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MTI MINETA TRANSPORTATION INSTITUTE

Exploring Electric Bicycle Safety Performance Data and Policy Options for California

Asha Weinstein Agrawal, PhD
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MINETA TRANSPORTATION INSTITUTE

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16. Abstract

This study was conducted as directed by California Senate Bill 381 (2023), which called for research to help policymakers develop effective laws and policy to support the twin goals of expanding electric bicycle use and protecting the safety of electric bicycle riders and other road users. The three major strands of findings presented in this report are (1) a review of how California and other states (and countries) regulate electric bicycle use, (2) a review of the electric bicycle safety literature, including original analysis of primary data on crashes, injuries, and deaths, and (3) strategies that the state could adopt to promote the safe use of electric bicycles. The strategies discussed include revising the way the California Vehicle Code defines and regulates electric bicycles, opportunities for improving electric bicycle safety data quality and analysis, building safe infrastructure for electric bicycling, and public education on electric bicycle rules of the road and safe riding practices.

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EXECUTIVE SUMMARY

E.1. INTRODUCTION

This study was conducted as directed by California Senate Bill 381 (2023), which called for research to help policymakers develop effective laws and policy to support the twin goals of expanding electric bicycle use and protecting the safety of both electric bicycle riders and other road users. The three major strands of findings presented in the report are (1) a review of how California and other states (and countries) regulate electric bicycle use, (2) a review of the electric bicycle safety literature, including original analysis of primary data on crashes, injuries, and deaths, and (3) strategies that the state could adopt to promote the safe use of electric bicycles. The strategies discussed include revising the way the California Vehicle Code defines and regulates electric bicycles, opportunities for improving electric bicycle safety data quality and analysis, building safe infrastructure for electric bicycling, and public education on electric bicycle rules of the road and safe riding practices.

The state has a strong incentive to create safe conditions for electric bicycle use because the devices offer substantial benefits to both individual riders and society at large. More than half of the trips people take in the U.S. are under three miles, a very reasonable distance to cover on an electric bicycle. For Californians who cannot or prefer not to drive a motor vehicle, electric bicycles offer a travel option that allows them to move around their communities easily, at the time of their choosing. Existing evidence points to a wide variety of people using electric bicycles for transportation, including children, older adults, and people with disabilities that prevent driving a vehicle or operating a conventional bicycle. And beyond these benefits to individual users, electric bicycles offer a valuable strategy to make significant inroads on some of California's thorniest transportation challenges, including injuries and deaths from motor vehicle crashes, greenhouse gas and air pollutant emissions, and traffic congestion.

While electric bicycles have many potential benefits, concern about electric bicycle safety has spiked in California—and nationally—as more and more crashes, injuries, and fatalities attributed to the devices are reported. Electric bicycle safety has become a popular story in the news media, and some local governments report regular demands for new restrictions on electric bicycles in response to sightings of reckless riding and reported crashes, injuries, and deaths. Amplifying the concern, law enforcement agencies and medical associations have issued statements warning about a rise in electric bicycle crashes and injuries.

This study aims to inform the ongoing policy debate on electric bicycle safety policy by documenting both the known facts about electric bicycle safety incidents and the major gaps in information about the risks. In addition, to offer policymakers information that helps them to assess the relative seriousness of the problem, the report compares safety incidents for electric bicycles to incidents for other modes of travel, such as conventional bicycles and electric kick-scooters. Each injury or death is a unique tragedy, yet policymakers also need to understand the relative scale of the safety problem in order to make evidence-based judgements about appropriate policy. Understanding the extent of known safety risks can inform state decisions about investments to support safe electric bicycle, such as education and infrastructure, as well as possible restrictions on use of a travel mode that offers so many benefits to both users and society at large.

E.2. STUDY METHODS

We collected data and insights related to electric vehicle safety through five research methods.

Review of international electric bicycle safety literature: We reviewed existing studies from around the world to identify existing insight on electric bicycle safety.

Original analysis of data on crashes, injuries, and deaths: We performed original analysis on datasets cataloging electric bicycle-related crashes, injuries, and fatalities. When available, we compared characteristics of electric bicycles with those of other travel modes. These sources range from local datasets to state-level and national-level datasets.

Analysis of news and social media stories about electric bicycle fatalities: We searched for fatalities reported in news media articles and social media posts to explore the numbers of fatalities, personal characteristics of those who died, and cause of the crash.

Review of laws that define electric bicycles and regulate their use: We reviewed the vehicle codes from all 50 states to determine the definitions and rules for operating electric bicycles, bicycles, other micromobility devices, and gas-powered two-wheeled devices like mopeds. We also looked more briefly at how other countries define and regulate electric bicycles.

Expert interviews: We interviewed 44 experts in electric bicycle safety. The interviewees were selected to cover a wide range of perspectives, including public health and injury prevention, emergency medicine, law enforcement, transportation planning, bicycle advocacy, shared mobility companies, and bicycle retailers.

E.3. WHEN IS AN “ELECTRIC BICYCLE” AN ELECTRIC BICYCLE?

A fundamental yet deceptively complicated question that must be answered in order to understand electric bicycle safety, is: what, exactly, *is* an electric bicycle. Some devices that members of the public might describe as electric bicycles are not, in fact, electric bicycles as the term is defined in California law. Similarly, many retailers use terms like “e-bike” to describe devices that are not electric bicycles under California law.

In California, as in most U.S. states, legal electric bicycles are bicycles with fully operable pedals and electric motors that do not exceed 750 watts of power (approximately one horsepower). Additionally, legal electric bicycles are divided into three “classes” that differ based on how the electric motor is activated and the speed above which the motor no longer supplies power (Table E.1). Class 1 and Class 3 electric bicycles are “pedal assist” electric bicycles, meaning that the motor only applies power while the rider is pedaling. Class 2 devices are “throttle” electric bicycles that riders can operate without pedaling, using a hand throttle. With respect to speeds, Class 1 and Class 2 electric bicycles must cease providing motor power above 20 mph. Class 3 electric bicycles must cease providing motor power above 28 mph.

Table E.1. Three-class electric bicycle categorization system adopted by California and most U.S. states

	Class 1	Class 2	Class 3
Electric power is applied:	Only when rider is pedaling	When rider is pedaling *or* by hand throttle	Only when rider is pedaling
Speed above which power will no longer be applied	20 mph	20 mph	28 mph

A critical complication is the presence in the market of electric two-wheelers that have motors which produce power in excess of 750 watts and reach speeds above 20 mph on motor power alone (Table E.2). These devices typically *look* like bicycles, and all have the words “bike” or “e-bike” in their product marketing material.

Table E.2. Examples of devices that exceed California's three-class system limits for speed and power

	Model name	Advertised motor power	Has throttle	Advertised top speed
	Lyric Graffit Electric Bike	1000 watts (continuous*) 2300 watts (peak)	Yes	33+ mph
	Segway Xyber Electric Bike	3000 watts [1 battery] or 6000 watts [2 batteries] (continuous)	Yes	35 mph
	Aipas M2 Pro Xterrain Bike	1800 watts (continuous/ peak not specified)	Yes	36+ mph
	Freesky Warrior Pro M-530: Dual-motor all terrain ebike	2000 watts (continuous) 3500 watts (peak)	Yes	38 mph

Sources: https://lyriccycles.com/collections/electric-bikes/products/graffiti, https://store.segway.com/segway-ebike-xyber, https://aipasbike.com/products/aipas-m2-pro-xterrain-ebike, https://www.freeskycycle.com/collections/e-bikes/products/warrior-pro-m-530

Note: Peak power is the maximum power that the motor can ever generate. However, a motor cannot sustain this power level over an extended period. Continuous power is the power level that a motor can generate indefinitely. A motor's continuous power is always much lower than its peak power.

*The webpage for the Lyric Graffiti states two power levels. 2300 watts is specifically identified as peak power. The 1000-watt figure does not have a descriptor, but is implied to be continuous here.

One could look at higher-power devices such as those in Table 2 and conclude these are not legal electric bicycles. However, the manufacturers of some of these devices have historically claimed their devices are indeed legal electric bicycles, despite having motors more powerful than 750 watts and providing electric assistance above 20/28 mph. Manufacturers ship the devices to customers with software settings that limit the devices to 750 watts of power output and a maximum assisted speed of 20 or 28 mph. However, the manufacturers still advertise that the owners can change the settings to make the devices faster and more powerful. Some manufacturers have made the settings very easy to unlock, with just a simple change on the device's control app or console. The State of California has tried to restrict such manufacturer behavior. Senate Bill 1271 (2024) added language declaring that devices where manufacturers intend for operators to be able to unlock higher power and higher speed settings do not qualify as "electric bicycles" in California, and cannot be sold, marketed, or labeled as such. In response, since 2024 some manufacturers have removed unlocking capabilities from their device control apps, but numerous third-party apps are still available that can unlock some devices.

U.S. definitions for electric bicycles are very different from those seen abroad. Most notably, most other countries we explored have maximum power levels lower than the 750W allowed in the U.S. (Table E.3), as well as lower caps on assisted speeds.

Table E.3. Standards on speed and power in select countries for electric bicycles that can be operated without a driving license

County/ region	Maximum watts	Throttle permitted	Maximum assisted speed	Other
United States	750 (federal limit)	No: Class 1 and 3 Yes: Class 2 (most states)	20 or 28 mph (most states)	
Canada	500 (federal limit)	Yes	20 mph (32 km/h)	
China	400	Yes	16 mph (25 km/h)	Limits battery voltage
New Zealand	300	Yes	none	
Australia	250 (most states, but New South Wales permits 500)	No	16 mph (25 km/h)	Power output must progressively reduce as travel speed increases
Japan	250	No	12 mph (20 km/h)	Power assist ratio set at 2; power output must progressively reduce as travel speed increases
European Union	250	No	16 mph (25 km/h)	Power output must progressively reduce as travel speed increases[d]

Sources: See Table 3 in the main report.
Note: Information about device definitions found online can sometimes be contradictory. Where possible, we cite information from official government sources. Some additional variances in standards may exist within a country across states, provinces, etc.

E.4. REGULATIONS ON OPERATING ELECTRIC BICYCLES

California's regulations on who may ride electric bicycles and the rules for operating them fall within the California Vehicle Code. We compared California rules to those in other states and countries.

Vehicle codes in California and most states declare that for all three classes, "an electric bicycle is a bicycle," a legal status that makes the U.S. a global outlier in how electric bicycles are regulated. Because California defines electric bicycles as bicycles, then except where otherwise specified, even the more powerful and faster Class 2 and Class 3 electric bicycles may follow the rules of the road for conventional bicycles. By contrast, most countries have a two-category system where lower-speed electric bicycles are legally equivalent to a bicycle but higher-speed devices are legally equivalent to a moped. Table E.4 presents an overview of California's rules and compares these to those in other states and other countries.

As previously mentioned, devices faster and more powerful than legal electric bicycles exist in the U.S. marketplace. If such devices are not legal electric bicycles, then they do not have the same rights and responsibilities as conventional bicycles. Higher-power devices potentially be street legal if they met the definitions of some other device types defined under California law, such as motorized bicycles/mopeds, motor-driven cycles, or motorcycles. This is unlikely to be true, however, because the devices typically do not meet safety standards for those faster devices. Many stakeholders (from government agencies, to safety advocates, to some in the mobility industry) believe that it is illegal to ride these higher-power devices on the street and that the devices therefore legal only on private property. Some manufacturers are aware of this interpretation and provide a disclaimer stating that their products are only legal for off-road use.

Table E.4. An overview of some key regulations related to electric bicycle use in California, other U.S. states, and other countries

	California	Other states	Other countries
Driving license, device registration, number plates	None required	None required in any state, except that Hawaii requires devices be registered.	For low-speed devices, most countries do not require these. For high-speed devices, most countries do require a driving license, device registration, and number plates.
Age restrictions	Anyone may ride a Class 1 or 2 device, but riders must be 16 to ride a Class 3 device. The state has also allowed Marin County and San Diego County to run pilots adding additional age restrictions.	Considerable variation by state. Hawaii and Minnesota are the most restrictive, setting a minimum of 15 years to ride any electric bicycle. Two states with age minimums nevertheless allow younger riders if supervised by an adult or guardian.	For low-speed devices, minimums vary considerably. A few countries have a minimum age for all riders. For example, Austria requires riders to be at least 12. One country allows any age if supervised by an adult. For high-speed devices, the minimum age is that for obtaining a driving license.
Helmet requirements	All Class 3 riders must wear a bicycle helmet. For Classes 1 and 2, helmets are required statewide only for riders under 18. A Marin County pilot requires helmets for all Class 2 riders.	Considerable variation by state, including some with requirements for any age. Oregon and Pennsylvania permit no helmet only if this violates a person's religious beliefs.	For low-speed devices, there is considerable variation, but most countries do not require helmets at all. Some exceptions are that France requires helmets up to age 11, Italy and Sweden up to age 14, and Japan up to age 16. Most countries require moped-style helmets for anyone riding higher-power electric bicycles.
Sidewalk riding	Allowed unless prohibited by local ordinance. (This is indirectly implied, rather than directly stated.)	Varies considerably. A few states entirely prohibit this, but most allow certain classes of electric bicycles, children, and/or use in certain locations. Two states permit sidewalk riding only with the motor off.	For high-speed devices, there is considerable variation. Some countries ban this entirely, but others permit it, at least in certain locations or for certain riders.

E.5. SAFETY FINDINGS

To understand the risks that electric bicycle riders may pose either to themselves or to others, we reviewed over 200 published research studies on electric bicycle safety and completed independent analysis of ten datasets reporting on safety incidents (Table E.5). Almost all research on electric bicycle safety outcomes relies on police crash reports, hospital medical records, or reported fatalities.

Table E.5. Primary data sources analyzed

Source	Type of incident	Geography	Timeframe
California Crash Data System	Crashes	California	2017-2024
Oregon Crash Data Products	Crashes	Oregon	2022-2023
Maryland Crash Data Dashboard	Crashes	Maryland	2024
Orange County Sheriff’s Department	Crashes	Orange County, CA	2024-2025
National Electronic Injury Surveillance System (NEISS)	Injuries and fatalities	United States	2020-2024
California Health and Human Services Open Data Portal	Injuries	California	2023
New York City Police Department TrafficStat	Injuries and fatalities	New York City	2023-2025
Rady Children’s Health of Orange County	Injuries (pediatric)	Orange County, CA	2020-2025
Marin County Department of Health and HumanServices	Injuries (911 responses)	Marin County, CA	2023-2025
Fatality Analysis Reporting System (FARS)	Fatalities	United States	2022-2023
News media articles	Fatalities	United States	2019-2025

A serious limitation to the strength of evidence about electric bicycle safety performance presented below is that, as explained above, it is highly likely that many of the “electric bicycles” involved in crashes, injuries, and fatalities are not, in fact, legal electric bicycles. The best evidence to support this hypothesis comes from the observation data from several California schools, where only 12% of two-wheeled electric devices were actually legal electric bicycles as defined by the three-class electric bicycle system used in California. Therefore, we are certain that some fraction of the reported “electric bicycle” incidents have been incorrectly labeled as such, and this share may represent a very large fraction of all reported electric bicycle incidents.

Electric bicycle incidents are less common than conventional bicycle incidents in most communities

The number of incidents attributed to electric bicycles have risen over the last several years, and this notable increase in injuries and deaths clearly warrants careful policy attention. However, while incidents have risen, and often at a fast rate, it is important to consider the incident numbers in a broader context: there are still many more incidents related to conventional bicycles than electric bicycles in most of the data we looked at (Table E.6). This finding especially holds true for state and national data. That said, a few datasets we reviewed that came from local areas where electric bicycles are especially popular show the reverse: there are more reported electric bicycle incidents than conventional bicycle incidents. This data comes from New York City, as well as California’s Orange County and Marin County.

Table E.6. Comparing the number of electric bicycle incidents to conventional bicycle incidents across multiple datasets

Data source	Time period	Electric/ motorized bicycle value	Conventional bicycle value	Ratio of conventional to electric bicycle values
Crashes				
California – California Crash Data System	2024	961	10,372	10.8
Oregon – Oregon Crash Data Products	2023	60	537	9.0
Maryland – Maryland Automated Crash Reporting System	2024	178	640	3.6
Orange County, CA – Orange County Sherriff's Department	2024 – August 2025	267	112	0.4
Injuries				
National hospital records – NEISS	2020 – 2024	3,179	54,115	17.0
	2024	1,290	10,532	8.2
California Hospital Records – CHHS Open Data Portal	2023	4,757	44,039	9.3
Illinois hospital records – Shannon, et al. (2025)	2021 – 2023	441	25,577	58.0
Pediatric trauma activations – Rady Children's Hospital Orange County	2020 – October 2025	390	279	0.7
	January – October 2025	165	27	0.2
EMS responses – Marin County, CA	October 2023 – October 2025	159	412	2.6
New York City – NYPD TrafficStat	Most of 2023, 2024, and 2025	565	3,014	5.3
Fatalities				
National hospital records – NEISS	2020 – 2024	2	75	37.5
	2024	1	17	17.0
National – Fatality Analysis Reporting System (FARS)	2022 - 2023	154	1,140	7.4
New York City – NYPD TrafficStat	Most of 2023, 2024, and 2025	44	24	0.5

Most data points to more severe outcomes in incidents involving electric bicycles than incidents involving conventional bicycles

In terms of injury severity, most but not all of the published literature we reviewed and the multiple datasets we explored ourselves indicate that electric bicycle-related incidents typically have more severe outcomes than conventional bicycle incidents. The most striking example of this discrepancy in terms of U.S. data comes from New York City police crash report data. Since 2023, there have been nearly twice as many electric bicycle fatalities than conventional bicycle fatalities, despite there being fewer electric bicycle *injuries* than conventional bicycle injuries. Similarly, studies on electric bicycle safety from around the world usually report more severe outcomes from electric bicycle incidents. However, our independent analysis of two large datasets suggests a more mixed message on injury severity (Table E.7). In the NEISS injury dataset of U.S. hospital patients, electric bicycle patients were hospitalized at only a three-percentage point greater rate than conventional bicycle patients (16% vs. 13%). Also, that gap disappeared when making an apples-to-apples comparison of only those injuries occurring on streets. Finally, while the California hospital data did show more electric bicycle than conventional bicycle hospitalizations, the difference was a relatively modest six percentage points (17% vs. 11%).

Table E.7. Share of injuries and fatalities involving a vehicle collision, across multiple datasets

Data source	Time period	Electric bicycles	Conventional bicycles	Powered/ electric scooters
Injuries				
NEISS (injuries to device operators)	2024	31%	24%	24%
California hospital data	2023	20%	18%	–
Fatalities				
Search of news articles by NTSB (2022)	2018 – 2020	57%	–	60%
Search of news articles by Podsiad, Harmon, and Combs (2023)	July 2022 – March 2023	83%	–	–
Original search of news articles	2019 – July 2025	70%	–	–

Other safety findings

Three other findings address factors that are particularly important to consider when identifying appropriate policy responses to safety concerns.

- **Age**: Most people involved in electric bicycle incidents are adults, although some local data points to particularly high rates of children in crashes. Also, the medical experts we interviewed are concerned older adults are more likely than children or younger adults to suffer serious medical consequences from crashes. In the national NEISS dataset, seniors had the highest rates of both hospitalizations and head injuries.

- **Crash cause**: Motor vehicle crashes are a factor in many injuries and most fatalities.

- **Bystander incidents**: Pedestrians and other bystanders struck by electric bicycles make up a very small proportion of electric bicycle-related incidents—no more than 4% in either of the two datasets that reported this.

E.6. OPPORTUNITIES FOR CALIFORNIA TO IMPROVE ELECTRIC BICYCLE SAFETY

There are numerous steps that the State of California can take to support safe electric bicycle riding for all road users. Achieving that vision will require a large number of complementary actions that include educating all road users about electric bicycle rights and responsibilities, building safe biking infrastructure, re-considering how the California Vehicle Code defines and regulates use of electric bicycles, and improving data collection and analysis of electric bicycle related incidents to inform policy changes. Specific actions that the state can explore that we concluded are worthy of further exploration include:

1. Integrate work on electric bicycle policy with work on conventional bicycles and other forms of micromobility

2. Create staff positions to coordinate statewide micromobility programs and policies

3. Integrate electric bicycles into relevant state plans and programs

4. Produce high-quality bicycle infrastructure

5. Establish device specifications and standards for electric bicycles

6. Revise the California Vehicle Code to update electric bicycle classes and operating rules

    a. Redefine electric bicycles into two categories: low-power devices regulated like conventional bicycles and high-power devices regulated like mopeds

   b. Clarify the legal status of the many two-wheeled, powered “bicycle-shaped devices” that do not fit into any device category in the California Vehicle Code

   c. Other revisions to the rules for operating electric bicycles

7. Require electric bicycle sellers to disclose relevant state regulations to buyers

   a. Require that sellers disclose the device type they are selling and laws on how that device may be used

   b. Establish clear processes to enforce disclosure laws

8. Improve the organization and expression of California Vehicle Code law related to electric bicycles

9. Provide materials to educate the public on electric bicycle rules and safe riding practices

   a. Produce a plain-language handbook with electric bicycle rules of the road

   b. Add electric bicycle content to DMV materials that educate motor vehicle operators

   c. Develop electric bicycle safety education materials for different age groups

   d. Offer electric bicycle training courses

   e. Produce content for public service announcements

10. Support enforcement of rules for operating electric bicycles

   a. Establish appropriate penalties for illegal operation of electric bicycles

   b. Provide guidance on how to store impounded electric bicycles

11. Collect better data on safety incidents

   a. Improve the quality of electric bicycle incident data already collected

   b. Explore sources of data that have not been used extensively

12. Collect better data on electric bicycle use rates

13. Make data easy to access and analyze

   a. Encourage hospitals, police departments, and other local entities to share detailed electric bicycle data

b. Create an electric bicycle data repository

c. Make it easy to extract electric bicycle data in publicly accessible data sets

d. Facilitate data linkage across sources

e. Hold a conference to assemble and synthesize electric bicycle data from across California

14. Encourage more extensive analysis of electric bicycle safety data

1. INTRODUCTION

This study was conducted as directed by California Senate Bill 381 (2023), which called for research to help policymakers develop effective laws and policy to support the twin goals of expanding electric bicycle use and protecting the safety of both electric bicycle riders and other road users. The three major strands of findings presented in this report are (1) a review of how California and other states (and countries) regulate electric bicycle use, (2) a review of the electric bicycle safety literature, including original analysis of primary data on crashes, injuries, and deaths, and (3) strategies that the state could adopt to promote the safe use of electric bicycles. The strategies discussed include revising the way the California Vehicle Code defines and regulates electric bicycles, opportunities for improving electric bicycle safety data quality and analysis, building safe infrastructure for electric bicycling, and public education on electric bicycle rules of the road and safe riding practices.

1.1 ELECTRIC BICYCLES: OPPORTUNITIES AND SAFETY CHALLENGES

This study was conducted as directed by California Senate Bill 381 (2023), which called for research to help policymakers develop effective laws and policy to support the twin goals of expanding electric bicycle use and protecting the safety of both electric bicycle riders and other road users. The three major strands of findings presented in the report are (1) a review of how California and other states (and countries) regulate electric bicycle use, (2) a review of the electric bicycle safety literature, including original analysis of primary data on crashes, injuries, emergency room visits, and deaths, and (3) strategies that the state could adopt to promote the safe use of electric bicycles. The strategies discussed include revising the way the California Vehicle Code defines and regulates electric bicycles, opportunities for improving electric bicycle safety data quality and analysis, building safe infrastructure for electric bicycling, and public education on electric bicycle rules of the road and safe riding practices.

The state has a strong incentive to create safe conditions for electric bicycle use because the devices offer substantial benefits to both individual riders and society at large. More than half of the trips people take in the U.S. are under three miles (U.S. Department of Energy - Vehicle Technologies Office, 2022), a very reasonable distance to cover on an electric bicycle. For Californians who cannot or prefer not to drive a motor vehicle, electric bicycles offer a travel option that allows them to move around their communities easily, at the time of their choosing. Existing evidence points to a wide variety of people using electric bicycles for transportation, including children, older adults, and people with disabilities that prevent driving a vehicle or operating a conventional bicycle. And beyond these benefits to individual users, electric bicycles offer a valuable strategy to make significant inroads on some of California's thorniest transportation challenges including injuries and deaths from motor vehicle crashes, greenhouse gas and air pollutant emissions, and traffic congestion.

While electric bicycles offer many potential benefits, concern about electric bicycle safety has spiked in California—and nationally—as more crashes, injuries, and fatalities attributed to the devices are reported. In recent years, electric bicycle safety has become a popular subject in feature articles and editorials in popular news media and scholarly literature (Reynolds, 2020; Marcius & Hu, 2021; Karlamangla, 2023; Richtel, 2023a; Richtel, 2023b; Richtel, 2023c; Richtel, 2023d; Toll, 2023; Wilson, 2023; Stewart, 2024; Travers, et al. 2024; Reilly, 2025; Hughes, 2025)1. In addition, many local governments report regular demands for new restrictions on electric bicycles in response to sightings of reckless riding and reported crashes, injuries, and deaths. For example, when the City of Carlsbad proposed in 2025 to limit Class 1 and 2 devices to riders aged 12 and older, the city reported an astounding number of public comments submitted—over 470 (City of Carlsbad, 2025). Amplifying the concern over electric bicycle safety, police departments and medical professionals have issued statements warning about a rise in electric bicycle crashes and injuries (Fernandez, 2024; Maa, Doucet, Ignacio, & Alfrey, 2024; Hill, 2025). Also, the American College of Surgeons issued a 2025 statement calling for new policies to reduce injuries and fatalities related to electric bicycle use (American College of Surgeons, 2025).

Concern over electric bicycle safety has come amidst a period of worsening transportation safety outcomes overall in the U.S. Motor vehicle crash fatalities have increased from 32,744 in 2014 to 39,345 in 2024, with fatalities exceeding 40,000 from 2021-2023 (National Highway Traffic Safety Administration, 2025). These increases have not just been a matter of population growth as motor vehicle fatalities per capita and per distance have also increased. For bicycles, the Centers for Disease Control reports that 1,377 cyclists were killed in the U.S. in 2023 (National Safety Council, 2025). Nationwide, there have been more than 1,000 cyclist fatalities every year since 2015 and have sat above 1,200 fatalities since 2020.

This study aims to inform the ongoing policy debate on electric bicycle safety policy by documenting both the known facts about electric bicycle safety incidents and the major gaps in information about the risks. In addition, to offer policymakers information that helps them to assess the relative seriousness of the problem, the report compares safety incidents for electric bicycles to incidents for other modes of travel, such as conventional bicycles and electric kick-scooters. Each injury or death is a unique tragedy, yet policymakers also need to understand the relative scale of the problem in order to make evidence-based judgements about how to spend scarce resources promoting safe electric bicycle use, as well as when it is justified to restrict use of a travel mode that offers so many benefits to both users and society at large.

1.2 STUDY METHODS

The report draws from data collected through five primary methods:

1. **Review of the published English-language research on electric bicycle safety:** The objective of the literature review was to identify evidence about the nature and severity of electric bicycle incidents, as well as evidence about correlating factors and best practices in improving electric bicycle safety. To identify relevant literature, we searched systematically with Google Scholar, PubMed, ScienceDirect, Scopus, Transport Research International Documentation (TRID), and Web of Science. These databases were selected to ensure coverage of both the public health and transportation literature. The search phrases combined a word describing the mode

1 The publications referenced in this sentence are included solely to illustrate the type of media articles and other literature that discuss and debate electric bicycle safety. The authors do not endorse any of the facts or opinions said therein.

("electric bicycle," "e-bike," or "pedelec") with a word related to safety ("safety," "crash," or "injury"). We also combined these search terms with the names of countries known to have significant bicycle mode share, such as Germany, the Netherlands, Israel, China, Japan, and European Union (EU) countries. The searches identified 197 relevant studies.

2. **Original analysis of data on crashes, injuries, and deaths:** For patient health records, we conducted original analysis of data from the National Electronic Injury Surveillance System, California hospitals, and Marin County Emergency Medical Services. For traffic crashes, we analyzed state crash databases from California, Maryland, and Oregon, as well as New York City Police Department data.

3. **Analysis of news and social media stories about electric bicycle fatalities:** We searched for fatalities reported in news media articles and social media posts. Media stories were identified by searching in Google News, Meltwater, ProQuest, and LexisNexis. Social media posts were identified through searches in Instagram, Twitter/X, Reddit, and Facebook community groups. News articles can identify some incidents and incident characteristics not captured in other datasets.

4. **Review of laws that define electric bicycles and regulate their use:** We reviewed the vehicle codes from all 50 states to determine the definitions and rules for operating electric bicycles, bicycles, other micromobility devices, and gas-powered two-wheeled devices like mopeds. In addition, we reviewed the electric bicycle definitions and rules of the road from 29 countries: Australia, Austria, Belgium, Canada, Chile, China, Colombia, Denmark, England, Finland, France, Germany, Ireland, Israel, Italy, Japan, Kenya, the Netherlands, New Zealand, Norway, Poland, Scotland, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, and the United Arab Emirates.

5. **Expert interviews:** We interviewed 44 experts in electric bicycle safety. The interviewees were selected to cover a wide range of perspectives, including public health and injury prevention experts, emergency medicine professionals, law enforcement professionals, transportation planners, bicycle advocates, shared mobility companies, and bicycle retailers. (Appendix A presents the full list of interviewees.) Each expert was interviewed for about an hour over Zoom to discuss their views on the unique safety challenges associated with electric bicycles, the adequacy of available data on electric bicycle use and incidents, how electric bicycles are defined and regulated in state law, and policy options to support safe electric bicycle use.

1.3 REPORT OVERVIEW

The remainder of the report is organized as follows. Chapter 2 and 3 introduce what electric bicycles are and the rules that regulate their use. Chapter 4 presents an overview of data available on electric bicycle ownership and use in the U.S. The next set of chapters, 5 through 9, discuss the nature of electric bicycle safety concerns; findings from the available data on crashes, injuries, and fatalities; and a synthesis of what we do—and do not—know about electric bicycle safety. Chapter 10 offers a set of recommended actions the State of California could undertake to support more and safer use of electric bicycles. Finally, Chapter 11 concludes with some reflections on the current state of understanding of electric bicycle safety issues.

2. WHAT HAS TWO WHEELS, A SEAT, AND A MOTOR? THE WIDE ARRAY OF POWERED, BICYCLE-SHAPED CONVEYANCES

Senate Bill 381 calls for an exploration of safety issues related to electric bicycles. A fundamental challenge to analyzing electric bicycles is defining what an electric bicycle actually is—and is not. This chapter dives into that complexity behind a deceptively simple question—“what is an electric bicycle?” —by discussing the components and operation of electric bicycles, legal and regulatory definitions of electric bicycles, and the wide array of powered, bicycle-shaped conveyances present in the marketplace. These include:

- Devices that members of the public perceive to be electric bicycles
- Devices that fit government regulatory definitions of electric bicycles
- Devices that device manufacturers or retailers market as electric bicycles

At the most general level, one can look at dictionary definitions. The *Merriam-Webster Dictionary* defines an electric bicycle as “a bicycle equipped with an electric motor that may be activated in order to assist with or replace pedaling.” The definition requires then looking to the definition of a “bicycle,” which per Mirriam-Webster is “a vehicle with two wheels tandem, handlebars for steering, a saddle seat, and pedals by which it is propelled.”

While at first glance the dictionary definition seems to offer a clear-cut description of electric bicycles, the federal and state governments define electric bicycles in much more narrow ways (discussed below). As a result, there are many devices sold in the U.S. that conceptually look like an electric bicycle—e.g., two tandem wheels, handlebars, seat, pedals, and an electric motor—yet do not fall under either federal or state government definitions of “electric bicycles.” In other words, there is a disconnect between devices the public assumes are electric bicycles and those defined as such by law.

Figure 1 shows a variety of two-wheeled electric-powered devices that are currently available to purchase. While all have two wheels, seats, and electric motors, they vary in characteristics such as maximum assisted speeds, motor power, method of motor activation, weight, wheel size, tire width, and form factor, among others.

