motor vehicle traffic”[16]. Rather than providing dedicated bicycle spaces like bike lanes, bicycle boulevards prioritize bicycle use of the entire street through vehicle speed and volume reductions using roadway features like speed humps and roadway diverters[17].

There are several benefits of bicycle boulevards that support cargo e-bike usage. First, they reduce the number of interactions between vehicles and cyclists, thereby making cycling a safer activity[18]. Second, they can offer a more efficient path for commercial cyclists to reach their destination, reducing their travel time and the amount of effort required[19]. Third, bicycle boulevards also increase the visibility of cycling as an alternative to driving, which can encourage companies to invest in cargo bicycle delivery and assist in rider recruitment. Finally, since bicycle boulevards encompass the entire width of a street, they allow for cargo bicycles of all shapes and sizes while leaving room for other cyclists.

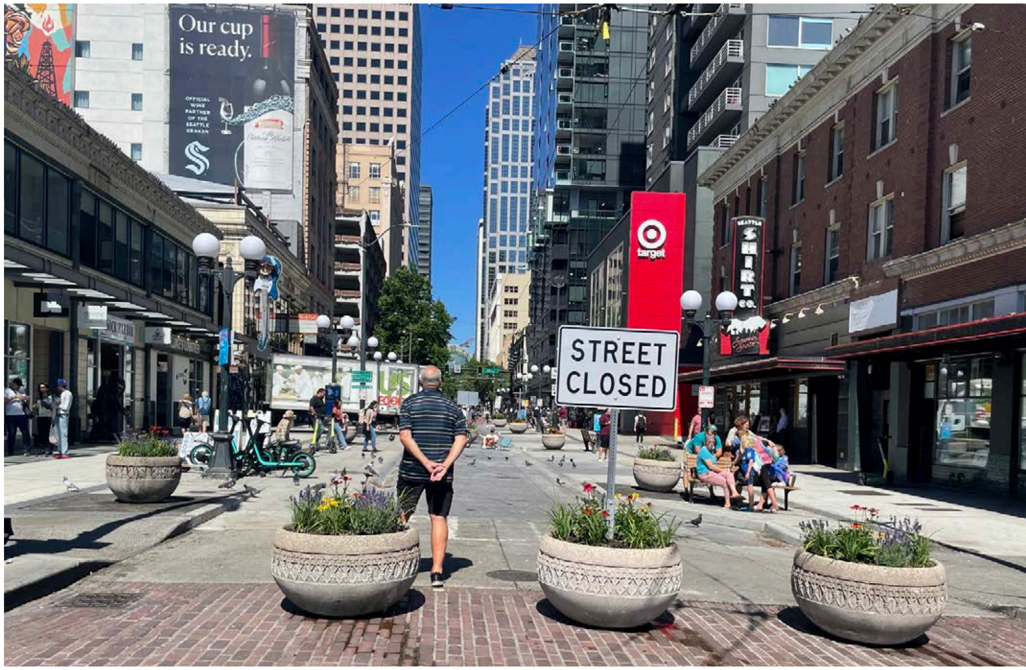
Action 1.4
Minimize vehicle traffic in dedicated "Car-free" areas

Prioritization of cycles can go further by removing vehicles entirely from dedicated areas. Several cities have implemented these "car-free" areas to reduce traffic congestion, improve local air quality, meet emissions goals, and reduce pedestrian injuries[20]. Restricting vehicle access also promotes alternative transportation methods. In particular, cargo e-bikes can replace the fleets of delivery vehicles that would have otherwise operated in these area[21].

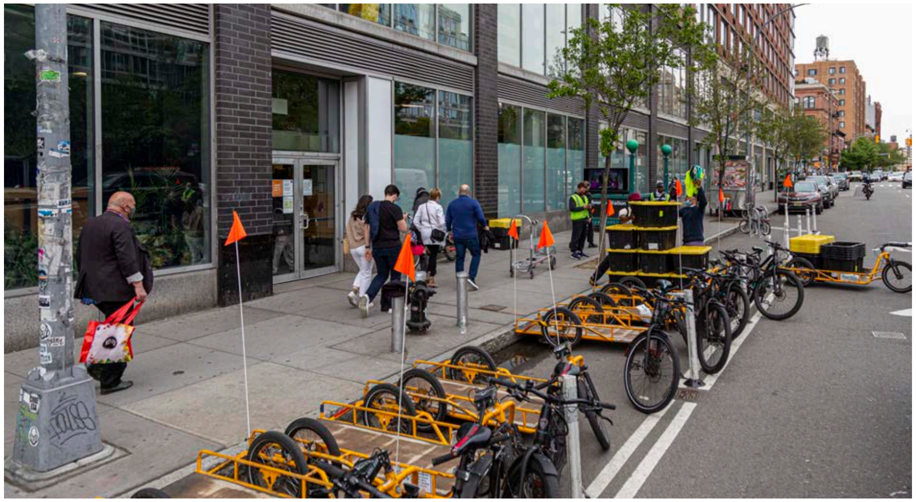
Action 1.5
Collaborate with private stakeholders in the deployment and funding of the bike lane network, bike boulevards, and car-free areas

