



E-bikes: Charging Toward Compact Cycling Cities



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AUTHORS:

Dana Yanocha **ITDP**
Jonas Hagen **Independent Consultant**
Research and drafting support provided by **Evelyn Yuen**

EXPERTS INTERVIEWED:

The authors thank the following experts who generously provided their time and insights during the interview phase, which strengthened the quality of this report.

Benjamin Hategekimana **ITDP Africa**
Danielle Hoppe **ITDP Brazil**
Shanshan Li **ITDP China**
Qiuyang Lu **ITDP China**
Mega Primatama **ITDP Indonesia**
Ciptaghani Antasaputra **ITDP Indonesia**
Syifa Maudini **ITDP Indonesia**
Deliani Siregar **ITDP Indonesia**
Philip Amaral **European Cyclists' Federation (ECF)**
PeopleForBikes (formerly)
Noa Banayan **Zoomo + ITDP Board**
Jules Flynn **Aliança Bike**
Daniel Guth **ITDP Board**
Justine Lee **Independent Consultant**
Michael Linke **Denver Office of Climate Action, Sustainability, and Resiliency (CASR)**
Mike Salisbury **Lyft**
Caroline Samponaro **Transport Decarbonization Alliance and ITDP Board**
Seble Samuel **The Urban Catalysts**
Sonal Shah **Lyft**
Tejus Shankar **European Cyclists' Federation (ECF)**
Ceri Woolsgrove

REVIEWERS

Ciptaghani Antasaputra **ITDP Indonesia**
Bernardo Baranda **ITDP Mexico**
Shelley Bontje **Dutch Cycling Embassy**
Jules Flynn **Zoomo + ITDP Board**
Camila Herrero **C40**
Rodriguez **ITDP Brazil**
Danielle Hoppe **ITDP Africa**
Chris Kost **ITDP Global**
Jacob Mason **Alta Cycling Group**
Larry Pizzi **PeopleForBikes**
Ashley Seaward **Lyft**
Tejus Shankar **ITDP Indonesia**
Deliani Siregar **ITDP India**
AV Venugopal **ITDP China**
Li Wei **2 Billion Bikes Foundation**
Jonathan Weinert **European Cyclists' Federation (ECF)**
Ceri Woolsgrove

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COVER PHOTO:
It is common to find electric and mechanical bicycles on Bogotá's bicycle lanes during rush hour.
SOURCE: ITDP

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I. INTRODUCTION

Unlocking the Potential of E-Bikes for Climate, Equity, and Access in Cities

Electric bicycles (e-bikes) are vastly popular with their owners, and their use is growing by leaps and bounds around the world. For the purposes of this report, we define e-bikes as electrically powered two- and three-wheeled cycles that are compatible in terms of size and maximum speed with conventional (nonmotorized) bicycles. Our definition of e-bikes does not include electric scooters or motorcycles (see Section II for a more complete definition). E-bikes have multiple positive impacts for the climate and access (see Section III), especially when used in place of private vehicles like cars and motorcycles:

Integration with the Built Environment

E-bikes are cleaner, quieter, and more space-efficient, and they integrate better into city streets than cars and internal combustion engine (ICE) two-wheelers. They have the potential to provide excellent mobility options—for people in cities, and for those living in more peripheral urban and even rural areas too.



SOURCE: City of Durham NC
via Flickr

Potential for Carbon Reductions

The potential for e-bikes to replace automobile (and, to some extent, ICE two-wheeler) trips is greater than for traditional bicycles, with electric motors reducing the challenges of hills, hot weather, and longer distances. E-bikes can also greatly expand the share of potential users of public transport, leading to further emissions reductions. This makes e-bikes a key piece in the puzzle of reducing carbon emissions from urban transport.

Improving Access and Equity

E-bikes have the potential to improve access to destinations — particularly for historically underserved groups, including women, the elderly, and low-income populations — given their low cost (relative to cars) and ease of use. Shared e-bikes as part of bikeshare systems are also being used at much higher rates compared to conventional bikeshare bicycles.



SOURCE: City of Durham NC via Flickr

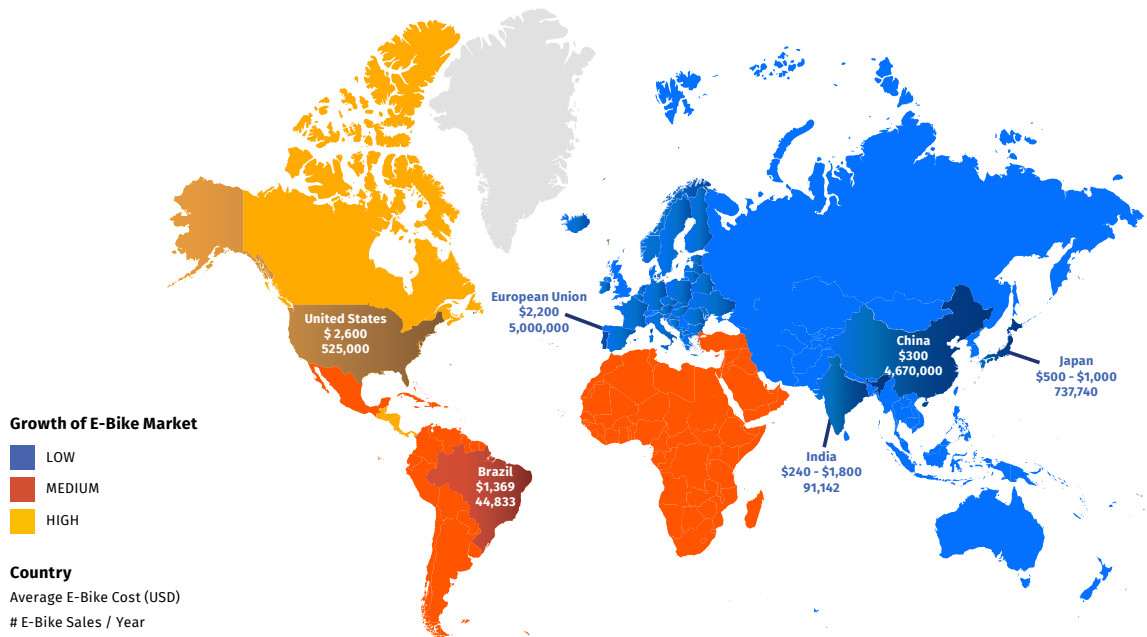
Stimulating Economic Opportunities

The domestic production of e-bikes is an opportunity for countries to stimulate both manufacturing and downstream jobs as a result of increased demand for e-bikes, such as in bicycle retail and mechanics. Further, e-bikes used in commercial applications provide a source of income and economic opportunity for bicycle delivery workers.

A Growing Market

In 2022, the global market for e-bikes was valued at USD \$37.5 billion, or about 15% of the global market for all electric vehicles (valued at USD \$246.7 billion in 2020).¹ With demand for e-bikes growing rapidly in many regions, the global market is expected to increase to \$119.7 billion by 2030, with an annual growth rate of 15% (total growth of 220%).² Many countries — including Japan, Brazil, the US, Australia — are experiencing rapid growth in demand for e-bikes. In the US, for example, the number of imported e-bikes increased from 25,000 in 2019 (pre-pandemic demand) to 463,000 units in 2020 and 790,000 in 2021 — an increase of more than 3,000% from 2019 to 2021. In the US, e-bike imports were higher than electric car and truck imports in 2020 (463,000 e-bikes versus 325,000 electric cars and trucks) and 2021 (790,000 e-bikes versus 652,000 electric cars and trucks).³

E-Bike Growth by Region 2020–2025⁴



¹ Fortune Business Insights. (May 2023). "Electric Bike Market Growth & Trends | Industry Analysis [2030]"
² Fortune Business Insights. (May 2023). "Electric Bike Market Growth & Trends | Industry Analysis [2030]"
³ North American Bikeshare and Scootershare Association. (August 2022). 3rd Annual Shared Micromobility State of the Industry Report 2021
⁴ eBicycles (January 2024) , Useful Facts & Stats of E-Bikes; Alexandru Arba (June 2023), Sales volume of electric power-assist (pedelecs) bicycles in Japan from 2011 to 2020; Aliança Bike (April 2023), <https://aliancabike.org.br/mercado-eletricas-2023/>; Confederation of European Bicycle Industry (July 2022), Bicycle and E-Bike Sales Continue to Grow, Reaching Record Levels; PeopleForBikes (May 2023), Electric Bicycle Incentive Toolkit; Blueweave Consulting (September 2022), India Electric Bicycle (E-Bike) Market—by Propulsion Type (Pedal-Assist, Throttle); By Battery Type (Lead Acid, Lithium-Ion, Nickel Metal Hydride, Others); By Region (North India, East India, West India, South India), Trend Analysis, Competitive Landscape, Market Share & Forecast, 2018–2028; ITDP India (June 2022), Status of E-Micro Mobility in India; iResearch Consultants (August 2022), China's Two-Wheeled Electric Vehicle Industry White Paper 2022.

The largest existing market for e-bikes is China, with more than 183 million e-bikes in urban areas⁵ and a reported 350 million e-bikes countrywide in 2021.⁶ The prevalence of e-bikes in China can be attributed to a variety of factors, including: 1) bans on motorcycles implemented in the late 1990s, 2) challenges associated with acquiring motorcycle licenses, 3) relatively short travel distances in Chinese cities, and 4) affordability of e-bikes. E-bikes became a popular replacement for motorcycles after major Chinese cities banned motorcycle licensing and use in the early 2000s.⁷ As a result, e-bikes in China are more visually similar to mopeds than bicycles, though their weight and power align with low-speed e-bikes. Many relatively low-cost e-bike options (low-end models start at around USD \$300) are available, too. Chinese cities have also expanded investments in cycle infrastructure over the past decade, providing safe and comfortable travel spaces for e-bike riders.



A family rides an electric bicycle along a downtown street in Beijing.
SOURCE:
1000 Words via Shutterstock

Overall, the projected global growth in the e-bike market in the coming years represents an opportunity for local manufacturing and assembly. Although most e-bikes are currently produced in China and the EU, companies in other countries, including the US, India, Indonesia, Brazil, Mexico, and Kenya, are beginning to produce e-bikes.

Context for This Report

While e-bikes are growing in popularity, it is also relatively early days in the development of this technology. Local, regional, and national governments are grappling with ways to integrate e-bikes into transportation networks in cities and in peri-urban and rural areas. Many countries and cities have not yet clearly defined what e-bikes are, what quality standards they must meet, and/or where they can be used. This lack of clarity has led to safety concerns around conflicts between people on e-bikes and other street users, deadly e-bike battery fires, and other challenges. To avoid these regulatory confusions, governments must engage the topic. However, we recognize that there is no single “best” way to regulate e-bikes and introduce them into local markets, so governments must work to develop the solutions that work best in their context.

Recognizing this pivotal moment in the trajectory of global e-bike uptake, this report aims to define e-bikes and evaluate how and where they are currently being used, the benefits e-bikes can deliver, factors preventing more widespread adoption, and how cities and national governments can respond. As part of this broader goal, the report has two main objectives:

- 1) to showcase how e-bikes can contribute to climate-friendly, livable, equitable cities by reducing carbon emissions and

⁵ ITDP. (December 2021). [The Compact City Scenario—Electrified](#).

⁶ Xu Bing, *China News Shanghai*. (June 18, 2023). [奔赴赛道，中国两轮电动车行业满足消费者多元需求-中新社上海 \[Heading for the track, China's two-wheeled electric vehicle industry meets diversified consumer demands!\]](#)

⁷ Guo et al. (2020). [Personal and societal impacts of motorcycle ban policy on motorcyclists' home-to-work morning commute in China](#).

2) to provide guidance to municipal, regional, and national governments on how to encourage and integrate e-bikes into existing transport networks.

We draw on existing research as well as lessons learned from government and private-sector successes and shortcomings from around the world. The report relies heavily on data gathered from 14 interviews with e-bike experts who work in nine countries across six continents, including ITDP staff and external consultants.

Notably, this report aims to evaluate the use and potential impacts of e-bikes separate from trips made by ICE two-wheelers (such as mopeds or motorcycles). E-bikes and two-wheelers are often conflated despite important differences in their use, requirements for safe operation, and purchase price. Cities and countries where two-wheelers are prevalent have faced particular challenges to adopting e-bikes (see Section IV). As the global e-bike market grows and a larger range of e-bike types becomes available, using them to replace ICE two-wheelers will likely become more competitive. Importantly, strategies to electrify two-wheeler fleets should include encouragement of modal shift to e-bikes.