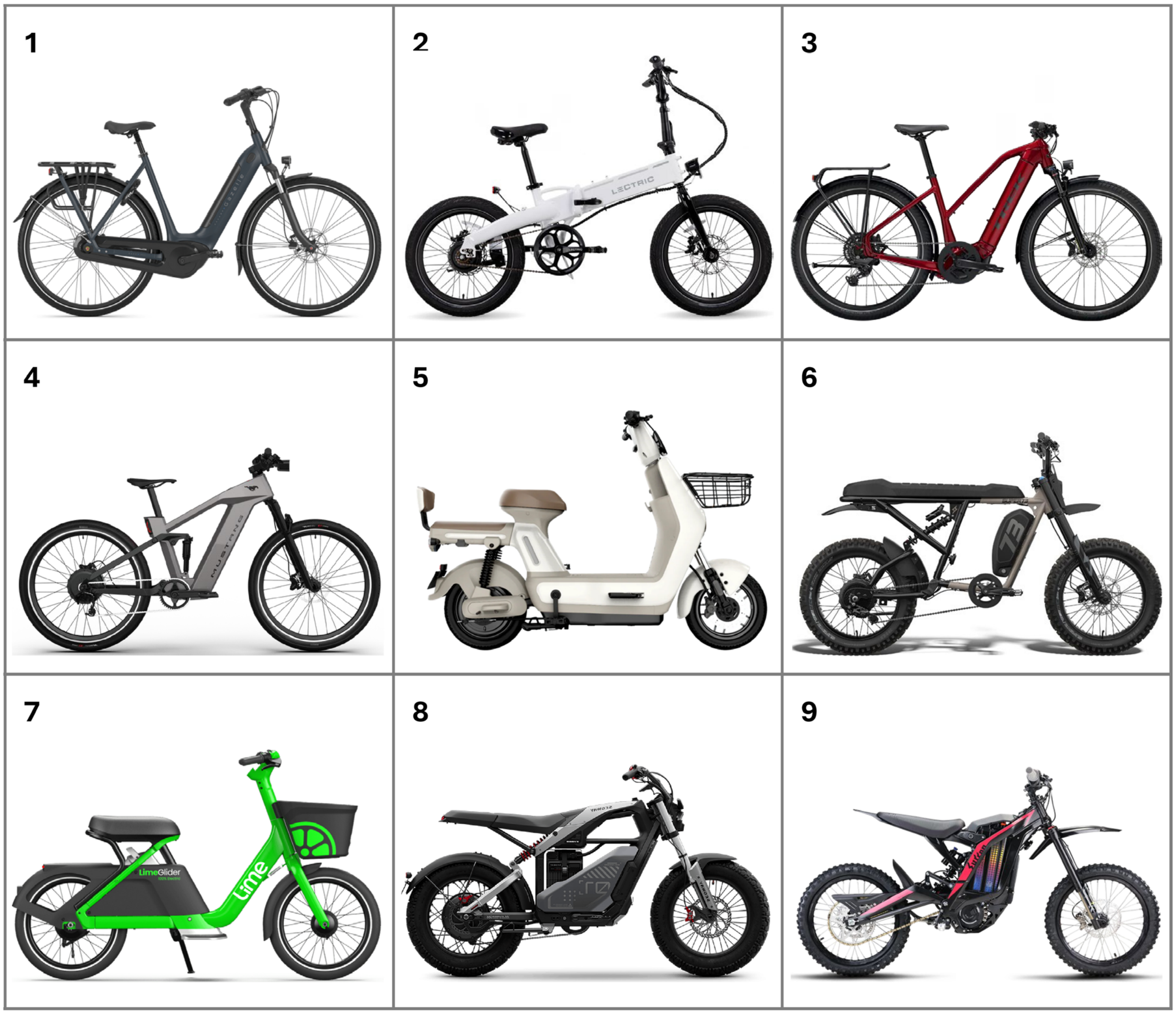


Figure 1. Examples of variety of two-wheeled electric-powered devices available in the market

Device models: [Row 1: Left to Right] Gazelle Arroyo C7 Elite, https://www.gazellebikes.com/en-us/ebikes/gazelle-arroyo-c7-elite; Lectric, XP Lite2 Arctic White Long-Range eBike, https://lectricebikes.com/products/xp-lite-arctic-white-long-range-ebike; Trek Allant+ 7S Midstep Gen 2, https://www.trekbikes.com/us/en_US/bikes/hybrid-bikes/electric-hybrid-bikes/allant/f/F473/allant+-7s-midstep-gen-2/40884/5293722; [Row 2: Left to Right] Ford Mustang E-bike, https://ford-bikes.com/products/mustang-electric-bike; LimeGlider, https://www.li.me/blog/introducing-the-limebike-limeglider-our-most-inclusive-rides-yet; Liva 7 Moped style Class 2 E-Bike, https://www.hmpbikes.com/products/hmpbikes-electric-moped-liva7; Super73-R Adventure Series Core, https://super73.com/products/super73-r-adventure-series-core?from=r-series-bikes; [Row 3: Left to Right] LimeGlider, https://www.li.me/blog/introducing-the-limebike-limeglider-our-most-inclusive-rides-yet; Segway Xyber Electric Bike, https://store.segway.com/segway-ebike-xyber; Electric motorcycle: Surron Light Bee S, https://us.sur-ron.com/compared?id=3

Confusingly, the devices shown in Figure 1 fall into the following categories:

- Devices that are clearly legal electric bicycles (Devices 1-3).

- Devices for which there are differences in opinion about whether they are legal electric bicycles (Device 4-6). As discussed later in this chapter, #4 is a multiple-class electric bicycle. These are not allowed in California, although allowed in some other states. The fifth example appears at first glance to be a seated electric scooter, but it has pedals which could technically allow it to be an electric bicycle. The sixth example has one user setting that restricts the device as required for Class 2, but the user can also choose settings where the device exceeds the motor power and speed limits of electric bicycles.

- Devices that are clearly not legal electric bicycles, even though many people may think of them as such. These devices might fit under the legal definition of another device type in the California Vehicle Code or may not clearly fall under any defined device or vehicle type (Devices 7-9). Number seven resembles a bicycle, but lacks pedals, so is technically not a bicycle. #8 and #9 have motor power and speed capabilities in excess of limits for electric bicycles.

This chapter fleshes out the challenge of defining electric bicycles by reviewing the (limited) federal guidance and the three-class definition system that most U.S. states have adopted, and relevant sections of the California Vehicle Code. For comparison, we also briefly explore how electric bicycles are defined in several other countries.

2.1 ELECTRIC BICYCLE TECHNICAL COMPONENTS AND MECHANICS

This section describes some of the key components of electric bicycles as well as some of their physical performance characteristics. Some of these concepts are important because they are embedded in legal definitions of electric bicycles. Additionally, some of these characteristics are central in debates over electric bicycle definitions and regulations and thus may be of interest in further policymaking.

2.1.1 The controller

The controller is the “brain” or “command center” of the electric bicycle. In most modern electric bicycles, the controller is a mini-computer, with a circuit board and software that controls the bicycle’s operations. The controller communicates with other key device components, such as the battery, motor, sensors, brake lever, pedals, and throttle (if present). Key functions that the controller will regulate are the amount of power drawn from the battery and sent to the motor, as well as the speed at which the motor runs.

2.1.2 User controls

Electric bicycles are typically equipped with a physical control console where users can adjust certain device settings. Manufacturers and third-parties also have developed smartphone apps where users can change device settings, track data, and update the device's software.

Figure 2 shows a screenshot from the Bosch eBike Flow app, where riders can select between different riding modes. Different modes on an electric bicycle can have different characteristics such as power levels, maximum speeds, acceleration rates, and assistance ratio. Users may want to use different settings depending on where they are riding (e.g., hilly vs. flat terrain), their muscle strength and fatigue level, riding skill, and en7ergy consumption considerations.

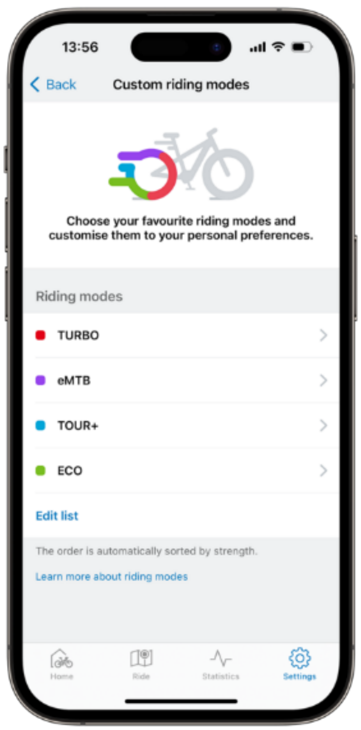


Figure 2. Screenshot from the Bosch eBike Flow app showing riding modes (turbo, eco, etc.)

Source: https://www.bosch-ebike.com/us/products/ebike-flow-app

2.1.3 Batteries

Electric bicycles rely on batteries to generate power. While lithium-ion batteries are currently the most common option, some devices use alternatives such as nickel-metal hydride batteries. Two key dimensions to battery power (watts) are the voltage and amperage. As a physics textbook would say:

$$Watts = volts * amps$$

Batteries have different combinations of voltage and amperage. With respect to voltage, 36 to 52 volts are common for electric bicycle batteries. Voltage, which measures the force the battery produces (or, more literally, the speed at which electrons flow), is responsible for the bicycle's power. A bicycle with higher wattage will accelerate more rapidly and carry heavier loads up a steep hill. Amperage, a measure of the volume of electrons moving through the electrical circuit, is often 10 to 12 amps in electric bicycle batteries. Amperage is constrained by the dimensions of the wiring the electrical current moves through (Bozick, 2023).

2.1.4 Electric motors

The motor in an electric bicycle converts electric power into motion (Guy, 2019). The motor receives electric current from the battery which it converts to rotational motion that is then used to spin the wheel of the bicycle and propel it forward. Motors are frequently attached to a wheel (hub motor) but can also be placed in the middle of the bicycle (mid-drive motor).

Motor power

Motor "power" is the rate at which the motor performs work. The international (SI) unit of measurement of power is the watt (W). Alternatively, motor power is also sometimes measured in horsepower. One horsepower equals approximately 750 watts. Historically, the concept of one horsepower originated as the power required to pull 33,000 pounds over one foot within a minute, which early experiments found a horse could sustain over long periods of time.

Motor power can be reported and marketed in either of two ways:

- **Continuous power (or "nominal" or "rated" power):** This is the maximum level of power that the motor can sustain continuously without overheating.

- **Peak power:** This is the highest output level that can possibly be provided. This output cannot be maintained for any length of time without burning out the motor.

A device's peak power level will be considerably greater than its continuous power level. Peak power is higher, but can only be maintained for a short period, while continuous power is lower, but can be run indefinitely.

A second key concept about wattage is that this can refer to either the electrical power or mechanical power of a device. When electric motors convert electrical power into mechanical power, some power is lost due to factors such as heat and friction. Therefore, a device's mechanical power output is always lower than its electric power.

A final key point to understand about the maximum wattage an electric bicycle produces is the ways that it can be increased through after-market modifications to the device. For most electric bicycles, the manufacturer limits the actual wattage to some level *below* the maximum that the battery can generate. For example, the manufacturer can limit voltage with settings in the controller. Manufacturers can limit amperage below the battery's potential peak through controller settings or by using electrical wiring that carries a lower amperage than the battery can generates. (The peak available amperage for the device is determined by the highest amount that can flow through the *entire* electrical system, including the maximum potential amperage of the battery and electrical wiring.)

Users who wish to increase the power of their device have many options, from changing controller settings, replacing the controller, changing wiring, and/or adding a more powerful battery. Depending on the configuration of the bicycle and its components, these changes can be quite simple or very difficult. On one end of the spectrum, making these changes can be as simple as downloading an app that lets users control the power settings. On the other hand, replacing the controller, battery, and wiring is a complex process that requires considerable time and expertise.

Motor activation via hand throttle or pedal-assist

Riders can activate the motors in electric bicycles in a couple of different ways, both of which are common in the U.S. market:

- **"Pedal assist" electric bicycles:** The rider must pedal in order to activate the motor

- **"Throttle" electric bicycles:** The rider uses a twist grip or other hand control (similar to operating a motorcycle) to activate the motor. Many electric bicycles with a throttle also have a pedal-assist option.

For pedal-assist bicycles, one characteristic of the bicycle's operation is its pedal "assistance ratio." The assistance ratio describes the degree to which the motor is amplifying the rider's pedaling force. For example, an assistance ratio of 3 means that if the cyclist produces a power output of 50 watts, the electric motor would contribute enough power to bring the total power driving the bicycle to 150 watts (3 x 50 watts) (ZIV: German Bicycle Industry, 2025).

2.1.5 Sensors

The controller receives information from various sensors equipped on an electric bicycle.

This includes a speed sensor, which will measure the speed an electric bicycle is traveling. This is particularly important, as electric bicycle regulations often dictate that electric motors cannot be activated above a certain speed.

Pedal-assist electric bicycles also need to detect that a rider is pedaling to activate the motor. There are two common types of pedal sensors on pedal-assist electric bicycles:

- **Cadence sensor:** Detects how fast the pedal is moving, measured as the number of rotations per minute.

- **Torque sensor:** Detects how much rotational force the cyclist is exerting on the pedal

2.2 FEDERAL DEFINITION OF AN ELECTRIC BICYCLE

The federal government first acknowledged electric bicycles in 2002 with the passage of HR 727 (2002), which introduced a definition of "low-speed electric bicycles" into Title 15 of the U.S. Code, Section 2085:

> For the purpose of this section, the term "low-speed electric bicycle" means a two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 h.p.), whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 mph.

Key features of this definition are operable pedals, a cap on motor power at 750 watts (approximately 1 horsepower), and a maximum speed of 20 mph when propelled solely by the motor. 15 USC 2085 makes no specific mention to throttle-activation or pedal-assist activation of the motor, however the reference to a maximum speed of 20 mph while powered solely by the electric motor implies the option of pedal-assist or throttle control.

Additionally, the definition leaves ambiguous key performance metrics that determine the operating speed and acceleration potential:

- There is no statement about whether the 750 watts refers to (1) peak power or continuous power, or (2) electrical vs mechanical power.

- The definition sets a speed limit for operation with a throttle but not for operation in a pedal-assist mode.

HR 727 (2002) also establishes that low-speed electric bicycles are not considered motor vehicles at the federal level but rather are "consumer products" and thus subject to regulation by the Consumer Product Safety Commission (CPSC). This determination is denoted in Title 49 of the U.S. Code, Section 30102, subsection on Statutory Notes and related Subsidiaries.

Additional technical specifications on bicycles in general, including low-speed electric bicycles can be found in Title 16 of the Code of Federal Regulations, Part 1512.

HR 727 was passed over two decades ago, and as evidenced by discussions in this report, much has happened in the realm of electric bicycles since then. No further federal legislation regulating electric bicycles has been passed since then[2], but there have been proposals for further action by the CPSC. In 2024, the Commission gave public notice that they were considering "developing a rule to address the risk of injury associated with electric bicycles" (Consumer Product Safety Commission, 2024) and solicited public comment. In 2025, the CPSC initially voted to advance new standards on lithium-ion batteries used in electric bicycles and other products. However, the proposed standards were withdrawn following the firing of the three CPSC commissioners who supported the standards (Liptak & Montague, 2025).

2 Title 23 of the U.S. Code, Section 217 (last amended in 2021) includes definitions of electric bicycles beyond those found in 15 USC 2085. Specifically, 23 USC 217 refers to the three class system of electric bicycles seen in most US states. The definitions of electric bicycles found in 23 USC 217 appear to only be present for the purposes of interpreting the rest of 23 USC 217, which covers the funding and planning of bicycle and pedestrian-related infrastructure.

2.3 STATE DEFINITIONS OF ELECTRIC BICYCLES

As more and more electric bicycles have appeared on U.S. streets in the past decade, states have further defined and regulated electric bicycles. In state regulations, *electric bicycle* is the most common term used in state vehicle codes to describe bicycles with electric motors. However, some states use other terms such as *electric-assisted bicycle*, *electric power-assisted bicycle, low-speed electric bicycle*, *bicycle with electric assistance*, and *pedalcycle with electric assist*.

2.3.1 The three-class system that most states follow

Most U.S. states, including California, have adopted a similar framework defining three classes of electric bicycles. In line with the Federal Consumer Product Safety Act, states using the three-class system generally set a maximum power of 750 watts. Importantly, as with the CPSC definition, California's definition of electric bicycles power is ambiguous because the definition does not specific whether the 750-watt maximum is peak vs. continuous power, or electric vs. mechanical power.

The three classes differ based on two factors: what an operator needs to do for electric power to be applied and the speeds at which power can be applied, as shown in Table 1. Class 1 and Class 3 electric bicycles are "pedal-assisted" electric bicycles, meaning that a rider must be pedaling in order for the motor to provide electric assistance. By contrast, Class 2 electric bicycles are throttle activated: the rider does not have to be pedaling for electric power to be provided. Most Class 2 bicycles also provide pedal assist.

Table 1. Three-class electric bicycle categorization system adopted by California and most U.S. states

	Class 1	**Class 2**	**Class 3**
Electric power is applied:	Only when rider is pedaling	When rider is pedaling *or* by hand throttle	Only when rider is pedaling
Speed above which power will no longer be applied	20 mph	20 mph	28 mph

For Class 1 pedal-assisted electric bicycles and Class 2 throttle electric bicycles, electric assistance may only be provided when the device is traveling up to 20 mph, a speed that a strong cyclist on a pedal bicycle can achieve on flat ground. For Class 3 pedal-assisted electric bicycles, the assist speed limit is 28 mph. Devices of all three classes can reach faster speeds from human propulsion or gravity, but the motor does not engage above the 20 mph or 28 mph limit.

The fact that Class 3 electric bicycles can reach 28 mph in the three-class system is noteworthy, given that the previously mentioned federal definitions include a 20-mph maximum speed. However, the federal definition only refers to maximum speed when *solely* on motor power. Class 3 electric bicycles require operators to pedal to receive electric assistance above 20 mph, apparently avoiding conflict with the federal definition. Class 2 electric bicycles, which can be operated solely on motor power, are capped at 20 mph.

The three-class system seen in most U.S. states is based on a definition that has been recommended since the mid-2010s by a bicycle manufacturer/retailer trade group, PeopleForBikes. As of the writing of this report, at least 43 states have enacted legislation following some version of the PFB's Model Electric Bicycle Law and its three-class system, making it the closest that exists to a national standard (PeopleForBikes, 2024).

2.3.2 California's modified three-class system

In 2015, California was the first state to adopt of the PFB three-class system, and through 2024, the California Vehicle Code defined electric bicycles using essentially identical language to that in PFB's Model Electric Bicycle Law. Since then, however, the legislature has modified the definitions. As of the writing of this report, California's definitions are still conceptually congruent with the core of the PFB model (three classes, pedal-assist and throttle, 20 and 28 mph assistance limits), but details have changed following the enactment of Senate Bill 1271 (2024), which took effect January 1, 2025.

The complete current text of the definition for electric bicycles in California is located in California Vehicle Code Section 312.5, sub-section A generally defines what an electric bicycle is" and defines the three classes, and reads as follows:

> (a) An "electric bicycle" is a bicycle equipped with fully operable pedals and an electric motor that does not exceed 750 watts of power.
>
> (1) A "class 1 electric bicycle," or "low-speed pedal-assisted electric bicycle," is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, that is not capable of exclusively propelling the bicycle, except as provided in paragraph (4), that ceases to provide assistance when the bicycle reaches the speed of 20 miles per hour, and that is not capable of providing assistance to reach speeds greater than 20 miles per hour.
>
> (2) A "class 2 electric bicycle," or "low-speed throttle-assisted electric bicycle," is a bicycle equipped with a motor that may be used exclusively to propel the bicycle, and that is not capable of providing assistance when the bicycle reaches the speed of 20 miles per hour.
>
> (3) A "class 3 electric bicycle," or "speed pedal-assisted electric bicycle," is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, that is not capable of exclusively propelling the bicycle, except as provided in paragraph (4), and that ceases to provide assistance when the bicycle reaches the speed of 28 miles per hour, and equipped with a speedometer.
>
> (4) A class 1 or class 3 electric bicycle may have start assistance or a walk mode that propels the electric bicycle on motor power alone, up to a maximum speed of 3.7 miles per hour.

Among the changes made by Senate Bill 1271 (2024) was the addition of additional, descriptive names of the three classes: “low-speed pedal-assisted electric bicycle” (Class 1), “low-speed throttle-assisted electric bicycle” (Class 2), and “speed pedal-assisted electric bicycle” (Class 3). This terminology is unique to California.

Class 1 and Class 3 electric bicycles generally require a rider to pedal for electric power to be provided. However, Senate Bill 1271 legalized a “start assistance or walk mode” which provides throttle power (without pedaling) up to 3.7 mph. This small amount of power is useful if an individual is walking a device rather than riding it (and thus not pedaling), or for riders who need help getting their bicycle started from a stand-still. The speed limit of 3.7 mph was presumably chosen to align with European Union regulations that allow a walk mode that provides power up to 6 kph (or 3.7 mph).

2.3.3 Other variations seen in U.S. states

New York

New York defines three classes of electric bicycles. The definitions for Class 1 and Class 2 match states following the PFB model law, however New York’s Class 3 definition is notably different. New York’s Class 3 covers throttle-activated electric bicycles with a max speed of 25 mph (New York Vehicle & Traffic Law Section 102-C [2024]). This conflicts with the aforementioned Title 15 of the U.S. Code, Section 2085 which limits electric bicycles to 20 mph when fully powered by the motor.

Additionally, New York only allows Class 3 electric bicycles in cities with a population of one million or more, which de facto prohibits them outside of New York City.

States that define a single class of electric bicycles

Most of the states that have not adopted the three-class system have a singular definition of electric bicycles. The definitions in most of these states are generally compatible with Class 1 and Class 2 electric bicycles as defined in the PFB model law, though exceptions exist. For example, in Hawaii, North Carolina, and South Carolina, devices may have a top assisted speed of 20 mph and motor power is capped at 750 watts. However, Montana does not set a maximum wattage, though the state caps motor-assisted speed at 20 mph. Rhode Island also has a single definition of devices. Notably, they allow more powerful devices (2 horsepower or approximately 1,500 watts) with a top speed of 25 mph.

2.4 PRODUCT COMPONENT AND LABELING SPECIFICATIONS

Related to the performance definitions of electric bicycles are three other requirements that relate to the physical device itself: safety standards for the construction and components of bicycles (and, by extension, electric bicycles); safety standards for batteries; and electric bicycle class labeling on the device.

2.4.1 Bicycle safety standards

Because electric bicycles are defined as a type of bicycle by both the CPSC and the State of California, electric bicycles sold in California must also comply with CPSC bicycle safety standards. The CPSC has adopted bicycle safety requirements by setting dozens of standards for how bicycles are assembled and for the functioning of components such as brakes, structural integrity, and reflectors (Title 16 of the Code of Federal Regulations, Part 1512). For example, the bicycle may not have sharp metal edges that would cut the rider, control cables must be capped or otherwise prevented from unraveling, and the brakes must be capable of stopping within 15 feet under certain test speeds and other conditions. Section 24016 of the California Vehicle Code states that electric bicycles must "comply with the equipment and manufacturing requirements for bicycles adopted by the United States Consumer Product Safety Commission (16 C.F.R. 1512.1, et seq.)"

2.4.2 Battery safety standards

The California legislature recently adopted battery safety standards for electric bicycles through Senate Bill 1271 (2024). As of January 1, 2026, all electric bicycles and other powered mobility devices that are sold or leased in the state must have batteries certified to meet safety standards set by UL 2849, EN 15194, or other standards that the State Fire Marshall should adopt.

At the federal level, both Congress and the CPSC have considered requiring electric bicycle batteries to meet safety standards (PeopleForBikes, 2025). The CPSC had begun a rulemaking process to consider requiring that electric bicycle batteries comply with UL 2849 standards, but that process is on hold and it is unclear when it may resume. As for Congress, in 2025 both the House and Senate have been considering legislation directing the CPSC to require that batteries for electric bicycles and other electric mobility devices meet UL safety standards.

Some cities have also adopted battery standards. Notably in 2023, New York City enacted a battery and electronics certification requirement for powered micromobility devices following a spate of deadly fires in residential buildings. Devices cannot be sold or rented unless their batteries and electrical systems have been "certified by an accredited testing laboratory for compliance" with standards including Underwriters Laboratories (UL) standards 2272 and 2849, or other standards "established by rule in consultation with the fire department" (New York City Local Law 39, 2023).

2.4.3 Labeling requirements

The PFB Model Law, Section 201 includes a requirement that electric bicycles be labeled as such. California has adopted this suggested labeling requirement verbatim. California Vehicle Code Section 312.5, subsection C states that "manufacturers and distributors of electric bicycles shall apply a label that is permanently affixed, in a prominent location." Each label should include "the classification number, top assisted speed, and motor wattage of the electric bicycle, and shall be printed in Arial font in at least 9-point type."

One challenge to identifying devices based on the presence, absence, and/or content of a decal is that decals are openly available for the purchase on the internet. Figure 3 shows Google Shopping results for a search on "electric bicycle class sticker."

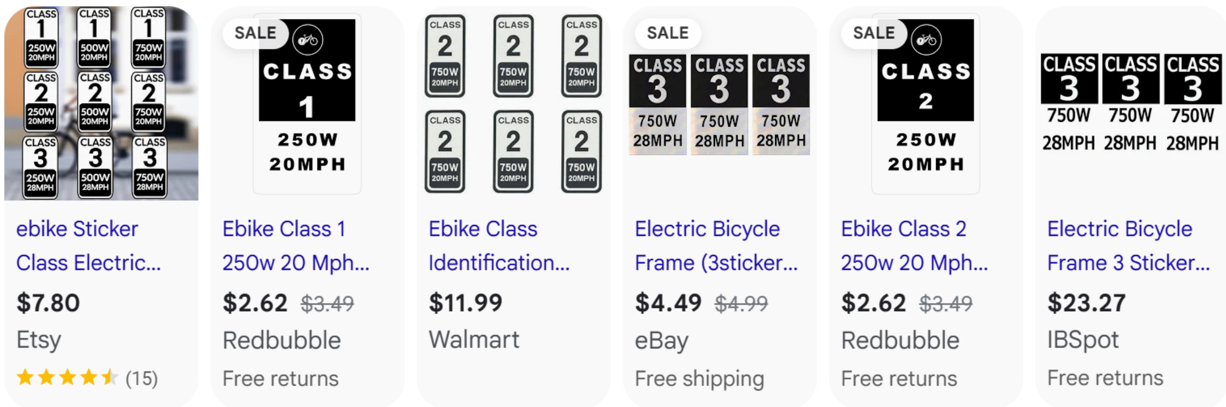


Figure 3. Google Shopping results for electric bicycle class sticker

2.5 BICYCLE-SHAPED CONVEYANCES WITH MORE POWERFUL MOTORS AND FASTER SPEEDS THAN THE THREE-CLASS SYSTEM ALLOWS

In California and the U.S. states that generally follow the three-class framework, electric bicycles are limited to 750 watts of motor power. Additionally, the devices use software to stop providing motor assistance above 20 mph (Class 1 and Class 2) or 28 mph (Class 3). However, there are many electric-powered, bicycle-shaped devices offered for sale that have motors more powerful than 750 watts (sometimes much more so), top speeds exceeding 28 mph, and/or throttles that will take the device past the 20 mph limit for throttle electric bicycles. These devices are sometimes referred to as "out-of-class" devices (Marin County Bicycle Coalition, 2023; McLeod, 2024; Maa, Doucet, Ignacio, & Alfrey, 2024) or "e-motos" (PeopleForBikes, 2025; Wright, 2025)..

Because these devices are not "electric bicycles" under California law, they are not legal to ride on public streets or, potentially, even on off-road facilities open to the public like mountain biking trails. However, and controversially, some retailers market higher-power devices as meeting the standards for Class 2 electric bicycles because the devices offer an optional setting that limits them to Class 2 power and maximum assisted speed.

Table 2 shows four examples of higher-power devices with motor power and speeds beyond the three-class system.

Table 2. Examples of devices with motor power and speeds that exceed rules under the three-class system

	Model name	Advertised motor power	Has throttle	Advertised top speed
	Lyric Graffit Electric Bike	1000 watts (continuous*) 2300 watts (peak)	Yes	33+ mph
	Segway Xyber Electric Bike	3000 watts [1 battery] or 6000 watts [2 batteries] (continuous)	Yes	35 mph
	Aipas M2 Pro Xterrain Bike	1800 watts (continuous/ peak not specified)	Yes	36+ mph
	Freesky Warrior Pro M-530: Dual-motor all terrain ebike	2000 watts (continuous) 3500 watts (peak)	Yes	38 mph

Sources: https://lyriccycles.com/collections/electric-bikes/products/graffiti, https://store.segway.com/segway-ebike-xyber, https://aipasbike.com/products/aipas-m2-pro-xterrain-ebike, https://www.freeskycycle.com/collections/e-bikes/products/warrior-pro-m-530

Note: Peak power is the maximum power that the motor can ever generate. However, a motor cannot sustain this power level over an extended period. Continuous power is the power level that a motor can generate indefinitely. A motor's continuous power is always much lower than its peak power.

*The webpage for the Lyric Graffiti states two power levels. 2300 watts is specifically identified as peak power. The 1000-watt figure does not have a descriptor, but is implied to be continuous here.

2.5.1 Marketing higher-power/higher-speed devices as off-road or all-terrain devices

Sometimes these higher-power devices are overtly marketed for off-road use, such as mountain biking. Two of the models in Table 2, the *Aipas M2 Pro Xterrain Ebike* and the *Freesky Warrior Pro M-530: Dual-motor all terrain e-bike*, have names/descriptions that imply off-road usage. Additionally, webpages profiling some models highlight off-road uses in text and imagery. For example, Figure 4 shows the website of *The Mule e-bike* by Bakcou featuring a hunter in camouflage gear riding off-road in mountainous terrain.

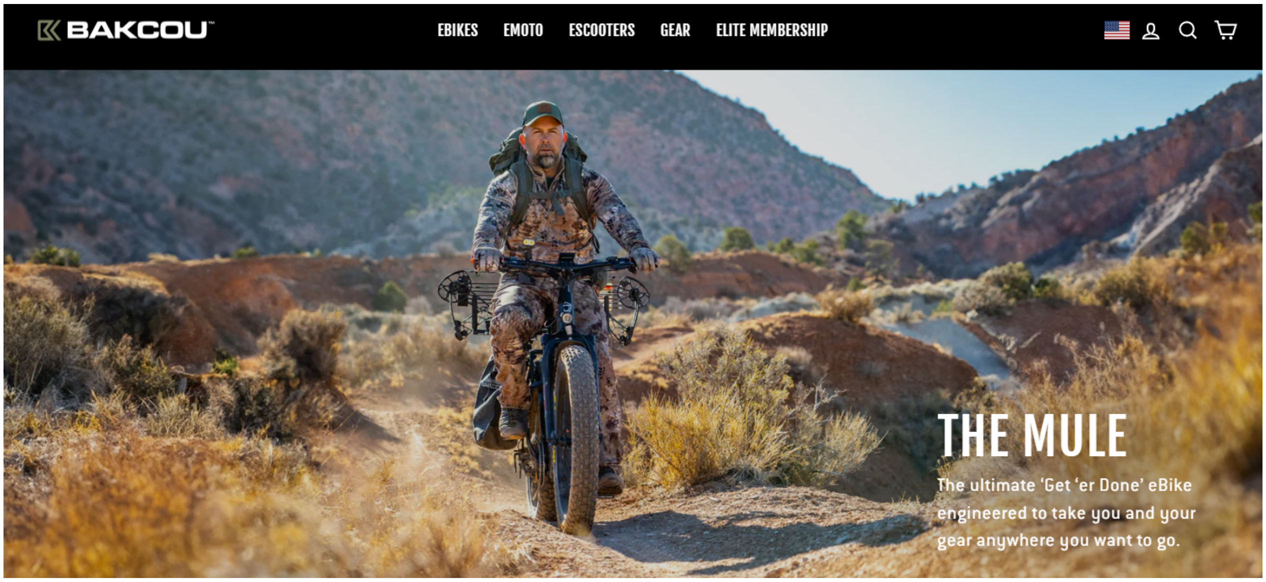


Figure 4. Screenshot of webpage of The Mule e-bike by Bakcou highlighting off-road use

Source: Screenshot of https://bakcou.com/products/mule-fat-tire-electric-bike (accessed September 20, 2025)

However, the marketing for these devices do not always stick to solely off-road examples; some advertising materials include mention of city riding, even if this is not prominent. For example, the webpage for the Freesky Warrior says "The Warrior is engineered to dominate diverse terrains," with one of these diverse terrains being "city streets."

2.5.2 Marketing higher-power devices as legal electric bicycles

Many devices marketed as Class 2 or Class 3 electric bicycles do not fit into the classification either because the motor is more powerful than 750 continuous watts or because the advertised top assisted speed is above the 20/28 mph limit. For some of these devices, manufacturers offer software settings that limit the motor to 750 watts of output, and do not provide electric assistance above 20 or 28 mph. In some cases, this limited setting is the default setting that the device is delivered in. However, by simply changing the settings, operators can take full advantage of a device's greater power and higher assisted speeds.