Improvement and enlargement of the bike lane network, establishments of bike boulevards, and car-free areas often come at the expense of reducing space for motorized vehicles to drive and park, including commercial vehicle fleets. Therefore, cities must engage the private sector stakeholders to understand their needs and establish phased plans for these changes.

An alternative way of collaboration is also through private-public partnerships. Cities have a limited budget for their transportation facility design and implementation on top of the stewardship of their existing network of roadways and other transportation facilities. Cities and jurisdictions can look toward private-public partnerships for funding opportunities to fill gaps in funding for the recommendations above, especially where funding could accelerate the implementation. Options for funding can include design-build projects, where public agencies remove themselves from the implementation but have oversight in the review and approval of the design or direct subsidization of a certain project type, like new cargo e-bike parking corrals within a specific neighborhood where private companies expect a high frequency of use. Standard details and plans for design can help speed review cycles and provide opportunities for private companies to install infrastructure while providing consistent design in the public right-of-way.



A car-free road segment in Seattle, WA / Source: Tyler Wong



Cargo e-bike corral in New York City, NY

RECOMMENDATION NO. 2

Provide and enhance parking and unloading spaces for cargo e-bikes

Action 2.1
Allow cargo e-bikes to park in load zones or other curb parking spaces

Delivery drivers park their vehicles as close as possible to the delivery destination. This destination (e.g., an apartment building or a store) is usually accessible through a sidewalk.

Since cargo e-bikes are agile enough to be on the sidewalk, it is expected for their drivers to park on the sidewalk unless alternative parking destinations are made available[6]. One such location is the curb lane. One of the curb's main functions is to provide vehicle access to the sidewalk by providing dedicated parking spaces. Many cities also dedicate part of the curb for commercial vehicle loading/unloading, often called Commercial Vehicle Load Zones. For instance, the Seattle Department of Transportation has had a CVLZ program since 1990 that allows commercial vehicles to use CVLZ on the curb upon payment or through a parking permit. However, while the curb is often dedicated only to motorized vehicles, micromobility devices, including bicycles and cargo e-bikes, are directed to park on sidewalks unless the space is designated with a bike corral. Cargo e-bikes, with their larger body, require the most space and can occupy a larger proportion of a parking space. Therefore, allowing cargo e-bikes to park at CVLZs or other curb spaces (e.g., paid parking areas or passenger load zones) reduces the likelihood of riders parking and driving on sidewalks, decreasing the likelihood of conflicts with pedestrians and avoiding blockages.

Action 2.2
Make sidewalk unloading accessible through mountable curbs and frequent curb cuts

Providing curb access for cargo e-bikes might not be enough if these spaces do not provide direct access to their delivery destinations. For instance, if a bike lane is located between the curb lane and the sidewalk, cargo e-bike riders might still prefer to ride and park on the sidewalk, especially when the sidewalk is not accessible from the bike lane. Cities can also ensure that the sidewalk is accessible from the bike and curb lanes by installing mountable curbs and introducing more curb ramps throughout the block to allow easy access for cargo e-bike deliveries.

Action 2.3
Create dedicated cargo e-bike corrals for parking

Alternatively, cities can provide dedicated parking spaces for cargo e-bikes. For instance, the New York City Department of Transportation, as part of their cargo e-bike pilot that started in 2019, not only allowed cargo e-bikes to park at CVLZs but also built designated cargo e-bike corrals in the public right-of-way. These cargo e-bike corrals were usually built near facilities operated by cargo e-bike carriers and allowed for cargo e-bikes to park while loading/unloading the vehicles at the start and end of their trips (or routes).