II. WHAT IS AN E-BIKE?

Defining E-bikes

E-bikes are electrically powered two- and three-wheeled cycles that are compatible in terms of size and maximum speed with conventional (non-motorized) bicycles. E-bikes come in various forms and serve multiple functions, including transporting passengers and goods. The major types currently on the market are detailed in Table 1. Notably, we do not consider e-mopeds and e-motorcycles without pedals and with maximum speeds above 45 kph (e-motorcycles can typically travel even faster) to be e-bikes.

Table 1: What is an e-bike?

		Type	Maximum speed before assist shutoff	Assist provided by
E-bikes	<i>Compatible with conventional bicycles in cycle lanes</i>	Low-speed e-bikes	25 kph	Pedal assist or throttle
		<i>E-cargo cycles</i>	25 kph	Pedal assist or throttle
		<i>Medium-speed e-bikes</i>	32 kph	Pedal assist or throttle
Not e-bikes	<i>Should not be ridden in cycle lanes</i>	Speed pedelecs	45 kph	Pedal assist
		E-mopeds	No speed limiter (top speed 50 kph+)	Throttle only
		E-motorcycles	No speed limiter (top speed 80 kph+)	Throttle only

As a first step to understanding how e-bikes are being used and what their potential can be, this report will primarily focus on low-speed e-bikes, including e-cargo cycles (see Highlight Box 1), where the electric assist shuts off when a maximum speed of about 25 kph (or up to 15 mph) is reached. Because the motor power is low (generally 250 watts or less), low-speed e-bikes function similarly to a conventional bicycle⁸ even when the electric assist is activated. This report occasionally references, but does not focus on, medium-speed e-bikes and speed pedelecs, though we do consider these to be e-bikes.

⁸ In this report, the authors use the terms “conventional” and “traditional” interchangeably to refer to bicycles that do not have motors.

BOX 1: TYPES OF E-CARGO CYCLES



E-cargo cycle used by the German postal service in Munich.
SOURCE: Anne Czichos via Shutterstock



Delivery bike



Long john bike



Longtail bike



Front load tricycle



Heavy-load tricycle

Electric cargo cycles serve as a last-mile solution for urban freight as well as to transport passengers and goods by private users, and they have great potential to substitute for vehicle trips in these contexts. Compared to standard electric bicycles, e-cargo cycles have a larger carrying capacity and higher power output. E-cargo cycles are used by prominent couriers such as Amazon, UPS, DHL, and Germany's postal service (Deutsche Post) in place of cars and light-duty trucks. Freight deliveries are trending toward smaller packages, with increased demand for tighter delivery time windows and same-day delivery. This trend makes e-cargo cycles increasingly attractive to replace cars and light commercial vehicles for urban freight delivery.⁹ Another advantage of e-cargo cycles is their ability to use cycle lanes when streets are congested, thereby saving time. This was the case for the operator of New York City's public bikeshare system, which started using e-cargo cycles to transport bicycles around the city's busiest streets, as vans performing the same task were frequently caught in traffic.¹⁰

Researchers have found that 19% to 48% of courier trips made by autos could be replaced by e-cargo cycles.¹¹ The CO₂ reductions from a large-scale shift to e-cargo cycles for freight would be dramatic: Case studies from Porto (Portugal),¹² the Netherlands,¹³ and São Paulo (Brazil)¹⁴ have found CO₂ reductions of 73%, 80%, and 90%, respectively, when shifting delivery services from autos to e-cargo cycles.

In a growing number of places, personal e-cargo cycles are used in place of cars to transport groceries, large-volume objects, and additional passengers. A program in Germany and Austria made cargo cycles (electric and conventional) available for free for more than 9,750 users, and a survey indicated that about half of participants (46%) substituted their car trips with the shared cargo cycles.¹⁵

⁹ Rudolph, C., & Gruber, J. (September 2017), "Cargo cycles in commercial transport: Potentials, constraints, and recommendations," *Research in Transportation Business & Management*, 24, 26–36.

¹⁰ Lyft, Inc., 2022, [How We're Rebalancing the Citi Bike System](#).

¹¹ Gruber, Johannes, Verena Ehrler, & Barbara Lenz. (2013). "Technical potential and user requirements for the implementation of electric cargo bikes in courier logistics services." *13th World Conference on Transport Research (WCTR)*.

¹² Melo, S., Baptista, P. (2017). "[Evaluating the impacts of using cargo cycles on urban logistics: integrating traffic, environmental and operational boundaries.](#)"

¹³ Moolenburgh, E., van Duin, R., Balm, S., Altenburg, M., & van Ploos Amstel, W. (2020). "[Logistics concepts for light electric freight vehicles: A multiple case study from the Netherlands.](#)"

¹⁴ Ormond Junior, P.A., Telhada, J., & Afonso, P. (December 2018). "[Evaluating the Economic and Environmental Impact of the Urban Goods Distribution by Cargo Cycles — a Case Study in Sao Paulo City.](#)"

¹⁵ Becker, S., & Rudolf, C. (2018). [Exploring the potential of free cargo-bikesharing for sustainable mobility.](#)

Classification of E-bikes Around the World

While demand for e-bikes is growing globally, the regional realities of access to, perception of, and use of e-bikes differ considerably. Classification and regulation of e-bikes also varies from country to country (and, in some cases, within countries), which heavily influences how e-bikes are produced and sold (see Appendix I for more).

There is also a wide range of contexts that cities and countries are experiencing with regards to e-bike use. **Nascent markets**, like Indonesia, Rwanda, and South Africa, have a very small market share of e-bikes.¹⁶ In some nascent markets, e-bikes may be primarily used by recreational cyclists, for example, people using e-mountain bikes. In South Africa, most of the demand for e-bikes comes from wealthy mountain bike riders purchasing high-end e-bikes to ride on trails, not for everyday transportation.¹⁷ In such places, a clear definition and classification for e-bikes may not be available because supply and use is so limited.



ICE two-wheelers are popular across Indonesia, which has limited the uptake of e-bikes. **SOURCE:** ITDP Indonesia

Fostering E-bikes in Indonesia, a Nascent Market

Most trips in Jakarta and other major cities in Indonesia are completed using ICE two-wheelers. Cheaper and easier to maneuver and park than private cars, ICE two-wheelers dominate streets, causing traffic congestion, air and noise pollution, and road safety challenges. The e-bike market in Indonesia is very nascent, however political will exists for transport electrification broadly--the president of Indonesia is interested in accelerating electrification and supports efforts like financial incentives to purchase electric two-wheelers and electric cars.

In 2021, the Indonesian Ministry of Transportation (MoT) sought to regulate micromobility in the country, implementing a regulation (PM45-2020) to address the gap between existing regulations and the new micromobility products on the market. However, the regulation has been poorly enforced, and safety issues have occurred when two-wheeler users encroach in bicycle lanes designed for low speed e-bikes and conventional bicycles. Further, circumventing the regulation by modifying lower-speed e-bikes to increase maximum speeds from 25 kph to up to 40 kph, making them incompatible with conventional bicycles, is common.

The MoT has not released a clear definition of e-bikes, and how they differ from electric (and ICE) two-wheelers. Because the e-bike market is so new, supply is limited, and it is more expensive to purchase an e-bike compared to an ICE two-wheeler due to the mature market for ICE two-wheelers. This has limited uptake of e-bikes in Indonesia. The government subsidizes electric two-wheelers and electric cars, but not e-bikes. This makes it more challenging to purchase an e-bike compared to other electric vehicles. In several major Indonesian cities including Jakarta, Semarang, and Surabaya, bikeshare operators have expressed interest in providing low-speed e-bikes as part of their fleets. This is an important step in building public awareness around e-bikes and the types of trips they can service. Clear classification of e-bikes and their ability to safely use cycle lanes will be important to support and grow shared — as well as personal — e-bike use.

In **emerging e-bike markets** like Brazil and the United States, where the supply of e-bikes is larger and use is more prevalent than in nascent markets, unclear classifications for e-bikes can pose significant challenges for regulators, retailers, and users. In these cases, unclear classification can inhibit growth of the e-bike industry by creating confusion, especially among potential users. E-bike users may be unsure whether they need a license, registration, and insurance to operate an e-bike, and about where on the street e-bikes can be ridden.

¹⁶ ITDP Indonesia, (May 17, 2023), video interview by author ; Benjamin Hategekimana (ITDP Africa), (June 1, 2023), video interview by author; Michael Linke, (May 2, 2023), video interview by author.

¹⁷ Michael Linke. (May 2, 2023). Video interview by author.



Before a recent regulation was adopted in Brazil, a lack of clarity about what can be categorized as an e-bike led to mopeds using cycle lanes, causing conflicts with lower speed e-bike and pedal bicycle riders.

SOURCE: ITDP
Brazil

Creating Clarity in Brazil, an Emerging Market

In recent years, the market for micromobility modes has grown in Brazil, with a large range of new vehicle types becoming available. An array of e-bikes, e-scooters, and electric two-wheelers were being imported and sold without adequate vehicle classifications and approvals. Some retailers misrepresented e-mopeds to customers, telling them the vehicles they were buying were legal to use in cycle lanes and would not require a license or registration to use. This contributed to a diverse array of electric two-wheelers, including higher-speed e-mopeds, using cycle lanes and causing frequent conflicts with pedal cyclists and pedestrians.

Even transportation authorities and police were not well-informed about the differences and whether these new vehicles were legally allowed to circulate in cycle lanes.¹⁸ This eventually led to the broad apprehension of e-mopeds, e-motorcycles, and e-bikes in São Paulo and Rio de Janeiro because they were circulating without license plates and users did not have driver's licenses. In the city of São Paulo, police apprehended 100 electric two-wheelers in the first four months of 2022.¹⁹

This lack of legal clarity led cycling interest groups to advocate for a new national law that classified e-bikes separately from higher-speed e-mopeds. This law was meant to address the large array of new vehicle types that were already circulating in Brazilian cities and to facilitate registration and licensing for higher-speed vehicles with local traffic authorities. The new regulation was implemented in July 2023, and it updated the classification of e-motorcycles and e-bikes. E-bikes now have the same registration requirements and rights to street infrastructure as bicycles, must be pedal-assist with a maximum speed of 32 kph (previously 25 kph), and have a motor power of 350 watts to 1,000 watts.

The new law aims to provide clarity for authorities and consumers. Notably, the law addresses the difference between vehicle maximum speeds and local speed limits. According to Brazilian legislation, local traffic authorities, not federal legislation, define speed limits. Therefore, the increased 32 kph maximum speed applies to the vehicle's capability and not to the speed limit on the street where the vehicle is being ridden. Despite attempts at clarity, the new legislation has faced some criticism, particularly for permitting moderate speeds for e-bikes (32 kph) and allowing small e-mopeds in the self-propelled category to circulate on sidewalks (up to 6 kph) unless prohibited by local authorities.²⁰

¹⁸ Daniel Guth (Aliança Bike). (June 1, 2023). Video interview by author.

¹⁹ William Cardoso. (May 20, 2022). [Motos elétricas são apreendidas em blitz e proibidas nas cicloviárias de São Paulo](#).

²⁰ Marcos de Souza. (June 26, 2023). [32 km/h não é demais para uma bike na cidade?](#)



E-cargo cycles built to carry additional passengers can substitute for cars.

Source: Waltarrrrr, flickr

Three Classes of E-bikes in the United States, an Emerging Market

In the United States, a federal definition adopted in 2002 states that an electric bicycle is a “two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts, whose maximum speed...is less than 20 mph [32 kph]” (2002 Public Law 107-310). This definition does not specify where on the road e-bikes are permitted, since state laws typically govern rules of the road. Therefore, individual state motor vehicle codes must define e-bikes and identify where and how they can be used. The vast majority (48 of 50) of state motor vehicle codes use a more detailed three-class definition based on speed and how the electric assist is delivered to identify which types of e-bikes are permitted to use bicycle infrastructure. All three classes are considered bicycles and do not require a license or registration. Class 1 and Class 2 e-bikes have a maximum speed of 20 mph, while Class 3 e-bikes can reach 28 mph (45 kph). Class 2 e-bikes have a throttle, while Class 1 and Class 3 are only pedal-assist. The two states that do not use the three-class system, Alaska and Rhode Island, define e-bikes more closely to that of a motorized vehicle than a bicycle, which can mean a license, insurance, and registration are required.