The following three examples illustrate this kind of marketing:

- The webpage for the Lyric Graffiti (Figure 5) states in the FAQ section that the device "can be operated as a Class 2 eBike with a 20 mph/32kmh top-speed." However, the webpage also notes that "the bike can be unlocked in the settings to reach top speed," which is stated as 33+ mph.
- Another example is the Aipas M2 Pro Xterrain Ebike (Figure 6). While the name of the device implies off-road use, the manufacturer's product description page has a section on urban commuting use cases. This section of the webpage states the device can go at assisted speeds from 20 mph (Class 2) to up to 36 mph. The page also erroneously indicates that a device going at 36 mph is a Class 3 device.
- Figure 7 shows a screenshot of an instructional video by device brand Bakcou that describes the simple way to switch the device shown between 750 watts and 1000 watts of power output.

Do I need a drivers license to ride? –

No, the Lyric Graffiti can be operated as a Class 2 eBike with a 20mph / 32kmh top-speed. For these types of vehicles a license is not required in Canada or the United States.

Please check your Federal, State, and Municipal eBike laws, as these can vary widely. Typically a top-speed will be prescribed for your area, and we recommend following your local laws.

The bike can be unlocked in the settings to reach top speed. These settings on the Lyric Graffiti should be used on private land and for off-road use only.

What is the top speed? –

Top speed is a function of voltage and the parameters of your motor. Watts are overall power, but they do not dictate top speed. The Graffiti has been designed to deliver more low end torque, and the top speed of the bike, while still fast, is 33+ mph.

Figure 5. Selections from the FAQ section for the Lyric Graffiti advertising both a 20 mph (Class 2) top speed and 33+ mph top speed

Source: Screenshots from https://lyriccycles.com/collections/electric-bikes/products/graffiti (accessed September 20, 2025)

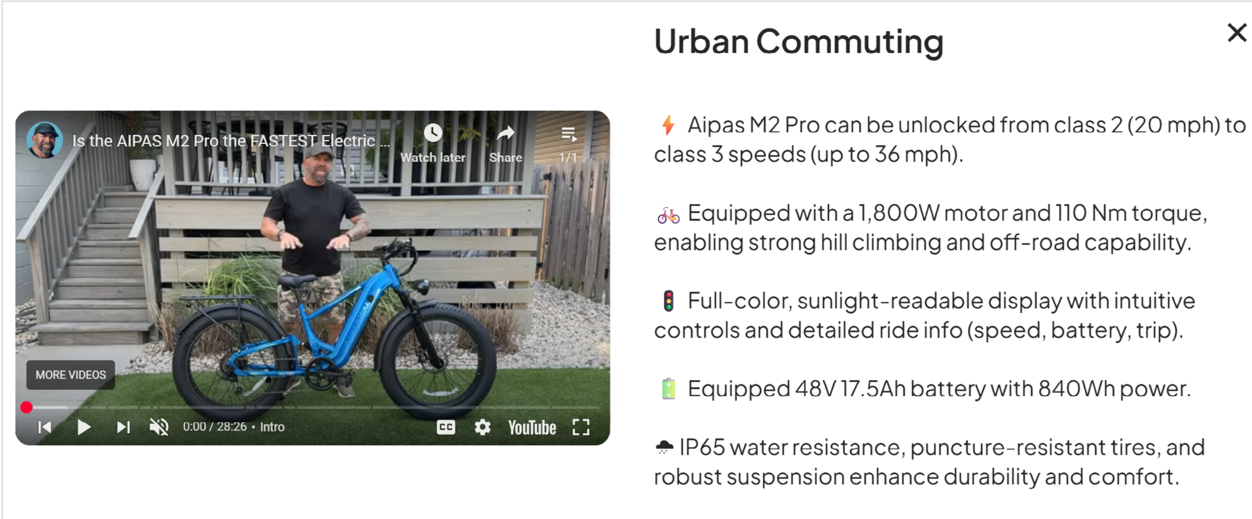


Figure 6. Webpage for the Aipas M2 Pro Xterrain Ebike highlighting limited (Class 2) and "unlocked" higher-power/higher-speed settings

Source: Screenshot from https://aipasbike.com/products/aipas-m2-pro-xterrain-ebike (accessed September 20, 2025)

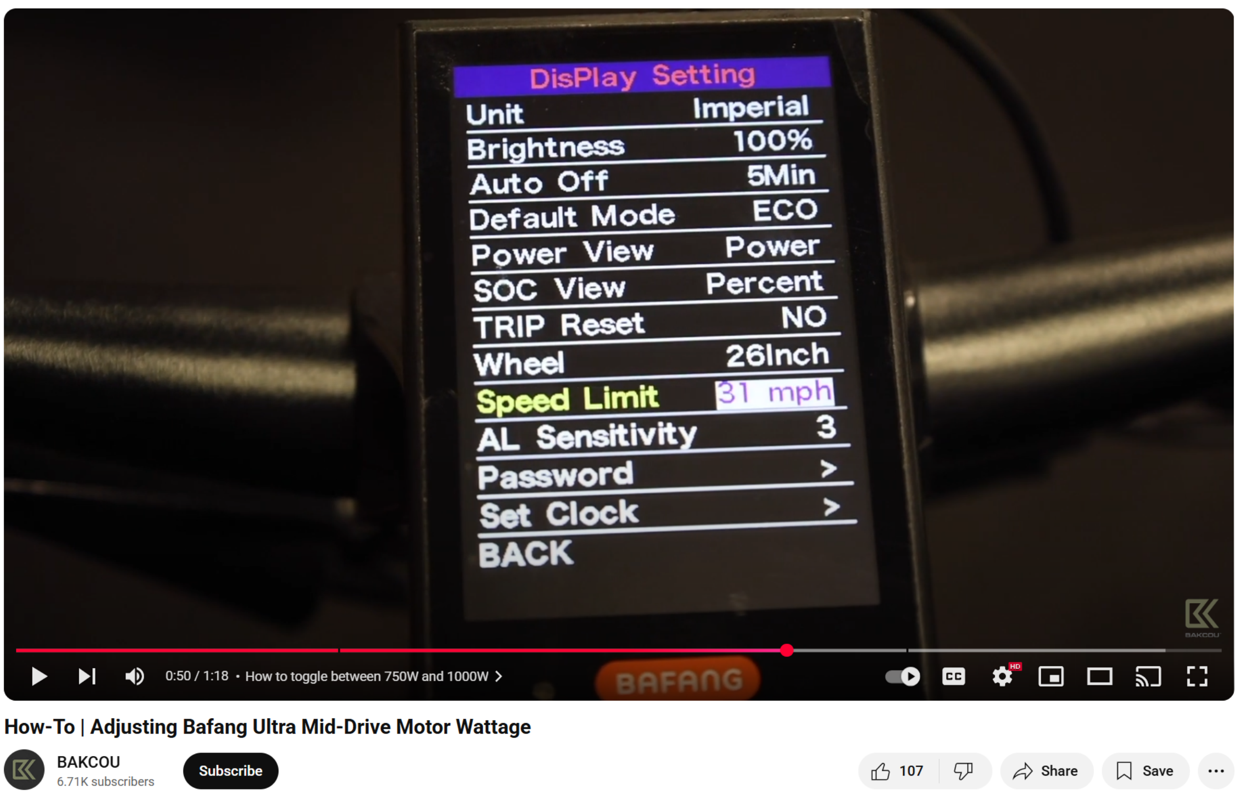


Figure 7. Screenshot of video on how to change power and speed settings on a device

Source: Screenshot from YouTube video – How-To | Adjusting Bafang Ultra Mid-Drive Motor Wattage, (accessed September 20, 2025)

The presence of devices that are switchable between 750-watt settings to much higher power settings highlight the significance of software and controllers in electric bicycles. As previously mentioned, electric bicycles frequently have control consoles and smartphone apps that allow users to change settings. Some manufacturers keep the adjustable power and speed settings compliant with Class 1, 2, or 3 rules and also actively try to prevent the unlocking of their devices above legal limits. Conversely, the devices shown in this section illustrate the opposite: manufacturers that allow owners to change easily to higher power and higher speed settings that exceed Class 1-3 maximums.

2.5.3 Marketing devices easily switchable between a 750-watt maximum setting and more powerful settings as "electric bicycles"

Federal code and the PeopleForBikes model law plainly state that electric bicycles can be equipped with an "electric motor that does not exceed 750 watts of power." As such, some have questioned whether a device that is software-limited to 750 watts of continuous power output but can easily be switched to exceed 750 watts complies with the codified power limit. Clearly however, some manufacturers have taken the perspective that their devices are street legal when switched to a setting that regulates the device to match the specifications for a specific electric bicycle class, even though the device can be *easily switched* to a higher power and speed setting.

The four examples of higher power devices shown in Table 2 all have power outputs greater than 750 watts. A government could conceivably enact a regulation defining that such devices are not electric bicycles since their hardware can produce power levels *in excess* of 750 watts. However, there are challenges to such an approach. Experts we talked to with experience in electric bicycle mechanics/electronics described that manufacturers generally use software to stay within maximum power and speed regulations, even those that do not provide easy ways to unlock that greater power. In other words, devices strictly locked with software to a maximum of 750 watts may have hardware that technically is capable of greater power.

The edits to the California Vehicle Code enacted by Senate Bill 1271 (2024) added language declaring that devices where manufacturers *intend* for operators to be able to unlock higher power and higher speed settings do not qualify as "electric bicycles" in California, and cannot be sold, marketed, or labeled as such. This is now noted in California Vehicle Code Section 312.5, sub-section D which reads as follows:

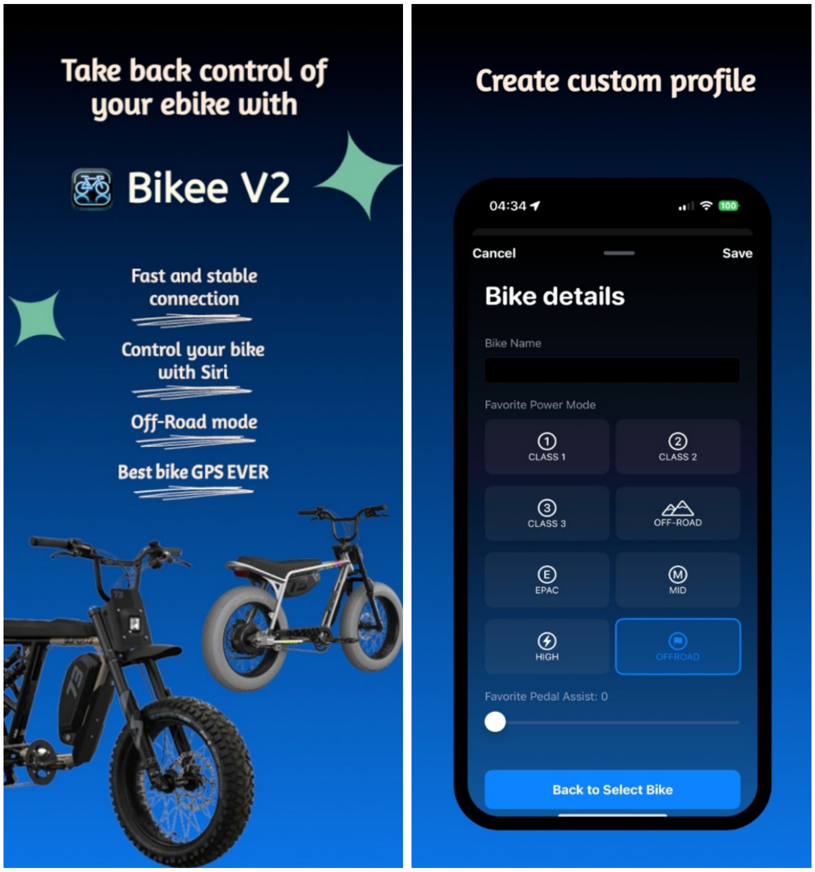
> (d) The following vehicles are not electric bicycles under this code and shall not be advertised, sold, offered for sale, or labeled as electric bicycles:
>
> (1) A vehicle with two or three wheels powered by an electric motor that is intended by the manufacturer to be modifiable to attain a speed greater than 20 miles per hour on motor power alone or to attain more than 750 watts of power.
>
> (2) A vehicle that is modified to attain a speed greater than 20 miles per hour on motor power alone or to have motor power of more than 750 watts.
>
> (3) A vehicle that is modified to have its operable pedals removed.

While Senate Bill 1271 targets manufacturers who intend for their devices to be unlockable to higher powers and speeds, it does not restrict manufacturers from having higher-power hardware itself, so long as the device is not designed or marketed to be modifiable to reach power levels greater than 750 watts.

There is evidence that some manufacturers have responded to Senate Bill 1271 by removing sanctioned unlocking of devices. For example, manufacturer Super73 now has language on the webpages for various models that says users “who download and pair the of SUPER73 app after January 1, 2025, will not have the ability to access modes other than the Class 2 mode in which the product is sold” (McCoy, 2025).

2.5.4 Using third-party apps to unlock higher power and speed settings

While Super73’s official app has been limited to Class 2 levels as of 2025, users wanting to unlock higher speeds may still be able to do so via third party apps. For example, the *Bikee* app, available on both the Apple App Store and Google Play, has an advertising slogan of “Take back control of your ebike” (Figure 8). Positive reviews of Bikee on the Apple App Store specifically mention users turning to the app once the aforementioned official Super73 app no longer had an option to unlock above 20 mph.



×

★★★★★

Gejdngxjd, 02/23/2025

Best app ever!
I have had a super 73 for 2 years now. One of the reasons I got a super 73 was because it could go faster than 20mph. When I saw you could not switch it to off road mode anymore I call my local shop to ask them. That is how I ended up here. This is the best $8.99 that I have ever spent! I also noticed that it is a little bit faster. I would highly recommend it if you have a super 73.

Figure 8. Screenshots from the *Bikee* app and reviews
Source: https://apps.apple.com/us/app/bikee/id6736371607

2.5.5 Disclaimers that higher-power, higher-speed settings are for use off-road or on private property

Device marketing materials do sometimes provide disclaimer material stating that if their devices are in settings that provide more than 750 watts and travel faster than 20/28 mph, then they are not street legal. For example, the FAQ section on the webpage for the Lyric Graffiti says that while "the bike can be unlocked in the settings to reach top speed," these settings "should be used on private land and for off-road use only."

Similarly, the webpage for the Segway Xyber Electric Bike states that the device is "recommended for riders 18 years and older, and for off-road use only." Additionally, the specification section of the webpage says, "Warning: this product is for off-road use only, not an on-road ebike."

2.6 MULTIPLE-CLASS DEVICES

One way to interpret the three-class system is that it creates three distinct classes of electric bicycles. A device can thus be either Class 1 *or* Class 2 *or* Class 3. However, some brands sell devices that have characteristics of multiple classes (e.g., Class 1 and 3, Class 2 and 3). Figure 9 shows information provided on the website advertising one such device, the *Ford Mustang eBike*. Like a Class 2 electric bicycle, it can reach 20 mph on throttle power and like a Class 3, it can reach 28 mph if the operator is pedaling.

Multiple-class devices are conceptually legal under federal definitions for electric bicycles so long as they are limited to 20 mph on throttle-power only. However, California's rules appear to prohibit multiple mode devices. The definitions for Class 1 and Class 3 read that vehicles in these classes must be "not capable of exclusively propelling the bicycle," except for the aforementioned walk mode in California Vehicle Code Section 312.5, sub-section A-4.

The PFB model law does not rule out multiple-class devices. At least two states, Minnesota and Utah, have taken the opposite approach to California, explicitly allowing devices that are switchable between Classes 1, 2, and/or 3. Minnesota defines multiple-class devices as "multiple mode electric-assisted bicycles" (Minnesota Transportation Statutes, Section 169.011, Subdivision 45a) and Utah defines them as "programmable electric assisted bicycles" (Utah HB 85 [2024]).

Power	750W* Motor with four modes: Eco, Normal, Sport, and Track • ECO – Energy conservation for long rides • TRAIL – A set-it-and-forget-it balance of power and efficiency • SPORT – Extra oomph for when the conditions demand more • TRACK - all-out performance Class 2: 20MPH** with throttle Class 3: 28MPH** without throttle

Figure 9. Product information from website for the *Ford Mustang eBike*

Source: https://ford-bikes.com/products/mustang-electric-bike

2.7 MOTORIZED SCOOTERS

A recent addition to the bicycle-shaped device category is seated e-scooters, which under California law are called “motorized scooters.” Because these devices do not have operable pedals, they are not legal electric bicycles. Some seated e-scooters look like lightly modified standing e-scooters, though others look like bicycles. For example, Figure 10 shows two types of e-scooters from shared micromobility company Lime, their Gen4 standing e-scooter and their Gen4 seated e-scooter. While the seated Lime Gen4 seater e-scooter does not look too much like a bicycle, other versions with larger seats and wheels start resembling bicycles.

Figure 10. Lime Gen4 standing and seated e-scooter

Source: https://www.li.me/vehicles

Figure 11 and Figure 12 show seated e-scooters that look much more like a bicycle. The Veo Cosmo S seated e-scooter is available both through sharing services and for purchase by consumers. Figure 12 shows a 2025 electric bicycle model by Lime as well as a newer concept called the LimeGlider. The LimeGlider and LimeBike are strikingly similar in shape and form. For example, Lime’s electric bicycle and Glider both feature 20-inch diameter wheels and 2.5-inch-wide tires.

While resembling bicycles in shape, both the Veo Cosmo and LimeGlider lack pedals, placing them outside dictionary and regulatory definitions of bicycles, even though other key performance characteristics would seem to qualify them as electric bicycles. For example, both have slightly lower top speeds versus Class 1 and Class 2 electric bicycles. The LimeGlider has a top speed of 15 mph and the for-sale versions of the Veo Cosmo has a maximum speed of 17 mph. As for wattage, the Veo has a 500 watt motor and, while Lime does not publicly state the power of its LimeGlider motor, previous generations of the electric bicycle had a motor power of 350 watts (Hawkins, 2022).

Figure 11. Veo Cosmo S seated e-scooter

Source: https://www.veoride.com/cosmo/

Figure 12. LimeBike (2025 model, left) and Lime Glider (right)

Source: https://www.li.me/blog/introducing-the-limebike-limeglider-our-most-inclusive-rides-yet

2.8 GAS-POWERED DEVICES: MOTORCYCLES, MOTOR-DRIVEN CYCLES, MOPEDS, AND MOTORIZED BICYCLES

The preceding sections of this chapter highlight that there is a gradient of two-wheeled, seated devices with electric motors that vary in speed and power. While two-wheeled electric-powered devices have only recently been defined in California law, a similar gradient of gas-powered devices with different capabilities has existed for decades.

2.8.1 Federal definitions of motorcycles and motor-driven cycles

Unlike all the other device types discussed in this chapter, these are the only devices that are subject to motor vehicle safety regulations from the National Highway Transportation Safety Administration (NHTSA). NHTSA defines motor vehicles as "a vehicle that is driven or drawn by mechanical power and manufactured primarily for use on public streets, roads, and highways." At the federal level, Title 49 of the U.S. Code, Part 571, Section 571.3 defines two types of two-wheeled or three-wheeled, seated devices that are classified as motor vehicles at the federal level: motorcycles and motor-driven cycles. Motorcycles are defined as a "motor vehicle with motive power having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground." Motor-driven cycles are a lower-powered form of motorcycles that produce a maximum of five horsepower.

The NHTSA Office of Vehicle Safety Compliance (OVSC) further notes on its importation and certification page that motorcycles and motor-driven cycles need to comply with Federal Motor Vehicle Safety Standards (FMVSS) and "bear a label certifying such compliance that is permanently affixed by the original manufacturer" (National Highway Traffic Safety Administration, 2025). The FMVSS standards are intended to reduce the likelihood of crashes, as well as the survivability of crashes. To meet this objective, the regulations outline a long set of very detailed requirements that included required components that vehicles must include, as well as minimum standards for the durability and safety of component parts and systems. Examples of safety requirements that apply to two-wheeled powered devices are that the device must have turn signals and side-view mirrors, as well as meet stringent brake performance standards.

Beyond motorcycles and motor-driven cycles, there are other gas-powered two-wheelers on the market such as motorized bicycles, mopeds, and gas-powered dirt bikes. NHTSA does not define terms beyond motorcycles and motor-driven cycles, but NHTSA does say that states are free to define such vehicles and regulate them.

2.8.2 California definitions of motorcycles, motor-driven cycles, and motorized bicycles/mopeds

The California Vehicle Code establishes definitions for three gas-powered device types that are legal for street use: motorcycles, motor-driven cycles, and motorized bicycles/mopeds.

California defines motorcycles with a nearly identical definition to the federal rules. Section 400 of the California Vehicle Code defines a motorcycle as “a motor vehicle having a seat or saddle for the use of the rider, designed to travel on not more than three wheels in contact with the ground.”

Motor-driven cycles as defined in California are again a subset of motorcycles. However, California differentiates motor-driven cycles from motorcycles based on engine displacement volume rather than horsepower. Section 405 of the California Vehicle Code defines motor-driven cycles as “any motorcycle with a motor that displaces less than 150 cubic centimeters.”

Motorized bicycles and *mopeds* are synonymous under California law. These terms encompass two-wheeled (or three-wheeled) devices that are motorized, but are slower and less powerful than motorcycles and motor-driven cycles. Section 406 of the California Vehicle Code defines motorized bicycles/mopeds as having motors that generate less than 4 horsepower (approximately 2,942 watts) and have a top speed of 30 miles per hour on level ground. Additionally, Section 406 specifies that motorized bicycles/mopeds are equipped with automatic transmissions.

Section 24015 of the California Vehicle Code requires motorized bicycles/mopeds be equipped with certain features. Notably, motorized bicycles/mopeds must meet federal motor vehicle safety standards that apply to motor-driven cycles, such as lamps, reflectors, and “adequate” brakes, as well as mirror and a horn.

Section 12500 of the California Vehicle Code requires that operators of motorcycles, motor-driven cycles, and motorized bicycles/mopeds have a driving license. Section 5030 – 5039 of the California Vehicle Code also requires that motorized bicycles/mopeds display a license plate.

2.8.3 Would electric two-wheelers that are not electric bicycles be motorcycles, motor-driven cycles, or motorized bicycles/mopeds under California law?

Earlier, we discussed the presence on the market of electric two-wheelers that are not electric bicycles due to their high motor powers and high speeds. If such devices are not electric bicycles, could they qualify as motorized bicycles/mopeds, motor-driven cycles, or motorcycles in California? This is possible, although perhaps unlikely for various reasons.

Motorized bicycles/mopeds

The motorized bicycle/moped definition in Section 406 of the California Vehicle Code does not specifically mention gasoline or internal combustion engines, so the definition does not rule out electric devices. In terms of motor power, motorized bicycles/mopeds are limited to 4 horsepower (~3,000 watts). Some, but not all higher-powered devices have motor power under 3,000 watts. In terms of speed, motorized bicycles/mopeds are limited to 30 mph. All four higher-speed devices shown in Table 2 have speeds greater than 30 mph, making them ineligible to be considered motor bicycles/mopeds. Higher power electric devices may also not qualify as motorized bicycles/mopeds due to the lack of automatic transmissions, which are uncommon on electric bicycles, and the requirement that motorized bicycles/mopeds meet federal motor vehicle safety standards (FMVSS) for motor-driven cycles.

Motor-driven cycles and motorcycles

It does not appear that higher-power electric devices can qualify as motor-driven cycles in California because Section 405 of the California Vehicle Code defines their motors in terms of internal combustion engine volume, thus implying that the devices must have an internal combustion engine. Electric devices could potentially qualify to be motorcycles, but in this case they would need to meet federal motor vehicle safety standards (FMVSS) for motorcycles to be street legal.

2.9 CALIFORNIA DEFINITIONS OF POWERED TWO-WHEELED DEVICES FOR OFF-ROAD USE

California establishes rules that create classes of vehicles that may not be used on public streets and roads, but nevertheless may be ridden in other locations. Some two-wheeled, powered devices fall into two of these categories: off-road vehicles (OHVs) and "pocket bikes."

2.9.1 Off-highway motorcycles

Off-highway motorcycles, a type of OHV, may be used *on lands open to the public that are not roads and highways*, as well as on private land (California Vehicle Code Section 436). OHVs may not be ridden on public roads and highways; they are legal only on "lands open and accessible to the public," such as park trails. Other examples of OHVs are all-terrain vehicles (ATVs), trail bikes, dune buggies, and snowmobiles (California Department of Motor Vehicles, 2025).

Owners who wish to ride OHVs on public lands like park trails do not need to register OHVs annually, like a car or motorcycle, but they must nevertheless "display an ID plate or placard issued by DMV." The current proof of registration for an OHV is in the form of a sticker: the Red Sticker or Green Sticker. Devices that meet emissions standards established by the California Air Resources Board (CARB) get the Green Sticker while those that do not meet emission standards get the Red Sticker (California Department of Motor Vehicles, 2025).

Figure 13. Example of off-highway vehicle (OHV) with California OHV registration green sticker

Source: https://offroadplates.com/products/dirt-bike-ohv-sticker-plate-for-front-forks (product page for a registration sticker mount)

Since at least 2024, the California Department of Parks and Recreation, in guidance offered to law enforcement agencies, has interpreted that electric two-wheeled devices that do not qualify as electric bicycles or motorized bicycles/mopeds are OHVs requiring OHV registration (green sticker) (California State Parks - Off-Highway Motor Vehicle Recreation Division, 2024).

Senate Bill 586 (2025), enacted in October 2025, clarified that OHVs includes electric devices by creating a new category, "off-highway electric motorcycles." This definition has been incorporated into Section 436.1 of the California Vehicle Code.

2.9.2 Pocket bikes

California has yet another category of two-wheeled motorized device, *pocket bikes*, and these can only be ridden on *private* land, such as ranches or closed-course racetracks (California Vehicle Code, Section 473). Pocket bikes are traditionally very small, two-wheeled motorized devices that look like motorcycles but have not been manufactured to meet federal motor vehicle safety standards in Title 49 of the Code of Federal Regulations. Because pocket bikes do not comply with those safety standards, pocket bikes may not be ridden on public streets and highways. In addition, the California Vehicle Code explicitly bans pocket bikes from being ridden on "lands open and accessible to the public."

In the absence of specific rules for electric two-wheelers that exceed power and speed rules for electric bicycles, some jurisdictions are classifying them as pocket bikes. For example, a social media post by the Huntington Beach Police Department, describing a Sur-ron brand device, stated that "for all intents and purposes, they are pocket bikes as defined in California Vehicle Code 473(a)."

2.10 A COMPARISON WITH INTERNATIONAL APPROACHES

In addition to the 50-state review, we conducted a short review of how 29 countries regulate electric-powered devices that may be used more or less the same way as a conventional bicycle (as opposed to higher-power devices that these countries regulate as mopeds or some form of motor vehicle). The countries reviewed were Australia, Austria, Belgium, Canada, Chile, China, Colombia, Denmark, England, Finland, France, Germany, Ireland, Israel, Italy, Japan, Kenya, the Netherlands, New Zealand, Norway, Poland, Scotland, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, and the United Arab Emirates.[3]

The U.S. approach to defining electric bicycle rules is by no mean common worldwide. Indeed, no other country that we reviewed used the three-class system, and almost every country requires a lower power output and lower maximum assisted speed for devices that are legally equivalent to a bicycle and may be ridden without a driving license. Also, some countries do not permit throttles on devices that may be ridden under the rules that apply to conventional bicycles. Finally, some countries add additional requirements, including maximum power assist ratios, maximum battery voltage, and maximum weight.

2.10.1 Power and speed

Table 3 show the speed and power maximums set in a select group of countries that were selected either because they have some of the largest electric bicycle markets in the world (China, Japan, European Union) or whose traffic environments are similar to the U.S. (Canada, New Zealand, Australia). The U.S. is a notable outlier with respect to both maximum watts and assisted speeds. The U.S. maximum wattage is three times more than Japan and the European Union, and half again higher than the next highest national wattage maximum, Canada. Notably, the U.S. and its states do not clarify whether the 750-watt limit is peak or continuous power. If the U.S. were to clarify that this is the peak power, then the U.S. standards for wattage would be in line with that of the other countries shown in Table 3. As for throttles, Canada and China allow throttles (these are allowed on Class 3 bicycles in the U.S.), but the other countries do not. Finally, with respect to assisted speeds, the 28 mph allowed for Class 3 electric bicycles in most states is considerably higher than all the other countries.

While wattage is typically the standard used to regulate how much power the motors produce, some countries have standards for other characteristics. For example, China specifies the maximum battery voltage. Japan specifies a maximum assist ratio of 2 (e.g., the motor can double the power the rider produces on the pedal, but not more.) Australia appears to have a related rule that dictates declining power assist as the travel speed rises, though we were unable to confirm the exact requirements. Finally, in 2025 the trade group for the German bicycle industry, ZIV, publicly advocated that the European Union add a maximum assist ratio of 4 to the pedelec rules.

3 This review was limited to materials available in English.

Table 3. Standards on speed and power in select countries for electric bicycles that can be operated without a driving license

County/ region	Maximum watts[a]	Throttle permitted[b]	Maximum assisted speed[c]	Other
United States	750 (federal limit)	No: Class 1 & 3 Yes: Class 2 (most states)	20 or 28 mph (most states)	
Canada	500 (federal limit)	Yes	20 mph (32 kmh)	
China	400	Yes	16 mph (25 kmh)	Limits battery voltage
New Zealand	300	Yes	none	
Australia	250 (most states, but New South Wales permits 500)	No	16 mph (25 kmh)	Power output must progressively reduce as travel speed increases
Japan	250	No	12 mph (20 kmh)	Power assist ratio set at 2; power output must progressively reduce as travel speed increases
European Union	250	No	16 mph (25 kmh)	Power output must progressively reduce as travel speed increases[d]

Note: Information about device definitions found online can sometimes be contradictory. Where possible, we cite information from official government sources. Some additional variances in standards may exist within a country across states, provinces, etc.
[a] Most countries specific that this is a continuous power limit (not a peak power limit). However, the U.S. does not specify whether 750 watts is continuous or peak power.
[b] Refers to a throttle that powers the bicycle to its maximum allowed speed. Some countries that don't allow full throttle control allow a "walk mode" throttle that powers the device only to a few miles per hour.
[c] For countries that set the rules in kilometers per hour, values are also converted to miles per hour, to facilitate comparison with U.S. standards.
[d] ZIV, the German bicycle industry trade group, is advocating for adopting a peak wattage of 750 and adding a maximum assistance ratio of 4.
Sources: Canada ("power assisted bicycles"): https://ebikecanada.com/e-bike-laws-in-canada/; China: https://medium.com/vision-zero-cities-journal/embracing-the-e-bike-boom-how-china-is-leading-on-regulations-and-infrastructure-6b3313f73c51, https://www.chinesestandard.net/PDF.aspx/GB17761-2018; New Zealand ("power-assisted cycles"): https://nzta.govt.nz/vehicles/vehicle-types/low-powered-vehicles, https://gazette.govt.nz/notice/id/2013-au4618/pdf, https://www.nzta.govt.nz/walking-cycling-and-public-transport/cycling/cycling-in-new-zealand/electric-bikes; Australia ("electrically power-assisted cycle"): https://www.transport.nsw.gov.au/operations/active-transport/e-bikes, https://www.transport.nsw.gov.au/system/files/media/documents/2024/crs_bikes_e-bikes_e-scooters.pdf, https://transport.vic.gov.au/road-and-active-transport/active-transport/bicycles/electric-bikes; Japan (specified small motorized bicycle; Dendo-assist Jitensha): https://www.npa.go.jp/bureau/traffic/anzen/tokuteikogata.html, https://www.npa.go.jp/english/bureau/traffic/document/Traffic_Rules_for_Specified_Small_Motorized_Bicycles.pdf, https://portal.jp-mirai.org/en/live/s/rules/bicycle-traffic-rules, https://www.seikatubunka.metro.tokyo.lg.jp/documents/d/seikatubunka/kick_board_eng; European Union ("pedelecs"; vehicle type L1e-A, per EU Directive 2002/24/EC): https://www.ziv-zweirad.de/en/e-bikes-active-mobility-crucial/

While the discussion above relates to electric bicycles that can be operated without a license, many countries also define another class of more powerful two-wheeled electric devices that require a driving license, registration, and insurance. For these devices, operators must follow the rules of the road that apply to mopeds. For examples, the European Union defines not only the pedelecs discussed above, but also a class of *speed-pedelecs* (vehicle type L1e-B, per EU Regulation 168/2013). Speed pedelecs have a maximum design vehicle speed of 28 mph (45 km/h), which is the same as the speed limit most U.S. states set for Class 3 electric bicycles. The speed pedelecs are allowed much more powerful motors, however—a maximum continuous rated power of 4,000 watts. These devices are regulated more or less like mopeds: they require registration, a driving license, and insurance, and operators must follow the rules of the road for mopeds and wear a moped-approved helmet (Hendriks, Köhler, & Schmidt, 2023).