RECOMMENDATION NO. 3

Enable microhub operations in commercial areas through zoning policy and private partnerships

Traditional warehouses supporting last-mile deliveries are often located in industrial zones and suburban areas. Consequently, delivery vehicles often travel long distances before reaching their customers. In the US, last-mile fulfillment centers are, on average, 15 miles away from urban cores[22]. In contrast, cargo e-bikes have a smaller radius of action and, therefore, need to operate from facilities closer to the areas they serve. These facilities are often called microhubs, urban logistics hubs, neighborhood logistics hubs, or micro depots.

In the past decade, several microhub models were developed in North America. In 2019, UPS ran a cargo e-bike pilot using a mobile microhub in Seattle[23]. Several cargo compartments were preloaded at a UPS facility, loaded onto a trailer together with the trike used, and transported to an off-street parking location, from which the trike performed several tours. Off-street and on-street parking locations can also be re-used as microhubs. In a different cargo e-bike pilot in Seattle in 2021, a container was placed in a fixed location in an off-street parking lot, hosting a trike to be stored overnight while a delivery truck was used to bring inventory daily to the container[6]. Some cities have found success in retrofitting existing infrastructure into micro-hubs. One example is Montreal's "Colibri," which uses a former bus depot in downtown Montreal where the courier company Purolator used one large truck to deliver packages to the micro-hub and five cargo e-bikes to deliver to customers.

While microhubs can take different forms, they have several common features. They are located in an urban or suburban area close to the customer they serve, they serve only the local community (compared to larger warehouses serving entire regions), they are suited to receive inbound delivery trucks to unload and temporarily store inventory, and they can securely store overnight and charge cargo e-bikes. They are paramount for the existence of a cargo e-bike service. However, regulatory barriers often limit the ability of private companies to establish them close enough to their customers.

Action 3.1
Allow zoning variances and special-use permits for microhubs to be located in commercial and mixed-use zones

As a logistics facility, microhubs may be treated similarly to traditional warehouses and relegated to industrial areas. For example, Portland, Oregon's land use code prohibits warehouse and freight movement downtown, which are residential and commercial zones, so micro-hubs have not been allowed downtown west of the Willamette River. The nature of industrial zones varies by city: some specify "light" industrial zones as suitable for warehousing, while others relegate warehousing to manufacturing zones. What these zones have in common is their distance away from commercial areas, and therefore might not always be suitable to host microhubs.

Special-use permits and zoning variances allow microhubs to operate in commercial and mixed-use zones even though they are a different use than what may be typically permitted. These approaches let cities grant

Neighborhood Logistics Hub in Seattle, WA exceptions to zoning codes while retaining control of the overall zoning district and requiring special review.

Microhubs should not be considered the same type of land use as a warehouse. They are smaller than traditional warehouses and see significantly lower vehicle traffic volumes due to their utilization for short-range, zero-emission deliveries performed by cargo e-bikes. In addition, microhubs can create a positive impact by reducing the number of vehicles in the areas in which they operate.

Action 3.2
Use private partnerships and pilot programs to test microhubs in commercial and mixed-use zones

Though microhubs can enable cargo e-bike operations, they still generate some negative externalities. Pedestrians can have conflicts with increased numbers of cargo e-bikes and increases in noise as a result of delivery activity can be disruptive to residents. This recently occurred in Paris, where an influx of rapid grocery delivery services, or "dark stores" operating in residential areas after the onset of the pandemic resulted in a court classification of "warehouses" after residential complaints and debate over rapid delivery effect on local retail. Notably, their previous classification as "urban logistics spaces" under the Paris Local Urban Plan was in keeping with the goals of microhubs: reducing vehicle miles traveled by heavy-duty trucks; however, the court found that these stores did not operate in the "collective interest" [24,25].


Microhub in Porte de Pantin, Paris, France / Source: Sogaris ©ThomasGarcia

Action 3.3
Solicit feedback from residents to address concerns around noise and modal conflicts

Cities and cargo e-bike delivery services have shared goals and can cooperate to determine best practices in their region. They can assist cargo e-bike delivery services by allowing microhubs to operate in commercial and mixed-use zones while also soliciting feedback from residents around noise and modal conflicts. Developed over time and in partnership, this can lead to cities enacting appropriate regulations on microhub operations (such as operating hours, street-level presence, etc.) and amending zoning code to general microhub operation. Furthermore, by leveraging private entity partnerships to initiate pilots, cities can also identify and test areas suitable for microhubs, considering the interplay with other supportive cargo e-bike strategies, such as expansions of biking infrastructure. The corrals installed in the New York City cargo e-bike pilot, though not a typical microhub, offered loading and unloading space for cargo e-bikes and demonstrated the success of private-public partnerships. Challenges included right-sizing corrals for the demand of businesses, placement of the corrals, and working with the community to overcome barriers such as limited overnight parking. New York City also plans to pilot 20 off-street microhubs in 2024[26].