Finally, China and countries in the European Union (such as Germany, Switzerland, and Sweden) have **developed e-bike markets**. In these markets, supply and access to e-bikes is widespread and they have a clear definition in vehicle regulations. In the EU, e-bikes are defined as exclusively pedal-assist, with power cutting out at 25 kph.²¹ In China, e-bikes can be either pedal-assist or throttle-powered, with a maximum speed of 25 kph, and they must have operable pedals.²²

²¹ Association Française de Normalisation. (January 2009). *Cycles — Electrically Power Assisted Cycles - EPAC Bicycles*.

²² Government of the People's Republic of China. (September 6, 2021). “《电动自行车安全技术规范》[Safety Technical Code for Electric Bicycles] (GB17761-2018) 国家标准解读” http://gxt.nmg.gov.cn/hdjl/hyqg/202201/t20220106_1990549.html.



Pedal assist e-bikes are defined as bicycles in the Chinese National Standards on Electric Bicycles. **SOURCE:** Alpha from Melbourne, Australia, via Wikimedia Commons

Refining E-bike Classifications in China, a Developed Market

With clear definitions and strong national laws guiding the use of e-bikes, China has one of the most established e-bike markets. China has had a strong cycling culture since the last century. This facilitated the continual refinement of cycling policies, including a national standard for e-bikes that was enacted in 1999. In 2018, a set of new National Standards on Electric Bicycles fine-tuned the definition of electric bicycles, strictly recognizing pedal-assisted e-bikes as bicycles but also adding tamper-proof and fireproof requirements. Although subnational governments in China have comparatively less authority to define e-bikes, these governments help enforce the standards established by the national government. Provincial governments regulate parking and charging of electric bicycles, while county governments fund law enforcement, emergency response, and administrative management of electric bicycles.

In March 2023, policymakers submitted a proposal to update the 2018 National Standards for Electric Bicycles to better accommodate e-bikes used in deliveries. E-bikes are widely used across China for delivery and courier purposes. The new proposal addresses the regulation of e-cargo cycles, calling for the existing standards to include a larger battery capacity and maximum loading weight. It also suggests the implementation of a smart system to prevent e-cargo cycle modifications that circumvent the regulation, a practice commonly seen with personal e-bikes as well. The proposal also aims to include a system to register e-cargo cycles used for commercial deliveries so that they can be more easily monitored for safety and compliance.

III. WHAT IMPACTS CAN E-BIKES DELIVER?

Like conventional bicycles, e-bikes currently account for a relatively small share of trips in most countries. However, the potential benefits they present, especially with a large-scale growth in ridership, are significant. E-bikes can contribute to climate goals by shifting trips away from high-polluting ICE cars and two-wheelers; improve equity by expanding access to affordable, clean transportation, especially for women and low-income populations; and create domestic economic opportunities.

Climate Impacts

Decarbonizing the Transport Sector by Replacing Car Trips

Experts agree that keeping global warming below 1.5°C is critical to avoiding the most serious and catastrophic impacts of climate change. Greenhouse gas (GHG) emissions from transport account for 24% of the world's total energy-related GHG emissions. Fueled by rapid urbanization and motorization in developing countries, this could increase by 60% by 2050.²³

Given this challenge, practitioners in the urban transportation sector are pursuing multiple avenues to decarbonize. Research and modeling conducted by ITDP and UC Davis show that both compact cities developed for walking, cycling, and public transit *and* a rapid and strategic transition to electric vehicles are needed to cut GHG emissions from urban transport by 50% by 2050, in line with a 1.5°C scenario.²⁴

E-bikes can play a critical role in this transition as substitutes for automobiles for many types of trips because they can serve relatively long trip distances.²⁵ This is especially important in areas where average trip distances are longer, including in large cities, low-density areas, and peripheral urban zones (see Highlight Box 2). Studies have also shown that increasing cycling leads to a decrease in the frequency of car driving. In some cases, e-bike use resulted in impressive reductions of car trips, ranging from 25% to 60%.²⁶ E-bikes also provide a more comfortable ride for users while cycling up hills, in warm climates, and when carrying additional passengers or goods, all trips that might otherwise be made with an automobile.

²³ World Bank. (2023). "[Global Facility to Decarbonize Transport \(GFDT\)](#)."

²⁴ Lewis Fulton & D. Taylor Reich. (December 2021). [The Compact City Scenario – Electrified.](#)

²⁵ Hiselius, L. W., & Svensson, Å. (2017). E-bike use in Sweden — CO₂ effects due to modal change and municipal promotion strategies. *Journal of Cleaner Production*, 141, 818–824.

²⁶ Helga Birgit Bjørnarå et al. (July 2019). [From Cars to Bikes — The Effect of an Intervention Providing Access to Different Bike Types: A Randomized Controlled Trial.](#)
[Joost De Kruijf et al. \(September 2018\). Evaluation of an Incentive Program to Stimulate the Shift from Car Commuting to E-Cycling in the Netherlands.](#)

BOX 2: CAN E-BIKES REPLACE VEHICLE TRIPS OUTSIDE OF URBAN AREAS?

E-bikes have the capacity for longer trip distances than traditional bicycles, allowing for the possibility of them replacing private vehicles for local trips. **SOURCE:** Bad Kleinkirchheim via Flickr



People in urban peripheral and rural areas often have few transportation options aside from private vehicles because of expensive, infrequent, and/or nonexistent public transport services as well as longer trip distances as a result of lower-density development. E-bikes present a viable solution to improve mobility in lower-density areas because they are better suited for longer trips than conventional bicycles. A study of 10,000 European cyclists reported an average e-bike trip of about 9 km compared to an average conventional bicycle trip of about 5 km.²⁷ A US study estimated average trip lengths of 7.5 km for e-bikes and 5 km for conventional bicycles.²⁸ However, a lack of protected cycle lanes and supportive infrastructure (i.e., convenient bicycle parking, repair locations, etc.) and limitations presented by inconsistent electricity access and charging infrastructure in rural areas likely present a more difficult environment for e-bike use than in urban contexts. However, in high-income country suburbs, low-speed neighborhood roads could support local e-bike trips, and theft may be less of an issue where space is available to store e-bikes indoors.

Studies and interviews conducted for this report highlight the potential of e-bikes for travel outside city limits. On large farms or other agricultural properties, e-bikes are being considered as quieter, cleaner options for moving around the property, substituting for gas-powered utility terrain vehicles.²⁹ In Tanzania, researchers estimated that e-bikes could save students traveling from rural areas to school up to 80% of commuting time, reducing a four-hour commute to 50 minutes.³⁰ E-bike use is growing in rural areas of the Netherlands, too, where there is a greater opportunity for e-bikes to substitute for car trips and yield emissions reductions than in cities where car ownership is lower.³¹ In China, rural poverty is closely intertwined with rural immobility, but e-bikes are considered a way for rural residents to access opportunities beyond those available in rural areas.³²

²⁷ Alberto Castro et al. (June 2019). [Physical activity of electric bicycle users compared to conventional bicycle users and non-cyclists: Insights based on health and transport data from an online survey in seven European cities.](#)

²⁸ Michael McQueen, John MacArthur, & Christopher Cherry. (October 2020). [The e-bike potential: Estimating regional e-bike impacts on greenhouse gas emissions.](#)

²⁹ Noa Banayan (PeopleForBikes). (May 4, 2023). Video interview by author.

³⁰ Kennedy Aliila Greyson et al. (June 2021). [Exploring the Adoption of E-bicycle for Student Mobility in Rural and Urban Areas of Tanzania.](#)

³¹ Michael Jenkins et al. (November 2022). [What Do We Know about Pedal-Assist E-Bikes? A Scoping Review to Inform Future Directions.](#)

³² Zhao Yu & Pengjun Zhao. (February 2021). [The Factors in Residents' Mobility in Rural Towns of China: Car Ownership, Road Infrastructure, and Public Transport Services.](#)

E-bike use has also been directly linked to reductions in vehicle kilometers traveled and related emissions. In North America, using e-bikes for 15% of all miles traveled could result in a 12% reduction in carbon dioxide emissions from transport.³³ In Denver, 71% of participants in the city's e-bike purchase incentive program reported reducing car trips (see Highlight Box 3).

BOX 3: EXPANDING ACCESS TO E-BIKES AS A CLIMATE SOLUTION IN DENVER



In Denver, e-bike rebates are coupled with improved bicycle infrastructure in order to incentivize climate friendly transportation options.

SOURCE: Lars Plougmann via Flickr

A citizen-led effort to push for more coordinated action to address climate change at the city level in Denver led to the passage of a ballot measure in 2020 to create a sales tax-supported Climate Protection Fund. Since then, the tax has generated around USD\$40 million per year, which the city's Office of Climate Action, Sustainability, and Resilience (CASR) has used to support climate actions across the transport, building, and energy sectors.

In 2021, CASR began to look into potential incentive programs for e-bikes in an effort to encourage more people — especially low-income residents — to purchase an e-bike as a way to reduce private vehicle use. The cost of an e-bike had been identified by low-income residents as a significant barrier to purchase and daily use. Because the program was primarily targeting low-income residents, a reimbursement or rebate received after the purchase would not be viable, because many low-income residents would not be able to afford the upfront price, even if they would receive a rebate (partial refund) later. CASR decided to pursue a point-of-sale discount, which means that bicycle retail shops would cover the full cost of e-bike purchases through the program until the city reimbursed them. Consultations with local bicycle retailers indicated that they were generally supportive of the program — it would increase e-bike sales — but were concerned about the reimbursement process and the time it would take. Given this feedback, CASR hired a third-party to implement and operate the program in an effort to deliver timely reimbursements to the bicycle shops.

³³ Michael McQueen, John MacArthur, & Christopher Cherry. (October 2020). [The e-bike potential: Estimating regional e-bike impacts on greenhouse gas emissions.](#)

Denver’s e-bike voucher program launched in 2022. The point-of-sale voucher can be used to purchase an e-bike or e-cargo cycle from any Denver-based bicycle retailer, with \$400 standard vouchers available for regular e-bikes and \$900 vouchers for e-cargo cycles. Income-based vouchers provided \$1,200 toward the purchase of a regular e-bike and \$1,700 toward an e-cargo cycle. CASR originally budgeted \$300,000 for vouchers, but demand significantly dwarfed that amount — more than 1,000 people applied for vouchers in the first few days of the program. CASR was able to allocate additional funds to support more vouchers, ultimately offsetting the purchase of about 4,700 e-bikes in 2022, about half of which were bought by residents using income-qualified vouchers.

A survey of users of the e-bike vouchers showed promising climate impacts from the program. E-bike owners reported riding an average of 26 miles (42 kilometers) per week, with income-qualified voucher recipients riding slightly more than average, at 32 miles per week. And 71% of respondents reported using their car less often, with the 4,700 e-bikes purchased through the program replacing approximately 100,000 vehicle miles traveled per week. Each year, the 4,700 e-bikes will offset approximately 1,450 metric tons of greenhouse gas emissions, or the equivalent of taking more than 300 cars off the road.³⁴

The program was renewed for 2023, and demand for e-bike vouchers is well beyond what CASR can provide. Meanwhile, the city is investing in complementary infrastructure, like protected bicycle lanes, that can support more frequent and longer e-bike trips and greater modal shift away from private vehicles.³⁵

Finally, as the share of electricity generated by renewable sources (e.g., wind and solar) increases around the world, and particularly in low- and middle-income countries, the potential for GHG reductions from e-bikes will grow. The promise of inexpensive, clean transportation from e-bikes can also add incentives for the creation of sustainable, consistent electricity supply to areas that currently have inconsistent (or no) supply and/or a GHG-intense electricity supply.

Estimating the Climate Impacts of a Large-Scale Global Shift to E-bikes

As outlined above, the emissions-reduction potential from replacing vehicle trips with e-bike trips is high, especially in places where car ownership is high. This is because for most people conventional bicycles are well-suited for trips under 5 kilometers, whereas e-bikes enable riders to cover longer distances (10 km or more) with less physical effort. As such, e-bikes are a useful addition to the active mobility fleet, substituting for cars over longer distances compared to conventional bicycles.

Using data from *The Compact City Scenario — Electrified*, we can estimate the impact of a large-scale global shift to e-bikes (away from polluting vehicles) by 2050.³⁶ In this high-shift scenario, we assume that cycling, walking, and public transport are the dominant and prioritized modes, supported by sustained funding and street space allocation. Vehicle travel still increases in the years leading up to 2050, albeit at a much slower rate than we currently see year over year. Overall, the share of urban passenger kilometers traveled (PKT) by car would decrease, and part of that decrease would be the result of an increase in e-bike PKT. Using research on existing conditions for e-bike access and use, we can estimate the percentage of the mode shift away from cars that e-bikes would be responsible for in each region and the associated emissions reductions (shown in Table 2).