2.10.2 Weight

Unlike in the U.S., some countries set a maximum weight for the device. This is often the “unladen” weight, without a rider or cardo. For example, Singapore sets a maximum weight of 20 kg (44 pounds) (Singapore Land Transport Authority, 2021), China sets a maximum weight of 55 kg (165 pounds) (National Standardization Administration (China), 2024) and the Canadian province of Ontario sets a maximum weight of 120 kg (265 pounds) (Ontario Minitstry of Transportation, 2024).

2.10.3 Dimensions

Unlike in the U.S., some countries set maximum dimensions for electric bicycles. For example, Singapore sets a maximum width of 70 cm (28 inches) for devices that may be ridden the same way as a conventional bicycle “to allow devices to cross each other safely on public paths” (Singapore Land Transport Authority, 2021). Also, Japan sets a maximum width of 60 cm (24 inches) and maximum length of 190 cm (75 inches) (Japan National Police Agency).

3. RULES OF THE ROAD FOR ELECTRIC BICYCLES

This chapter expands on the discussion in the previous chapter of how electric bicycles are regulated in the California Vehicle Code and compares the state's approach to that taken in other states and other countries.

To investigate the state of electric bicycle regulations, we conducted a review of state vehicle codes in all 50 states, on the presumption that vehicle codes are the most likely part of state law to contain rules of the road for electric bicycles. For context, we also searched for the rules in state vehicle codes that relate to bicycles: "bicycle-like devices" (e.g., mopeds) and other forms of micromobility, including standing e-scooters. The search primarily took place in the spring and early summer of 2024. Although we have attempted to follow major legislative updates, specific state rules cited in this chapter may be outdated. Finally, to set the U.S. rules in contest, we conducted a briefer review of the rules of the road, as available in English, for electric bicycles in Australia, Austria, Belgium, Canada, Chile, China, Colombia, Denmark, England, Finland, France, Germany, Ireland, Israel, Italy, Japan, Kenya, the Netherlands, New Zealand, Norway, Poland, Scotland, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, and the United Arab Emirates.

3.1 CRITICAL CONTEXT FOR UNDERSTANDING ELECTRIC BICYCLE RULES: KNOWING THAT NOBODY KNOWS WHAT THE RULES ARE

A critical point to know about California's rules for defining and operating electric bicycles is that most people don't know what the rules are. While a few members of the public are aware of the three-class system mentioned above, most are not. Virtually every one of the 44 experts interviewed for this project lamented that almost nobody understands the three-class system. As for the full set of rules for how either bicycles or electric bicycles may be operated, this is even less well understood. California does not publish a complete set of the rules in a format aimed to educate the public (or law enforcement or transportation professionals, for that matter), so a law-abiding Californian who wants to know the rules will have to turn to internet searches.

In fact, the rules are so difficult to determine that even organizations that wish to share the rules with the public frequently present most of these contain inaccuracies and/or only a partial set of the rules. For example, as of October 2025, discerningcyclist.com states that in California you must be 16 to operate a Class 1 or 2 bicycle and 18 to operate a Class 3 electric bicycle, all factually incorrect (DiscerningCyclist.com, 2023).[4] Another common point of inaccuracy relates to sidewalk riding. For example, law firm Duque & Price states on its webpage "California State Electric Bike Laws" that "You can ride an e-bike on a sidewalk in California if street signs expressly grant this right" (Duque and Price Injury Attorneys, 2025). This statement is incorrect, since sidewalk riding is

4 As further discussed later in this chapter, California Vehicle Code Section 21213 places an age minimum of 16 years old for Class 3 electric bicycles.

permitted be default except where prohibited by local ordinance.[5] As a third example, the City of Folsom's helpful page on "Know Before You Go: E-Bikes, E-Scooters, and E-Motorcycles" is largely accurate, but does have incorrect information about the requirements for lighting on electric bicycles (City of Folsom, 2025).

3.2 RULES FOR ELECTRIC BICYCLES ARE DEFINED IN TERMS OF OTHER MODES

Identifying the rules that apply to riders of electric bicycles can be complicated. One factor creating confusion is that rules applying to electric bicycles are found in several separate sections of a state vehicle code. Additionally, rules that apply to electric bicycles may not appear in any section of the code specifically applicable to electric bicycles, showing up instead in rules for bicycle operators or even vehicle operators. Rules that electric bicycle operators must follow may include:

- Rules that specifically apply to electric bicycle operators
- Rules that apply to anyone operating a bicycle, including an electric bicycle
- Rules that apply to operators of a vehicle, which may be defined in the vehicle code to include riders of bicycles and, by extension, operators of electric bicycles

Section 231 of the California Vehicle Code, which defines the term "bicycle," states that "an electric bicycle is a bicycle." Further, Section 21200 of the California Vehicle Code states that a cyclist, which includes operator of electric bicycles, has "all the rights and is subject to all the provisions applicable to the driver of a vehicle." California's approach thus follows the recommendation in the PFB Model Law, Section 201, which calls for electric bicycles to be "afforded all the rights and privileges, and be subject to all of the duties, of a bicycle or the operator of a bicycle." In California and the states that have adopted the PFB law, electric bicycles are street legal in the same ways that bicycles are.

Looking internationally, it is very common to afford *some* electric bicycle riders the rights and responsibility of bicyclists, but this is typically true only for operators of lower-powered devices. For example, most E.U. countries grant so-called "pedelec" operators the rights and responsibilities of conventional bicyclists, whereas operators of the higher-powered speed pedelecs have the rights and responsibilities of moped riders in terms of where and how they may ride the device.

5 The California Vehicle Code indirectly gives bicycles permission to ride on sidewalks by stating that local authorities have the right to prohibit this by ordinance. One portion of the code states that "Local authorities may adopt rules and regulations by ordinance or resolution regarding all of the following matters" and lists among the permitted rules "operation of bicycles…. on public sidewalks" (California Vehicle Code Section 21100). Another section of the code states that vehicles shall drive to the right of the roadway, except that this "does not prohibit the operation of bicycles on any shoulder of a highway, on any sidewalk, on any bicycle path within a highway, or along any crosswalk or bicycle path crossing, where the operation is not otherwise prohibited by this code or local ordinance" (California Vehicle Code Section 21650).

3.3 REQUIREMENTS FOR A DRIVING LICENSE, DEVICE REGISTRATION, NUMBER PLATE, AND INSURANCE

California does not require that electric bicycle operators have a driving license of any kind or carry insurance, and electric bicycles do not need to be registered with the state or to have a number plate. These rules are the same in almost all other states. No state currently requires that electric bicycle operators have a license, though Connecticut allows local governments to add a local license requirement and California had such a provision until it was removed in 2023. Also, no state requires that electric bicycle operators carry collision insurance. With respect to device registration, Hawaii is the only state that requires registration. Hawaii requires both conventional bicycles and electric bicycles to pay a one-time registration fee and display the metallic tag or decal provided for registered devices.

Very few countries require a license, insurance, registration, or number plates for the low-powered electric bicycles that are treated as legally equivalent to a conventional bicycle, though there are exceptions. Singapore has perhaps the most extensive set of requirements. The country does not require a license, but operators must pass a “Theory Test” (Singapore Land Transport Authority, 2021). This test is required even if the electric bicycle operator has a driving license, a requirement that the Singapore Land Transport Authority explains is needed because “driving licenses do not cover rules on paths, and navigating the roads as a PAB [power-assisted bicycle] rider differs from a motorist.” In addition, the device must be inspected at a government-approved inspection center, registered, have seal that includes the device serial number, and have a number plate affixed at the rear of the device.

3.4 AGE REQUIREMENTS

In California, there is no statewide age minimum to ride a Class 1 or 2 electric bicycle, but Class 3 devices are restricted to riders 16 years and older (Section 21213 of the California Vehicle Code). These rules mimic the PFB Model Law, Section 301.

In 2024, the California Legislature authorized two pilot projects that allow Marin and San Diego Counties to experiment with more stringent age minimums:

- Assembly Bill 1778 (2024), established the Marin County Electric Bicycle Safety Pilot Program, which allows the county and local jurisdictions within the county to adopt an ordinance requiring that operators of Class 2 electric bicycles be at least 16 years old.

- Assembly Bill 2234 (2024), established the San Diego Electric Bicycle Safety Pilot Program, which allows San Diego County and local jurisdictions within the county to adopt an ordinance banning children under the age of 12 from riding Class 1 or Class 2 electric bicycles.

Both pilot programs run through January 1, 2029, and both require participating jurisdictions to provide a report to the Legislature by January 1, 2028, that documents in detail enforcement efforts related to the ordinance, as well as data on crashes and injuries among children in the affected age groups (under 16 in Marin County and under 12 in San Diego County).

In our exploration of state codes, we found that many states have adopted the same age minimum used by most of California (outside pilot projects areas, the requirement that Class 3 electric bicycles be at least 16 years old. However, a number of states have adopted slightly different approaches (Table 4). For example, some states set a different age minimum for Class 3 electric bicycles (e.g., 14 years in Tennessee), set age minimums for Class 1 and 2 electric bicycles, have no age minimums at all (e.g., Nevada), or require a minimum age for all electric bicycle classes (Hawaii). Also, a couple of states require younger riders to be supervised by an adult or guardian (Utah and Virginia).

Table 4. Age minimums for electric bicycle operators in U.S. states

State	Age Limit	State	Age Limit
Alabama	Class 3: 16 years	Montana	–
Alaska	–*	Nebraska	–
Arizona	–	Nevada	–
Arkansas	Class 3: 16 years	New Hampshire	Class 3: 16 years
California	Class 3: 16 years	New Jersey	–
Colorado	Class 3: 16 years	New Mexico	Class 3: 16 years
Connecticut	Class 3: 16 years	New York	16 years
Delaware	Class 3: 16 years	North Carolina	–
Florida	–	North Dakota	–
Georgia	Class 3: 15 years	Ohio	Class 3: 16 years
Hawaii	15 years	Oklahoma	Class 3: 16 years
Idaho	–	Oregon	16 years
Illinois	Class 3: 16 years	Pennsylvania	16 years
Indiana	Class 3: 15 years	Rhode Island	–
Iowa	Class 3: 16 years	South Carolina	–
Kansas	Class 3: 16 years	South Dakota	Class 3: 16 years
Kentucky	–	Tennessee	Class 3: 14 years
Louisiana	Class 3: 12 years	Texas	Class 3: 15 years
Maine	Class 2 or Class 3: 16 years	Utah	Class 1 & 2: 14 years, unless supervised by parent or guardian Class 3: 16 years
Maryland	Class 3: 16 years	Vermont	Class 3: 16 years
Massachusetts	–	Virginia	Class 3: 14 years, unless supervised by someone over 18
Michigan	Class 3: 14 years	Washington	Class 3: 16 years
Minnesota	15 years	West Virginia	–
Mississippi	–	Wisconsin	Class 3: 16 years
Missouri	Class 3: 16 years	Wyoming	–

Note: This search was conducted in Summer 2024. Some states may have updated their rules since then.
* The symbol “–” denotes that no age limit was mentioned in the state’s vehicle code.

Internationally, age minimums vary a great deal. For example, there is no age minimum in Germany and in some Australian states, but age minimums are 12 years in Victoria, Australia (if riders have demonstrated responsible riding skills) and Austria; 14 in France, Switzerland, and New Zealand; and 16 in the Netherlands, Singapore, and Japan. In Poland, there is no age minimum, but children under 10 must be supervised by an adult, a requirement similar to rules in Utah and Virginia.

3.5 HELMET REQUIREMENTS

In California, anyone riding a Class 3 device must wear a helmet. For Classes 1 and 2, helmets are required statewide only for riders under 18 (California Vehicle Code, Section 21213). The helmet must meet standards for bicycle helmets established by the U.S. Consumer Product Safety Commission or American Society for Testing and Materials. California's approach mimics that recommended by the PFB Model Law, which calls for a helmet requirement only for operators and passengers of Class 3 electric bicycles. The one exception to California's statewide law is that Assembly Bill 1778 (2024), the Marin County Electric Bicycle Safety Pilot Program, establishes a pilot program allowing the County of Marin and its local jurisdictions to pass ordinances requiring all Class 2 bicycle operators to wear a helmet. (The pilot ends on January 1, 2029.)

While many states have adopted the PFB recommended helmet requirement, there are numerous variations in the law. Some states do not require anyone to use a helmet for any class of electric bicycle, while other states have helmet requirements for young riders of any class, which is typically in line with similar requirements for riders of conventional bicycles. Finally, Oregon and Pennsylvania permit no helmet if this violates a person's religious beliefs, and Maryland has a highly specific carve-out that requires electric bicycle operators under 16 to wear helmets *unless* they are in the Town of Ocean City.

Internationally, many countries do not require helmets at all for low-speed devices regulated as equivalent to conventional bicycles. Some exceptions are that France requires helmets up to age 11, Italy and Sweden up to age 14, and Japan up to age 16. However, for higher-power electric bicycles, many countries require moped-style helmets that offer greater protection.

3.6 RULES FOR RIDING ON SIDEWALKS

One safety concern that has arisen in discussions of electric bicycles has been crash-risk with pedestrians, particularly if electric bicycles are ridden on sidewalks. The California Vehicle Code does not have a direct statement about whether electric bicycles (or bicycles) may or may not be ridden on sidewalks. However, California *indirectly* allows electric bicycles to be ridden on sidewalks unless prohibited by local authority, because the state defines electric bicycle riders as having the rights and responsibilities of bicyclists, and bicyclists are permitted to ride on the sidewalk unless prohibited by local authority.

Table 5 presents the results of a search of how all 50 states set rules on sidewalk riding for electric bicycles, conventional bicycles, and electric scooters. No state always explicitly permits this, but there are a variety of other approaches. Table 5 uses the following abbreviations:

- Not mentioned (-)
- Always allowed (A)
- Always prohibited (P)
- Allowed, unless expressly prohibited by a local authority (A-UP)
- Prohibited, unless expressly allowed by the local authority (P-UA)

Additionally, some entries include the letter “I” for inferred. These are cases where a state does not have specific rules for electric bicycles, but the state treats electric bicycles as bicycles, so we presume that electric bicycles follow the bicycle rules.

Table 5. State rules on riding bicycles, electric bicycles, and electric scooters on sidewalks

State	Electric bicycle	Conventional bicycle	Electric scooter
Alabama	–	–	–
Alaska	Outside business districts: IA-UP Inside business districts: IP	Outside business districts: A-UP Inside business districts: P	–
Arizona	–	–	–
Arkansas	–	–	–
California	I-A-UP	A-UP	P "except as may be necessary to enter or leave adjacent property"
Colorado	A-UP	A-UP	A-UP
Connecticut	A-UP	A-UP	A-UP
Delaware	With motor off: P Without motor: A-UP	A-UP	With motor off: A With motor on: P
Florida	A-UP	A	A-UP
Georgia	Riders under 12 years: I-P-UA Riders over 12 years: I-P	Riders under 12 years: P-UA Riders over 12 years: P	–
Hawaii	Outside business districts: A-UP, but rider may not use motor or travel above 10 mph Inside business districts: P	Outside business districts: A-UP, but rider may not travel above 10 mph Inside business districts: P	All regulation at county level
Idaho	A-UP	A-UP	–
Illinois	P	A-UP	–
Indiana	–	–	–
Iowa	–	–	–
Kansas	I-A-UP	–	–
Kentucky	–	–	–
Louisiana	–	–	A-UP
Maine	–	–	–
Maryland	I-P-UA	P-UA	–
Massachusetts	P	A-UP-EB	–
Michigan	I-A-UP	A-UP	–
Minnesota	Outside business district: I-A-UP Inside business district: I- P-UA	Outside business district: A-UP Inside business district: P-UA	P unless entering adjacent property
Mississippi	–	–	–
Missouri	Outside business district: I-A Inside business district: P	Outside business district: A Inside business district: P	–

Table 5, continued

State	Electric bicycle	Conventional bicycle	Electric scooter
Montana	I-A-UP	A-UP	–
Nebraska	I-A	A	–
Nevada	–	–	A-UP
New Hampshire	–	–	–
New Jersey	–	–	–
New Mexico	Class 1: AUP Class 2 + 3 : P-UA	–	–
New York	P-UA[a]	A-UP	P-UA
North Carolina	–	–	–
North Dakota	–	–	–
Ohio	–	–	–
Oklahoma	–	–	State leaves control to municipalities
Oregon	P	A	P except to access adjacent property
Pennsylvania	Outside business district: A Inside business district: P-UA	Outside of business district: A Inside business district: P-UA	–
Rhode Island	I-A-UP	A-UP	–
South Carolina	–	–	–
South Dakota	I-A-UP	A-UP	A-UP
Tennessee	Without motor: P-UA With motor: P	–	–
Texas	I-A-UP	A-UP	A-UP
Utah	Riders under 18: I-A Riders 18+ years: I-A-UP	Riders under 18: A Riders 18+ years: A-P	–
Vermont	–	–	–
Virginia	A-UP	A-UP	A-UP

Table 5, continued

State	Electric bicycle	Conventional bicycle	Electric scooter
Washington (state)	Class 1 + 2: A Class 3: P	A	–
West Virginia	–	–	–
Wisconsin	A-UP	–	A-UP
Wyoming	–	–	–

Note: This search was conducted in Summer 2024.
Legend:
– = not mentioned
A = allowed
P = prohibited
A-UP = allowed, unless prohibited by the local authority
P-UA = prohibited, unless expressly allowed by the local authority
I = State treats electric bicycles as bicycles, rules are inferred from bicycle rules
[a] New York State bans Class 3 electric bicycles in cities with less than a million people, meaning New York City is the only one in which they are allowed.

In the countries we explored, sidewalk riding is rarely allowed as a blanket rule. One exception is New Zealand, where cyclists may ride on sidewalks but must be "considerate" of others. In other countries, like China and Canada, the rules vary by state or province.

3.7 SHOULD ELECTRIC BICYCLES THAT ANYONE CAN RIDE HAVE THE POWER OF A HUMAN OR A HORSE?

States like California that have adopted the PFB framework generally give electric bicycles the same rights and responsibilities as conventional bicycles. For example, as previously mentioned, California Vehicle Code plainly states "an electric bicycle is a bicycle." One possible rationale for doing this is that electric bicycles and conventional bicycles are ridden similarly enough such that having the same rules is logical. The following two sub-sections explore similarities and differences in the power and speed of conventional bicycles versus electric bicycles.

3.7.1 Human power vs. the motor power of a horse

To understand what 750 watts of power (equivalent to one horsepower) represents, it is useful to compare this to the power that conventional bicyclists generate. The only human cyclists who can reach that same level are strong professional cyclists, and even they can maintain that output only very briefly. For example, Valenzuela, et al. (2022) measured the power output of 144 professional male cyclists and found that only the top 25 percent most powerful cyclists sampled could sustain 744 watts for a minute. A look at Strava files for Tour de France competitors shows that professionals can average around 400 watts over 20 minutes (Yeager, 2015). A typical cyclist can sustain far less power. For example, a story from NPR reports that a human pedaling a bike at a reasonable pace generates about 100 watts of power (Frank, 2016). Yeager (2015) states that more experienced and physically fit riders "can hammer out about 250 to 300 watts for a 20-minute power test."

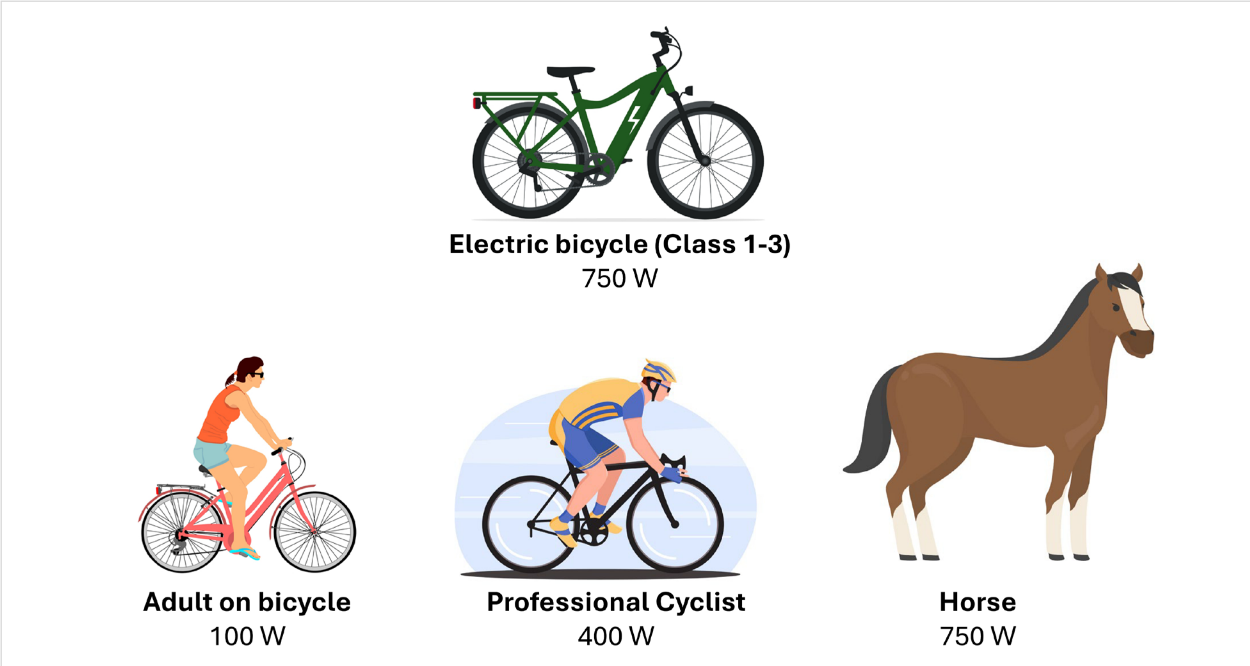


Figure 14. Comparison of power outputs from humans propelling conventional bicycles, legal electric bicycles, and horses

Electric two-wheelers with motors than produce more power than 750 watts of continuous power are *more* powerful than a single horse. For example, the previously mentioned *Segway Xyber Electric Bike* has the power of either four or eight horses, depending on whether it is equipped with one or two batteries (Figure 15).

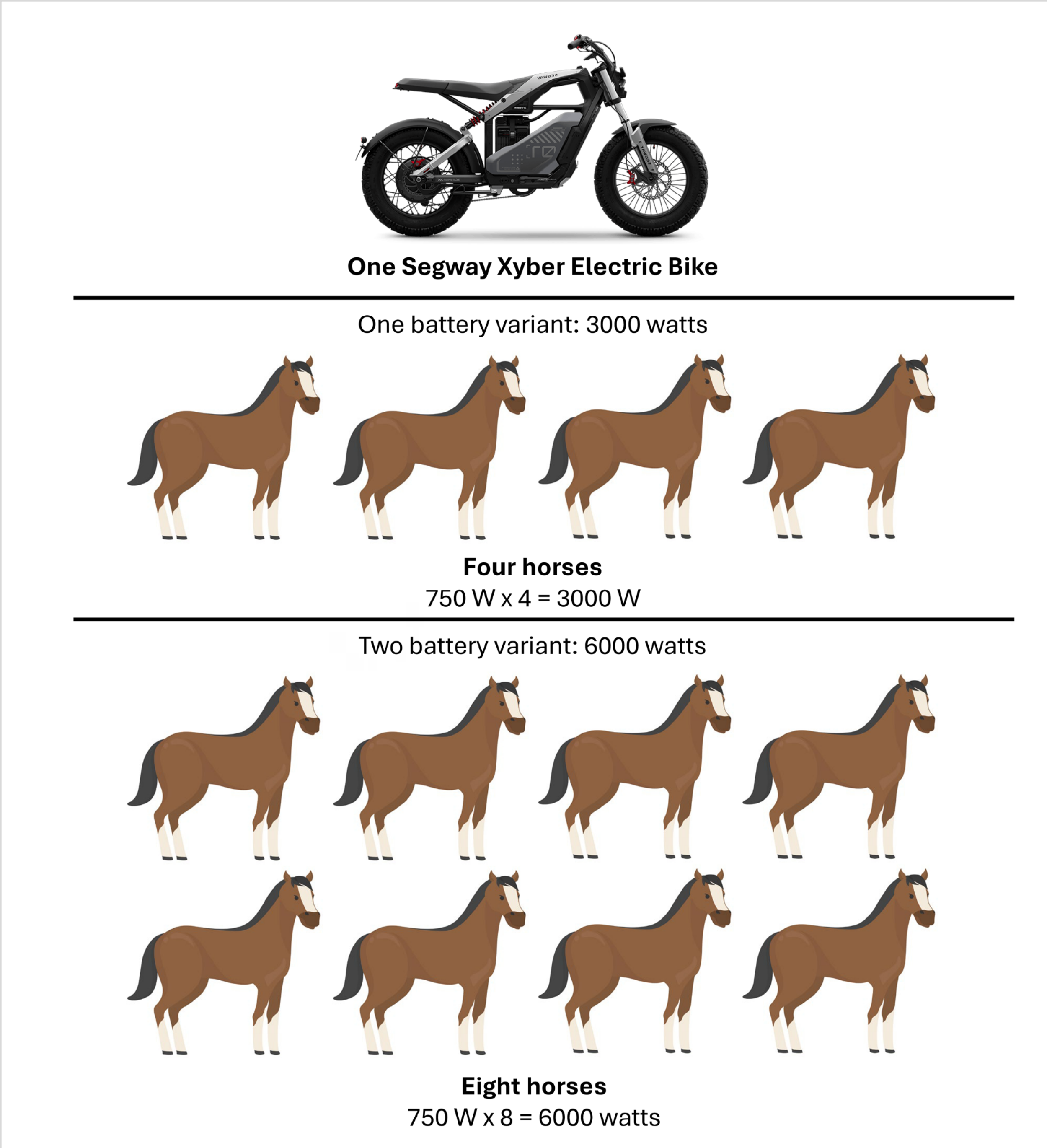


Figure 15. Segway Xyber Electric Bike **power output and equivalent number of horses**

3.7.2 Observed speeds of conventional bicycles and electric bicycles

Riders of Class 1 and Class 2 electric bicycles can receive electric assistance up to 20 mph and riders of Class 3 electric bicycles can receive electric assistance up to 28 mph. While electric bicycles can go those maximum speeds, and it is presumably easier to reach and maintain those speeds on an electric bicycle than a conventional bicycle, electric bicycle riders are not necessarily always going that fast.

Several studies have explored the speeds of micromobility devices. Hassanpour and Bigazzi (2024) performed recent observations of contemporary micromobility devices in Vancouver, Canada. The observations took place at 12 physically separated off-street paths, thus none were in mixed traffic with automobiles. Table 6 shows some of their observations for bicycles and selected other micromobility devices.

They found that, on average, electric bicycles (13.9 mph) were about 18 percent faster than conventional bicycles (11.8 mph). Of note, in British Columbia, electric bicycles (referred to as Motor Assisted Cycles) are limited to 20 mph and 500 watts of continuous power output (Government of British Columbia, 2025). Hassanpour and Bigazzi also observed devices that they called *sit-down e-scooters* or *motorcycles,* which they describe as vehicles similar to motorcycles equipped with pedals solely to quality as an electric bicycle. Vehicles they identified as sit-down e-scooters/motorcycles (17.6 mph) were 50 percent faster than conventional bicycles.

Table 6. Observed speeds of micromobility devices in Vancouver, Canada

	Non-motorized			Electric-assist (motorized)		
Device type	**Average speed (mph)**	**Share of riders observed over 20 mph**	**n**	**Average speed (mph)**	**Share of riders observed over 20 mph**	**n**
Bicycle	11.8	2	22,689	13.9	7	1,032
Shared bicycle	9.6	0	468	--	--	--
Cargo cycle	10.9	0	18	13.4	0	25
Kick scooter	6.0	0	87	13.8	7	77
Skateboard	8.0	1	170	13.5	8	26
Sit down e-scooter or motorcycle	--	--	--	17.6	32	63

Note: Original paper reports speeds in kph, converted here to mph. Observations took place at 12 physically separated off-street paths.
Source: Hassanpour and Bigazzi (2024)

4. DATA ON ELECTRIC BICYCLE OWNERSHIP AND USE

This chapter presents available data on electric bicycle ownership and use. (As discussed later, there is not much available.) The first section presents recent survey data findings on electric bicycle ownership and use. The second section discusses data on what *type* of electric two-wheeled devices are owned, with the most extensive data available coming from counts of devices parked at middle and high school schools. The final section looks at indications of increased electric bicycle usage over time.

4.1 CURRENT OWNERSHIP AND RIDERSHIP NUMBERS

With respect to how many Americans *currently* ride electric bicycles, three recent surveys from 2024 and 2025 suggest that more than 10% of U.S. adults are riding electric bicycles, at least occasionally.

A 2024 survey of U.S. adults from *Consumer Reports* found that 11% had ridden an electric bicycle in the previous twelve months, 6% owned an electric bicycle, 4% planned to buy an electric bicycle, and another 28% had no plans to buy one but would consider doing so (Consumer Reports, 2024). Another 2024 survey of U.S. adults, this one from the Mineta Transportation Institute, found similar results: 16% of adults had ridden an electric bicycle in the previous 12 months, and 6% rode one at least once a week (Agrawal, Fang, and Nixon, forthcoming). Finally, a February 2025 survey from the Mineta Transportation Institute found that 5% of U.S. adults live in a household where at least one person in the household had used an electric bicycle in the previous 30 days (Agrawal and Nixon, forthcoming). Notably, for 80% of those electric bicycle-using households (4% of all respondents' households), no one in the household had ridden a conventional bicycle in the preceding 30 days.

People need not own an electric bicycle to have experience riding one. The North American Bikeshare and Scootershare Association (NABSA) reports that in 2024, riders logged 59 million trips on the 76,000 shared electric bicycles available in the U.S. (North American Bikeshare and Scootershare Association, 2025). The previously mentioned 2024 survey from the Mineta Transportation Institute found that 25% of respondents reported that they have ridden a shared bicycle at least once in their lives. This includes 34% of men, 16% of women, and 41% of adults under age 45.

4.2 DEVICE TYPES

As discussed in Chapter 2, the devices ridden in California that people may call "electric bicycles" have a very wide range of capabilities. Not only are there significant differences among the three legal classes, but many devices have much more powerful motors and/or allow higher speeds than permitted by California law. This section presents some of the very minimal data available on this matter.

One source of information comes from bicycle sales data. Market research firm Global Market Insights estimates that 43% of devices sold in 2024 were Class 1 (Global Market Insights, 2025). The report also notes that devices with motors above 750 watts is the fastest growing segment in the electric bicycle market.

Another opportunity to understand the distribution of device types is to look at the electric devices that children use to commute to school. Schools typically have designated parking on campus for micromobility devices, making it easy to document the distribution of device types, particularly if the school administration permits researchers to visit. Much of the public concern over electric bicycle safety relates to use by children, so this data is valuable for setting policy, even though it does not capture the full spectrum of devices being ridden in a community.

Figure 16. Electric devices parked at Diablo Vista Middle School in Danville, California

Source: “E-Moto” Safety Assessment – San Ramon Valley Unified School District (Danville Safety Advocates, November 1, 2025).

Table 7 presents data from counts of devices parked at middle schools and high schools in two counties in the San Francisco Bay region of California where electric bicycles have become popular for school commutes—and many community members are very concerned about reckless riding and crashes. The counts were made by Robert Mittelstaedt, a founder of E-Bike Access, a Marin County advocacy organization, along with representatives of San Mateo County Office of Education Safe Routes to School, who assisted with the San Mateo counts. They visited 19 schools in 2025 to count device types. The counts were made during the school day, at a time when students were in class.

To determine whether each electric device parked on the campus complies with the California three-class system, Mittelstaedt and his partners examined whether or not the devices had the legally required electric bicycle class sticker affixed by the manufacturer or retailer. In addition, they recorded each electric device’s brand, model, and any other details that would indicate the exact type. The last step was web-based research to determine which electric bicycle class (if any) each device fell into.