Policy and regulation

RECOMMENDATION NO. 4

Create a legal framework for commercial cargo e-bike use

Legal uncertainties regarding laws and regulations affecting cargo e-bikes hinder investment by private companies, individuals, and local governments in drafting policies and running pilots. Creating a legal environment that ensures regulatory clarity on what a cargo e-bike is and how it can use the urban transport infrastructure allows private companies to make short and long-term investments in new technologies and new operational processes.

Action 4.1

Adopt the 3-class electric bicycle model law

While the US Consumer Product Safety Commission provides a federally applied definition of an e-bike, each US State can draft different regulations for traffic codes. Over the past few years, a standard set of state laws emerged based on an e-bike model law introduced by PeopleforBikes[27]. This model law introduced a 3-class classification system; each class is characterized by a maximum allowed speed (20 or 28 miles per hour) and by the presence of a throttle. The e-bike classes are:

- **Class 1 electric bicycle** *shall mean an electric bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 20 miles per hour.*

- **Class 2 electric bicycle** *shall mean an electric bicycle equipped with a motor that may be used exclusively to propel the bicycle, and that is not capable of providing assistance when the bicycle reaches the speed of 20 miles per hour.*
- **Class 3 electric bicycle** *shall mean an electric bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 28 miles per hour.*

As of July 2023, this classification was adopted by 40 states and Washington, DC[28]. This model law addresses several objectives. First, it updates laws that were not written with e-bikes in mind. It specifies that e-bikes are bicycles and are afforded the associated rights and privileges. Furthermore, the law ensures that e-bike operators do not need licenses, registrations, or financial responsibility. This allows for e-bikes to retain the flexibility in use that bi-cycles enjoy. Finally, this encourages public and commercial use of e-bikes by clarifying their definition. For states that have not yet adopted this system, it is a necessary first step towards cargo e-bike usage.

Action 4.2
Define cargo e-bikes within a "4th class" of e-bike laws

With the above rules in place, all cargo e-bikes must meet the CPSC requirements and the 3-class standards in the states where they are sold. The State of New York and the City of Denver, Colorado, have introduced policies that explicitly define cargo e-bikes as a separate class of e-bikes.

In New York State, a new pending bill will introduce a 4th e-bike class that explicitly defines cargo e-bikes[29].

"A bicycle designed to carry and deliver more than ten cubic feet of property, or a bicycle towing a trailer designed to carry property, with electric assist having an electric motor that provides assistance only when the person operating such bicycle is pedaling or that may be used exclusively to propel such bicycle, that is manufactured or modified for the purpose of transporting property in commerce and operated for such purpose. Every person riding a cargo bicycle with electric assist upon a roadway shall be granted all of the rights and shall be subject to all of the duties applicable to the driver of a vehicle and the rider of a bicycle by this title, except as to special regulations in this article and except as to those provisions of this title which by their nature can have no application."

The bill also relaxes the previously introduced restriction on the width of e-bikes from 36 inches to 48 inches while introducing a maximum allowed speed of 12 miles per hour.

The City of Denver, Colorado, has introduced a definition of cargo e-bikes in the regulations administering their new e-bike rebate program. The following criteria characterized cargo e-bikes[30].

"E-cargo bicycles must have an extended frame designed to carry additional people or cargo. E-cargo bikes must meet all of the following criteria:

- *Designed to carry one or more passengers in addition to the rider OR designed to carry heavier or bulkier loads than a traditional bicycle can carry*
- *Bike has an extended frame (long tail, long john, Bakfiet or box bike)*
- *Bike's extended frame has a published cargo load carrying capacity of at least 100 lbs."*

Introducing cargo e-bikes as an additional class of e-bikes has several advantages.

- It clarifies their status as a class of e-bike, thereby inheriting all the benefits that come with it, including access to cycling infrastructure and no requirement for a driver's license.
- It provides individuals and businesses confidence in purchasing specific models, as they can ensure they adhere to existing legislation.
- Local authorities can target them with specific regulations, incentive programs, and policies. For instance, New York City started a cargo bike pilot in 2019, while the City of Denver introduced rebates for cargo e-bikes.