Table 2. Projected Impacts of a High Shift to E-bikes

Country/Region	E-bike [^] mode share in 2050	Number of e-bikes in use to support shift (millions)	Millions of cars taken off the road	Millions of ICE 2W taken off the road	Annual emissions reductions due to e-bike shift (Mt/year)
Non-OECD Europe/Asia	10%	325	25.9	25.1	105
India	14%	200	25.1	15	84
United States	7%	55	7.8	0.1	54
Other Americas	11%	80	7.1	2.1	44
Europe (OECD)	9%	120	9.8	3.2	43
China	16%	360	11.6	5.2	40
Africa/Middle East	3%	80	3.9	3.2	31
Brazil	11%	25	2.7	1.3	11

[^]E-bike refers to low-speed electric bicycles (not e-mopeds or e-motorcycles) as defined in Section II.

³⁴ City and County of Denver et al. (2023). [Denver’s 2022 E-bike Incentive Program Results and Recommendations](#).

³⁵ Mike Salisbury (Office of Climate Action, Sustainability, and Resiliency, City of Denver). (May 4, 2023). Video interview by author.

³⁶ Lewis Fulton & D. Taylor Reich. (December 2021). [The Compact City Scenario — Electrified](#).

Worldwide, approximately 1.25 billion e-bikes are needed to support a shift that would yield about 400 megatonnes (Mt) of annual emissions reductions. This means that more than 1 billion additional e-bikes are needed worldwide by 2050. After the non-OECD Europe and Asia region, the individual countries with the largest emissions reductions potential are India and the United States, where a high shift to e-bikes could take more than 40 million private vehicles (cars and ICE two-wheelers) and 8 million cars, respectively, off the road.

Access Impacts

Expanding Access to Affordable, Clean Transportation

The integration of e-bikes with public transport can further reduce emissions, especially for first- and last-mile trips.³⁷ E-bikes can significantly expand public transport station catchment areas beyond walking and conventional bicycles, enabling more people to consider using public transport.³⁸ E-bikes are more likely to become a viable transport option for both personal and commercial vehicle trips when they are integrated with existing sustainable transport modes like rail and buses, and especially when coupled with complementary policies. Such policies include enabling safer, more secure cycle trips by providing protected cycle lanes and convenient bicycle parking, or policies like low-emission zones and pricing parking, which disincentivize driving. Notably, e-bike battery fire concerns have led some transport agencies — such as PATH, which operates commuter trains between New York City and New Jersey — to consider banning e-bikes onboard metro trains, indicating a need to balance integration and safety goals.^{39 40}



[In New York City] our low-income members use bikeshare very frequently. And they disproportionately choose electric bikes.”

—Caroline Sampanaro, Lyft

SOURCE: Antonio Reynoso, Flickr

Providing Alternatives for Underserved Groups

E-bikes can also improve mobility for underserved populations by connecting to transit or fulfilling entire trips. Women, older adults, people with disabilities, students, and even informal street vendors report being more willing to use an e-bike compared to a conventional bicycle.⁴¹ In the Copacabana neighborhood of Rio de Janeiro, Brazil, women make up 33% of e-bike users compared to 25% of traditional bicycle users.⁴² E-bikes make carrying goods and extra passengers — tasks often required by women — more manageable than when using conventional bicycles, and e-bikes offer more route flexibility compared to public transport. In the Netherlands, production of adapted e-bikes is growing, offering active mobility options for people with physical disabilities.⁴³

³⁷ Michael Jenkins et al. (November 2022). [What Do We Know about Pedal Assist E-Bikes? A Scoping Review to Inform Future Directions.](#)

³⁸ TUMI. (2023). [Increasing catchment area for public transport through e-bikes](#)

³⁹ Henry Beers Shenk. (June 23, 2021). [The PATH Train Just Quietly Banned E-Bikes at All Times.](#)

⁴⁰ Jules Flynn (Zoomo). (May 16, 2023). Video interview by author.

⁴¹ Samantha J. Leger, Jennifer L. Dean, Sara Edge, & Jeffrey M. Casello. (May 2019). [“If I had a regular bicycle, I wouldn’t be out riding anymore”: Perspectives on the potential of e-bikes to support active living and independent mobility among older adults in Waterloo, Canada; ITDP Indonesia.](#) (May 17, 2023). Video interview by author.

⁴² Transporte Ativo. (August 2014). [Contagem de Ciclistas.](#)

⁴³ See: [Van Raam.](#)

“In Jakarta, women [surveyed] said they prefer to use e-bikes because it was more advantageous. They think it’s easier to use them in this kind of humid climate, and they are usually carrying goods.”

—Deliani Poetriayu Siregar, ITDP Indonesia



SOURCE: Toto Santiko Budi via Shutterstock

In some cities, e-bikes have been integrated into bikeshare programs, providing access without the upfront cost to users. For example, Tembici, a Brazilian bikeshare operator, offers shared e-bikes in eight of the 10 Brazilian cities it operates in, as well as in Bogotá, Colombia.⁴⁴ **Shared e-bikes are growing in popularity: Data from eight bikeshare systems in the US operated by Lyft in 2022 shows a 107% increase in new e-bike riders since e-bikes were added to their systems in 2020.** Data from the North American Bikeshare Association (NABSA) shows a similar trend, with the percentage of bikeshare systems offering e-bikes growing from just under 30% in 2019 to 50% in 2021, and shared e-bike trips tripling from about 6 million to 18 million over the same period.⁴⁵ Income-qualified riders who use Lyft’s reduced-fare membership take twice as many e-bike rides compared to standard members.⁴⁶

Though e-bikes are increasingly popular among users, bikeshare operators face challenges, as they cost more and have the higher operational costs of battery swapping and charging. This has limited the availability of e-bikeshare, especially in low- and middle-income countries (see Highlight Box 4).

⁴⁴ Tembici. (2020). [Tembici — Tem coisa boa.](#)

⁴⁵ North American Bikeshare and Scootershare Association. (August 2022). [3rd Annual Shared Micromobility State of the Industry Report 2021.](#)

⁴⁶ Lyft. (2023). [Lyft Multimodal Report 2023.](#)

BOX 4: DESPITE DEMAND, OPERATIONS COSTS HOLD BACK SHARED E-BIKES



Tembici electric bikes are part of the company's bikeshare fleet in Sao Paulo. **SOURCE:** Toto Santiko Budi via Shutterstock

Since 2018, both public and privately operated bikeshare systems have been integrating e-bikes into their fleets. Most bikeshare systems that include e-bikes see high utilization of e-bikes compared to conventional bicycles; for example, in New York City, electric Citibikes are used for two out of five (40%) trips, despite making up only 20% of the fleet.⁴⁷ Shared e-bike riders in New York have also reported connecting with public transport more than twice as often as conventional bikeshare riders.⁴⁸ Globally, as of 2022, 29% of all bikeshare systems worldwide (567 total) offer e-bikes, up from 18% of systems in 2021.⁴⁹

While shared e-bikes can greatly improve urban access, especially for low-income residents, the cost of purchasing shared e-bikes compared to traditional bicycles — as well as the cost and logistics of ensuring shared e-bikes remain charged — complicate bikeshare operations.⁵⁰ Existing bikeshare stations may need to be retrofitted to connect to the electricity grid and enable e-bikes to charge when docked at a station. The cost of this varies widely by region because of labor and construction costs as well as permitting. Bikeshare operator Lyft estimates that if 20% to 30% of a system's stations are connected to the grid, that can offset up to 90% of vehicle miles traveled to conduct battery swaps.⁵¹ Indeed, battery swapping, where the bikeshare operator replaces low e-bike batteries with charged ones throughout the day, presents a different set of costs and limitations. Cities interested in integrating e-bikes into existing or planned bikeshare systems must understand these potential challenges and work with utility providers and other relevant stakeholders to identify feasible solutions.

In low- and middle-income cities, financing might be available to support such solutions. For example, Brazil's National Bank for Economic and Social Development (BNDES) financed Brazilian bikeshare company Tembici so it could expand its fleet of electric bicycles and increase its capacity to manufacture bikeshare bicycles domestically in Manaus, a hub for bicycle manufacturing in Brazil. The investment is meant to address the negative impacts of climate change and reduce harmful emissions by encouraging people to switch from driving to using clean mobility options like e-bikes.⁵²

⁴⁷ Lyft. (2023). [Lyft Multimodal Report 2023](#).

⁴⁸ Lyft. (May 18, 2023). Video interview by author.

⁴⁹ The Meddin Bike-Sharing World Map. (December 2022). [The Meddin Bike-Sharing World Map Report](#).

⁵⁰ Justine Lee (25Madison). (April 27, 2023). Video interview by author; Caroline Samponaro and Tejus Shankar (Lyft). (May 18, 2023). Video interview by author.

⁵¹ Lyft. (May 18, 2023). Video interview by author. The right percentage of grid-connected bikeshare stations will vary based on system design, as well as constraints as a result of permitting and site selection.

⁵² Brazilian Development Bank. (February 2023). [BNDES Finances Tembici in an Unprecedented Micromobility Operation](#).

Economic Impacts

E-bikes can improve access to destinations (education, jobs, etc.), generating economic returns, though these can be difficult to quantify. E-bikes have also contributed to economic growth by supporting local delivery companies and expanding domestic manufacturing opportunities.



E-cargo cycles serve as a lower cost option for delivery drivers that may otherwise be unable to enter the market.

SOURCE: Angus Gratton via Flickr

Providing Economic Opportunity for Delivery Workers

Given their relatively low cost and ability to cover longer distances, e-bikes can help people (especially those without access to a car) access economic opportunities. With the rise of app-based and traditional delivery companies, demand for delivery drivers is high. For example, in China in 2022, more than 7 million e-bike delivery drivers⁵³ earned income from Meituan and Ele.me, the two largest food delivery apps in the country.^{54 55} Experts estimate that the total number of app-based delivery workers in China may be around 10 million.⁵⁶ Many of these are low-income workers: According to Meituan, approximately four out of five of the app's delivery workers in 2022 were low-income "rural transfer laborers" and 6% report being impoverished. A large percentage of New York City's reported 65,000 delivery workers⁵⁷ use e-bikes (many also use motorized scooters; however, data on specific modes used by these workers is unavailable) largely because it is easier to maneuver and park an e-bike around the city than an automobile. Many of these delivery workers are low-income immigrants to the US, a group that faces high rates of unemployment.

These economic opportunities are only accessible if potential drivers can afford a vehicle to use for deliveries. Though they are less expensive than cars, e-bikes can still be unaffordable, especially for people with limited income. In Brazil, bikeshare operator Tembici launched a partnership with a food delivery app to offer reduced-rate bikeshare plans for delivery workers.⁵⁸ This includes special rates for e-bikes in seven major Brazilian cities. These plans put e-bikes within reach of low-income delivery workers, improving daily incomes with the greater speed and range that e-bikes provide.

Unlocking Domestic Manufacturing

Beyond their potential for emissions reductions and access to clean transport in cities, e-bikes can present positive impacts for the economy. China and countries in the EU have been leveraging the economic opportunity presented by e-bikes for some time in the form of domestic production and sales. Consumers in EU countries are buying between 5 million and 6 million e-bikes per year, which is about a quarter of the total bicycle market (about 22 million bicycles sold per year). The e-bike market has yet to plateau in the EU, with about 30% growth each year.⁵⁹

Alternatively, in Brazil, demand for e-bikes is largely concentrated in wealthier cities such as São Paulo and Rio de Janeiro, and e-bikes make up a relatively small share — about 1.5% — of the overall bicycle market. Experts forecast e-bikes to grow to around 5% of the Brazilian bicycle market in the next few years.⁶⁰

⁵³ Many app-based delivery workers in China use vehicles that would not be considered e-bikes in this report (instead riding e-scooters or similar); however, some use true e-bikes (e.g., pedal-assist or throttle e-bikes with a maximum speed of 25 kph).

⁵⁴ Meituan. (February 2023). [美团发布2022年骑手权益保障社会责任报告：624万骑手通过美团获得收入 \[2022 Meituan Rider Rights Protection Social Responsibility Report\]](#).

⁵⁵ Ele.me. (October 2022). [2022蓝骑士发展与保障报告：全职或兼职送外卖-云快卖，移动点单服务商 \[2022 Delivery Rider Development and Protection Report\]](#).