As Table 7 shows, across all the schools, about 30% of devices observed were electric devices. Among electric two wheelers, only 12% were Class 1-3 electric bicycles, while 88% were higher-power/higher-speed devices.

Table 7. Counts of two-wheeled devices at a sample of California middle and high schools

Schools	Conventional bicycles	Electric two-wheelers: Comply with three-class electric bicycle system	Electric two-wheelers: Do not comply with three-class system (not electric bicycles)
Marin County (January 2025)			
Middle schools (6)	499	20	103
High schools (6)	214	17	174
All schools (12)	*713*	*37*	*277*
Share of all devices	*69%*	*4%*	*27%*
Share of electric devices	--	*12%*	*88%*
San Mateo County (October 2025)			
Middle schools (4)	397	10	65
High schools (3)	310	12	86
All schools (7)	*418*	*22*	*151*
Share of all devices	*70%*	*4%*	*26%*
Share of electric devices	--	*13%*	*87%*
Both counties			
Middle schools (10)	896	30	168
High schools (9)	524	29	260
All schools (19)	*1,131*	*59*	*428*
Share of all devices	*70%*	*4%*	*26%*
Share of electric devices	--	*12%*	*88%*

Source: Counts of devices parked on school campuses by Robert Mittelstaedt and San Mateo County Office of Education Safe Routes to Schools.
Note: Non-compliant electric two-wheelers are devices that the cited observers judged to be more powerful or faster than Class 1, 2, 3 electric bicycles.

Mittelstaedt noted that simply looking at the class stickers (when these were present) was insufficient to determine the class type because the devices sometimes had incorrect stickers, presumably added by riders who wanted to disguise the type of vehicle. As illustrated in Figure 17 (E-Bike Access (Marin County), 2025), and previously mentioned in Chapter 2, stickers are readily available for purchase on the internet.

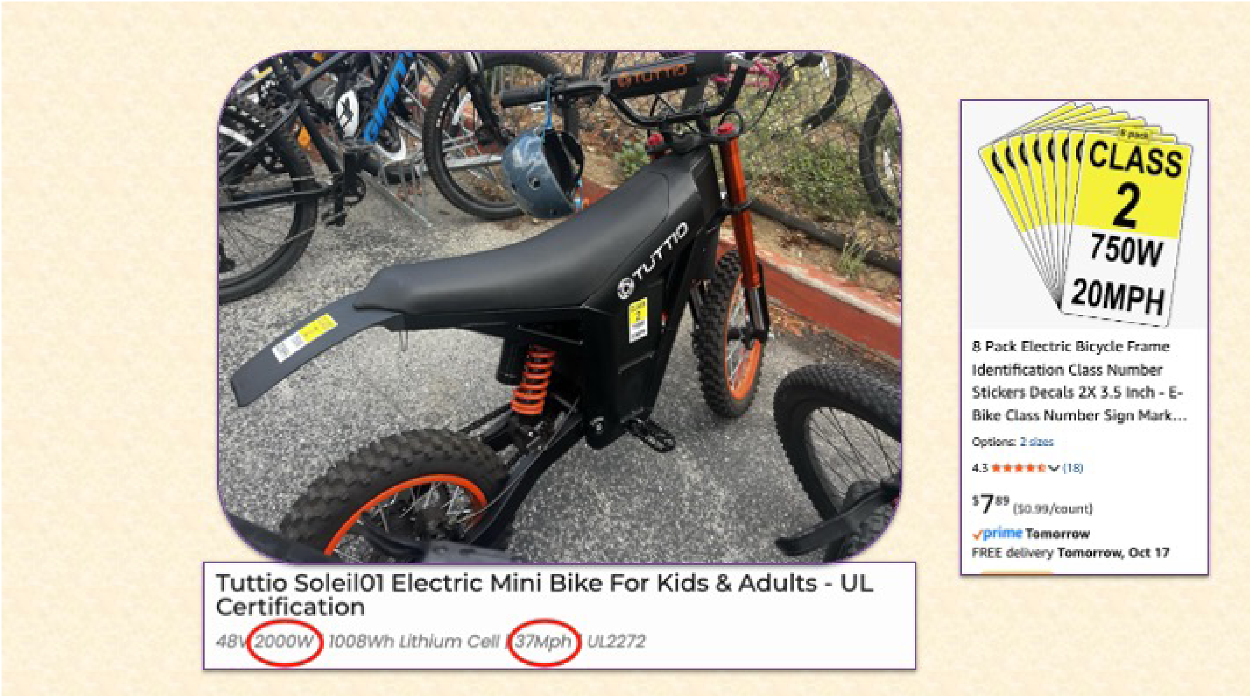


Figure 17. Photograph of an illegal electric bicycle with fake "Class 2" sticker, parked at a school in San Mateo County

Source: E-Bike Access, "E-Moto Advisories" (no date), https://www.ebikeaccess.org/e-moto-advisory.

Other school device counts that have been conducted in Bay Area schools also demonstrate that many tweens and teens are riding out-of-class electric devices. In the San Ramon Valley Unified School District, a count of out-of-class electric bicycles at 7 middle schools that was conducted twice, in February and May of 2025, shows a steep growth in numbers: from 157 devices in February to 202 devices in May, a 39% increase in less than six months (Danville Safety Advocates, 2025). However, there was little increase between May and October; in the latter, the count jumped by only 3. In Palo Alto, an October 2025 count of electric two-wheelers at a local high-school identified 52 devices that were out-of-class compared to 7 that were legal electric bicycles.[6]

6 Analysis by Robert Mittelstaedt of photos taken by Asha Weinstein Agrawal.

Table 8. Counts of two-wheeled devices considered to be "out of class" at middle schools in the San Ramon Valley Unified School District

School	February	May	October	Change (Feb to Oct)
Stone Valley	52	70	71	37%
Diablo Vista	36	37	50	39%
Los Cerros	30	32	33	10%
Charlotte Wood	17	35	36	112%
Pine Valley	8	9	5	-38%
Windemere Ranch	7	9	4	-43%
Iron Horse	7	10	6	-14%
Total	*157*	*202*	*205*	*31%*

Note: Non-compliant electric two-wheelers are devices that the cited observers judged to be more powerful or faster than Class 1, 2, 3 electric bicycles.
Source: Danville Safety Advocates, "'E-Moto'" Safety Assessment - San Ramon Valley Unified School District" (November 1, 2025).

4.3 GROWTH IN ELECTRIC BICYCLE SALES AND RIDERSHIP OVER TIME

It is also important to understand how electric bicycle use has grown over time. As discussed in the chapters below, the numbers of crashes, injuries, and fatalities have increased in recent years, but it is important to understand if the increase in incidents is proportionate to the rate of growth in device use.

One key source of data on trends over time is data on electric bicycle sales. One electric bicycle trade group estimates that electric bicycle sales in the U.S. quadrupled from around a quarter million in 2019 to over one million in 2022 (U.S. Department of Energy - Vehicle Technologies Office, 2022) (Figure 18). Data from market research firm Circana also shows substantial growth in electric bicycle sales in the U.S.: sales grew by a factor of 10 from 50,000 in 2017 to 527,000 in 2022 (PeopleForBikes, 2024) (Figure 19). Another market research firm, Bicycle Market Research LLC, which analyzes U.S. Customs records, reports steadily rising imports for most years since 2016, including a 72% growth rate between 2023 and 2024 (eCycle Electric, 2025) (Figure 20).

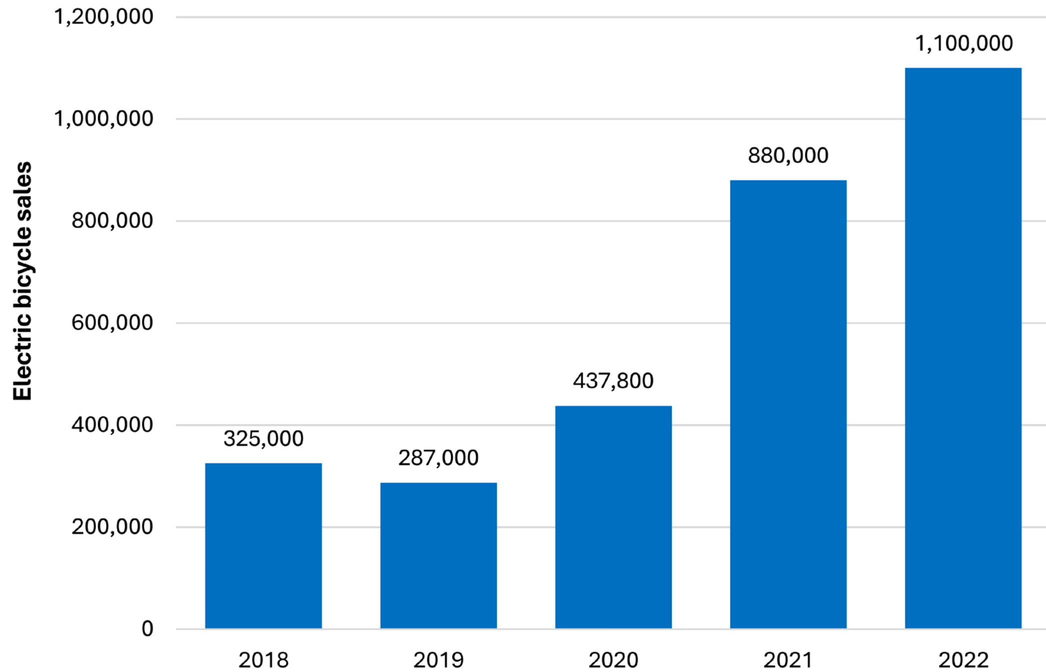


Figure 18. Number of electric bicycle sales in the U.S. from 2018 to 2022, as reported by the Light Electric Vehicle Association

Source: Adapted from United States Department of Energy – Vehicle Technologies Office, Fact of the Week #1321, https://www.energy.gov/eere/vehicles/articles/fotw-1321-december-18-2023-e-bike-sales-united-states-exceeded-one-million, via Business Insider and Light Electric Vehicle Association.

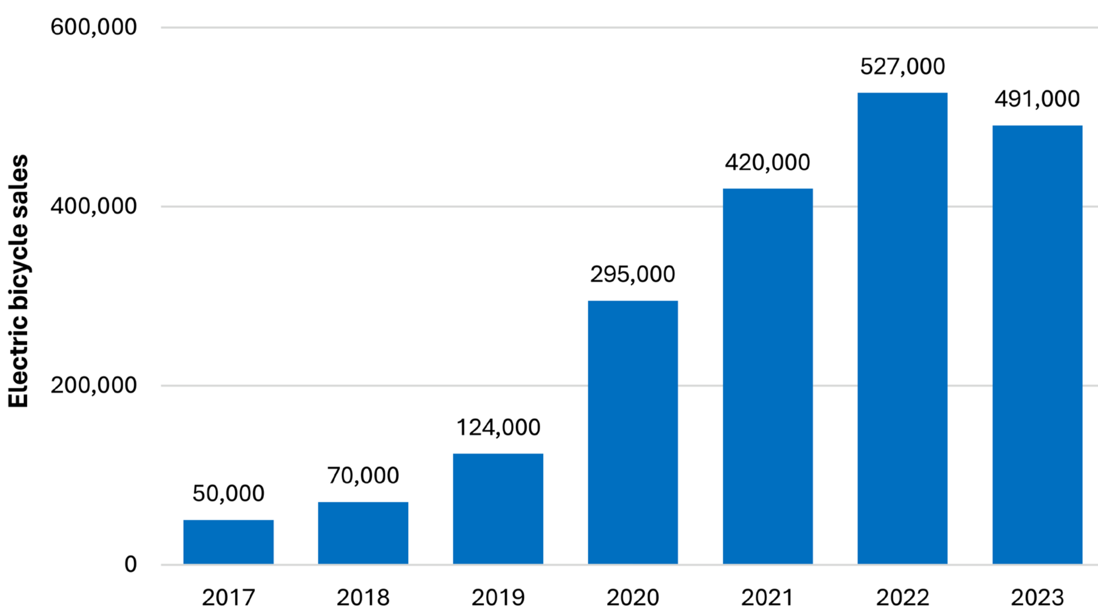


Figure 19. Number of electric bicycle sales in the United States from 2017 to 2023, as reported by Circana

Source: Adapted from PeopleforBikes, Electric Bicycle Market Insights From Industry Experts, https://www.peopleforbikes.org/news/electric-bicycle-market-insights-2024. PeopleforBikes reported Circana market research.

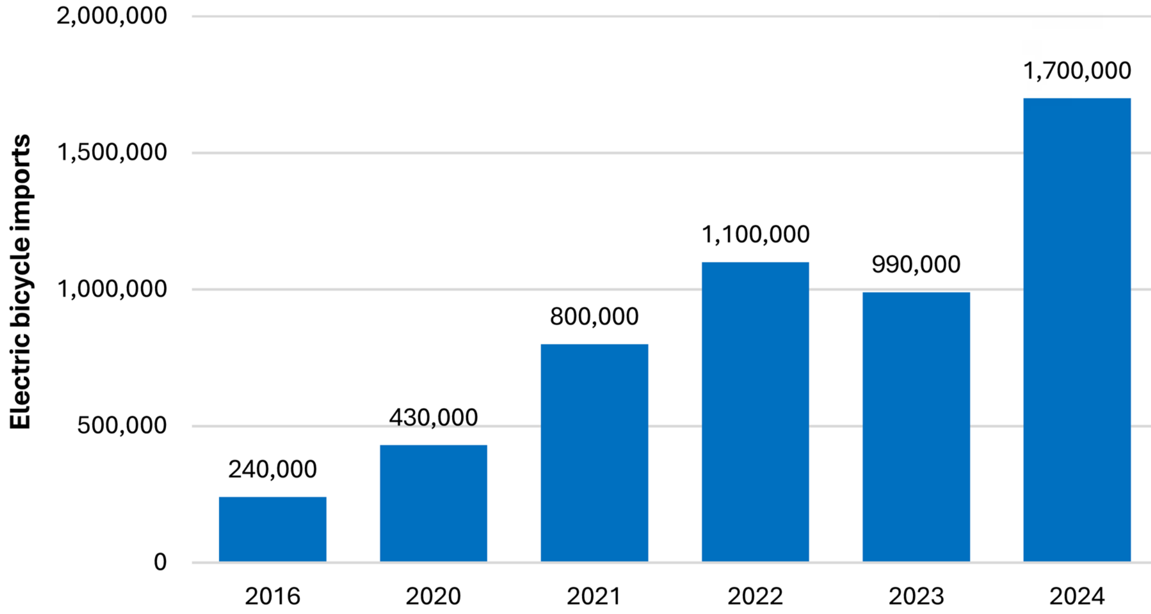


Figure 20. Electric bicycle imports to the U.S., 2016 – 2024, as reported by eCycleElectric

Source: Adapted from eCycleElectric, "How Big is the USA E-bike Market in 2024-25?" https://www.ecycleelectric.com/blog/2025/2/12/how-big-is-the-usa-e-bike-market-in-2024-25.

Looking just at California, market research firm Global Market Insights estimated that $529 million worth of electric bicycles were sold in 2024. This is up from $498 in 2023 and $483 million in 2022) (Global Market Insights, 2025) (Figure 21).

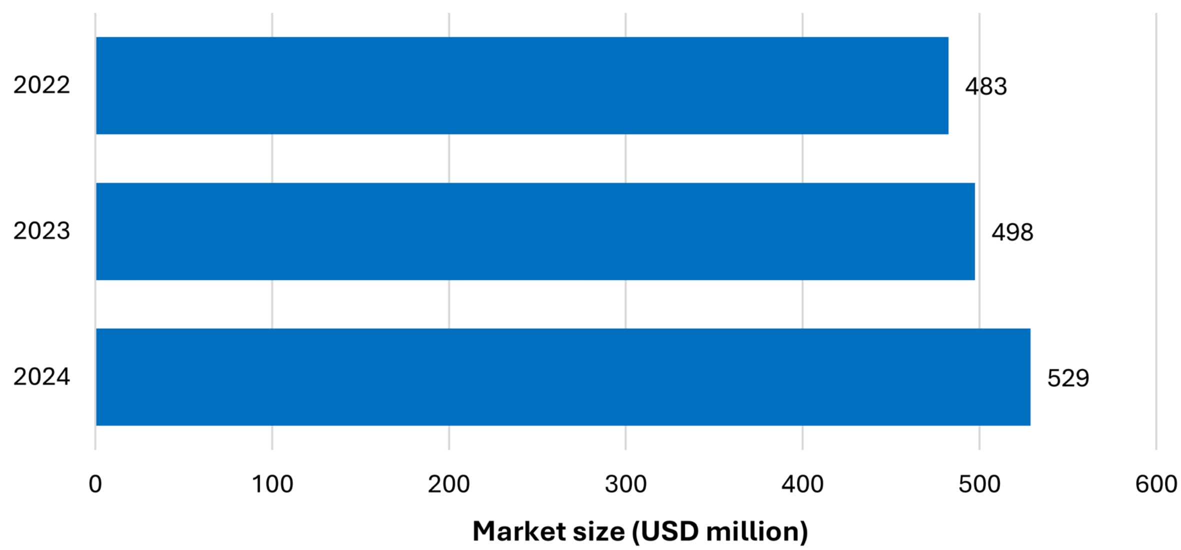


Figure 21. California electric bicycle market size, 2022 – 2024, as reported by GM Insights

Source: Adapted from Global Market Insights, "US E-Bike Market Size - By Product, By Battery, By Motor, By Propulsion, By Ownership, By Power Output, By Application, By Sales Channel, By Price Range, Growth Forecast, 2025 - 2034," July 2025, https://www.gminsights.com/industry-analysis/us-e-bike-market.

While the growth in device sales provides one way to estimate use—more devices probably equate to more use—another source of data to consider is ridership with bicycle-sharing programs. While the shared electric bicycles are only a part of the overall ridership, the organizations that offer the service have very accurate data on the numbers of trips made. Reports from the North American Bikeshare and Scootershare Association show that the number of trips made on electric bicycles has risen steadily since 2020 (North American Bikeshare and Scootershare Association, 2025). Just from 2023 to 2024, trips rose 65%, from 35.4 to 58.5 million trips (Figure 22). Also, in 2024 almost twice as many shared bicycle trips were made on electric bicycles as on conventional bicycles (58.5 billion vs 30.8 million). Narrowing the focus to just one operator, Lyft, the company has seen trips on electric bicycles grow while trips on conventional bicycles fall. For 2024, Lyft reported that 61% of trips in the U.S. were taken on electric bicycles, even though only 39% of the fleet is electric (Lyft, 2025).

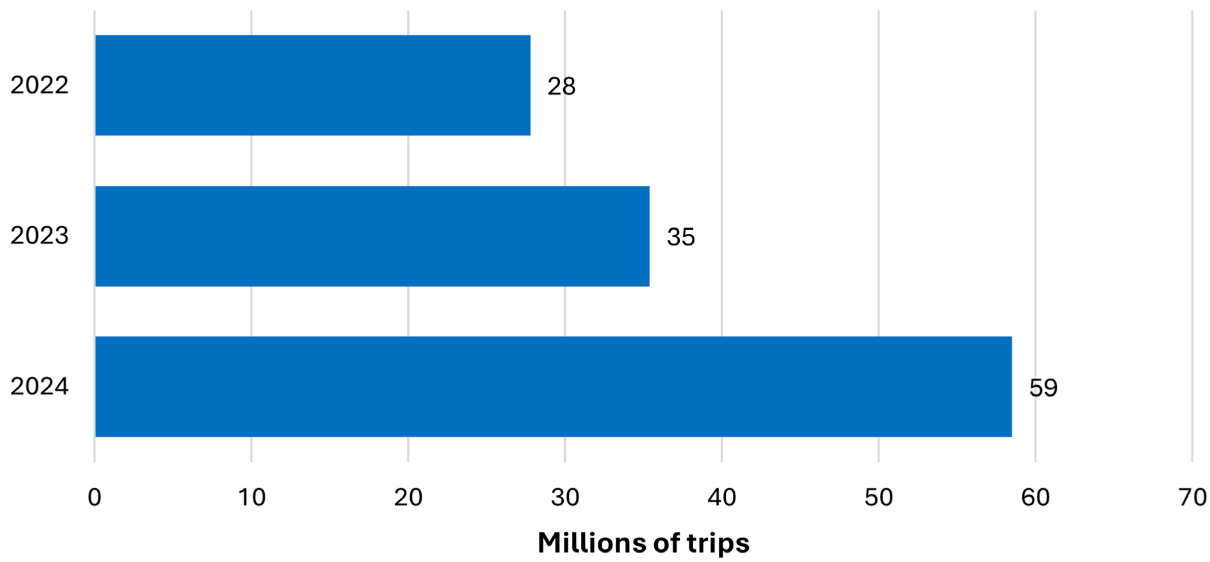


Figure 22. Millions of trips on shared electric bicycles, 2022 – 2024, as reported by the North American Bikeshare and Scootershare Association

Source: North American Bikeshare and Scootershare Association, annual "Shared Micromobility State of the Industry" reports, https://nabsa.net/about/industry/.

5. OVERVIEW OF POTENTIAL ELECTRIC BICYCLE SAFETY ISSUES AND AVAILABLE DATA TO RESEARCH SAFETY

This chapter has two main goals. The first section explores reasons the factors that create safety risks related to operating electric bicycles, addressing both the risks that are similar across all light modes and the reasons why electric bicycles may pose unique safety issues. The second section previews the type of data available to researchers studying electric bicycle risk.

Overall, this chapter prepares readers for Chapters 6, 7, and 8, which analyze the available data on crashes, injuries, and fatalities, and Chapter 9, which summarizes what we do—and do not—know about the risks associated with riding electric bicycles.

5.1 THE SAFETY RISKS ASSOCIATED WITH OPERATING ELECTRIC BICYCLES

Electric bicycles pose safety risks to operators themselves and other road users for a variety of reasons. Some of these have nothing to do with the presence of motor power, but others likely are connected to the specific characteristics of electric bicycles as compared to their conventional counterparts.

5.1.1 Risks that electric bicycles share with other light modes

Many of the safety risks associated with riding electric bicycles are unrelated to the fact that the device is powered. Like conventional bicyclists, electric bicyclists on most California streets and roads must ride on infrastructure that has not been designed to safely accommodate them (National Association of City Transportation Officials, 2025). For example, motor vehicle drivers traveling at high speeds in the same street space as bicycles create serious risk of collision. Also, high-speed streets without physically separated bikeways often incentivize cyclists to ride on the sidewalk, and while this could reduce exposure to motor vehicles, sidewalk riding also creates danger at intersections and driveways, places where other road users do not expect high-speed devices to appear. Another problem is that many intersections are not designed to keep cyclists visible to turning motor vehicles, and/or intersection design encourages motorists or cyclists to cross the intersection at high speed (Wilson, 2021). Finally, Figure 23 shows that even where bicycle infrastructure is present, such as separated bikeways, poor maintenance or illegally parked vehicles can push bicycles out into fast traffic (Karoly, 2023).

Figure 23. Examples of bikeway obstructions

Source: Scott Karoly. "What's in the Bike Lane? A Study of the Factors Leading to Bike Lane Obstructions in Two Bay Area Cities." Masters thesis (MUP), San Jose State University. December 2023. https://www.sjsu.edu/urbanplanning/docs/honors-reports/2023_2024_Karoly.pdf.

5.1.2 Conceptual reasons why electric bicycles may pose unique transportation safety risks

There are a number of reasons why electric bicycles might pose more safety challenges than conventional bicycles. We focus on how electric bicycle risk compares to the risk of riding conventional bicycles, in particular, because setting different rules for electric bicycles and conventional bicycles is more clearly justified if there are fundamental reasons that one mode poses greater risk to either riders or other road users.

The following factors have been raised in the scholarly literature, in the popular media, and/or among our interviewees as factors that might make electric bicycles comparatively more dangerous. Some of these factors are directly related to electric motorization, such as the potential for higher speeds and acceleration. Other factors arise more downstream of motorization, such as from the extra weight required for batteries and other components.

While the following factors could have safety implications, available data does not generally indicate the degree to which these ideas are true.

- **Higher crash force:** Crash impacts will be worse because crash force increases with both weight and speed.

- **Longer stopping distances:** Electric bicycles can require more time and distance to stop as a result of both heavier device weight and higher travel speeds.

- **Faster speeds require faster reactions from riders and other road users**: To the extent that electric bicycle riders travel faster than conventional bicyclists, both electric bicycle riders and the road users around them have less time to react to dangerous situations.

- **Abrupt acceleration**: It is possible for riders to accelerate some, though not all, electric bicycles very quickly. This is true of bicycles with throttles, as well as devices where the pedal assist ratio can be set to accelerate rapidly even with slow pedaling. Fast acceleration can throw riders themselves off balance, as well as lead to crashes if other road users are not anticipating those amplified changes in speeds.

- **Poor quality components and construction:** Many of the cheaper electric bicycles are built to the standards required for conventional bicycles, in terms of brake and frame strength, but those standards may be inadequate for heavier and faster electric bicycles. In addition, many of the cheap imported electric bicycles use substandard and nonstandard parts, creating a higher risk of device failures. The durability of the components and construction is even more critical in electric bicycles than conventional bicycles because the former are typically heavier and are often ridden faster.

- **Inadequate maintenance**: One reason for inadequate maintenance is that some riders do not know that electric bicycles require different maintenance practices than conventional bicycles, such as for the brakes. Not only do electric brake pads wear out faster than conventional bicycle brake pads because of heavier device weight and higher speeds, but the type of brakes used on some electric bicycles does not give any signal through a change in performance to indicate the need for new pads. In addition, it can be difficult to find professional mechanics to repair some devices because bicycle repair shops often refuse to service brands that they do not carry. As a result, some electric bicycle owners go without regular maintenance.

- **After-market modifications**: There is an active sub-culture of people modifying their electric bicycles with software or mechanical changes to make the devices faster or more suitable for stunt riding, and the result is less safe devices (American Bicycling Education Association, 2025). Modifications discussed on internet sets include change software controls that limit the motor power, clipping wires essential for speed governors to function, re-positioning sensors used to estimate speed so that the readings will be lower than actual speeds, and installing higher-voltage batteries (Guy, 2019).

- **Rider inexperience**: Riding a fast device like an electric bicycle in traffic requires knowledge about defensive riding skills that most people are not taught when they learn to ride a bicycle. While classes exist to teach these skills, most people do not take them. Another risk is that some electric bicycle riders are not experienced in following the rules of the road. This lack of experience is particularly common with children and teens who have little experience riding or driving in the roadway with any travel mode. Finally, some riders who use electric bicycles have not ridden a bicycle in traffic for years, if not decades.

- **Stunt riding and reckless riding:** A final safety risk arises when operators ride in a reckless manner. In recent years, social media influencers like Sur Ronster, who has a million followers on Instagram and almost three million on YouTube, have been posting videos of teens and young adults riding electric bicycles in aggressive ways that create safety hazards and intimidate other road users. Figure 24 shows individual riders doing stunts that make the bicycles difficult to control, and well as a group of riders who have taken over both lanes of traffic on a road. In some cases, social media has been used to organize "ride out" events that draw hundreds of riders. Reckless riding is not unique to electric bicycles, but it appears that some electric devices—especially the higher-powered ones that are not legal electric bicycles—make stunts and aggressive riding accessible to more people.

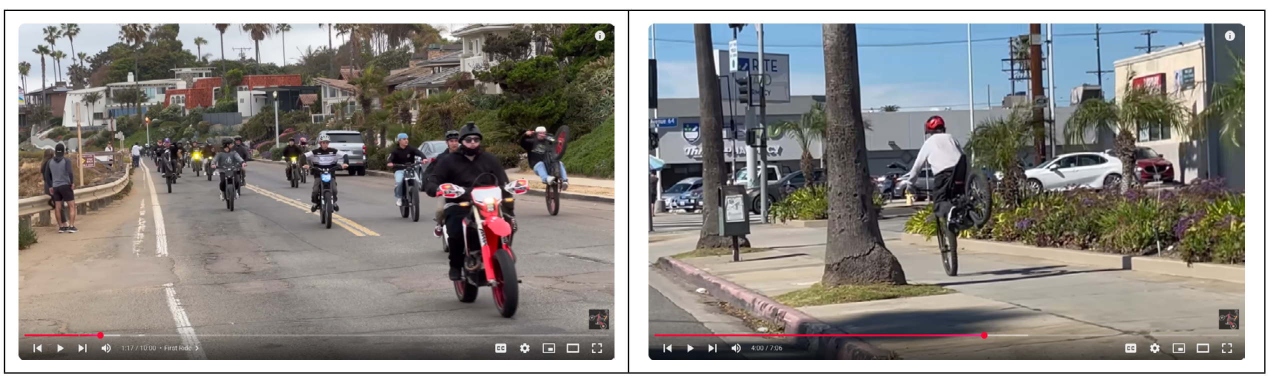


Figure 24. Screenshots from YouTube videos showing stunt riding

Source: YouTube videos: Taking a $2,900 E-Bike to an Illegal Stunt Ride and Reckless Teens CRASH laesk8 on Sur Ron Electric Dirt Bikes.

Finally, while many of these factors may individually play a causal role in electric bicycle crashes, it seems likely that the risks are particularly high when the inherent risk of higher speed overlaps with unsafe road infrastructure and riders who are either inexperienced with the rules of the road and navigating roadways (e.g., young people who have not taken driver's education courses) or not experienced micromobility users (e.g., older riders who have not ridden a bicycle in decades before they try an electric bicycle).

5.2 AN OVERVIEW OF SAFETY DATA SOURCES AND RESEARCH

The following chapters explore two different strands of research about electric bicycle safety: a review of published studies and independent analysis of several key datasets. The goal of the work was to answer five key questions that support evidence-based policymaking:

1. When and where have studies on electric bicycle safety been published?

2. What topics have researchers studied?

3. What primary data sources have been used?

4. How safe are electric bicycles compared to conventional bicycles and e-scooters?

5. How many electric bicycle incidents occur annually in the U.S.?

We addressed the first three questions primarily through a review of over 200 published reports, journal articles, and conference papers about electric bicycle safety that were published in English (Ghanbari, Agrawal, & Fang, 2025). This work revealed that most of the research has been published since 2016, though there were some studies as early as 2007. By far the most common country where electric bicycle safety has been studied is China, though a considerable number of papers have also been published that explore data from the United States, Israel, the Netherlands, Germany, and Switzerland.

These safety studies address a wide variety of topics. By far the most common topic is investigations of the demographics of people in crashes, injured, or killed, usually age and gender. Next most common were studies documenting the number of people in electric bicycle incidents, with studies of injuries twice as common as crash studies, and only a handful of studies analyzing fatalities. Many studies looking at electric bicycle incidents investigated them in the context of incidents from other modes; these studies compare electric bicycle incidents to incidents with other modes, especially conventional bicycles and electric kick-scooters. While many studies explored the correlations between safety incidents and electric-bicycle rider behaviors or infrastructure factors, few studies explored similar enough factors to suggest lessons that can confidently be generalized beyond the specific study context. Finally, we found no studies at all that could shed light on two topics of particular interest to legislators: the safety risks posed by electric devices with different capabilities (i.e., class 1, 2, or 3 devices, or more powerful two-wheeled electric conveyances) and the safety implications of different rules for operating electric bicycles.

With respect to data sources, the most common are hospital records and surveys of either riders or the general public. Less common but still prevalent are studies that look at crash reports or field observations of electric bicyclists' behavior. Finally, much smaller numbers of studies used interviews, social media post analysis, video analysis, or simulations.

To answer the final two questions, about the relative safety of electric bicycles compared to similar modes and the overall numbers of safety incidents in the U.S., we complemented the review of published literature with our own original analysis of primary data sets that government agencies collect and, to some extent, make public: traffic crash reports, patient records, and fatality records. The following three chapters explore our original analysis of these sources, and then Chapter 9 synthesizes what the data as a whole reveals about electric bicycle safety.

6. DATA ON CRASHES

This chapter explores available data on crashes involving electric bicycles. Such data comes from a variety of sources, as the reporting of traffic crashes is largely decentralized. State and local police agencies have specific policies on types of crashes that are reported, specific data to be collected, and the specific formats by which information will be reported in so-called *traffic crash reports*.

The federal government mandates that states aggregate traffic crash reports for certain kinds of incidents and submit data to the National Highway Traffic Safety Administration (NHTSA). The Model Minimum Uniform Crash Criteria by NHTSA identifies recommended variables to track.

Police-reported crash data is typically limited to incidents that cause significant personal injury and/or property damage, and that occur on public roadways. Therefore, crashes resulting in no or minor injuries, and no or limited property damage are generally not captured. Some states allow or require motor vehicle drivers to complete a crash report themselves, if the police do not investigate, for incidents that meet the reporting threshold criteria. For example, California requires motorists to submit reports on collisions to the DMV if there is more than $1,000 of damage or anyone was injured or killed.