While the definition of cargo e-bikes should be detailed enough to distinguish them from non-cargo models, it should avoid excessively restricting them. A recently proposed amendment to the New York City Traffic Rules allows cargo e-bikes to be up to 48 inches wide and for quad cargo e-bikes but introduces a new restriction in length to 120 inches[31]. Such length restriction would make illegal many of the existing cargo e-bikes in New York City, which, by abiding by the previously 36-inch restriction, adopted long and narrow trailers to operate efficiently.

Cargo e-bikes can be defined as carrying payloads over 100 lbs, having a carrying volume capacity of over 10 cubic feet, having an attached trailer, having an extended frame or basket, carrying one or more passengers in addition to the rider, or being used with the primary purpose of carrying goods and commerce. Structuring a definition in this fashion is not restrictive to what a cargo bicycle can be; instead, it describes what makes cargo e-bikes unique. However, introducing definitions that involve structural restrictions, such as limitations in width, height, and length, might have the unintended consequence of hampering adoption, impacting existing operations, and deterring future investments while not necessarily enhancing safety. Safety-focused regulations can be introduced separately, and can directly target how cargo e-bikes are used.

RECOMMENDATION NO. 5

Prioritize cargo e-bike safety through safety-focused regulations in partnerships with delivery fleets

Action 5.1
Introduce regulations to allow cargo e-bike operations while guaranteeing the safety of all road users

Defining cargo e-bikes as a separate class enables local authorities to target them with specific incentive programs, policies, and regulations.

For example, the New York City Department of Transportation (NYCDOT) launched a cargo bike pilot program in 2019, providing incentives for adoption while simultaneously restricting their operations to enhance safety. The program targeted cargo e-bikes used by businesses, requiring their riders to take a safety training course, to wear a helmet and reflective apparel, and to equip cargo e-bikes with safety devices such as wheel reflectors and head and tail lights, among others. The businesses were also required to register and display a roaster with information about the rider and the unique pilot registration identifier. Such a roaster was a form of parking permit, enabling the holders to park and load/unload the cargo e-bikes at any curb space reserved for commercial vehicle parking, free of charge. Moreover, the NYCDOT would also introduce, by request of the participating businesses, dedicated curb spaces equipped with bike corrals for cargo e-bike load/unloading[32].

Safety-focused rules can also include speed limits and the provision of proof of insurance. Additional incentives include the establishment of microhubs near delivery customers, extending the bicycle infrastructure, and establishing rest areas and charging stations for cargo e-bike delivery drivers.

Adopting safety-focused regulations on cargo e-bike operations allows local governments to promote safety while not hampering adoption. It could also represent an alternative to introducing over-restricting cargo e-bike restrictions, as discussed in action 4.2.

Action 5.2
Use pilot programs to test individual rules in partnership with delivery fleets

Regulations focused on the safe use of cargo e-bikes can be established and tested collaboratively through partnerships and pilot programs, allowing experimentation and investments without stymying the market[33].

Well-structured pilot programs include data release requirements and third-party program evaluators to gather and analyze such data to estimate performance metrics. Pilot programs can also collaboratively test regulations with delivery fleets and inform local governments about future legislative actions.

Action 5.3

Increase public awareness of e-bike safety practices and support battery safety standards

E-bikes, like many micromobility devices, use lithium-ion batteries as a power source. Cargo e-bike

delivery services place a high priority on equipment safety, with protocols for inserting batteries each day and supervised charging, in addition to sourcing high-quality components. However, due to the high price of cargo e-bikes and their components, individuals who purchase them for personal use or independent contracting may opt for lower-quality battery options. Individuals may also not be aware of the risks associated with charging in residences or overnight or may not have access to supervised alternative charging stations.

If sourced by cheaper, low-quality manufacturers, using lower-end battery management systems, or improperly used, lithium-ion batteries can cause an explosive thermal runaway, resulting in a quickly generated fire that is difficult to put out and emits toxic fumes[34]. There exist nationally recognized testing laboratories that provide certifications for e-bike devices, batteries, and charging equipment that are safer to use and lower the risk of incidents[35]. A common testing certificate for

e-bike batteries in North America is the UL Certification issued by the UL Research Institute, specifically, UL 2272 and UL 2849.