⁵⁶ Shanshan Li (ITDP China) & Qiuyang Lu (ITDP China). (May 4, 2023). Video interview by author.

⁵⁷ Nathaniel Meyersohn. (May 2023). [How On-Demand Delivery Services Hobbled an American City](#).

⁵⁸ Tembici. (January 17, 2024). [Planos — Ifood Pedal](#).

⁵⁹ Ceri Woolsgrove (ECF) & Philip Amaral (ECF). (May 23, 2023). Video interview by author.

⁶⁰ Daniel Guth (Aliança Bike). (June 1, 2023). Video interview by author.

Demand and potential for domestic design and manufacturing is also growing in African countries, where dozens of local private start-up companies are offering e-bike fleets for local deliveries, personal transport, and ambulance services.⁶¹

Given that the global e-bike market is projected to grow by about 220% from 2022 to 2030,⁶² e-bikes are a viable product for the growth of domestic green manufacturing. Countries seeking to lead the way to greener industry have an opportunity in the coming years to bolster domestic production of e-bikes, contributing to their own national supply and, potentially, offering e-bikes as exports to other countries as demand grows. Additionally, as production of electric cars ramps up in many places, demand for lithium-ion batteries will grow. Industrial policies that prioritize e-bike production will be a more equitable, sustainable use of limited batteries and materials — for example, because an e-bike battery capacity is 0.5kWh and an electric car's is 80kWh, many more (e.g., 160) e-bikes can be produced for every electric car.⁶³



SOURCE:
International Labor
Organization via Flickr

⁶¹ Emilie Martin et al. (2023). [African Electric Bicycles Start-Up Booklet](#).

⁶² Fortune Business Insights. (May 2023). [Electric Bike Market Growth & Trends | Industry Analysis 2030](#).

⁶³ Authors' calculations.

IV. SEVEN KEY BARRIERS TO E-BIKE UPTAKE

In nascent and developing e-bike markets and even in established ones, many barriers to access and use exist. These barriers limit e-bike uptake and thereby limit potential climate, access, and economic benefits from these vehicles. It is important to understand these barriers so that infrastructure and policy interventions promoting e-bikes can be most effective.

“Without safe infrastructure, few people will actually consider shifting from cars to e-bikes.”

—Jules Flynn, Zoomo



SOURCE: Lars Plougmann via Flickr

1. Streets and policies prioritize vehicles

Many barriers to e-bike use are the same as those limiting the use of bicycles for everyday trips, and interventions that enable more and safer cycling also enable e-bike adoption. In many cities, even those where the majority of people do not own or have access to a car, streets are designed primarily for car users. Critical infrastructure that makes cycling safe, convenient, and comfortable includes: a network of interconnected cycle lanes (both for local and longer-distance trips between cities), low-speed streets with low volumes of vehicle traffic for travel within neighborhoods, and secure bicycle parking near all destinations. Without this infrastructure, women, young children, and older adults — groups who consistently report not feeling safe or comfortable riding a bicycle without separation from vehicles — are not likely to consider using an e-bike even if other major barriers like affordability, storage, and charging concerns are minimized.⁶⁴

Without safe spaces on the street to ride an e-bike, and in the face of policies that heavily incentivize and prioritize driving, e-bike uptake will be marginal at best. Policies that promote vehicle use include fuel subsidies, discounted or free parking provided by employers, and free municipal on-street parking. Even free on-street parking/charging and rebates for electric autos make e-bikes less attractive compared to private cars. This is especially true when there are no similar subsidies to offset the cost of purchasing an e-bike or provide cash-outs for cycling to work.

⁶⁴ Jennifer Dill, Tara Goddard, Christopher Monsere, & Nathan MacNeil. (January 2015). [Can Protected Bike Lanes Help Close the Gender Gap in Cycling? Lessons from Five Cities](#)

Well-established legacy markets for ICE two-wheelers and the lower upfront cost of tuk tuks inhibit the uptake of e-bikes, particularly in nascent markets.
SOURCE: Katell Ar Gow via Flickr



2. Limited supply, high cost, and legacy market for competing modes

In nascent e-bike markets especially, supply of e-bikes and replacement parts is limited because of a combination of low (or no) domestic manufacturing, high import tariffs, and few secondhand bicycles or parts. There also may not be accessible, low-risk alternatives to purchasing an e-bike — such as community e-bike libraries or e-bikes integrated into bikeshare systems — which allow people to try an e-bike before committing to purchasing one. Limited supply makes e-bikes and their parts expensive for people to purchase, especially compared to the mature markets for competing modes like ICE two-wheelers and used cars. In secondary cities in Ethiopia, potential for bicycle ridership is higher than in major cities because trip distances are shorter and there is less traffic; however, tuk-tuks dominate short-distance trips because most people do not have the disposable income to pay upfront for a bicycle (or e-bike).⁶⁵ Similarly, e-bikes are more expensive than ICE two-wheelers in many African cities, where people have less disposable income compared to other regions, and e-bikes are too expensive to consider for personal use.⁶⁶ Further, insufficient electrical grid capacity and inconsistent electricity access in general, especially for low-income populations, currently make it difficult to substitute e-bikes for ICE two-wheelers, which can be more reliably fueled with gas or diesel.⁶⁷

In Indonesia, e-bikes are also more expensive to purchase than ICE two-wheelers because the two-wheeler market is very well-established and benefits from subsidies and economies of scale.⁶⁸

Commercial use of e-bikes is also limited by a lack of supply. For example, in a pilot aiming to use bicycles for goods delivery in Mexican cities, none of the participating cooperatives used e-cargo cycles because they were not able to afford them. Some organizations attempted to adapt e-bikes to transport cargo, but the added weight and limited carrying capacity made this unsuccessful.⁶⁹ Substituting e-bikes for higher-polluting, higher-speed ICE two-wheelers (to reduce pollution and emissions) is challenging when e-bikes that are built to carry extra weight (i.e., e-cargo cycles) are not readily available.

⁶⁵ Seble Samuel. (June 15, 2023). Video interview by author.

⁶⁶ Michael Linke. (May 2, 2023). Video interview by author; Benjamin Hategekimana (ITDP Africa). (June 1, 2023). Video interview by author.

⁶⁷ Seble Samuel. (June 15, 2023). Video interview by author.

⁶⁸ ITDP Indonesia. (May 17, 2023). Video interview by author.

⁶⁹ Eloy Gonzalez (ITDP Mexico). 2023. Email communication with author.

Unclear distinctions between e-bikes and two-wheelers causes confusion for those trying to enforce regulations and those considering purchasing an e-bike.
SOURCE: V.T. Polywoda via Flickr



3. Unclear classification for e-bikes

As noted in Section II, classifications of e-bikes vary widely from country to country (and, often, subnationally). For example, in the EU, e-bikes must be pedal-assist, while in the US, e-bikes can have pedal-assist or a throttle. In the EU, China, and India, e-bikes are classified as bicycles and do not require riders to be licensed, carry insurance, or pay for registration, whereas in Vietnam and Singapore, registration for e-bikes is required, adding an extra barrier to their use.⁷⁰ In other places, such as Indonesia, e-bikes exist in a poorly classified gray area between bicycles and motor vehicles.

Unclear classification causes confusion for potential riders, who may not feel confident purchasing an e-bike if they are unsure of the rules for where e-bikes can be ridden and what documentation is required.⁷¹ Fear of policy changes that may cause e-bikes or their parts to fluctuate in cost also reduces consumer confidence.⁷² It also creates challenges for retailers, who may choose not to stock e-bikes because of low consumer demand. Furthermore, unclear visual distinctions between vehicle classifications make it difficult to enforce regulations on where e-bikes versus heavier, faster two-wheelers are permitted to be ridden.

Regulators often see e-bikes as recreational vehicles, not transport modes, resulting in extraneous taxes that inflate e-bike purchase costs..
SOURCE: Canyon Bicycles



4. E-bikes are perceived, taxed, and regulated as luxury goods

Similar to bicycles, e-bikes are often seen as something used for recreation rather than for everyday transport in cities. The perception of e-bikes as recreational not only impacts how individual people make choices about how to move around their cities but it underscores how e-bikes are taxed and regulated. E-bikes are often taxed as luxury items. This is especially true in Brazil, where 85% of the cost of an e-bike is taxes; the IPI tax (a national tax on manufactured products) makes up 35% of the taxes on e-bikes, which is a higher share than on cars, guns, and certain alcohols.⁷³ Regulators also look at e-bikes as a recreational vehicle, not a mode of transport, which leads to unclear and uninformed classification.⁷⁴

⁷⁰ ITDP Indonesia. (September 2023). [Road Map and Timetable of Two-Wheeler Electrification in Greater Jakarta: Electric 2W Integration to Urban Traffic Guideline](#).

⁷¹ Noa Banayan (PeopleForBikes). (May 4, 2023). Video interview by author.

⁷² Adam Mayer. (2019). [Motivations and barriers to electric bike use in the U.S.: Views from online forum participants](#).

⁷³ Daniel Guth (Aliança Bike). (June 1, 2023). Video interview by author.

⁷⁴ Jules Flynn (Zoomo). (May 16, 2023). Video interview by author.

“If you don’t have a good place to store an e-bike, that becomes an issue. You’ve got more to lose. Parking is an issue.”

—Philip Amaral, ECF



SOURCE:
Katell Ar Gow via Flickr

5. Few secure storage and theft-prevention options

Even in established e-bike markets, secure storage and theft prevention are important factors that influence whether or not to purchase an e-bike for daily use. Because of their size and weight, it can be more difficult to lock e-bikes at traditional bicycle parking racks, and users may be unsure if they can safely lock an e-bike at every destination. E-bikes are also generally known to be more expensive than conventional bicycles, making them targets for theft. Recommendations to use more than one lock or a lock and chain also pose additional upfront costs — it’s expensive to purchase high-quality locks. Furthermore, e-bike battery theft can be difficult to mitigate depending on the design of the e-bike.

It is preferable to store an e-bike in a covered, dry location because battery degradation can occur more quickly with exposure to moisture. In dense cities, many people do not have the space or physical ability (i.e., to carry an e-bike up several flights of stairs) to store an e-bike inside their building or apartment, and few, if any, alternative secure storage options are available. In some cities, such as in China, it is illegal to store e-bikes indoors due to concerns surrounding battery fires (see [Barrier 7 for more](#)).

Use of e-bikes on shared paths causes concern for potential conflicts with pedestrians. Infrastructure that separates cyclists from pedestrians, such as protected bicycle lanes, deters unsafe incidents.

SOURCE: V.T. Polywoda via Flickr



6. Perceived lack of safety

Many people have never ridden an e-bike and likely will not feel comfortable purchasing one without having that experience. People often perceive riding an e-bike as less safe than riding a conventional bicycle because of its weight, ability to accelerate quickly, and motor. However, data shows that the risk of a crash involving e-bikes is only slightly higher than for conventional bicycles, and this is mainly attributed to balance problems.⁷⁵ E-bikes have not been found to be more likely to cause a serious crash than conventional bicycles.^{76 77 78}

⁷⁵ A. Fyhri, O. Johansson, & T. Bjornskau. (November 2019). [Gender differences in accident risk with e-bikes](#).

⁷⁶ Ibid.

⁷⁷ Institute for Road Safety Research. (May 2022). [Pedelecs and speed pedelecs: Is a pedelec or speed pedelec more dangerous than a conventional bicycle?](#)

⁷⁸ German Insurance Association. (November 2014). [Compact accident research: Traffic safety of electric bicycles](#).