6.1 STATE-LEVEL CRASH DATA

All U.S. states collect police-reported crash data, which they aggregate from state and local law enforcement crash reports (Younes & Noland, Crash data availability and best practices across the United States, 2025). This data collection is mandatory in part because the National Highway Traffic Safety Administration (NHTSA) relies on statewide data to compile national datasets, including the Fatality Analysis Reporting System (FARS), which covers all fatal motor vehicle crashes nationwide.

Unlike fatal crash data, non-fatal crash data is not aggregated at the federal level. Instead, each state determines how to collect, categorize, and share its own crash data, resulting in significant variation in the level of detail and public accessibility. Nineteen states plus the District of Columbia currently provide easily accessible raw crash data available for direct download.

Unfortunately, most states do not design the collision report forms to distinguish between conventional bicycles and electric bicycles, limiting the ability to conduct detailed research on electric bicycle safety. We identified only four states (California, Pennsylvania, Oregon, and Maryland) that have distinct codes that enable officers to explicitly record the involvement of electric bicycles in crash reports. A fifth state, New York, recently passed legislation calling for reporting of electric scooter and electric bicycle crashes. At the time of writing, we found available data from three of the four states that have implemented electric bicycle codes: California, Oregon, and Maryland.

6.2 CALIFORNIA CRASH DATA

In California, the California Highway Patrol (CHP) provides guidance to local police departments on what data must be documented in each traffic crash report (TCR), though local departments have the flexibility to use their own templates and reporting procedures so long as they submit the specific crash data that CHP requires. Some police departments use electronic records, but others still report crashes on paper forms. California started adding electric bicycles as a mode choice on TCRs in 2017.

The CHP requires that local law enforcement agencies submit their TCRs and aggregates all reports into a single database, the Statewide Integrated Traffic Records System (SWITRS). SWITRS data used to be publicly available, but as of January 2025 crash data is shared publicly only through the California Crash Reporting System (CCRS).

Table 9 shows data on crashes involving electric bicycles and conventional bicycles from the California Crash Data System. The number of electric bicycle crashes has increased each year, rising to 961 crashes reported in 2024. The number of crashes with conventional bicycles has fluctuated somewhat over the period, but generally hovered around 10,000 reported crashes per year. In 2024, there were 10,372 conventional bicycle crashes reported, almost 11 times the number of reported electric bicycle crashes.

Table 9. California crash data

Year	# of crashes involving electric bicycles	# of crashes involving conventional bicycles	Ratio of conventional bicycle to electric bicycle crashes
2017	1	12,493	12,493
2018	2	12,246	6,123
2019	4	11,324	2.831
2020	43	8,851	206
2021	74	8,764	118
2022	242	9,693	40
2023	541	9,645	18
2024	961	10,372	11

Notes: The party-level datasets for each year contain a vehicle type field ("Vehicle1TypeId") that indicates the type of vehicle involved in the collision. The codes are 91 for electric bicycles and 4 for regular bikes. Data was aggregated to the crash-level in order to count the *number of crashes* involving these modes rather than the number of times these vehicles appeared in crash data.
Source: California Crash Reporting System

Notably, fewer than 5 electric bicycle crashes were reported each year from 2017 to 2019, but this is almost certainly an undercount. Even though electric bicycles were less common in those years, the low numbers of reported crashes suggest the law enforcement officers who produced crash reports may not have been aware of the new code for electric bicycles that was added in 2017. It is impossible to know the extent to which undercounting of electric bicycle crashes has continued, though likely it still occurs. Conversely, it is possible that police record some devices as “electric bicycles” that do not fall under the state’s definition for the device type.

6.2.1 Oregon crash data

Table 10 shows data on crashes involving electric bicycles from the Oregon Crash Data Products portal. Oregon began collecting electric bicycle crash data in 2022. Notably, Oregon reports Class 1 and Class 2 electric bicycles together. Class 3 electric bicycles are grouped with motorcycles and dirt bikes, obscuring trends related to Class 3 electric bicycles.

Oregon’s crash data is most easily accessed through its annual Geodatabase products, which require at least a basic familiarity with geographic information system (GIS) tools to extract and analyze.

Table 10. Oregon crash data

Year	# of crashes involving conventional bicycles	# of crashes involving Class 1 and Class 2 electric bicycles	# of crashes involving Class 3 electric bicycles, motorcycles, and dirt bikes	Ratio of conventional bicycle to Class 1 and Class 2 electric bicycle crashes
2022	493	29	1,016	17.0
2023	537	60	945	9.0

Source: Oregon Crash Data Products
Notes: The vehicle-level dataset for each year contain a vehicle type field (VHCL_TYP_CD), that includes codes for electric bicycles and other motorized vehicles. Oregon groups Class 1 and 2 electric bicycles together under category 16 (“Motorized Bicycle or Electric Bicycle (eBike), Tiers 1 and 2 only”). Class 3 electric bicycles are classified with motorcycles and dirt bikes under category 09 (“Motorcycle, dirt bike, and Tier 3 eBikes”). Conventional bicycle data is found in the crash-level dataset (CRASH_TYP_CD) which contains codes for non-motorized vehicles, under category 6. Data was aggregated to the crash-level in order to count the number of crashes involving these modes rather than the number of times these vehicles appeared in crash data. Population data was collected from U.S. Census population estimates.

6.2.2 Maryland crash data

As of 2024, Maryland began reporting electric bicycle-specific crash data using the new “Cyclist (Electric)” category introduced in their Automated Crash Reporting System (ACRS) 2.0. While Maryland previously provided easily accessible crash data through its open data portal, in recent years, the state shifted to a dashboard-based system. This dashboard allows users to filter and view data, but it offers only limited download options. In 2024, 178 crashes were reported that involved electric bicycles and 640 that involved conventional bicycles, a ratio of 3.6 times more conventional bicycle incidents.

Table 11. Maryland crash data

Year	# of crashes involving electric bicycles	# of crashes involving conventional bicycles	Ratio of conventional bicycle to electric bicycle crashes
2024	178	640	3.6

Source: Maryland Crash Data Dashboard

6.3 LOCAL CRASH DATA: ORANGE COUNTY

Some local police departments make crash data publicly available, and a small subset of these provide data in a format that distinguishes electric from conventional bicycle incidents. It is also sometimes possible for researchers or other members of the public to receive summary data on crash reports through California Public Records Act requests. We share findings from one example of each.

We were able to explore crash data from one local jurisdiction in California—Orange County—that separates crashes by electric vs. conventional bicycles (see Table 12). This data was shared with us by a community member who had made a California Public Records Act request for the data to the Orange County Sheriff's Department. Unlike every other crash dataset discussed in this chapter, in Orange County more electric bicycle crashes were reported than conventional bicycles; indeed, there were more than twice as many electric bicycle crashes.

The Orange County data also includes the manufacturer of the electric bicycles involved, where the reporting officer determined this. Just under a third of all reported crashes involved devices made by either Super73 or Rad Power Bikes, two brands that are primarily known for selling throttle bicycles.

Table 12. Orange County crash data (January 1, 2024, to August 18, 2025)

Year	# of crashes involving electric bicycles	# of crashes involving conventional bicycles	Ratio of conventional bicycle to electric bicycle crashes
2024 – 2025	267	112	0.4

Source: Data received from the Orange County Sheriff's Department.

7. DATA ON INJURIES

This chapter explores available data exploring injuries sustained by electric bicycle riders. We begin with an overview of available scholarly literature exploring injuries related to the use of electric bicycles. Later sections in the chapter present original analysis of several datasets: two sources reporting data from hospitals (one looking at a sample of hospitals nationwide and one look at hospitals specifically in California), New York City police reports on persons injured in traffic collisions, and Marin County emergency medical services data.

7.1 LITERATURE REVIEW FINDINGS

As part of the development of this report, we identified and reviewed approximately 200 publications around the world exploring themes related to electric bicycle safety (Ghanbari, Agrawal, & Fang, 2025). In addition to the U.S., these studies primarily came from countries with relatively high bicycle use such as Germany, Israel, the Netherlands, and Switzerland.

A handful of U.S. studies have explored electric bicycle safety performance utilizing the National Electronic Injury Surveillance System (NEISS), data for which we conducted an original analysis of NEISS data presented later in this chapter. Literature exploring electric bicycle safety that uses NEISS data include Di Maggio, et al. (2020), Fang (2022), Fernandez, et al. (2024), Tark (2024), and Younes (2025). Several additional studies utilize NEISS to focus on a narrow set of injuries such as fractures (Jiang, Davison-Kerwood, & Gonzalez, 2022), head and neck injuries (Williams, Kafle, & Lee, 2024), and explore only pediatric injuries (Goodman, et al., 2023). Our original analysis of NEISS data differs from these earlier studies in a variety of ways, but most notably includes more data that the earlier studies. Unlike the earlier studies, our analysis includes 2024 NEISS data, the first year that NEISS used a specific data code for electric bicycles.

Through our global review, we identified a number of studies comparing crash frequency, injury frequency, hospitalization rates, and injury severity comparing electric bicycles to either conventional bicycles or electric scooters. Table 13 and Table 14 show some of these comparisons. Notably, all studies that compared injury severity by device type where the difference was statistically significant found higher proportions of severe injuries and hospitalizations among electric bicycle riders. These ratios ranged from 1.2 to 2. These studies also found that head, neck, and face injuries were more common among electric bicycle riders than conventional bicyclists. For the comparison of electric bicycles with electric scooters, the ratios were mostly from 1 to 2, though none of these differences were statistically significant.

Data analyzed in international literature came from primarily medical records, but also sometimes crash records and patient surveys. Many of the sources had relatively small sample sizes, particularly relative to the NEISS dataset from the United States, due to relatively narrow geographic or temporal scopes. However, many of these international data sources captured medical outcomes not captured well by NEISS.

Table 13. Studies from outside the U.S. comparing the safety of electric bicycles with conventional bicycles

			# of rashes or injuries		Hospitalization		Severe injuries	
Study	**Country**	**Data[a]**	**# EB cases**	**Ratio[b]**	**EB%**	**Ratio[b], sig[c]**	**EB%**	**Ratio[b], sig[b]**
Verstappen et al. (2021)	Netherlands	PS	78	0.9	21%	1.5, S	--	--
Verbeek (2019)	Netherlands	MR	379	0.8	27%	1.2, S	--	--
Van der Zaag et al (2022)	Netherlands	MR	73	0.3	57%	1.7, S	--	--
Berk et al. (2022)	Switzerland	MR	27	0.5	48%	2.0, S	--	--
Sporri et al. (2021)	Switzerland	MR	67	<0.1	--	--	19%	1.1, NA
Qian and Shi (2023)	China	CR	873	8.9	5%	0.6, NA	--	--
Hu et al (2014)	China	MR	146	2.5	--	--	33%	1.9, S
Rauer et al. (2023)	Switzerland	MR	19	<0.1	--	--	26%	0.9, NS
Zmora et al. (2019)	Israel	MR	46	0.5	--	--	34%	1.8, S
Simon-Tov et al. (2018)	Israel	MR	1,733	0.2	16%	1.5, S	13%	1.2, S
Otte & Facius (2019)	Germany	CR	64	<0.1	--	--	2%[d]	0.4, NA
Gehlert (2017)	Germany	PS	2,495	<0.1	--	--	28%	1.6, NA

Source: Ghanbari, Agrawal, & Fang (2025)
[a] PS=patient survey, MR=medical records, and CR=crash records.
[b] Ratio of electric bicycle to conventional bicycle incidents.
[c] Statistical significance of the ratio. S=statistically significant, NS=not statistically significant, and NA=statistical significance not reported.
[c] These values represent nationally weighted estimates derived from the database, rather than the actual patient counts recorded.

Table 14. Studies from outside the U.S. comparing the safety of electric bicycles with electric (kick) scooters

			# of crashes or injuries		Hospitalization		Severe injuries	
Study	Country	Data[a]	# EB cases	Ratio[b]	EB%	Ratio[b], sig[c]	EB%	Ratio[b], sig[c]
Arbel et al. (2022)	Israel	MR	82	0.3	35%	1.5, S	--	--
Savitsky et al., (2021)	Israel	MR	3,996	5.4	84%	5.4, NA	--	--
Simon-Tov et al (2017)	Israel	MR	663	10.5	--	--	3%	0.9, NS
Hashavia et al (2024)	Israel	MR	466	0.7	--	--	24%	1.4, S
Lin et al (2020)	Israel	MR	321	5.7	--	--	--	--
Cha Sow King et al (2020)	Singapore	MR	33	0.4	--	--	43%	1.5, S

Source: Ghanbari, Agrawal, & Fang (2025)
[a] PS=patient survey, MR=medical records, and CR=crash records.
[b] Ratio of electric bicycle to electric scooter incidents.
[c] Statistical significance of the ratio. S=statistically significant, NS=not statistically significant, and NA=statistical significance not reported.
[c] These values represent nationally weighted estimates derived from the database, rather than the actual patient counts recorded.

7.2 NATIONAL EMERGENCY ROOM INJURY DATA

This section presents our original analysis of data on injuries that were observed at hospital emergency rooms reporting to the National Electronic Injury Surveillance System (NEISS). We present data over a five-year period from 2020-2024.

7.2.1 Data and methods

About the NEISS

NEISS is a database maintained by the U.S. Consumer Product Safety Commission (CPSC) that records emergency room visits associated with "unintentional consumer product-related injuries and deaths." The list of consumer products is extensive, tracking items ranging from eggbeaters to end-tables to electric bicycles.

NEISS data is collected from a representative sample of 96 hospitals across the U. S. that operate a 24-hour emergency room. If a patient seen at the ER of a sample hospital suffers an injury involving a consumer product, hospital staff log the case into NEISS.

For each NEISS case, coders enter information for a series of variables collected for every case. These pre-coded variables include information on the demographics of the patient (gender, age, and race), the location where injuries took place (e.g., street, home, or park) and the injury incurred (disposition, diagnoses, and body part(s) injured).

In addition, hospital staff report a narrative “comment” line for each case. The NEISS coding manual specifies that the comment should be no more than 400 characters in length and include details about the incident (who, what, why, when, where, and how) as well as information given about product brand, manufacturer, and model (United States Consumer Product Safety Commission, 2022). In practice, comments vary in detail, with some comments providing much of the information specified in the coding manual but many others lacking detail.

The consumer products associated with ER visits are identified in NEISS using NEISS Product Codes. NEISS has had a specific code for “electric power-assisted pedal bicycles” since 2024. Prior to 2024, earlier versions of the NEISS coding manual specified that injuries related to electric bicycles be recorded using the code for “Mopeds or power-assisted cycles.” For injuries from 2020 to 2023, we read the comment lines for moped or power-assisted cycle cases and identified and extracted cases related to electric bicycles.

To place the findings on electric bicycles into context, we also present findings on several other micromobility and wheeled devices in the discussion below. Table 15 summarizes the device types discussed in this section as well as the corresponding NEISS product codes. As visible in the table, the names of NEISS product codes can be very long, so we have abbreviated them here.

Table 15. Devices mentioned in this section and the corresponding NEISS product code(s)

Device type (as defined in this report)	NEISS product codes
Electric bicycles	2020-2023 Subset of 3215: Mopeds or power-assisted cycles 2024 5045: Electric power-assisted pedal bicycles (excluding off-road vehicles and minibikes)
Conventional bicycles	5040: Bicycles or accessories (excluding mountain or all-terrain bicycles)
Mopeds/power-assisted cycles	2020-2023 Subset of 3215: Mopeds or power-assisted cycles 2024 5046: Power-assisted cycles, not elsewhere classified (excluding off-road vehicles, minibikes, and licensed vehicles.)
Minibikes	5035: Minibikes, powered
Powered scooters	5022: Scooters Powered
Skateboards	1333: Skateboards, unpowered or unspecified
Hoverboards/powered skateboards	5025: Hoverboards and powered skateboards
Off-road vehicles, 2-wheel, powered	5036: Two-wheeled, powered, off-road vehicles (including dirt bikes and trail bikes; excluding mopeds and minibikes)
All-terrain vehicles	3286: All-terrain vehicles (four wheels)

Readers should note that our analysis of NEISS data reports the actual numbers of patients treated at the 96 hospitals. Many other NEISS papers report national estimates, which the authors produce using NEISS-provided expansion factors that estimate total numbers of injuries nationwide. In any event, most of our analyses explore *percentages* of injury circumstances, rather than total numbers. Also, using the actual patient counts more overtly communicates the size of the sample those proportions cover than would the national estimates.

7.2.2 Number of patients

For the five years from 2020 to 2024, we identified 3,179 injuries involving electric bicycles at the 96 NEISS sample hospitals nationwide (Table 16). Unsurprisingly, the number of injuries increased over the five-year period, growing from 115 injuries in 2020 to 1,290 in 2024, a greater than ten-fold increase (Table 16 and Figure 25). However, given the substantial (though unknown) increase in electric bicycle use over that time, some increase in injuries is to be expected.

Although electric bicycle injuries increased considerably between 2020 and 2024, in 2024 there were still fewer injuries for electric bicycle patients than for patients of some of the other micromobility and wheeled devices we explored. For example, 2024 saw eight times more injuries reported for conventional bicyclists than for electric bicyclists. Also, there were fewer injuries involving electric bicycles than injuries involving powered scooters, skateboards, and off-road vehicles (two-wheels, powered). Finally, 2024 did see more electric bicycle patients than mopeds/power-assisted cycles patients, though across the full five years there were fewer electric bicycle patients.

Table 16. Patients per year by device type, 2020 – 2024

							Change, 2020 – 24	
	2020	2021	2022	2023	2024	Total	%	#
Electric bicycles	115	290	526	958	1,290	3,179	+1,022%	+1,175
Conventional bicycles	12,587	10,826	9,807	10,363	10,532	54,115	-16%	-2,055
Mopeds/power-assisted cycles	637	881	900	1,062	1,065	4,545	+67%	+428
Minibikes	97	138	91	101	117	544	+21%	+20
Powered scooters	833	1,522	1,618	2,023	2,815	8,811	+238%	+1,982
Skateboards	3,320	3,176	2,224	1,865	1,630	12,215	-51%	-1,690
Hoverboards/powered skateboards	1,009	933	620	504	447	3,513	-56%	-562
Off-road vehicles (2-wheel, powered)	1,546	1,628	1,367	1,442	1,550	7,533	0%	+4
All-terrain vehicles	1,448	1,339	906	960	975	5,628	-33%	-473

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

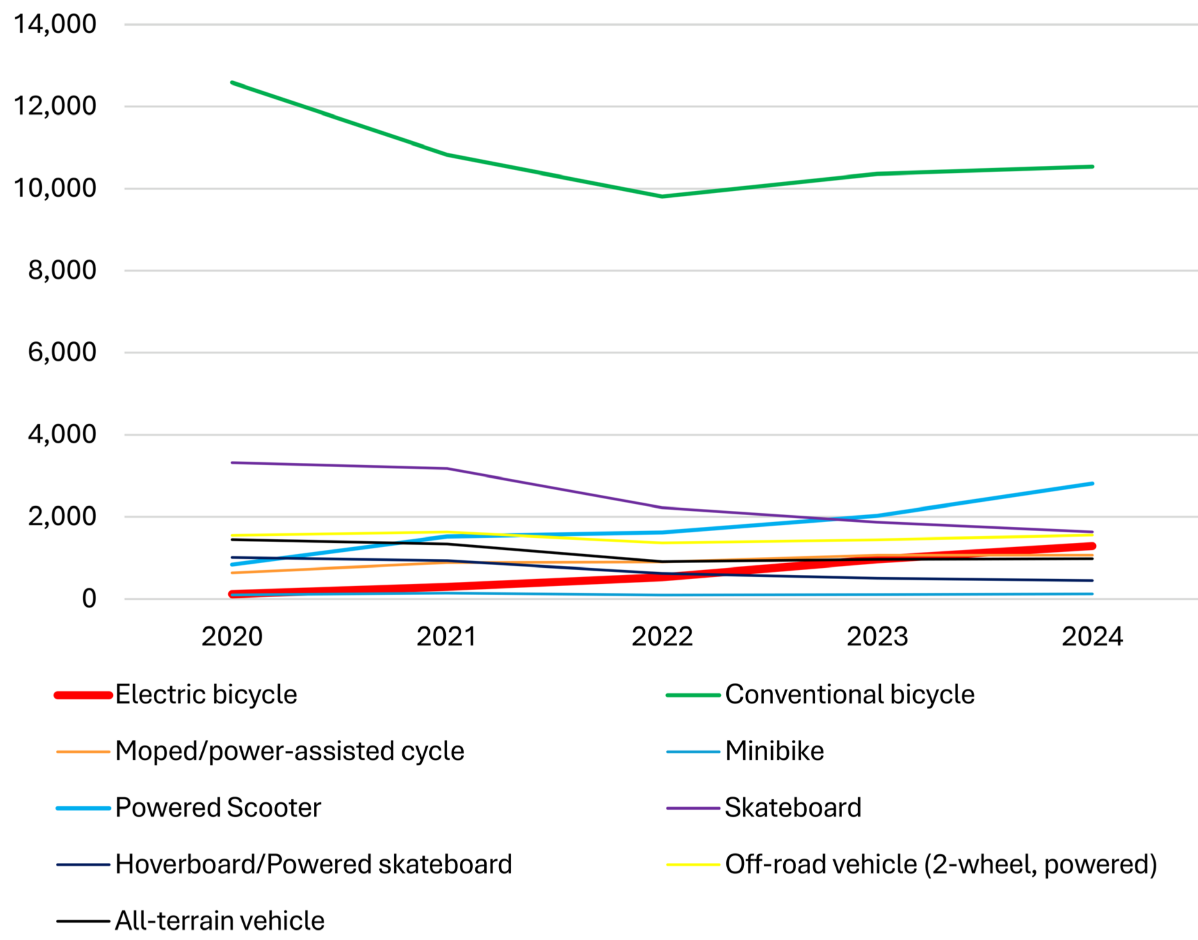


Figure 25. Patients per year by device type, 2020 – 2024

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

7.2.3 Patient demographics

For both electric bicycles and conventional bicycles, around three out of four patients were male (see Table 17). The other devices had roughly similar patterns; all saw more male patients, and for all devices except hoverboards/powered skateboards, at least two thirds of patients were male.

Table 17. Gender distribution of patients, 2020 – 2024 pooled data

Device type	Male	Female	n
Off-road vehicles (2-wheel, powered)	89%	11%	7,533
Minibikes	82%	18%	544
Mopeds/power-assisted cycles	81%	19%	4,545
Electric bicycles	78%	22%	3,179
Conventional bicycles	75%	25%	54,115
Skateboards	75%	25%	12,215
All-terrain vehicles	68%	32%	5,628
Powered scooters	66%	34%	8,811
Hoverboards/powered skateboards	55%	45%	3,513
All-terrain vehicles	68%	32%	5,628

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Notes: Percents may add up to slightly less than 100% because we do not report values for the very small number of patients (0.2% or fewer, depending on device type) who reported genders other than male or female. NEISS records come from a sample of 96 hospitals nationwide.

With respect to age, about one in five electric bicycle patients (20%) were minors, almost identical to their share of the U.S. population. In comparison, 43% of bicycle patients were minors. Slightly over half of the electric bicycle patients (54%) were adults aged 18 to 49 years. Electric bicycle patients had the oldest median age (34 years), a full decade higher than conventional bicycles (24 years). Mopeds/power-assisted cycles have the second highest median age, 30 years.

Figure 26 further explores the age distribution of electric bicycle patients. In each of the five years shown here, a plurality of patients were adults aged 18 to 34 years. The age group with the second greatest share over all five years shown was adults aged 35 to 49. However, since 2022 the age group with the fastest growth rate has been minors. In 2024, for the first time minors exceeded adults aged 35 to 49.

Table 18. Age distribution of patients, 2020 – 2024 pooled data

	0 – 17	18 – 34	35 – 49	50 – 64	65+	Median age
Electric bicycles	20%	32%	22%	18%	9%	34
Mopeds/power-assisted cycles	12%	48%	20%	15%	4%	30
Powered scooters	24%	39%	20%	12%	5%	28
Conventional bicycles	43%	19%	14%	15%	10%	24
Minibikes	45%	33%	13%	6%	2%	20
All-terrain vehicles	39%	31%	17%	8%	4%	22
Off-road vehicles (2-wheel, powered)	44%	38%	13%	5%	<1%	19
Skateboards	51%	40%	7%	2%	<1%	17
Hoverboards/powered skateboards	74%	14%	8%	4%	1%	10
Share of U.S. population in 2024	*21%*	*23%*	*20%*	*18%*	*18%*	*39*

Sources: Authors' analysis of data from U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System and U.S. Census Bureau, American Community Survey, 2024 (1-year estimate).
Notes: Percents may add up to slightly less than 100% due to other/unknown values. NEISS records come from a sample of 96 hospitals nationwide.

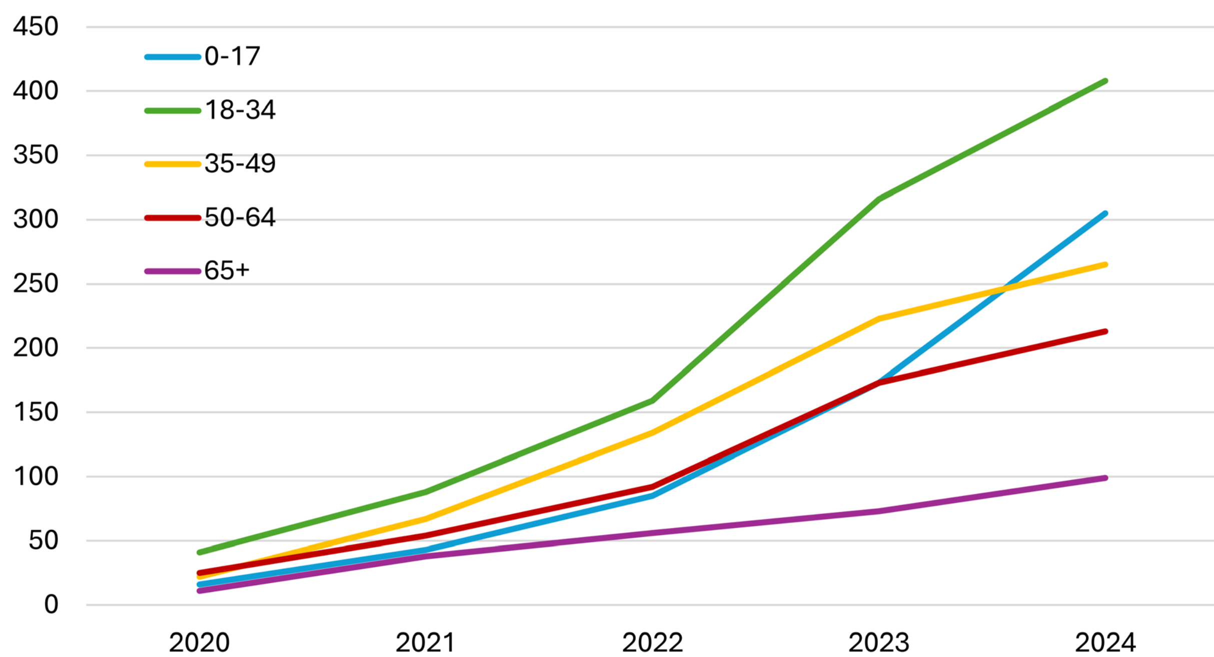


Figure 26. Electric bicycle injuries by age, by year, 2020 – 2024

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

7.2.4 Injury location

NEISS also collects information on where a patient was injured. The categories available are very broad (e.g., street, home, school). Unsurprisingly, for both electric bicycle patients and conventional bicycle patients, the majority of injuries for which a location was reported took place on a street (80% and 62%, respectively). However, bicycle injury patients had a slightly higher share of injuries taking place at home or sports/recreation places than electric bicycle patients.

Table 19. Percent of patients injured, by incident locations, 2020 – 2024 pooled data

	Street	Home	Place of recreation/ sports	Other	n: location reported	n: all patients
Conventional bicycles	62%	11%	9%	18%	28,305	54,115
Skateboards	24%	14%	36%	26%	4,439	12,215
Powered scooters	71%	6%	2%	21%	5,004	8,811
Off-road vehicles (2-wheel, powered)	26%	15%	46%	13%	3,777	7,533
All-terrain vehicles	16%	32%	39%	13%	2,681	5,628
Mopeds/power-assisted cycles	94%	1%	<1%	4%	3,936	4,545
Hoverboards/powered skateboards	18%	63%	6%	13%	1,375	3,513
Electric bicycles	80%	3%	3%	14%	1,978	3,179
Minibikes	56%	23%	5%	16%	279	544

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: Percentages are out of total number of cases where location was reported, NEISS records come from a sample of 96 hospitals nationwide.

As shown previously in Table 18 and Table 19, there are notable differences between electric bicycles and conventional bicycles in terms of who was injured and where they were injured. For patients where age and location were reported, 70% of electric bicycle patients were adults injured on streets, compared to just 47% for conventional bicycle patients (see Table 20). Conversely, 13% of conventional bicycle patients were minors injured at home or a recreational place, compared to only 2% for electric bicycles. Since adults riding on streets is a markedly different context than children riding in parks, analysis in the following sections emphasizes how injury outcomes vary by location, to provide more like-for-like comparisons.

Table 20. Why composition of patient age and location of injury, conventional bicycles and electric bicycles, known locations only (2020 – 2024 pooled data)

Age	Injury location	Electric bicycles	Conventional bicycles
0-17	Street	10%	15%
	Home or place of recreation/sports	2%	13%
	Other	3%	7%
18+	Street	70%	47%
	Home or place of recreation/sports	4%	7%
	Other	11%	11%
All		*100%*	*100%*

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

7.2.5 Medical outcomes

NEISS does not report injury severity scores but does have a variable called "disposition" which describes the outcome of the ER visit: treated and released, hospitalized, or a fatality. The latter two outcomes are the most serious. There were so few fatalities reported, however, that we focus our analysis of severe outcomes on the percentage of patients hospitalized.

There was very little difference in the proportion of electric bicycle patients hospitalized compared to the percentages for injuries involving bicycles, powered scooters, and mopeds/power-assisted cycles. Looking at patients injured for all location combined, 16% of electric bicycle patients were hospitalized, only 3 percentage points higher than the hospitalization rate for conventional bicycle patients (13%), and 5 percentage points lower than the rate for mopeds patients (see Table 21). Looking at just injuries that took place on streets, conventional bicycles and electric bicycles had virtually identical hospitalization rates (18% vs 17%, respectively).

Table 21. Share of patients hospitalized, by location, 2020 – 2024 pooled data

	Street locations		Other/unknown Locations		All locations	
Travel mode	**%**	**n**	**%**	**n**	**%**	**n**
Electric bicycles	17%	1,581	15%	1,598	16%	3,179
Conventional bicycles	18%	17,554	11%	36,561	13%	54,115
Mopeds/power-assisted cycles	23%	3,706	15%	839	21%	4,545
Powered scooters	16%	3,569	12%	5,242	13%	8,811

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

Table 22 explores injury disposition by age for just those patients injured at street locations. For minors, the hospitalization rate ranged from 11% for conventional bicycle patients to 17% for mopeds/power-assisted bicycle patients, with electric bicycle patients in the middle of that narrow range, at 14%. For all devices, hospitalization rates were higher for patients 50 and older compared to those younger than 50. The age group with the lowest hospitalization rates for most devices, including electric bicycles, was young adults aged 18 to 34.

Table 22. Share of patients hospitalized by age, street location injuries only, 2020 – 2024 pooled data

Travel mode		0 – 17	18 – 34	35 – 49	50 – 64	65+	Overall
Electric bicycles	%	14%	11%	15%	26%	31%	17%
	n	199	605	394	275	108	1,581
Conventional bicycles	%	11%	12%	17%	24%	35%	18%
	n	4,117	4,734	3,320	3,465	1,904	17,554
Mopeds/power-assisted cycles	%	17%	18%	24%	34%	42%	23%
	n	343	1,887	762	575	136	3,706
Powered scooters	%	12%	12%	17%	25%	34%	16%
	n	556	1,629	785	451	145	3,569

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

7.2.6 Medical diagnoses

NEISS data provides the medical diagnosis each patient received. All patients have at least one diagnosis recorded, though NEISS also records a second injury if one was diagnosed. (Additional diagnoses are not coded, however.) Table 23 shows the share of patients who suffered a second injury. Among those injured on streets, electric bicycle patients suffered multiple injuries at a 9 percentage-point greater rate than conventional bicycle patients (63% to 54%). Additionally, across all four devices shown, those injured on streets more frequently suffered multiple injuries than those injured in other/unknown locations.