To address this, the U.S. Consumer Product Safety Commission (CPSC) recently published a call on manufacturers to comply with the UL standards or face “possible enforcement action”[36]. A New York City law goes further and will implement this enforcement of standards in September 2023, prohibiting the sale of e-bikes and other micromobility devices that are not compliant[37]. Cities should prepare to enact similar legislation and engage in public educational campaigns on the safe usage of e-bikes and other electric micromobility. To support riders or delivery workers who purchase their equipment, financial incentives for safe equipment can also be offered.

Financial Incentives

RECOMMENDATION NO. 6

Increase cargo e-bike demand

Action 6.1

Establish cargo e-bike purchase rebate programs, targeting them with higher rebates and promoting safety

Compared to conventional bikes, e-bikes and cargo e-bikes are more expensive: on average an e-bike costs $2,600 and a cargo e-bike costs $5,000[38]. Though lower than a vehicle, this high startup cost is a financial barrier to cargo e-bike adoption. E-bike purchase rebates, which involve a partial repayment or discount on the initial price at purchase, can mitigate the adoption entry barrier and promote the adoption of safer cargo e-bike models.

At the US Federal level, an initial draft of the Build Back Better Act included a 30 percent tax liability credit on the purchase price, with a maximum rebate of $900[39, 38]. However, several States and local governments created incentive programs that supplemented this federal incentive. In a policy scan, Bennett et al. found over 75 e-bike incentive programs were launched between 2019 and 2022[38]. Only a few of these included incentive programs that directly targeted cargo e-bikes. Given their ability to substitute vehicle miles traveled and higher purchase prices, cargo e-bikes should be targeted with higher rebates than e-bikes. Considering average prices, an additional subsidy of $2,500 may be needed to reach purchase parity with e-bikes[38].

One such rebate program was rolled out in Denver, Colorado, in 2022. The program offered $300 for any resident joining the program, and $1,200 for income-qualified residents, with an additional $500 for cargo e-bikes. Rebates came in the form of vouchers that offered point-of-sale discounts at the time of purchase at eligible bike stores. Demand for the vouchers quickly exceeded supply, providing rebates to 4,734 residents after 9 months of the program launch[39].

There are many cargo e-bike models, and the market is continuously evolving. Consequently, identifying what models should be considered eligible for the rebate program might add a layer of complication. Administrators should use a cargo e-bike definition that is detailed enough to be applicable and general enough not to restrict particular types of cargo e-bike models and uses similarly to the e-bike "Class 4" definition described earlier.

Rebate programs for cargo e-bike purchases may also be targeted at businesses and organizations instead of sole individuals. For instance, the United Kingdom Department of Transport funded 2021 the eCargo Bike Fund, through which businesses could request up to 40 percent refund on the purchase cost of cargo e-bikes, for a maximum of £2,500 ($3,270) for 2-wheel models and £4,500 ($5,884) for trikes, for a maxim of five cargo e-bikes per organization[40]. Another example is the rebate program instituted by Austin Energy, the electric utility provider of Austin, Texas, which includes rebates of up to $800 for fleet applicants, with the additional requirement that fleet owners purchase between 5 and 25 e-bikes to qualify[41].

Colorado e-bike program

	Base incentive	**Cargo e-bike incentive**
Standard rebate	$300	$500
Income-qualified rebate	$1,200	$1,400

RECOMMENDATION NO. 7

Subsidize businesses using and operating cargo e-bike services

Though cargo e-bikes have a lower total cost of ownership than delivery vehicles, they are a less mature delivery model than traditional vans. Rider recruitment, training, and insurance all present challenges for new cargo e-bike delivery businesses due to the relative novelty of the field. Heavy-duty cargo e-bikes also necessitate frequent safety inspection of their drive systems and tires, in-house maintenance service, and supervised charging of batteries. Furthermore, the benefits of cargo e-bikes are not necessarily captured in a cost structure even if they are a public good: less traffic congestion and lower emission rates do not directly increase profit margins[7].

As a result, the cost of utilizing cargo e-bike delivery services can be difficult for businesses to bear as they experiment with new systems and discover how cargo e-bikes may fit into their existing operating models. Cities can support the development of cargo e-bike businesses in their regions with subsidies to decrease the cost of utilizing cargo e-bike services.

Action 7.1
Subsidize businesses utilizing cargo e-bike delivery services

One form of subsidy involves lowering the cost of businesses that use delivery services from operators of cargo e-bike fleets. Such a subsidy allows the cargo e-bike delivery service to be competitive with a vehicle delivery service, especially during the start-up phase of new operators.