Other related safety concerns exist around e-bikes and potential conflicts with lower-speed conventional bicycles in bicycle lanes and pedestrians in shared paths or sidewalks. A Dutch study that compared adult and elderly cyclists each riding e-bikes and conventional bicycles along the same route found that the speed of elderly cyclists riding an e-bike was about the same as adult cyclists riding a conventional bicycle.⁷⁹ Both groups slowed their speeds when riding an e-bike in “complex traffic situations,” indicating that e-bike riders self-regulate their speed based on their surroundings. Observations of e-bike riders, conventional bicycle riders, and pedestrians in Shenzhen showed that conflicts between e-bike riders and pedestrians were most frequent, exposing pedestrians to higher injury risks.⁸⁰ Cities that lack sufficient infrastructure separating e-bike (and conventional bicycle) riders from pedestrians are more likely to experience these conflicts. Nonetheless, the vast majority of pedestrian injuries and fatalities come about in crashes with heavier, higher-speed motor vehicles.⁸¹



Public charging stations for e-bikes serve as a solution to charging indoors, which can be a fire hazard.
SOURCE:
 Herzi Pinki
 via Wikimedia Commons

7. Charging and battery handling

Charging an e-bike battery is much simpler than charging larger electric vehicles like cars and buses; most e-bike batteries can be removed from the bicycle frame and charged using a standard wall outlet. As the market continues to mature, the range for e-bike batteries is expanding, making charging and what is often referred to as “range anxiety”⁸² less of an issue.⁸³ However, in places where residential access to electricity is intermittent, needing to charge an e-bike at home presents a serious barrier to use.⁸⁴

Improper charging of lithium-ion e-bike batteries has also led to serious fires, especially when batteries are left to charge over long periods of time or when low-quality or incorrect voltage chargers are used. Repairs using low-quality or incorrect components can also increase risk of fires. In New York City during the first six months of 2023, 13 people died as a result of more than 100 fires caused by e-bikes (likely by faulty lithium-ion batteries overheating).⁸⁵ Without national battery or charging standards in the US, state and city-level legislators are pursuing safety standards for batteries and charging in New York.⁸⁶ In Chinese cities, where one in five people owns an e-bike, concerns about battery fires means that people are not permitted to charge their e-bike batteries inside their homes. Large cities like Beijing provide public charging cupboards, similar to public cell phone charging stations, where people can pay a fee to leave their e-bike battery to charge.

⁷⁹ Willem P. Vlakveld, Divera Twisk, Michael Christoph, Marjolein Boele, Rommert Sikkema, Roos Remy, & Arend L. Schwab. (January 2015). [Speed choice and mental workload of elderly cyclists on e-bikes in simple and complex traffic situations: A field experiment.](#)

⁸⁰ Xinyu Liang, Xianghai Meng, & Lai Zheng. (August 2021). [Investigating conflict behaviours and characteristics in shared space for pedestrians, conventional bicycles and e-bikes.](#)

⁸¹ World Health Organization. (June 2018). [Global status report on road safety 2018.](#)

⁸² Range anxiety refers to the concern that an electric vehicle will run out of power before the user is able to reach a charging station.

⁸³ Ceri Woolsgrove (ECF) & Philip Amaral (ECF). (May 23, 2023). Video interview by author.

⁸⁴ Seble Samuel. (June 15, 2023). Video interview by author.

⁸⁵ Winnie Hu. (June 2023). [How E-Bike Battery Fires Became a Deadly Crisis in New York City.](#)

⁸⁶ *Bicycle Retailer and Industry News*. (November 28, 2023). [Bill would require all NY State shops selling e-bikes to have fire suppression equipment.](#)

V. RECOMMENDATIONS TO SUPPORT E-BIKE UPTAKE



E-bikes open up cycling to more people and trip types.
SOURCE: ITDP Indonesia

The following recommendations are meant to address the barriers discussed in Section IV and to expand access, affordability, and ridership of e-bikes for both personal and commercial uses, as well as to cultivate a stronger cycling culture more broadly. Doing so will position cities and countries to benefit from the climate, economic, and equity gains presented by a large-scale growth in e-bike use. Some recommendations should be implemented at the national level, some at the city level, and some at both national and subnational levels, as shown in Table 3.

Table 3. Recommendations for Scaling E-bike Use

Recommendation	Level of government	
	National	City
Develop a definition for e-bikes and their use	✓ (or higher)	
Ensure quality manufacturing standards for e-bikes, batteries, and battery recycling	✓ (or higher)	
Improve affordability of e-bikes		✓
Fund cycle infrastructure	✓ (or higher)	✓
Educate potential e-bike users		✓
Increase access to shared e-bikes		✓
Develop an enforcement plan for e-bikes and cycle infrastructure		✓
Improve ability to import and/or produce quality e-bikes domestically	✓	
Disincentivize private vehicle use	✓	✓
Align e-bikes with climate pledges	✓	
Pursue universal charging for e-bikes	✓	
Incorporate e-bikes into electrification plans	✓	✓

National

Recommendation 1 | Develop a definition for e-bikes and their use

- Define weight, width, speed, and power maximums for e-bikes separate from ICE two-wheelers.
- Identify where e-bikes are permitted, such as on bicycle infrastructure, off-street trails, and the street.

With regard to traffic laws and regulations, national governments should clearly define e-bikes as bicycles for use on roads. Defining e-bikes as bicycles (for use on the road) facilitates their operation without obtaining a license, insurance, or registration. This is key to enabling broad, easy use of e-bikes. A national standard helps consumers know what type of e-bike is safe. Local road rules can then point to the national standard and permit the use of compliant e-bikes in bicycle lanes. A national standard also safeguards customers from false or misleading information, such as companies branding electric mopeds as e-bikes. A clear definition of e-bikes helps define what is *not* an e-bike. For example, electric mopeds or motorcycles, which are heavier and can reach top speeds higher than 32 kph, should not be defined as e-bikes and should not be permitted to use bicycle lanes.

“It is really important to have the Ministry of Transport launch the specification, define what e-bikes are, and talk about safety, because we don’t want mopeds in bike lanes.”

—Deliani Poetriayu Siregar, ITDP Indonesia

National governments should also use an industry standard for accepting e-bikes into consumer markets. For example, the European Union uses industrial standard EN15194,⁸⁷ the world’s first comprehensive safety standard for electric-assisted bicycles, and requires all electric-assisted bicycles to comply in order to be sold in the EU. China uses the GB 42295⁸⁸ standard. A national, regional, or federal definition helps to ensure consumer safety, standardizes production requirements, and enables enforcement for violations. Such standards should also require anti-tampering to reduce instances of after-market modifications of e-bikes to exceed speed restrictions.

Another reason to develop a national definition is to facilitate national funding streams. A standardized national definition facilitates the deployment of national subsidies and grants to regional or municipal programs. For example, the Swedish ministry struggled to award funding from a €125 million fund for e-bikes and e-cargo cycles because it lacked a clear national definition for what qualified as an e-bike.⁸⁹



National

Recommendation 2 | Ensure quality manufacturing standards for e-bikes, batteries, and battery recycling

The cycling industry has lacked standardization of components but the electric evolution of bicycles can change that.

SOURCE:
aerogondo2 via Shutterstock

- Introduce, disseminate, and enforce quality and safety standards for e-bikes and batteries.
- Develop a plan for e-bike battery (and other parts) recycling that mandates how materials are recovered or disposed.
- Encourage manufacturers, retail shops, bikeshare operators, etc. to maximize interchangeability and reuse of e-bike components and materials.

The two main types of batteries used in e-bikes today are lead-acid and lithium-ion. Lead-acid batteries are not easily flammable and are much less expensive, but lithium-ion batteries are lighter, hold more energy, last longer, and charge faster. Lead-acid batteries are widely used in China because of their low cost. Unfortunately, their widespread use has also caused serious lead pollution in that country.⁹⁰

⁸⁷ The European Committee for Standardization. (August 2023). [Cycles — Electrically power assisted cycles — EPAC Bicycles.](#)

⁸⁸ National Standards. (December 2022). [电动自行车电气安全要求.](#)

⁸⁹ Cycling Industries Europe. (2023). [CIE Expert Group on Cargo Bikes and Cycle Logistics.](#)

⁹⁰ Min Liu et al. (January 2023). [Life Cycle Environmental and Economic Assessment of Electric Bicycles with Different Batteries in China.](#)

Lithium-ion batteries are widely used in e-bikes outside of China. As mentioned in the previous section (on barriers to e-bike uptake), low-quality lithium batteries are the cause of most e-bike fires, as they are highly sensitive to high temperatures and can burst into flames. Water seepage can also lead to fires.⁹¹ Low-quality batteries (not conforming to any existing standard) coupled with improper charging, storage, and maintenance of e-bikes increases this risk.

National authorities can prevent these deadly fires by introducing, disseminating, and enforcing existing standards for e-bikes and batteries. Batteries for e-bikes are relatively tightly regulated in the EU, and there have been few safety issues in the region. In the EU, a Batteries Regulation ensures that batteries entering the EU market are sustainable and properly disposed of.⁹² An equivalent standard used in the US and elsewhere around the world is Underwriter's Laboratories (UL) 2849,⁹³ the Standard for Electrical Systems for E-bikes. Further, UL 2271⁹⁴ is specifically for batteries used in light electric vehicles. Lawmakers in the US have introduced legislation to ensure higher levels of safety by taking faulty lithium-ion batteries off the market and setting consumer guidelines. This legislation is currently under consideration at the national level⁹⁵ as well as in New York City.⁹⁶

Battery fires have also been a concern in China, where more than 6,000 e-bike related fires were reported in the first six months of 2021.⁹⁷ Although China has a standard for e-bike batteries, it is not compulsory, with lax implementation by manufacturers and enforcement by authorities.⁹⁸ A compulsory standard for lithium-ion e-bike batteries is in development; however, lead-acid batteries will not be covered.

Further, technical training and certification for e-bike retailers and guidance for users on proper e-bike storage, maintenance, and battery charging is essential to prevent dangerous fires from occurring.

National governments should also help ensure responsible battery recycling and disposal, especially as e-bike use expands and legacy models reach the end of their life span. The EU provides perhaps the most comprehensive example to date of battery recycling. The union has taken a unified approach to e-bike battery recycling, addressing this through the European Green Deal and as part of the circular economy.⁹⁹ Beginning mid-2025, a more comprehensive regulatory framework on Extended Producer Responsibility will come into enforcement, with new rules for production, recycling, and repurposing of batteries. This will include higher collection and recycling targets being introduced over time: All collected batteries have to be recycled and high levels of recovery have to be achieved, in particular of valuable materials such as copper, cobalt, lithium, nickel, and lead.¹⁰⁰

Conversely, the US has not sought to address e-bike battery recycling in a coordinated way. In lieu of a national-level mandate, private-sector firms are leading the way in battery recycling. For example, Redwood Materials¹⁰¹ is working with Lyft — the operator of several major bikeshare programs in North America, including New York City's system (which has e-bikes) — to recycle shared e-bike batteries. Another industry-led program enables private owners to easily recycle e-bike batteries.¹⁰² While these initiatives are a step in the right direction, without a national mandate, they are not compulsory, and there is little oversight of how materials are being recovered or disposed of.

In addition to batteries, national governments should seek to improve recovery of other materials used in e-bikes. An emerging area for e-bike recycling is electric motors. This is particularly important, as e-bike motors are one of the components with a large environmental footprint because of the high use of copper in motor production.¹⁰³ Overall, governments should nudge the e-bike ecosystem (manufacturers, retail shops, bikeshare operators, etc.) toward maximum interchangeability and reuse of e-bike components and materials. Including e-bikes in an overall effort to achieve a circular economy will increase the environmental sustainability of this transport mode.

“Technical standards and certification are important to improve safety, particularly for [commercial] e-bike fleets. Say you have a fleet of 500 e-bikes, and one or two catch fire, you could be looking at a catastrophe.”

—Michael Linke

National City

Recommendation 3 | Improve affordability of e-bikes

- Offer e-bike purchase incentives.
- Reduce import or other tariffs that inflate the cost of e-bikes.

⁹¹ HDFCErgo. (June 2022). [Why Do E-Bikes Catch Fire? Check Out 12 Tips to Prevent It.](#)

⁹² EUR-Lex. (July 2023). [Regulation \(EU\) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation \(EU\) 2019/1020 and repealing Directive 2006/66/EC.](#)

⁹³ UL Solutions. (n.d.). [E-Bikes Certification: Testing to UL 2849.](#)

⁹⁴ UL Standard. (September 2018). [UL 2271 | UL Standards & Engagement | UL Standard.](#)

⁹⁵ United States Congress. (March 2023). [H.R.1797 Setting Consumer Standards for Lithium-ion Batteries Act.](#)

⁹⁶ E-bike Lovers. (March 2023). [New Law Requires Certification for Electric Bicycles and Batteries in NYC to Improve Safety Standards.](#)

⁹⁷ Shawn Lin. (October 2021). [China's 300 Million E-Bikes Cause Alarming Number of Fires](#)

⁹⁸ Shanshan Li & Qiuyang Lu. (May 4, 2023). Video interview with ITDP China.