Table 23. Share of patients with two injuries diagnosed, 2020 – 2024 pooled data

	Street locations		Other/unknown locations		All locations	
Travel mode	**%**	**n**	**%**	**n**	**%**	**n**
Electric bicycles	63%	1,581	51%	1,598	57%	3,179
Conventional bicycles	54%	17,554	35%	36,561	41%	54,115
Mopeds/power-assisted cycles	65%	3,706	49%	839	62%	4,545
Powered scooters	60%	3,569	47%	5,242	52%	8,811

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

Table 24 shows the proportion of patients who were diagnosed with a selection of common injuries. Injury diagnoses were diverse, with the most common diagnoses being suffered by around a third of patients for a given device. For electric bicycles and conventional bicycles, the most common injuries were soft tissue injuries (contusions, abrasions, lacerations, strains, and sprains) and fractures.

Table 24. Selected injury diagnoses, 2020 – 2024 pooled data

Travel mode	Concussion	Internal organ injury	Fracture	Strain/ sprain	Contusion/ abrasion	Laceration	Total patients
Electric bicycles	4%	17%	32%	7%	31%	18%	3,179
Conventional bicycles	4%	14%	30%	7%	28%	18%	54,115
Mopeds/power-assisted cycles	2%	15%	32%	6%	32%	18%	4,545
Powered scooters	4%	15%	32%	7%	30%	18%	8,811

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Notes: Up to two injuries reported per patient, thus sum of proportions for each device exceed 100%. NEISS records come from a sample of 96 hospitals nationwide.

Table 25 shows the percentage of patients who suffered injuries to various body parts. For electric bicycle patients, 64% suffered an injury to an extremity (e.g., arm, leg, foot, hand). Forty-seven percent suffered an injury from the neck up, including 23% with a head injury. Notably, electric bicycles had a higher share of patients injuring every body region compared conventional bicycles. This is possible due to the aforementioned higher share of electric bicycle patients having two injuries reported rather than one.

Table 25. Body part(s)[a] injured: percent of patients suffering injury, 2020 – 2024 pooled data

Travel mode	Head	Face	Neck	Trunk	Arm or leg	Total patients
Electric bicycles	23%	21%	3%	20%	64%	3,179
Conventional bicycles	19%	1*%	2%	19%	61%	54,115
Moped/power-assisted cycles	19%	1/%	4%	21%	68%	4,545
Powered scooters	21%	23%	2%	15%	64%	8,811

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
[a] Up to two injuries reported per patient, thus sum of proportions for each device exceed 100%.
Note: NEISS records come from a sample of 96 hospitals nationwide.

Table 26 further explores head injuries. Looking only at injuries that occurred on streets, the electric bicycles have a very similar head injury rate as bicycles.

Table 26. Share of patients with head injuries by injury location, 2020 – 2024 pooled data

	Street locations		Other or unknown locations		All locations	
Travel mode	%	n	%	n	%	n
Electric bicycles	23%	1,581	23%	1,598	23%	3,179
Conventional bicycles	23%	17,554	17%	36,561	19%	54,115
Mopeds/power-assisted cycles	20%	3,706	18%	839	19%	4,545
Powered scooters	22%	3,569	21%	5,242	21%	8,811

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

Table 27 breaks down head injuries occurring on streets by age. For conventional bicycles and electric bicycles, young adults (age 18 – 34 years old) had the lowest share of patients suffering head injuries and seniors had the highest share of head injuries.

Table 27. Share of patients with head injuries by age, street location injuries, 2020 – 2024 pooled data

Travel mode		0 – 17	18 – 34	35 – 49	50 – 64	65+	Overall
Electric bicycles	%	29%	19%	21%	28%	33%	23%
	n	199	605	394	275	108	1,581
Conventional bicycles	%	22%	20%	22%	25%	28%	23%
	n	4,117	4,734	3,320	3,465	1,904	17,554
Mopeds/power-assisted cycles	%	21%	19%	17%	23%	26%	20%
	n	343	1,887	762	575	136	3,706
Powered scooters	%	29%	20%	21%	24%	29%	22%
	n	556	1,629	785	451	145	3,569

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

7.2.7 Activity of patients at time of injury

Not every patient suffering an injury related to a device was riding that device. For example, a pedestrian could have been struck by a moving bicycle or tripped over a parked scooter. To ascertain whether NEISS patients were riding a device or not, we read the comment lines for a subset of NEISS cases. Looking at the most recent year of data, 2024, we read the comment lines to determine the activity occurring at the time of injury for all electric bicycle cases, as well as subsets of 1,500 conventional bicycle cases and 1,500 powered scooter cases. (We randomly selected the samples of bicycle and scooter cases.) Activities were coded into five broad categories:

- Device operator
- Passenger
- Non-travel by user (e.g., injured when carrying the device or if the device fell on the rider's foot, in the garage)
- Bystander – struck by device (e.g., a pedestrian struck by someone traveling on the device)
- Bystander – other (e.g., pedestrian tripped over parked device or a child injured from swallowing a screw that belonged to an electric bicycle being repaired)
- Unknown

Table 28 shows that nearly all patients were operators for all device types analyzed, and the distribution of activities was very similar across the three devices. For electric bicycles, 92% of patients were operating the device when injured. Bystanders struck by moving devices were 4% of electric bicycle patients, 3% of powered scooter patients, and 1% of conventional bicycle patients.

Table 28. Activity of injured patients (2024)

Activity	Electric bicycles	Conventional bicycles	Powered scooters
Operator	92%	95%	93%
Passenger	2%	<1%	<1%
Non-travel by user[a]	<1%	1%	1%
Bystander struck by device	4%	1%	3%
Bystander – other[b]	<1%	2%	<1%
Other/unknown	<1%	<1%	2%
n	All 1,290 cases	Random subset of 1,500 cases	Random subset of 1,500 cases

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
[a] Non-travel by user includes device users/owners who were not traveling on their device when injured
[b] Injuries to non-users involving devices not in motion
Note: NEISS records come from a sample of 96 hospitals nationwide.

Table 29 shows hospitalization rates by activity. Looking just at operators, the difference in hospitalization rate for electric bicycles (17%) and conventional bicycles (16%) is just one percentage point. Bystanders struck by powered scooters were hospitalized 15% of the time, bystanders struck by electric bicycles were hospitalized 12% of time, and bystanders struck by conventional bicycles were hospitalized 5% of the time. These bystander figures should be interpreted with caution, due to very small sample sizes.

Table 29. Share of patients hospitalized by activity of injured patients (2024)

	Electric bicycles		Conventional bicycles		Powered scooters	
Activity	%	n	%	n	%	n
Operator	17%	1,188	16%	1,425	14%	1,390
Bystander struck by device	12%	49	5%	19	15%	48
n	All 1,290 cases		Random subset of 1,500 cases		Random subset of 1,500 cases	

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.

7.2.8 Motor vehicle collisions

In our detailed reading of comment lines from 2024 (all electric bicycle cases, subset of 1,500 bicycle and powered scooter cases) we also identified whether patients operating a device were injured in a collision with an automobile or other traveler, or were involved in a solo crash. Table 30 shows that the majority of injured electric bicycle, conventional bicycle, and power-scooter operators were injured in a solo crash. For electric bicycles, 31% of injured operators collided with a motor vehicle, slightly higher than the 23% of bicycle operators who were injured in motor vehicle collisions.

Table 30. Immediate cause of injury, operators only (2024)

	Electric bicycles	Conventional bicycles*	Powered scooters*
Collision with automobile	31%	24%	24%
Collision with other mode	2%	3%	1%
Solo crash	61%	61%	68%
Other/unknown	6%	13%	7%
n	1,188	1,425	1,390

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.
*Based on analysis of a randomly selected subset of 1,500 cases for the year.

Patients involved in automobile collisions were hospitalized at higher rates than those involved in solo crashes (Table 31). This was especially true for powered scooters (12 percentage point difference). For electric bicycles, patients involved in automobile collisions were hospitalized 19% of the time versus 15% for solo crashes.

Table 31. Share of patients hospitalized, by immediate cause of injury, operators only (2024)

	Electric bicycles		Conventional bicycles*		Powered scooters*	
	%	n	%	n	%	n
Collision with automobile	19%	373	17%	336	20%	336
Collision with other mode	14%	22	14%	37	6%	18
Solo crash	15%	721	15%	870	8%	941
Other/unknown	21%	72	20%	182	13%	95
Total	*17%*	*1,188*	*16%*	*1,425*	*13%*	*1,390*

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.
*Based on analysis of a randomly selected subset of 1,500 cases for the year.

7.3 CALIFORNIA EMERGENCY ROOM DATA

This section explores data on injuries observed at California hospitals in 2023, using data available through the California Health & Human Services (CHHS) Open Data Portal.

Both the CHHS data described here and the NEISS data described in the previous section look at injuries treated at hospitals. While NEISS provides substantially more information about each injury case it records, NEISS data is based on a sample of just 96 hospitals nationwide. Inversely, much less information is available about each case is available from the CHHS, but the California data captures injuries seen at more than 300 licensed state hospitals in California, resulting in a much greater sample size. One other key difference between the two data sets is that the CHHS codes are assigned for billing purposes while the NEISS data is designed to assist with injury prevention, so it is likely the NEISS data more accurately captures the type of device and activity at time of injury.

7.3.1 Data and methods

For all patient encounters, hospital staff report the reasons for a patient's visit, such as an illness or cause of an injury. Hospital staff select from a pre-defined set of alphanumeric codes that correspond to various illnesses or injuries. (The use of pre-defined codes in the CHHS data differs from the NEISS data, where reasons for an emergency room visit are captured in an open-ended narrative comment line.)

The possible illness and injury codes used by California hospitals are defined by the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) system (National Center for Health Statistics, 2024). The ICD-10-CM system was developed by the National Center for Health Statistics and is a U.S. modification of the World Health Organization (WHO) ICD-10 system (NCHS; part of the Center for Disease Control and Prevention).

Codes can be up to seven characters in length, with the first character being a letter. There are hundreds of codes, most referring to medical diagnoses. However, codes beginning with V, W, X, or Y capture hospital visits due to external causes of morbidity, including injuries. We examined codes beginning with V, which are the ones that cover transportation-related incidents.

As of October 1, 2022, the ICD-10-CM system was updated to add codes related to the use of "electric (assisted) bicycles" (National Center for Health Statistics). We analyzed California's hospital data from 2023, the first year that the electric bicycle codes were used. Data from 2024 patient encounters was not available as of the writing of this section.

Table 32 shows examples of ICD-10-CM external cause codes, illustrating how the patient's travel mode and injury context are represented in the coding system. Electric bicycle rider injuries are coded within the V20–V29 block, which is the same range used for motorcycle riders. Specific codes correspond to additional characteristics such as whether the patient was an electric bicycle rider or passenger, collided with other modes or fixed objects, or was injured in incidents not involving a collision.

Table 32. Examples of ICD-10-CM codes for external causes of injuries involving transportation

ICD-10-CM code	Official long descriptor
Electric bicycle operators	
V23.41	Electric (assisted) bicycle driver injured in collision with car, pick-up truck or van in traffic accident
V23.51	Electric (assisted) bicycle passenger injured in collision with car, pick-up truck or van in traffic accident
V27.41	Electric (assisted) bicycle driver injured in collision with fixed or stationary object in traffic accident
V20.41	Electric (assisted) bicycle driver injured in collision with pedestrian or animal in traffic accident
V28.41	Electric (assisted) bicycle driver injured in noncollision transport accident in traffic accident
Other travelers	
V03.10	Pedestrian on foot injured in collision with car, pick-up truck or van in traffic accident
V23.4	Motorcycle driver injured in collision with car, pick-up truck or van in traffic accident
V43.51	Car driver injured in collision with sport utility vehicle in traffic accident
V43.61	Car passenger injured in collision with sport utility vehicle in traffic accident
V00.131	Fall from skateboard
V18.0	Pedal cycle driver injured in noncollision transport accident in nontraffic accident
V99	Unspecified transport accident

Source: https://www.cdc.gov/nchs/icd/icd-10-cm/files.html

7.3.2 Number of patients with transportation-related injuries

In 2023, a total of 461,062 patients were treated at California hospitals with transportation-related injuries. Only 4,757 patients were identified as electric bicycle riders (see Table 33 and Figure 27). Thus, electric bicycle riders comprised just 1% of all patients with a transportation-related injury. Comparatively, 44,039 patients were identified as conventional bicycle riders, or 10% of all transportation-related patients. Overall, there were more than 9 times more injured conventional bicycle riders than injured electric bicycle rider. By far the most patients were injured in motor vehicle incidents: 62%.

Table 33. Travel mode of California ER patients treated for injury in a transportation-related incident (2023)

Mode	Number of patients	Share of all patients
Motor vehicle	287,184	62%
Other	45,596	10%
Conventional bicycle	44,039	10%
Other micromobility – unpowered*	25,905	6%
Motorcycle	23,832	5%
Pedestrian	21,780	5%
Other micromobility – powered*	7,969	2%
Electric bicycle	4,757	1%
Total	*461,062*	*100%*

Source: Authors' analysis of California Health & Human Services data.
*Includes the powered or unpowered versions of micromobility devices such as kick scooters and skateboards.

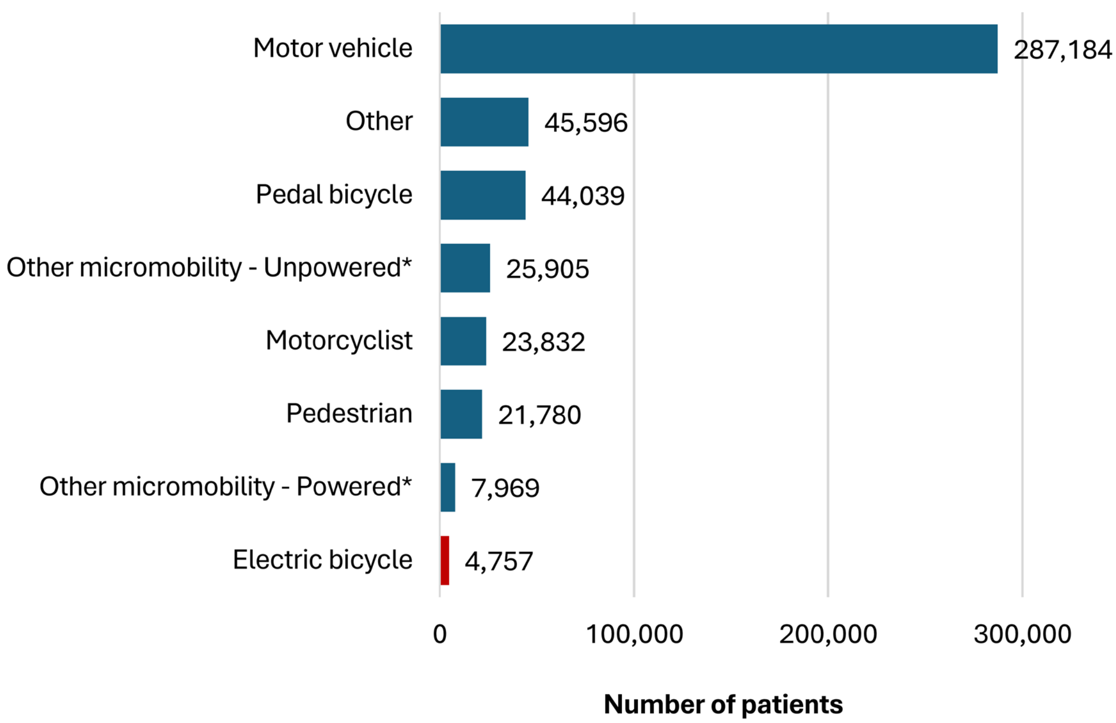


Figure 27. Travel mode of California emergency room patients treated for injury in a transportation-related incident (2023)

Source: Authors' analysis of California Health & Human Services data.
*Includes the powered or unpowered versions of micromobility devices such as kick scooters and skateboards.

7.3.3 Hospitalizations versus outpatient treatment

The great majority (90%) of patients who visited California hospitals in 2023 with transportation-related injuries were “outpatients”—i.e., they were treated at an emergency department but not admitted to the hospital. Only 10% of patients with transportation-related injuries were hospitalized (Figure 28).

By mode, pedal bicycle patients (10%) were hospitalized at a similar rate to all patients with transport-related injuries. Electric bicycle patients (17%) were 6 percentage points more likely to be hospitalized than conventional bicycle patients (11%). Pedestrians and motorcyclists had higher hospitalization rates than electric bicycle riders by 9 and 10 percentage points, respectively.

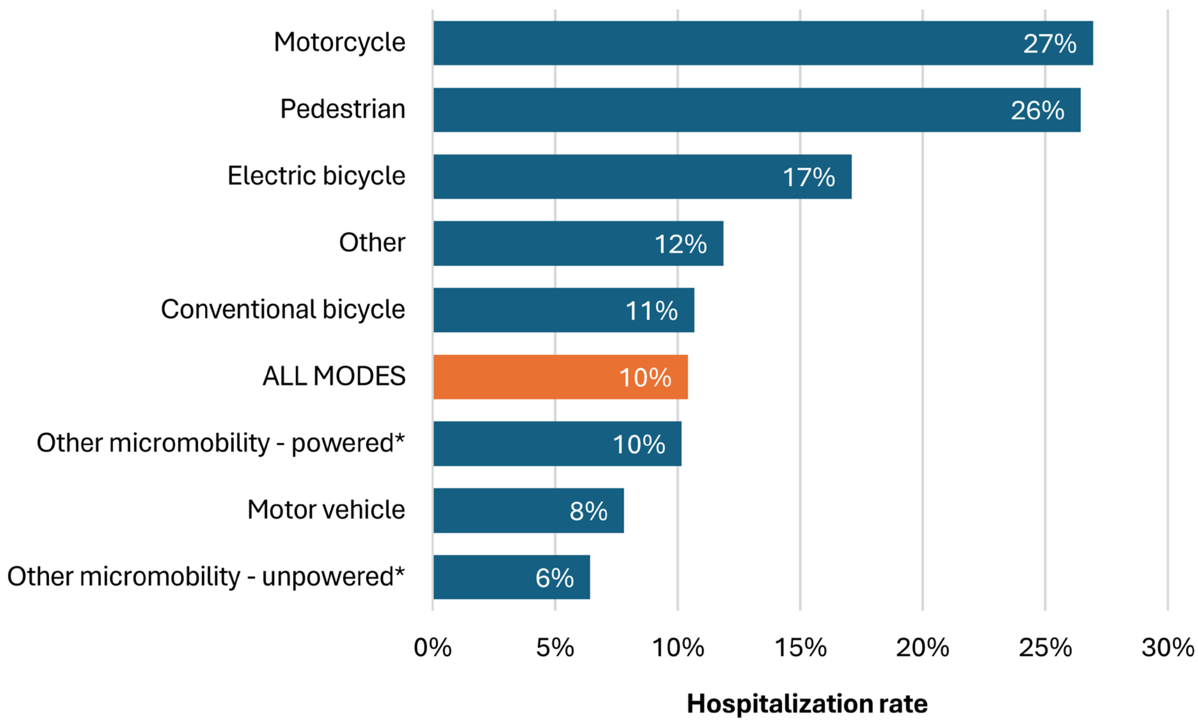


Figure 28. Hospitalization rate by mode (2023)

Source: Authors’ analysis of California Health & Human Services data.
*Includes the powered or unpowered versions of micromobility devices such as kick scooters and skateboards.

As previously mentioned, a majority of all patients seen at hospitals with transportation-related injuries were motor vehicle occupants. However, among hospitalized patients, who presumably have more severe injuries, over half (53%) were non-motorists, further indicating the vulnerability of non-motorists. Electric bicycle riders made up 2% of hospitalized patients, compared to 1% of outpatients (Table 34).

Table 34. Outpatient and hospitalization status by mode, 2023

Mode	Outpatients		Hospitalized patients		Total patients		Mode hospitalization rate
	Number	Share	Number	Share	Number	Share	
Motorcycle	17,412	4%	6,420	13%	23,832	5%	27%
Pedestrian	16,021	4%	5,759	12%	21,780	5%	26%
Electric bicycle	3,944	1%	813	2%	4,757	1%	17%
Other	40,189	10%	5,407	11%	45,596	10%	12%
Conventional bicycle	39,339	10%	4,700	10%	44,039	10%	11%
Other micromobility – powered*	7,159	2%	810	2%	7,969	2%	10%
Motor vehicle	264,745	64%	22,439	47%	287,184	62%	8%
Other micromobility – unpowered*	24,240	6%	1,665	3%	25,905	6%	6%
Total	*413,049*	*100%*	*48,013*	*100%*	*461,062*	*100%*	*10%*

Source: Authors' analysis of California Health & Human Services data.
*Includes the powered or unpowered versions of micromobility devices such as kick scooters and skateboards.

7.3.4 Cause of injury

As shown previously in the examples of ICD-10-CM codes (Table 32), the codes contain information about the circumstances of a transportation-related injury, such as whether the patient collided with a vehicle, collided with fixed objects, or was involved in a non-collision incident (such as a fall).

Figure 29 shows the injury circumstances for electric bicycle and conventional bicycle patients. The distribution across the different causes was almost identical for the modes, with variations of at most 5%. A slight majority of patients on both devices were involved in solo crashes. 20% of electric bicycle patients were coded as in a collision with a motor vehicle. It is important to note that some unknown fraction of the "solo crashes" would have resulted from interactions with a motor vehicle, such as a bicyclist falling when swerving to avoid a collision.

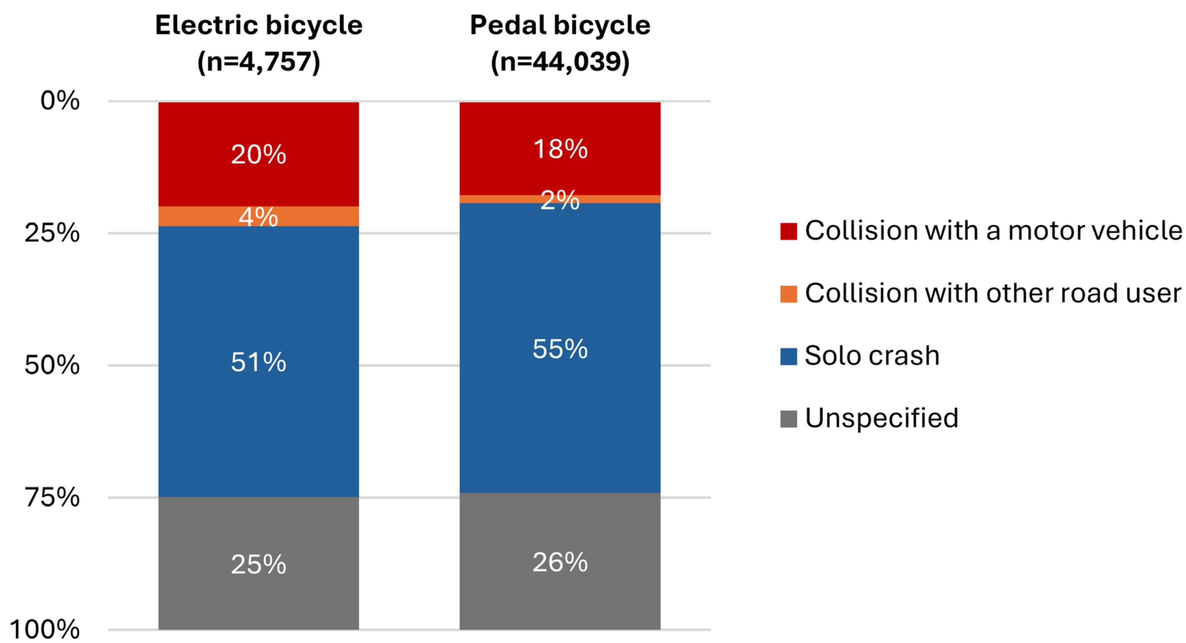


Figure 29. Cause of injury for electric bicycle and conventional bicycle patients

Source: Authors' analysis of California Health & Human Services data.

Table 35 shows hospitalization rates by cause of injury. For both conventional bicycles and electric bicycles, those who collided with motor vehicles were more frequently hospitalized than patients who were not involved in a motor vehicle collision, though the percentage point differences are small.

Table 35. Hospitalization rate by cause of injury

	Electric bicycles		Conventional bicycles	
Cause of injury	**Hospitalization rate**	**Number of patients**	**Hospitalization rate**	**Number of patients**
Collision with a motor vehicle	19%	944	17%	7,835
Collision with other road user	7%	180	13%	667
Solo crash	14%	2,437	8%	24,114
Unspecified	23%	1,196	10%	11,423
All causes	17%	4,757	12%	44,039

Source: Authors' analysis of California Health & Human Services data.

7.4 ILLINOIS EMERGENCY ROOM DATA

Shannon, et al. (2025) explored Illinois emergency room data on patients who were injured by electric bicycles, conventional bicycles, and other micromobility modes. The authors identified 441 patients with electric bicycle injuries who were treated from 2021 to 2023 (Shannon, Ni, Ehsani, & Friedman, 2025). This number was lower than that for several other micromobility devices and far lower than conventional bicycles (25,577).

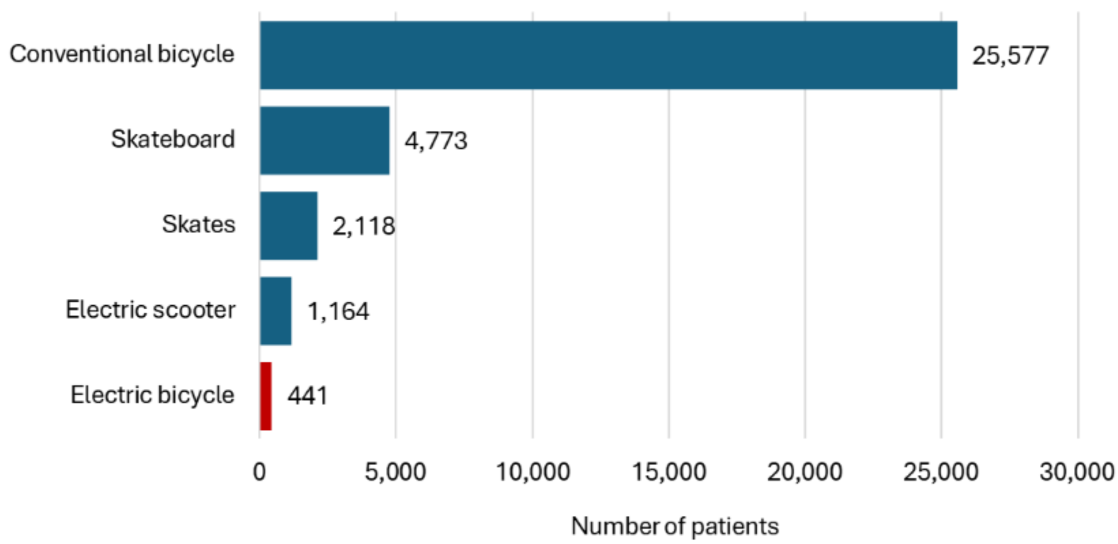


Figure 30. Illinois emergency room patients treated for injury related to micromobility devices, 2021 – 2023

Source: Based on data from Shannon, et al. (2025)

Shannon, et al. had access to data about the patients' personal characteristics and injures. Table 36 shows the share of patients who were children and teenagers: 21% of electric bicycle patients were aged 0 to 19. This was a smaller share of seniors than for all four other devices they explored.

Table 36. Share of children and teenagers (%) among Illinois ER patients (2021 – 2023)

Age	Electric bicycle	Conventional bicycle	Electric scooter	Skateboard	Skates
0 – 4	<1	3	<1	<1	<1
5 – 9	4	12	7	6	16
10 – 14	9	18	16	22	26
15 – 19	8	9	13	27	9
20 – 24	6	8	14	18	7
25 – 34	12	19	20	17	14
35 – 44	10	18	13	6	12
45 – 54	10	14	8	3	8
55 – 64	11	12	5	<1	6
65 – 74	7	7	2	<1	2
75+	2	2	1	<1	<1
Total, ages 0 –19	*21*	*43*	*37*	*56*	*51*
Total 65+	*9*	*9*	*3*	*<1*	*2*

Source: Based on data from Shannon, et al. (2025).

Table 37 shows selected medical diagnoses of Illinois ER patients. Similar to what we found in the NEISS dataset, the most common injuries tended to be contusions and fractures.

Table 37. Selected medical diagnoses among Illinois ER patients (% of patients) (2021 – 2023)

Diagnoses	Electric bicycle	Conventional bicycle	Electric scooter	Skateboard	Skates
Contusion (superficial)	53	47	49	29	17
Fracture	42	42	40	42	54
Skull	6	2	4	1	<1
Other head/face	7	4	6	1	<1
Upper extremity	22	22	23	28	29
Lower extremity	7	6	7	10	13
Traumatic brain injury	27	22	25	15	7

Note: An individual patient can sustain more than one injury
Source: Based on data from Shannon, et al. (2025).

Shannon, et al. did not report raw hospitalization rates by mode, so we cannot use that metric to compare outcomes across modes. However, the authors calculated odds ratios for hospitalization of electric bicycle patients compared to conventional bicycle patients. Electric bicycle patients were more than twice as likely to be hospitalized (admitted as inpatient). The adjusted odds ratio[7] was 2.37. They also found electric bicycle patients were significantly more likely to be admitted to an intensive care unit (adjusted odds ratio = 3.96) and suffer a traumatic brain injury (adjusted odds ratio = 1.62).

7.5 LOCAL INJURY DATA

7.5.1 New York City injury data

The New York City Police Department publishes data on traffic crashes, crash-related injuries, and crash-related fatalities on the NYPD TrafficStat Dashboard. The dashboard reports injury and fatality data for a variety of modes of travel, including electric bicycles. This section describes available injury data. Information on fatalities is discussed in the next chapter.

The NYPD updates their dashboard weekly. The most recent data on the dashboard at the time of this writing was through November 2, 2025. The dashboard clearly presents data over the last week, last 28 days, or year-to-date. While we are appreciative of the data provided by the NYPD on its dashboard, we could not easily ascertain data over specific time periods like whole months, or whole years. Thus, to find statistics for close to a whole year, we searched the Internet Archive Wayback Machine for older versions of the dashboard data. Through this search, we found archived reports from 2024, the latest of which included collisions from January 1, 2024 to December 22, 2024. The year-to-date comparison on this archived report also provided data from the same period the previous year (January 1, 2023 to December 22, 2023).

Table 38 shows injury numbers for the three time periods we were able to find data:

- January 1, 2023 to December 22, 2023
- January 1, 2024 to December 22, 2024
- January 1, 2025 to November 2, 2025

Through roughly the first 51 weeks of 2023, New York City police reported 763 electric bicycle-related traffic injuries. The number declined to 644 over the same period in 2024. Electric bicycle injuries in 2025 will exceed the numbers in 2023 or 2024, as 765 electric bicycle injuries had taken place by November 2.

Electric bicycle injuries were less common than traditional bicycle, moped, or motorcycle injuries. For example, across all three time periods, there were 5.8 traditional bicycle injuries for every electric bicycle injury.

7 The odds ratio was adjusted for nine variables about the patient, year of injury, and location.

Table 38. New York City traffic-related injuries by mode, portions of 2023, 2024, and 2025

Travel mode of injured person	1/1/2023 to 12/22/2023	1/1/2024 to 12/22/2024	1/1/2025 to 11/02/2025	Total across three sample periods
Car	19,046	19,018	14,771	52,835
SUV	12,595	12,469	9,678	34,742
Pedestrian	8,481	8,857	7,077	24,415
Conventional bicycle	4,362	4,430	3,874	12,666
Moped	2,727	2,215	1,309	6,251
Other motor vehicle	2,048	1,723	1,378	5,149
Motorcycle	1,462	1,377	1,226	4,065
Stand-up scooter	1,201	1,178	1,048	3,427
Electric bicycle	763	644	765	2,172
Off-road device (e.g., dirt bike or ATV)	123	113	56	292
Total	*52,808*	*52,024*	*41,182*	*146,014*
Ratio of traditional bicycle injuries to electric bicycle injuries	5.7	6.9	5.1	5.8

Source: Authors analysis of data from the NYPD TrafficStat Dashboard.

7.5.2 Injury data from Rady Children's Health of Orange County, California

We received unpublished data on the numbers of pediatric trauma activation patients[8] injured from conventional bicycle and electric bicycle incidents who were treated at Rady Children's Health of Orange County (CHOC), a Level 1 Trauma Center.[9] Within California, Orange County has been a primary center of reported electric bicycle use among minors—and widespread community safety concerns.