An example of a subsidy targeting businesses using cargo e-bike services is the ongoing Boston Delivers program[42]. In 2022, the City of Boston issued a Request for Proposals (RFP) to identify a cargo e-bike operator to serve businesses in the Allston neighborhood and surrounding areas of Boston, Massachusetts. Subsequently, businesses would individually apply to receive tiered subsidies based on their delivery needs, ranging from $500 per month (for 20-80 monthly deliveries) to $1,500 per month (for 150 or more monthly deliveries). Through a competitive RFP process, NetZero Logistics was selected. The program is being rolled out in September 2023 with an initial eight participating businesses and will last 18 months. The potential advantages of such a program include the establishment of a cargo e-bike operator and a starting market demand.

Action 7.2
Use public procurement to support carriers using cargo e-bikes

Public entities use procurement processes to award contracts to businesses to supply them with goods and services. Forty-five states already have policies that enable prioritizing certain businesses over others based on factors like small business certification, being veteran, female, or minority-owned. Though cities in the US currently cannot regulate vehicle emissions directly, procurement allows cities to participate in the market and assert their preferences for zero-emission delivery with cargo e-bikes. In many states, this is created through a percentage preference, where a preferred company doesn't need to make the lowest bid to secure a contract but must bid within a certain percentage of the lowest bid received. The "market participation exception" to the Commerce Clause of the US Constitution typically applies when these preferences face legal challenges. However, there are limits when this goes beyond the immediate service being provided. Cargo e-bikes can be brought in in two major ways: for direct delivery services and for transporting people and cargo as part of a regular job function. For instance, the City of Portland awarded its procurement of office supplies to a partnership between Office Depot, a leading national provider of business services and supplies, and B-Line, a local cargo e-bike operator[43]. Cargo e-bikes can also be procured to replace city fleet vehicles, as was done for a Fleet Cycles pilot project in Madison, Wisconsin, and the Seattle Downtown Ambassadors. In these applications, cargo e-bikes were used for trash removal, graffiti removal, brush hauling, facility maintenance, and biohazard cleaning.

Culture and education

RECOMMENDATION NO. 8

Promote a culture of biking and safe driving among individuals, workforce, and business owners

Promoting cargo e-bike adoption should be a component of a wider vision to promote biking in all forms. Beyond the social, health, and environmental benefits of biking, an increased rate of bike and e-bike adoption would also benefit cargo e-bike adoptions. First, an increase in biking demand would increase the political will to invest in cycling infrastructure, making cargo e-bikes a more efficient mode of transporting goods in urban areas. Second, residents would be more willing to accept cargo e-bikes as a mode of urban transportation not only for leisure but also for commuting, shopping, and other travel purposes. Third, an increase in biking demand would spur business investments in developing new and improved cargo e-bike models, generating economies of scale and reducing the total cost of ownership, making cargo e-bikes more affordable.

Action 8.1

Use income-qualified rebates to create affordable transportation options for low-income residents and expand the population of cyclists

However, one significant barrier to e-bike adoption is its price. As discussed in recommendation 6, e-bike rebates can incentivize individual adoption of e-bikes by making them more affordable. Several existing rebate programs also provide higher rebates for "income-qualified" residents. These programs compare residents' income with the federal poverty level and may have proportional, tiered, or flat rates of additional benefits. There are several benefits to including income qualification in a rebate program. First, this expands the population of people who may use e-bikes. Income-qualified rebates effectively increase the market of potential cargo e-bike users to many residents who otherwise would consider them to be out of their price range.

Action 8.2

Support cargo e-bikes educational and training programs for individuals, delivery drivers, and business owners

While e-bike rebates are one policy tool that can spur demand for e-bikes in the short term, cities should consider investing in educational initiatives that not only teach urban residents how to ride a bike safely but also teach future drivers how to drive, prioritizing the safety of pedestrians and bicyclists. Biking education can go a long way, not only in spurring future demand for biking but also in creating a more biking-friendly workforce. More targeted training programs can also be developed as a pathway to commercial "green" jobs. These programs can provide existing delivery drivers and small business operators with access to cargo e-bikes and train them how to ride them safely and efficiently. They can also provide basic training on maintenance, repair, and other skills useful to operate a cargo e-bike business.