⁹⁹ European Commission. (December 2022). [EU agrees new law on more sustainable and circular batteries.](#)

¹⁰⁰ European Commission. (August 2023). [Batteries.](#)

¹⁰¹ Redwood Materials. (n.d.). [Redwood Materials.](#)

¹⁰² eBike Battery Recycling. (n.d.). [Hungry for E-bike Batteries.](#)

¹⁰³ Liu et al. (January 2023). [Life Cycle Environmental and Economic Assessment of Electric Bicycles with Different Batteries in China.](#)

While mid-range e-bikes cost 10 to 15 times less than a mid-range car,¹⁰⁴ they are still more expensive than the majority of conventional bicycles and therefore remain unaffordable for many. In recent years, local and national governments (particularly in wealthier countries, such as the US, Australia, and EU members) have offered incentives such as point-of-sale vouchers, rebates, and credits for trading in a vehicle to reduce the cost of purchasing an e-bike or e-cargo cycle.¹⁰⁵ ¹⁰⁶ Incentive programs in other cities and countries have also been extended to businesses to purchase e-bikes for deliveries or other commercial uses. National-level examples of this include the Netherlands (up to 62% of purchase offset through tax deductions), Germany (up to €4,200 purchase subsidy), and Belgium (up to €4,000 purchase subsidy).¹⁰⁷

Of course, initiatives to improve the affordability of e-bikes should reflect each country's economic reality. An example of such an initiative from a middle-income country comes from India. As part of the Delhi EV Policy adopted in 2021, offering a 25% discount to 10,000 e-bike customers and a 33% discount to 5,000 e-cargo cycle customers is meant to generate both personal and commercial demand for e-bikes.¹⁰⁸

The design of these incentive programs is important: Many offer vouchers or credits on a sliding scale based on income, with lower-income residents able to receive more support. Point-of-sale vouchers (like those used in Denver; see Highlight Box 3) are preferred over rebates, because people do not have to be able to pay the full amount up front and wait for reimbursement. Ensuring support and buy-in from bicycle retailers is also critical. Notably, Delhi's incentive program includes a scrappage scheme where e-bike and e-cargo cycle buyers can receive an extra Rs 3,000 (USD \$36) to scrap or deregister an ICE two-wheeler.¹⁰⁹ Incentive programs could also be tied to quality standards, where only certified e-bikes and batteries qualify for the incentive.¹¹⁰

Jurisdictions that offer tax advantages for the purchase of an electric car should work to ensure that these can also be applied to e-bikes. Compared to EVs, subsidies for e-bikes may do more to incentivize purchase because the cost offset by the subsidy is much higher. For example, a \$1,000 subsidy offsets 66% of the cost of a \$1,500 e-bike compared to 3% of a \$30,000 EV. In this hypothetical scenario, the presence of the subsidy likely reduces the purchase price enough to change the demand for e-bikes, while those who could not afford a \$30,000 electric car or truck will most likely not be able to afford one that is 3% cheaper. A survey of e-bike voucher users in Denver showed that 67% of low-income respondents would not have purchased an e-bike without the subsidy.¹¹¹

Securing and allocating funding for e-bike purchase incentives may be challenging for local and even national governments with limited budgets. However, many governments have been able to introduce and dedicate funding for incentives to offset the cost of purchasing an electric automobile (as well as for electric car charging on public rights of way) as a means of encouraging electric car or truck uptake. City and national governments should revisit these incentives and explore how allocating some of those funds or designing similar programs to support the purchase of e-bikes could be a more effective path to reducing harmful emissions and achieving related environmental and access goals. Revenues generated from policies intended to reduce demand for driving, such as priced on-street parking or congestion pricing, could also help fund e-bike purchase incentives (see Recommendation 9).

Alternatively, market-based interventions, such as supporting the local production and distribution of e-bikes across a range of price points, could increase supply and lower overall purchase costs for consumers.¹¹² While some governments may not be able to offer upfront purchase incentives for e-bikes, they may be able to reclassify e-bikes so they are no longer considered "luxury goods" or forgo import tariffs (see Recommendation 8). This is what Brazil has done with electric cars since 2015¹¹³, and Ethiopia's national NMT strategy suggests this for bicycles.¹¹⁴ Countries could consider lowering taxes for, or otherwise incentivizing, the domestic production of e-bikes to boost local supply and drive down the cost to purchase.

"We know that if we only make progress on EVs [electric cars and trucks] or e-bikes, we won't get anywhere near our climate goals. We know that we need to make action on both fronts. So we want to promote EVs, but we also know that we need to get people out of their cars, so just investing in EVs is not going to get us to our climate goals; we need to invest in e-bikes as well."

—Mike Salisbury,
City of Denver

¹⁰⁴ Dana Yanocha and Mackenzie Allan. (2019). [The Electric Assist: Leveraging E-bikes and E-scooters for More Livable Cities.](#)

¹⁰⁵ Noa Banayan, Ashley Seaward, & Kyler Blodgett. (2023). [Electric Bicycle Incentive Toolkit.](#)

¹⁰⁶ European Cyclists Federation. (n.d.). [Money for bikes: Tax incentives and purchase premiums for cycling in Europe.](#)

¹⁰⁷ Urban Arrow. (November 2022). [Receive Subsidies When Purchasing Cargo Bikes for Businesses.](#)

¹⁰⁸ Transport Department of NCT of Delhi. (2021). [Delhi EV Policy.](#)

¹⁰⁹ Express News Service. (April 2022). [Delhi government includes e-cycle under its EV policy.](#)

¹¹⁰ Connecticut Department of Energy and Environmental Protection. (July 2023). [Electric Bicycles — eBikes.](#)

¹¹¹ City and County of Denver et al. (2023). [Denver's 2022 E-bike Incentive Program Results and Recommendations.](#)

¹¹² Michael Linke. (May 2, 2023). Video interview by author.

¹¹³ Waldheim Garcia Montoya. (March 2023). [EV import subsidies divide Brazil's auto industry.](#)

¹¹⁴ ITDP. (May 2020). [Ethiopia Non-Motorized Transport Strategy 2020-2029.](#)



National City

SOURCE:
ITDP Mexico

Recommendation 4 | Fund cycle infrastructure

- Develop, finance, and implement a network of bicycle lanes and supportive bicycle infrastructure that accommodates e-bikes.
- Designate annual, national-level funding for active mobility.

E-bikes thrive when cycling is an irresistible choice for travel. A connected network of protected cycle lanes, greenways, safe intersections, and low-speed streets is critical to support many types of people cycling for everyday trips. The same is necessary to support the use of e-bikes.¹¹⁵ Cities in China and Western Europe, where e-bike use is highest, also have some of the world's most extensive cycle lane networks, coupled with low speed limits for vehicles and safe crossings at intersections. While providing cycle lanes and bicycle parking is an important first step, these should be designed in a way that also accommodates e-bikes. For example, allowing for wider cycle lanes and including a passing lane in the design can make maneuvering an e-bike easier and more comfortable. Bicycle parking racks should be far enough apart that an e-bike can fit between racks with other parked bicycles present.

Parking racks should also be located far enough away from walls or other items so it is easy to maneuver a larger, heavier e-bike into the parking space. E-bike chargers could be installed in high-demand bicycle parking areas.

National and local governments play key roles in creating environments that support people using bicycles and e-bikes, including through:

- Creating standards for infrastructure design (national governments).
- Providing funding for implementation of infrastructure and programming (national and local governments).
- Creating platforms for local governments to exchange information to facilitate peer-to-peer learning about cycling (national governments and/or civil society organizations).

Recently, Ireland and France have both made significant progress in supporting cycling (and e-bike use) at the national level. Ireland's National Transport Authority allocated 290 million euros (USD \$323 million) to deliver hundreds of projects to support cycling and walking in line with the government's Climate Action Plan.¹¹⁶ Similarly, in 2023, the French government committed 2 billion euros (USD \$2.2 billion) through 2027 to improve cycle infrastructure and help people buy bicycles in an effort to reduce car use and boost cycling across the country. E-bikes are gaining popularity in France, with one in four bicycles purchased in 2022 being electric,¹¹⁷ and 65 million euros (\$72.3 million) have been allocated to help people buy e-bikes as part of this program.

National governments can also be particularly important players in stimulating e-bike use in suburban and rural areas where municipal authorities may not have jurisdiction or sufficient resources. Another key role that national governments can play is in stimulating countrywide, inter-city cycle networks. E-bikes are particularly well-suited for longer-distance trips, such as between cities. When cyclists can complete these trips on high-quality off-road paths specifically designed for cycles (or "bicycle highways"¹¹⁸), e-bikes become a very attractive substitute for vehicles for more types of trips.

¹¹⁵ Shanshan Li (ITDP China) & Qiuyang Lu (ITDP China). (May 4, 2023). Video interview by author. Noa Banayan (PeopleForBikes). (May 4, 2023). Video interview by author; Justine Lee (25madison). (April 27, 2023). Video interview by author.

¹¹⁶ National Transport Authority. (n.d.). [Active Travel Investment Programme](#).

¹¹⁷ Sandy Dauphin. (May 2023). [The Government Releases Two Billion Euros for Its New Bicycle Plan](#).

¹¹⁸ ITDP. (February 2020). [Will E-Bikes Make Cycle Highways Happen?](#)

National City

Recommendation 5 | Educate potential e-bike users

- Develop educational campaigns to encourage e-bike use across demographic groups.
- Shift perception of cycling (and e-bike use) from recreational to transportation.

Because e-bikes are less familiar than traditional bicycles to most people, cities should work to educate the public about what an e-bike is (classification, speed, etc.) and how they differ from higher-speed vehicles like mopeds and motorcycles. Education on e-bike safety, regulations for use on the street, and related policies is also needed. This could include partnering with local cycling advocacy groups or bicycle retailers to disseminate information and communicate new programs, like the availability of e-bike purchase incentives or community e-bike libraries. Outreach events where people are able to test-ride e-bikes and receive information on incentive programs or sign up for a bikeshare membership could help people feel more comfortable integrating an e-bike into their daily life. Furthermore, promoting the safe use of e-bikes and noting the dangers associated with improper charging or battery use can help to curb accidents and injuries. Cities might also consider partnering with private sector companies, such as those that employ delivery workers who use e-bikes, to ensure that commercial e-bikes and batteries meet safety standards.



City

Recommendation 6 | Increase access to shared e-bikes

SOURCE:
Ana Nassar

- Offer e-bikes as part of public bikeshare programs.
- Consider incentives for local delivery companies that offer employees long-term access to shared e-bikes instead of vehicles.

Even if people know how to ride a bicycle, they may never have tried riding an e-bike. Giving people a low-risk opportunity to experience riding an e-bike (i.e., without the responsibility to purchase, store, or maintain one) can help people better visualize how an e-bike might fit into their life and work for the types of trips they make. Many cities have done this by integrating e-bikes into existing bikeshare programs.

Similar to integrating e-bikes into bikeshare systems as a low-risk way for people to try them, long-term e-bike rentals are also gaining popularity, especially in the United States and Australia. Long-term e-bike rental programs are also increasingly used by local delivery workers who do not have access to a car or two-wheeler. Monthly subscription programs typically provide access to an e-bike whenever it's needed, as well as maintenance and even spare batteries. While these programs are largely offered by private companies, cities might consider incentives for local delivery companies that offer their employees access to e-bike rentals, or subsidizing e-bike rental programs for public employees.

Though much smaller than a citywide bikeshare system, e-bike libraries function similarly in terms of expanding access and awareness and reducing barriers. These programs are typically run by community-based organizations and enable residents to borrow an e-bike free of charge for weeks or months at a time. Users can charge and store their rented e-bikes at home, or they can drop them off at a designated location between uses. This model can be particularly ideal if a short-term grant or local funding is secured for a limited number of e-bikes. E-bike libraries can be a good option to provide access to e-bikes in places where a full bikeshare system may not be available.¹¹⁹

¹¹⁹ Noa Banayan (PeopleForBikes). (May 4, 2023). Video interview by author.

City Recommendation 7 | Develop an enforcement plan for e-bikes and cycle infrastructure

- Designate responsibility for citing noncompliant vehicles that use cycle lanes.
- Ensure enforcement officers can visually distinguish between e-bikes and higher-speed mopeds and motorcycles.

With speeds comparable to conventional bicycles, low-speed e-bikes should be permitted to ride in bicycle lanes and other bicycle infrastructure citywide. For speed pedelecs and other e-bikes that can reach speeds of 45 kph, we recommend differentiating between the ability to use bicycle infrastructure in high- and low-density urban areas. In high-density urban areas, where vehicle speeds tend to be lower and there are many people cycling and walking, speed pedelecs should not use cycle or pedestrian infrastructure unless that infrastructure has been designed to accommodate them, such as the inclusion of passing lanes. However, in lower-density areas farther from the city center, where vehicle speeds may be higher and cycling infrastructure is likely to be less crowded, speed pedelecs could be permitted to use cycle lanes where available.