Pedaling Relief Project volunteers in Seattle, WA / Source: Seattle Bike Blog

RECOMMENDATION NO. 9

Promote cargo e-bike use among community groups, public institutions, and non-profit organizations

Cargo e-bikes are not solely used by for-profit businesses. Many local communities, non-profit organizations, and public institutions can take advantage of the flexibility, agility, and lower cost of ownership of cargo e-bikes. Many of these local organizations might already be using cargo e-bikes. For instance, the Cascade Bicycle Club, a local non-profit bicycle advocacy educational organization based in Seattle, coordinates the Pedaling Relief Project, a network of volunteers that use bikes, e-bikes, and cargo e-bikes to rescue food and support local food banks' home delivery programs. Another example is the University of Washington mailing services that use cargo e-bikes for mail deliveries. While the service has been leasing delivery vans to perform the deliveries on campus, several employees who were already commuting by bike to the mailing facility started experimenting with using their bikes to perform some of the deliveries and pick-ups. In 2019, after receiving funding from a UW's "green grant," the mailing service was able to purchase 3 cargo e-bikes. Over the years, the service now operates eight cargo e-bikes and retired three of the delivery vans.

Other organizations, such as schools and kindergartens, campuses, churches, volunteer organizations, and other community groups, may benefit from using cargo e-bikes to support their operations and activities. However, these organizations often lack the financial resources to cover the initial purchase cost of the cargo e-bikes. The city can financially support these organizations by providing "green grants," evaluated on a case-by-case basis, to purchase and maintain cargo e-bikes.

Action 9.1

Establish "green grants" to support local communities and organizations to purchase and use cargo e-bikes

University of Washington mailing service / Source: University of Washington

Strategy toolkit

RECOMMENDATION	ACTION
1 Infrastructure	
1. Build and improve cycling infrastructure to support cargo e-bike operations while reducing interactions with other road users	1.1 Expand the network of bike lanes to minimize conflicts with pedestrians on sidewalks 1.2 Provide wider bike lanes and intersection accommodations 1.3 Prioritize bicycles over vehicles in "Bicycle boulevards" 1.4 Minimize vehicle traffic in dedicated "Car-free" areas 1.5 Collaborate with private stakeholders in the deployment and funding of the bike lane network, bike boulevards, and car-free areas
2. Provide and enhance parking and unloading spaces for cargo e-bikes	2.1 Allow cargo e-bikes to park in load zones or other curb parking spaces 2.2 Make sidewalk unloading accessible through mountable curbs and frequent curb cuts 2.3 Create dedicated cargo e-bike corrals for parking
3. Enable microhub operations in commercial areas	3.1 Allow zoning variances and special-use permits for microhubs to be located in commercial and mixed-use zones 3.2. Use private partnerships and pilot programs to test microhubs in commercial and mixed-use zones 3.3 Solicit feedback from residents to address concerns around noise and modal conflicts
2 Policy and regulation	
4. Create a legal framework for commercial cargo bike use	4.1 Adopt the 3-class electric bicycle model law 4.2 Define cargo e-bikes within a "4th class" of e-bike laws

RECOMMENDATION	ACTION
2 Policy and regulation (continued)	
5. Prioritize cargo e-bike safety through safety-focused regulations in partnerships with delivery fleets	5.1 Introduce regulations to allow cargo e-bike operations while guaranteeing the safety of all road users 5.2 Use pilot programs to test individual rules in partnership with delivery fleets 5.3 Increase public awareness of e-bike safety practices and support battery safety standards
3 Incentives	
6. Increase cargo e-bike demand	6.1 Establish cargo e-bike purchase rebate programs, targeting them with higher rebates and promoting safety
7. Subsidize businesses using and operating cargo e-bike services	7.1 Subsidize businesses utilizing cargo e-bike delivery services 7.2 Use public procurement to support carriers using cargo e-bikes
4 Culture and education	
8. Promote a culture of biking and safe driving among individuals, workforce, and business owners	8.1 Use income-qualified rebates to create affordable transportation options for low-income residents and expand the population of cyclists 8.2 Support cargo e-bikes educational and training programs for individuals, delivery drivers, and business owners
9. Promote cargo e-bike use among community groups, public institutions, and non-profit organizations	9.1 Establish "green grants" to support local communities and organizations to purchase and use cargo e-bikes

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The Urban Freight Lab (UFL), housed at the University of Washington, is an innovative partnership bringing together private industry, academic researchers, and public transportation agencies to solve urban freight management problems that overlap private and public spaces and have wide-ranging benefits.

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