Higher-speed (ICE or electric) mopeds and motorcycles should not be permitted to use cycle lanes, and there should be clear and enforced penalties for doing so. Cities will need to designate responsibility for citing mopeds and motorcycles that use or block cycle lanes — this could fall under the purview of municipal police and therefore will require coordination between police and the transport agency. It is important to establish clear, visual distinctions between e-bikes and faster mopeds to ensure enforcement officers can more easily identify violating vehicles. In other words, high-speed devices should look out of place in low-speed infrastructure. Strict penalties should be set and enforced for modifying e-bikes to travel at higher speeds, as well as for counterfeiting manufacturer labels that differentiate between devices.

National Recommendation 8 | Improve ability to import and/or produce quality e-bikes domestically

- Remove (or reduce) import tariffs on foreign-produced e-bikes.
- Offer incentives to attract e-bike manufacturers to produce domestically.

One of the biggest barriers to e-bike uptake, especially in nascent markets, is a lack of supply of e-bikes and e-bike parts, which leads to high prices and a sense of scarcity. Governments need to ensure that safe, quality e-bikes (see Recommendation 2) can be imported or manufactured domestically and sold to consumers at affordable prices. It is also important to have measures in place to avoid dumping of low-quality e-bikes from foreign markets.

Foreign brands may be subject to import taxes and other restrictions that contribute to supply issues. Reducing import tariffs can be very helpful to stimulating emerging modes. This was the case in Brazil, where electric cars and parts have been exempt from the country's 35% vehicle import tariff since 2015, helping make Brazil the biggest electric car and truck market in Latin America.¹²⁰ A more welcoming tax structure for e-bike production would help stimulate job creation as well as e-bike supply. Ethiopia's national NMT strategy identifies the existing 20% import tariff on bicycles and bicycle parts as an impediment to accessing high-quality bicycles, and it recommends removing the tariff as part of the implementation of the strategy.¹²¹ Currently, Ethiopia's Ministry of Transport and Logistics and Ministry of Finance are coordinating on such an exemption on taxes for importing bicycles and e-bikes.

National (and in some cases subnational) governments could also consider offering incentives to attract local manufacturing of e-bikes and e-bike parts, increasing overall domestic supply and ensuring a range of models are available at different price points. Introducing a simple, lower-cost, good-quality e-bike model to the market could be even more impactful at spurring uptake than a government-sponsored subsidy scheme that lowers the purchase cost of a higher-priced model for a small subset of potential users.¹²² Experts warn against encouraging very inexpensive, low-end e-bikes, though, as these have very limited ranges and low-quality batteries, which greatly increases the risk of fires (in the case of lithium-ion batteries) or serious environmental damage (in the case of lead-acid batteries).

¹²⁰ Waldheim Garcia Montoya. (March 2023). [EV import subsidies divide Brazil's auto industry](#).

¹²¹ ITDP Africa. (May 2020). [Ethiopia Nonmotorized Transport Strategy 2020-2029](#).

¹²² Michael Linke. (May 2, 2023). Video interview by author.



National City

Recommendation 9 | Disincentivize private vehicle use

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- Implement parking pricing and/or zone-based vehicle restrictions such as congestion pricing or a low-emission zone, and direct revenue to e-bike programs.

Making the implicit costs of driving explicit through policies like pricing parking, fees per vehicle kilometer traveled, congestion pricing, and emissions-based pricing can nudge people and companies to rethink using a private vehicle for every trip and shift some trips to cycling/e-bikes.¹²³ The City of London (a one-square-mile commercial district within Greater London) announced in 2018 that it would restrict vehicle access on half its roads and limit vehicle speeds to 15 mph to reduce emissions and improve comfort and safety for pedestrians and people riding bicycles.¹²⁴ Five years later, pedestrians account for the majority of trips in this area, and cyclists make up 40% of road traffic during peak hours.¹²⁵

Low-emission zones designed to levy a fee on — or restrict access for — the highest-polluting freight vehicles could encourage delivery companies to switch to a model where last-mile deliveries are done using e-cargo cycles. Focusing on commercial fleet transitions that integrate e-bikes as opposed to individual uptake is a helpful entry point for broader e-bike adoption, especially in cities where e-bikes are relatively expensive or difficult to find.¹²⁶ A portion of revenues from low-emission zone or congestion-pricing entry fees could be allocated to e-bike purchase subsidy or e-bikeshare programs. Importantly, these policies need to be coupled with cycle infrastructure that supports direct, comfortable trips by bicycle or e-bike.



SOURCE:
ITDP China

¹²³ ITDP. (March 2021). [Taming Traffic](#).

¹²⁴ Eillie Anzilotti. (October 2018). [The City of London is kicking cars off half its roads](#).

¹²⁵ Carlton Reid. (March 2023). [“Cyclists Now Outnumber Motorists in City of London](#).

¹²⁶ Danielle Hoppe (ITDP Brazil). (June 1, 2023). Video interview by author.

National Recommendation 10 | Align e-bikes with climate pledges

- Integrate e-bikes into Nationally Determined Contributions (NDCs).
- Explore Article 6 (Carbon Credit) projects for e-bikes.

A key way to coordinate national efforts for e-bike promotion is to ensure that e-bikes are built into countries' Nationally Determined Contributions (NDCs) to the Paris Agreement on Climate Change. This could make efforts to promote e-bike use in low- and middle-income countries eligible for carbon credits. NDCs detail what actions countries will undertake across all sectors to align with the Paris Agreement goal to limit global warming to 1.5°C. A search of NDCs¹²⁷ revealed that only three countries — Nepal (Second NDC), Sierra Leone (Revised First NDC), and Tuvalu (Revised First NDC) — mention e-bikes.¹²⁸ Including e-bikes in NDCs would help align national institutions, create plans with measurable outcomes, improve Monitoring, Reporting, and Verification (MRV) of GHG emissions avoided through e-bike uptake, and improve funding prospects for programs to support e-bikes and cycle infrastructure. Furthermore, as carbon markets mature in coming years, additional funding for carbon-reducing projects will become available under Article 6 of the Paris Agreement. Article 6 establishes mechanisms for selling carbon credits, and plans to support e-bike use could be candidates for international funding under Article 6. To ensure that e-bike projects are eligible, countries should add e-bikes to their NDCs.



National Recommendation 11 | Pursue universal charging for e-bikes

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- Gather knowledge from manufacturers and other stakeholders around challenges and opportunities related to universal e-bike charging.

At present, e-bike batteries and chargers come in all sorts of configurations, with each manufacturer using its own battery dimensions and chargers that cannot be used with other brands. While universal batteries and chargers would be desirable from a user perspective, experts shared that this is not likely to happen in the near term.¹²⁹ Nonetheless, national governments should learn which options are available now and may be available in the future that reduce barriers to e-bike charging and enable more options for public charging. This could include investigating the possibility of requiring manufacturers to supply universal e-bike chargers, which would be a major win for users and could also lead to safer and more equitable charging practices, such as by facilitating public charging infrastructure. If a few national governments required this, others could follow suit, and the industry would likely create a universal charger to anticipate pending legislation.¹³⁰ There may also be potential to integrate e-bike charging into public electric car charging stations, and to provide on-street e-bike parking, just as many cities now offer on-street electric car parking at chargers.

¹²⁷ Conducted using Climate Watch's [NDC Search Tool](#).

¹²⁸ . Nepal's NDC mentions "e-vehicles ... including two-wheelers" and "electric-rickshaws," Sierra Leone's includes "electric ... motor tricycles," and Tuvalu's includes "solar-powered e-bikes."

¹²⁹ Noa Banayan (PeopleForBikes). (May 4, 2023). Video interview by author; Ceri Woolsgrove (ECF) and Philip Amaral (ECF). (May 23, 2023). Video interview by author.

¹³⁰ This is the case for mobile device (e.g., tablet and smartphone) chargers, which the EU has required to be universal by the end of 2024. See: [Long-awaited common charger for mobile devices will be a reality in 2024](#).



National City

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Recommendation 12 | Incorporate e-bikes into electrification plans

- Review existing electrification plans and integrate e-bikes if they are not mentioned.
- Develop an electrification plan with explicit strategies and targets for e-bike uptake as part of transport sector electrification and for the agency responsible for program implementation.
- Consider how public e-bike charging and substituting e-bikes for some city-owned vehicles can support wider e-bike uptake.

In recent years, national and city governments have prepared electrification plans, some of which focus broadly on expanding electricity access, with others focus more narrowly on electrifying and decarbonizing the transportation sector. Pakistan's National Electric Vehicle Policy (2019) focuses on expanding the availability and use of electric vehicles as a strategy to reduce transport sector emissions. The policy acknowledges that Pakistan has more than 20 million two- and three-wheelers in use, with 90% of these produced domestically. The policy identifies the need to incentivize the conversion of some of this manufacturing expertise to produce e-bikes and e-rickshaws.¹³¹

At the city level, transport electrification plans have primarily focused on encouraging uptake of electric vehicles (cars and two-wheelers), and implementing infrastructure and policies that will support a shift away from fossil fuel-powered vehicles. On cursory review, electrification plans for [New York City](#), [Delhi](#),¹³² and Jakarta do not mention e-bikes at all, despite the potential e-bikes available for replacing high-polluting vehicle trips and reducing greenhouse gas emissions.

Cities should more explicitly integrate targets and actions to encourage e-bike uptake into their electrification plans. For example, Mexico City's Electric Mobility Strategy includes a goal to have at least 30% of bikeshare bicycles be electric by 2030, identifies the need to develop standards around e-bike charging points, and calls for a tax rebate to offset the cost to purchase an e-bike.¹³³ Mexico City's plan also identifies the agency that will be responsible for each of these deliverables.

Electrification plans are also an opportunity to explore the city's role in siting and maintaining public e-bike charging. Public e-bike charging is growing in cities in China and Europe, with neighborhood charging stations being integrated into construction codes for new buildings. In the EU, providing standard bicycle parking is required for residential and nonresidential buildings over a certain size, and cycling advocacy organizations have been pushing for regulations to also include e-bike charging infrastructure.¹³⁴ In Beijing, private e-bike charging service providers have largely dictated the location of their charging stations, which could result in inequitable access from neighborhood to neighborhood.¹³⁵ Cities need to be proactive in identifying where potential charging stations should be located and how they are funded. Electrification plans might also examine potential for grid-connected charging at bikeshare stations to better facilitate e-bikeshare operations.

Cities should also consider their purchasing power and commit to replacing some city-owned vehicles with e-bikes, where appropriate, as part of their electrification plan. A review of plans for 25 cities leading on electrification, including Tokyo, Beijing, London, Paris, and Amsterdam, showed that 24 included commitments to electrify their municipal vehicle fleets but did not mention substituting e-bikes for cars and trucks.¹³⁶ Indeed, certain municipal tasks that currently rely on vehicles could feasibly be carried out using an e-bike, such as parking enforcement. Upfront purchase costs for e-bikes is much lower than for cars or trucks, and, similar to EVs, cost savings on fuel when switching to e-bikes would be an added benefit.

¹³¹ Ministry of Climate Change. (2019). [National Electric Vehicle Policy 2019](#).

¹³² Delhi's [Electric Vehicles Policy 2020 establishes purchase subsidies for electric two-wheelers](#).

¹³³ Ciudad de México. (October 2018). [Estrategia de electromovilidad de la Ciudad de México 2018-2030](#).

¹³⁴ Ceri Woollsgrove (ECF) and Philip Amaral (ECF). (May 23, 2023). Video interview by author.

¹³⁵ Shanshan Li (ITDP China) & Qiuyang Lu (ITDP China). (May 4, 2023). Video interview by author.

¹³⁶ Dale Hall, Hongyang Cui, Marie Rajon Bernard, Shuyang Li, & Nic Lutsey. (September 2020). [Electric vehicle capitals: Cities aim for all-electric mobility](#).

VI. APPENDIX I: COMPARING E-BIKE DEFINITIONS ACROSS COUNTRIES

Country	Name	Assist mode	Max motor-assisted speed (kph)	Max power (watts)
Japan	Pedelec	Pedal	24	1:2 power ratio
European Union members	Pedelec/EPAC	Pedal	25	250 (rated)
China	Electric bicycle	Pedal or throttle	25	400
India	Electric cycle	Pedal	25	250
United States	E-bike (Classes 1-2)	Pedal or throttle	32	750
Brazil	Electric bicycle	Pedal	32	1,000



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