As Figure 31 shows, the number of electric bicycle trauma patient activations has risen from 0 in 2020 to 165 in 2025 (the data for 2025 is only through mid-October). For conventional bicycles, injuries increased from 39 in 2020 to 77 in 2022, before dropping to 27 in 2025. Looking at just 2025, there were 6 times as many trauma patient activations for electric bicycles as for conventional bicycles.

8 "Trauma activation" patients require a team of emergency medical staff to assemble rapidly to evaluate the patient's medical condition. The hospital would have treated other electric bicycle trauma patients who are not included in this data.

9 Data from personal correspondence with Dr. Laura F. Goodman, Trauma Medical Director, Rady Children's Health of Orange County, on November 11, 2025.

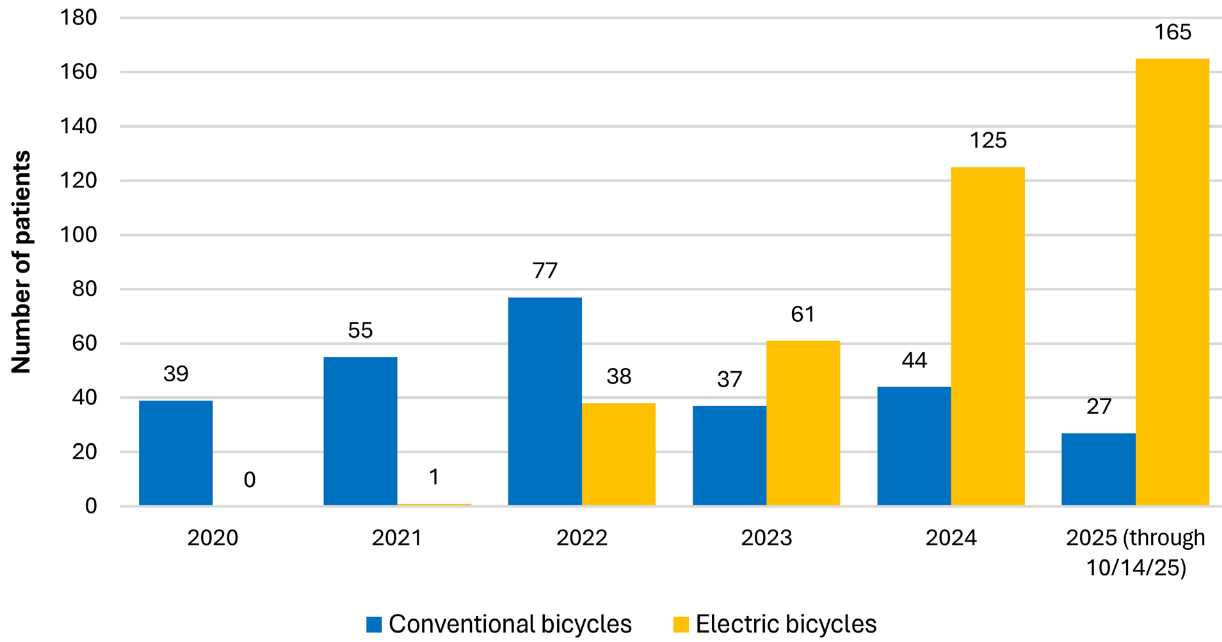


Figure 31. Number of electric and conventional bicycle trauma activation patients[a] at Rady Children's Hospital of Orange County, 2020 – 2025[b]

Source: Data from personal correspondence with Dr. Laura F. Goodman, Trauma Medical Director, Rady Children's Health of Orange County, on November 11, 2025.

[a] These are the most seriously injured patients, those who require a team of emergency medical staff to assemble rapidly to evaluate the patient's medical condition.

[b] Data for 2025 was available only through October 14, 2025.

7.5.3 911 responses in Marin County, California

Marin County Department of Health and Human Services maintains a dashboard that presents information on 911 responses by Emergency Medical Services related to bicycle and electric bicycle incidents. At the time of writing, the dashboard presented data from October 1, 2023 to October 6, 2025. Over this period, there were 412 incidents involving conventional bicycles and 159 incidents involving electric bicycles.

Table 39 shows some information on the characteristics of people involved by age (which is presented on the dashboard in four age categories). For those aged 16 and up, there were several times more cases involving conventional bicycles than electric bicycles. However, for those aged 10-15, there were more incidents involving electric bicycles than conventional bicycles. Thus, for electric bicycles, 31% of patients were aged 10-15, while they made up only 10% of conventional bicycle patients.

Table 39. 911 responses in Marin County, California, by age, 2023 – 2025[a]

	Electric bicycle		Conventional bicycle	
	Number	Percent	Number	Percent
10 – 15	49	31	40	10
16 – 39	47	30	127	31
40 – 59	30	19	126	31
60+	43	27	119	29
Total	*159*	*100*	*412*	*100*

Source: Marin County Department of Health and Human Services.
[a] Data from October 1, 2023 to October 6, 2025.

Table 40 shows the gender of people involved in incidents. Of cases where gender information was available, both electric bicycles and conventional bicycles had the same gender proportions, with 74% of patients being male and 26% being female.

Table 40. 911 responses in Marin County, California, by gender, 2023 – 2025[a]

	Electric bicycle		Conventional bicycle	
	Number	Percent	Number	Percent
Male	116	74	303	74
Female	40	26	105	26
Total	*156*		*408*	

Source: Marin County Department of Health and Human Services.
[a] Data from October 1, 2023 to October 6, 2025.

8. DATA ON FATALITIES

This chapter discusses available data about individuals who sustained fatal injuries in electric bicycle-related incidents: the data from two national datasets, as well as from explorations of news media articles. Each dataset described below does not capture every fatality, because each by design reports only a subset of fatalities.

8.1 FATALITY ANALYSIS REPORTING SYSTEM (FARS)

One of the most frequently utilized data sources on traffic fatalities is the Fatality Analysis Reporting System (FARS) produced by the National Highway Traffic Safety Administration (NHTSA).

8.1.1 About FARS data

NHTSA relies on states to report the fatality data compiled into FARS. Each state is required to have one or more “trained FARS analysts” who collect fatality data by drawing on a wide range of sources that includes police crash reports, death certificates, emergency medical service reports, and vehicle registration records. For every fatality identified, the analyst completes a form requiring information on approximately 150 data elements. Required data includes the details of the crash and the medical outcomes of the people involved, though no personally identifying information such as names or addresses are included (National Highway Traffic Safety Administration, 2025).

FARS does not track fatalities specifically for electric bicycles, but has historically tracked some fatalities on “motorized bicycles,” a classification that includes any power source. Since 2022, FARS has classified motorized bicycle riders as a type of “pedalcyclist” (National Highway Traffic Safety Administration). FARS records classify pedalcyclists as being on a motorized bicycle, non-motorized bicycle, or bicycle of unknown motorization.

Detail on cyclist motorization is not available on the publicly available FARS internet dashboard, but through correspondence with NHTSA staff we were able to access data for 2022 and 2023 fatalities involving all types of bicycles. At the time we received the data from NHTSA, October 1, 2025, data was only available through 2023.

It is essential to note that FARS *by design* misses some electric bicycle fatalities because of the criteria bounding what fatalities are included in the dataset. NHTSA includes only fatalities that meet three criteria: someone died within 30 days of the crash, the crash involved a motor vehicle, and the crash occurred “on a trafficway customarily open to the public” (National Highway Traffic Safety Administration, 2025). Therefore, FARS does not report cyclists killed in a solo crash or killed at a location outside of public roadways, such on park lands or private property. FARS also would not capture non-travel-related fatalities, such as those caused by battery fires.

As with the other data sources described in this report, FARS data is only as accurate as the data used to create case records (e.g., police crash reports, medical records) As discussed in previous chapters, these data sources all have significant limitations. Additionally, we observed some variation in data reporting practices by states. Some states have identified whether the cyclists who died were riding a motorized or non-motorized device for every case in their state, while other states had large number of cases where motorization was unknown (including all cases in Virginia).

8.1.2 FARS findings on electric bicycle fatalities

FARS reported 67 motorized bicycle fatalities in 2022 and 87 motorized bicycle fatalities in 2023 (Table 41). There were many more non-motorized bicycle fatalities—529 in 2022 and 611 in 2023). There were also several hundred more bicycle fatalities where motorization type was not reported. Among *known* motorized bicycle cases, there were 7.9 fatalities on a non-motorized bicycle for every fatality on a motorized bicycle in 2022. In 2023, this figure dropped to 7.0 non-motorized bicycle fatalities for every motorized bicycle fatality. However, it should be emphasized that some fraction of the large proportion of bicycles where the motorization status is unknown could well be electric bicycles.

Table 41. Bicycle fatalities reported in FARS[a], by motorization status (2022 – 2023)

	2022		2023		Total	
Bicycle motorization	Number	Percent	Number	Percent	Number	Percent
Motorized	67	6	87	7	154	7
Non-motorized	529	47	611	52	1,140	50
Unknown	521	49	468	40	989	43
Total	*1,117*	*100*	*1,166*	*100*	*2,283*	*100*
Ratio of non-motorized to motorized bicycle fatalities	7.9		7.0		7.4	

Source: Authors' analysis of FARS data, emailed to authors by NHTSA staff on October 1, 2025.
Notes: FARS reports only fatalities involving motor vehicle collisions that occur on a "trafficway customarily open to the public." FARS classifies electric bicycles as "motorized bicycles."

We looked at the fatality data by two demographic factors, gender and age, pooling the data from 2022 and 2023. (Here, we look only at motorized and non-motorized bicycles, excluding the large proportion of bicycles with unknown motorization status.) An extremely high proportion of those killed were men. For both motorized and non-motorized bicycles, 88% of deceased cyclists were men. By age, only 5% of those killed on motorized bicycles were minors (Table 42). This share is nearly the same as the 7% share of minors among non-motorized bicycle fatalities. Looking at adults, there were modestly more motorized than non-motorized bicycle fatalities for adults aged 18 to 49, but modestly fewer for adults aged 50 and older. The median age of motorized bicycle fatalities was 43 years of age, slightly younger than the median age of bicycle fatalities, 50 years of age.

Table 42. Motorized and non-motorized bicycle fatalities reported in FARS in 2022 and 2023, by age

	Motorized bicycle		Non-motorized bicycle	
Age	**Percent**	**Number**	**Percent**	**Number**
0 – 17	5	7	7	85
18 – 29	17	26	9	99
30 – 39	17	26	14	164
40 – 49	21	32	18	205
50 – 64	23	36	31	359
65+	16	25	19	212
Unknown	1	2	1	16
Total	*100*	*154*	*100*	*1,140*

Note: FARS reports only fatalities involving motor vehicle collisions that occurred on a “trafficway customarily open to the public.”
Source: Authors’ analysis of FARS data, emailed to authors by NHTSA staff on October 1, 2025.

We also looked at the fatality data by state. As with our analysis of the demographic data, we pooled data from 2022 and 2023 and do not report findings for the large proportion of bicycles with unknown motorization status (Table 43). New York had the most motorized bicycle fatalities (26), followed by California (23), Florida (16), and Arizona (11). In California, there were 8.4 non-motorized bicycle fatalities for every one motorized bicycle fatality, similar to the national average. New York, however, is a striking outlier to the national pattern; there were only 1.3 non-motorized bicycle fatalities per motorized bicycle fatality. One caveat to keep in mind when comparing data across states is that states differ is how the report to FARS the motorization status of bicycles.

Table 43. Motorized bicycle and bicycle fatalities reported in FARS in 2022 and 2023, by state

State	Motorized bicycle	Non-motorized bicycle	Motorization unknown	Total	Ratio of non-motorized to motorized bicycle fatalities
Alabama	0	24	0	24	--
Alaska	0	2	0	2	--
Arizona	11	28	55	94	2.5
Arkansas	0	9	8	17	--
California	23	194	111	328	8.4
Colorado	3	15	17	35	5.0
Connecticut	0	2	6	8	--
Delaware	1	7	3	11	7.0
District of Columbia	0	5	1	6	--
Florida	16	161	279	456	10.1
Georgia	2	22	29	53	11.0
Hawaii	2	13	0	15	6.5
Idaho	0	11	0	11	--
Illinois	5	70	1	76	14.0
Indiana	2	17	30	49	8.5
Iowa	1	1	7	9	1.0
Kansas	0	13	0	13	--
Kentucky	0	30	0	30	--
Louisiana	8	67	5	80	8.4
Maine	0	1	1	2	--
Maryland	0	3	22	25	--
Massachusetts	4	13	1	18	3.3
Michigan	6	18	36	60	3.0
Minnesota	1	3	8	12	3.0
Mississippi	0	28	2	30	--
Missouri	3	15	3	21	5.0
Montana	0	4	1	5	--
Nebraska	1	4	1	6	4.0

Table 43, continued

State	Motorized bicycle	Non-motorized bicycle	Motorization unknown	Total	Ratio of non-motorized to motorized bicycle fatalities
Nevada	0	29	0	29	--
New Hampshire	0	3	1	4	--
New Jersey	9	6	30	45	0.7
New Mexico	1	15	0	16	15.0
New York	26	34	41	101	1.3
North Carolina	3	57	7	67	19.0
North Dakota	0	1	0	1	--
Ohio	2	27	1	30	13.5
Oklahoma	4	23	3	30	5.8
Oregon	2	24	4	30	12.0
Pennsylvania	6	31	7	44	5.2
Rhode Island	1	1	0	2	1.0
South Carolina	1	42	7	50	42.0
South Dakota	0	3	0	3	--
Tennessee	1	11	14	26	11.0
Texas	4	0	193	197	0.0
Utah	3	19	2	24	6.3
Vermont	0	2	0	2	--
Virginia	0	0	26	26	--
Washington	2	20	7	29	10.0
West Virginia	0	6	0	6	--
Wisconsin	0	3	19	22	--
Wyoming	0	3	0	3	--

Source: Authors' analysis of FARS data, emailed to authors by NHTSA staff on October 1, 2025.
Note: FARS reports only fatalities involving motor vehicle collisions that occurred on a "trafficway customarily open to the public."

8.2 NATIONAL EMERGENCY ROOM DATA

The National Electronic Injury Surveillance System (NEISS), discussed in the previous chapter, which captures injuries seen at emergency rooms at a sample of U.S. hospitals, also reports some fatality data. Fatalities in the NEISS datasets include patients who died after arriving at the hospital or those who were deceased upon arrival at the hospital. Individuals who passed away at the scene of an incident and thus were never taken to a hospital are not included. Table 44 shows the number of encounters at NEISS sample hospitals ending with a patient fatality from 2020 to 2024. In the five-year period, NEISS sample hospitals only saw two electric bicycle fatalities. Over the same period, there were 75 bicycle-related fatalities.

Table 45 shows the share of all NEISS cases for a device that ended in a fatality. One caveat when comparing fatalities by device type is that if a device type has a greater rate of fatalities occurring *at the site of an incident*, then that device's fatality rate *at the hospital* as captured by NEISS would be lower.

Table 44. NEISS injury cases ending in a fatality

Travel mode	2020	2021	2022	2023	2024	Overall
Electric bicycles	0	0	1	0	1	2
Bicycles	17	14	16	11	17	75
Mopeds/power-assisted cycles	2	4	4	2	1	13
Minibikes	0	0	0	0	0	0
Powered scooters	0	1	2	2	2	7
Skateboards	0	1	0	0	0	1
Hoverboards/powered skateboards	0	0	0	1	0	1
Off-road vehicles (2-wheel, powered)	2	2	0	0	0	4
All-terrain vehicles	2	1	1	1	2	7

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

Table 45. Share of fatal injury outcomes recorded in NEISS, by year

Travel mode	2020	2021	2022	2023	2024	Overall
Electric bicycles	0.00%	0.00%	0.19%	0.00%	0.08%	0.06%
Bicycles	0.14%	0.13%	0.16%	0.11%	0.16%	0.14%
Mopeds/power-assisted cycles	0.31%	0.45%	0.44%	0.19%	0.09%	0.29%
Minibikes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Powered scooters	0.00%	0.07%	0.12%	0.10%	0.07%	0.08%
Skateboards	0.00%	0.03%	0.00%	0.00%	0.00%	0.01%
Hoverboards/powered skateboards	0.00%	0.00%	0.00%	0.20%	0.00%	0.03%
Off-road vehicles (2-wheel, powered)	0.13%	0.12%	0.00%	0.00%	0.00%	0.05%
All-terrain vehicles	0.14%	0.07%	0.11%	0.10%	0.21%	0.12%

Source: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System.
Note: NEISS records come from a sample of 96 hospitals nationwide.

8.3 FATALITIES DOCUMENTED IN NEWS REPORTS

One method that a few researchers have used to identify fatalities that will be missed by police reports is to search news media stories for mention of electric bicycle fatalities. These stories provide an opportunity to identify fatalities caused by solo crashes or battery fires, or fatalities that occurred off the public roadway, all cases that FARS would not cover. The media search has its own limitations, however. While many electric bicycle fatalities are covered by the news media, some will be missed. For a story to be written, there must be a local news outlet whose reporters and editors find out about the case and deem it newsworthy. Also, news reports may contain errors of fact, whether because the reporter made a mistake or because later investigation proved that initial assumptions about the events were incorrect.

8.3.1 Previous studies

We identified two published studies that searched news media stories to identify electric bicycle fatalities. The more extensive analysis is a 2022 report by the National Transportation Safety Board (NTSB) that outlined data challenges in assessing electric scooter and electric bicycle fatalities (National Transportation Safety Board, 2022).

As part of that analysis, the NTSB attempted to identify fatalities by search news media stories published on the internet. From 2017 to 2021, NTSB identified 53 electric bicycle fatalities and 66 electric scooter fatalities (Table 46). For electric bicycles, the number of fatalities identified increased each year, nearly tripling from 11 to 30 just between 2020 to 2021, the two most recent years NTSB searched. A majority of electric bicycle cases found by the NTSB were in New York (53%). California, with 10 cases (19% of all cases nationally), was the only other state with double-digit numbers of fatalities (Table 47).

Table 46. Electric bicycle and electric scooter fatalities identified by the NTSB, 2017 – 2021

Year	Electric bicycle fatalities	Electric scooter fatalities
2017	1	1
2018	5	6
2019	6	24
2020	11	6
2021	30	29
Total	*53*	*66*

Source: National Transportation Safety Board (2022).

Table 47. Electric bicycle and electric scooter fatalities identified by the NTSB, by state, 2017 – 2021

State	Electric bicycle fatalities	Electric scooter fatalities
New York	28	6
California	10	13
Pennsylvania	4	0
Minnesota	2	0
Ohio	2	1
Arizona	1	1
Florida	1	9
Hawaii	1	0
Illinois	1	0
New Jersey	1	2
Texas	1	4
Virginia	1	0
Georgia	0	5
Colorado	0	4
Connecticut	0	3
Idaho	0	2
Kentucky	0	2
Michigan	0	2
Oregon	0	2
Tennessee	0	2
Utah	0	2
District of Columbia	0	1
Maryland	0	1
Nevada	0	1
Oklahoma	0	1
Unknown	0	1
Washington	0	1

Source: National Transportation Safety Board (2022).

The other study, by Podsiad, Harmon, and Combs (2023), also identified electric bicycle fatalities through news reports published July 2022 to March 2023. For this period, they identified 20 fatalities in the United States (Podsiad, Harmon, & Combs, 2023). One victim was a bystander struck by an electric bicycle, and the other 19 victims were electric bicycle riders. Sixteen of the 19 deceased electric bicycle riders were involved in collisions with motor vehicles.

8.3.2 Original search for news reports of fatalities involving electric bicycles

Similar to the studies by the NTSB (2022) and Podsiad, Harmon, and Combs (2023), we conducted a search for news articles documenting electric bicycle-related fatalities. We searched for news reports on electric bicycle fatalities that occurred from January 2019 through July 2025, thus taking our search to more recent fatalities than the NTSB report, which looked for fatalities through the end of 2021, and the Podsiad, Harmon, and Combs study, which looked through Spring 2023. Additionally, we looked for more variables than the NTSB (2022) report (which only stated year and location). Finally, our data also differed from both the other studies because we included non-transportation-related fatalities (e.g., from fires).

One limitation of this new primary research is that it since we looked in 2025, we would have been less likely to find fatality cases in the earlier years due to “link rot,” the potential for web links to become dead over time (Chapekis, Bestvater, Remy, & Rivero, 2024).

To find news articles, we utilized news search tools such as Meltwater, Google News, ProQuest, and Lexis Nexis. Additionally, we searched for social media mentions of news articles through keyword searches on Instagram, Twitter/X, Reddit, and Facebook. Overall, Meltwater yielded the most cases, with a plurality of cases (44%) first identified through Meltwater. Less than 5% of cases were identified exclusively through social media, although our social media search did yield individuals sharing articles that we had already found through news media databases.

Overall, we identified news articles reporting on 133 fatalities related to electric bicycles. This includes:

- 101 deceased electric bicycle riders
- 4 non-riders killed in crashes with electric bicycles
- 28 people who died in fires related to electric bicycles

Rider fatalities

We identified 101 electric bicycle rider fatalities from news reports from 2019 through July 2025. The number of fatalities identified per year has been rising overall, though not consistently (Table 48).

Table 48. Electric bicycle rider fatalities, by year, 2019 – 2025

Year	Number of fatalities
2019	5
2020	7
2021	15
2022	5
2023	34
2024	14
2025 (January – July)	21
Total	*101*

Source: Authors' search for news articles, 2019 to July 2025.

Of the 101 rider fatalities, 70 involved a collision with a moving motor vehicle. Twenty-eight fatalities were solo crashes, including five riders who struck a parked vehicle (Table 49). We classified three fatalities as having some other or an unknown cause. This includes one case where an electric bicycle rider was killed in a crash with a pedestrian (the pedestrian survived), a homicide where an electric bicycle rider was fatally shot, and a case where the news article provided no detail on the nature of the fatal incident.

Table 49. Electric bicycle rider fatalities, by cause of crash (2019 – 2025 pooled data)

	Number of fatalities
Motor vehicle collision	70
Solo crash	28
Other	3
Total	*101*

Source: Authors' search for news articles, 2019 to July 2025.

The greatest number of fatalities occurred in New York (28). California (18) and Florida (13) also experienced double-digit numbers of fatalities (Table 50).

Table 50. Electric bicycle rider fatalities, by state (2019 – 2025 pooled data)

State	Number of fatalities
New York	28
California	18
Florida	13
Nevada	6
New Jersey	6
Massachusetts	4
Michigan	4
Minnesota	3
Hawaii	2
Oklahoma	2
Oregon	2
13 states*	1

Source: Authors' search for news articles, 2019 to July 2025.
*GA, IA, IL, ID, KS, MO, NH, OH, PA, RI, UT, VA, and WA.

Demographically, the vast majority of deceased riders were male (86% of cases where gender was reported). When age was reported, deceased riders ranged in age from 7 and 91. The median age of deceased riders was 39 years old, which is equal to the median age of the U.S. population in 2024. Seventeen percent of deceased riders were under the age of 18. Twenty-one percent of deceased riders were aged 30 to 39, which included five fatalities of people 37 years of age. Another 21% of deceased riders were aged 50 to 64 (Table 51).

Table 51. Electric bicycle rider fatalities, by age group (2019 – 2025 pooled data)

Age	Number of fatalities	Share of cases (age-reported only)
0 – 17	15	17%
18 – 29	12	13%
30 – 39	18	20%
40 – 49	13	14%
50 – 64	18	20%
65+	14	16%
Not reported	11	--

Source: Authors' search for news articles, 2019 to July 2025.

Non-rider, travel-related fatalities

We found four news articles documenting a fatality of a non-rider killed in a crash with an electric bicycle. Three of the four fatalities were suffered by pedestrians, including one in a crosswalk and one crossing a bicycle lane. The fourth fatality was a bicycle rider involved in a crash with an electric bicycle. By age, three of the four deceased non-riders were seniors.

Fire-related fatalities

We found news articles documenting 28 fatalities caused by fires. All but one of these fatalities were in the New York State, with the lone other case in Virginia. Of the fatalities in New York State, all but one were in New York City. Nineteen of the fatalities occurred in a single year, 2023 (Table 52).

Table 52. Battery fire fatalities, by year (2019 – 2025 pooled data)

Year	Number of fatalities
2019	0
2020	0
2021	2
2022	5
2023	19
2024	2
2025	0
Total	*28*

Source: Authors' search for news articles, 2019 to July 2025.

The 27 fatalities occurred across 17 discrete fire events. Thus, several of these fires were multiple-casualty events. There were two four-fatality fires and one three-fatality fire. Several of the multi-fatality fires took place in apartment buildings, including one in an apartment building with a first-floor electric bicycle shop. The fire in that shop highlighted the risk of shops offering battery swapping services for delivery riders. These shops charge a large number of batteries in a single location, a situation that can overload the electrical system (Chan, 2023).

8.4 LOCAL FATALITY DATA: NEW YORK CITY

As mentioned in the previous chapter, the New York City Police Department publishes data on traffic crashes, crash-related injuries, and crash-related fatalities on the NYPD TrafficStat Dashboard. We were able to find data on the dashboard covering the following three time periods:

- January 1, 2023 to December 22, 2023
- January 1, 2024 to December 22, 2024
- January 1, 2025 to November 2, 2025

Over all three time periods combined, there were 44 electric bicycle fatalities (Table 53). This was nearly twice the number of traditional bicycle fatalities (24). There were also more electric bicycle fatalities than moped fatalities (34) and stand-up scooter fatalities (9).

Table 53. New York City traffic-related fatalities by mode, for portions of 2023, 2024, and 2025

Device type	1/1/2023 to 12/22/2023	1/1/2024 to 12/22/2024	1/1/2025 to 11/02/2025	Total across three sample periods
Pedestrian	100	114	92	306
Motorcycle	47	42	23	112
Car	37	37	21	95
Electric bicycle	13	17	14	44
SUV	16	17	10	43
Moped	12	8	14	34
Conventional bicycle	13	8	3	24
Stand-up scooter	9	4	4	17
Other motor vehicle	7	2	1	10
Off-road device (e.g., dirt bike or ATV)	1	0	1	2
Total	*255*	*249*	*183*	*687*
Ratio of traditional bicycle fatalities to electric bicycle fatalities	1.0	0.5	0.2	0.5

Source: Authors' analysis of data from the NYPD TrafficStat Dashboard.

Table 54 shows the ratio of injuries to fatalities by mode. For electric bicycles, there were 49 injuries for every fatality. This is a much higher rate compared to traditional bicycles (528 injuries per fatality) and even mopeds (184 injuries per fatality) and motorcycles (36 injuries per fatality). The electric bicycle injury-to-fatality rate is closest to the rate for motorcycles.

Table 54. New York City: Ratio of traffic-related injuries to fatalities by mode, for portions of 2023, 2024, and 2025

Device type	1/1/2023 to 12/22/2023	1/1/2024 to 12/22/2024	1/1/2025 to 11/02/2025	Total across three sample periods
Motorcycle	31	33	53	36
Electric bicycle	59	38	55	49
Pedestrian	85	78	77	80
Off-road device (e.g., dirt bike or ATV)	123	–	56	146
Moped	227	277	94	184
Stand-up scooter	133	295	262	202
Other motor vehicle	293	862	1378	515
Conventional bicycle	336	554	1291	528
Car	515	514	703	556
SUV	787	733	968	808
Total	*207*	*209*	*225*	*213*

Source: Authors' analysis of data from the NYPD TrafficStat Dashboard.

9. SAFETY FINDINGS SYNTHESIS: WHAT DOES THE DATA TELL US?

The previous chapters present information from our independent analysis of multiple crash, injury, and fatality datasets that documented electric bicycle incidents, as well as published literature on the topic. Each of these individual sources provides insight into electric bicycle safety performance in the specific types of incidents they capture in the specific geographic areas they explore.

This chapter synthesizes findings from these multiple sources and discuss what we can—and cannot—conclude from the available data.

9.1 CRITICAL LIMITATIONS

This section discusses the serious limitations to the available data on electric bicycle crashes, injuries, and fatalities. While there is a certain amount of data available, and it is certainly worthy of careful consideration, none of the data is likely to be particularly accurate.

9.1.1 Many "electric bicycle" incidents may not involve electric bicycles at all

In Chapter 2, we discussed how California and the majority of other U.S. states define electric bicycles using three-class categorization system first proposed by PeopleForBikes (PFB). While some devices in the marketplace fit within the three-class system, many others have more powerful motors and higher speeds such that they are not legally considered electric bicycles. And even if higher power devices are not legally electric bicycles, a casual observer may perceive them to be so and they be marketed as such. The challenges related to defining what is, or is not, an electric bicycle, extend to the analysis of crash, injury, and fatality data.

Generally speaking, for a data source to capture an incident as being related to an electric bicycle, someone must identify that a crash involved an electric bicycle or that an injured patient or fatality victim involved an electric bicycle. This identification could be made by a rider, a patient, or someone else (e.g., friend, family member, witness, first responder, medical practitioner) if the patient cannot report the device type (e.g., the injured person was unconscious, cannot remember, or died). If someone making a report thinks a device involved in an incident is an "electric bicycle," even if it is not legally one, then the incident will most likely be recorded as related to an electric bicycle.

While it is certain that many incidents attributed to electric bicycles do not, in fact, involve a legal electric bicycle, we do not know how often devices are misclassed. However, the percentage is possibly very high. In Chapter 4, we reference observations conducted in 2025 at several schools in Marin County and San Mateo County, California. Almost 90% of the electric two-wheelers observed appeared to be higher-power and higher-speed devices that are not legally electric bicycles. If a similar device mix is common in other locations and for other age groups, then it is possible that most incidents attributed to electric bicycles did not involve a legal one.

9.1.2 The challenge of defining electric bicycles also complicates learning from safety studies conducted outside the U.S.

Other countries, including the European Union, set rules for electric bicycles that are not identical to the limits on speed and power to the U.S. three-class system. Other countries often set lower assisted speed and power limits. Also, in China the term electric bicycle encompasses devices that in the U.S. would likely be classified as mopeds (Fishman & Cherry, 2016). The published studies on electric bicycles from other countries generally do not discuss exactly what type of devices would be recorded as an electric bicycle, making it difficult to predict if the findings would be similar in the U.S. context.

9.1.3 Incident data by device class is virtually non-existent

While any kind of data about electric bicycles is frustratingly rare, data that breaks down the devices by type is virtually nonexistent. For example, none of the more than 200 research publications we reviewed discussed what types of electric bicycles they had included (Ghanbari, Agrawal, & Fang, 2025), let alone compared findings by class type. The only two datasets we found that identified device class and/or provided enough device information to allow researchers to estimate the class were both from the U.S., the State of Oregon and Orange County, California, crash data. For Oregon, though, the data is still of very limited use because Class 1 and Class 2 electric bicycles are grouped together, while Class 3 electric bicycles are grouped with motorcycles and dirt bikes. However, the crash data received from the Orange County Sherrif's Office included the device manufacturer and sometimes the model, allowing researchers to code the devices according to what class (if any) they fall into. From this data it appears that a high proportion of the reported crashes involve either Class 2 (throttle) or out-of-class devices.

9.1.4 We don't have the data needed to quantify the risk of incidents per trip, mile, or rider with any confidence

The preceding chapters identify counts of crashes, injuries, and fatalities reported in various datasets. Where time series data is available, it is apparent that electric bicycle incidents have notably increased in recent years. Such increases in incident counts are not particularly surprising given indications of increased electric bicycle usage. As the *Journal of Transport and Health* states in their guide for authors, "the fact that more people are injured where, or when, more people travel is not very enlightening." To have a firm grasp of the true danger of riding electric bicycles and place this into the context of risk relative to other modes, it is necessary to calculate the incident rates on a per trip, per distance, or per-rider basis.

The stumbling block to calculating electric bicycle risk is that we do not have good data on how many people use electric bicycles, how many trips people make on electric bicycles, or how many miles they travel on electric bicycles. Data on electric bicycle trips and distances traveled is almost never collected. For example, neither the most recent National Household Travel Survey in 2022 and its California add-on (Federal Highway Administration, 2024), nor the U.S. Census Bureau's American Community Survey, include electric bicycles as a mode choice option. As discussed in Chapter 4, there are several groups attempting to track electric bicycle sales. While interesting, sales data in a given year is not sufficient to come up with a confident calculation of risk.

While there is no good data on use of electric bicycles in the overall population, there is quite precise data on electric bicycle use for trips taken on shared micromobility devices. The shared micromobility industry releases national-level estimates on trip volumes and, more usefully, many shared micromobility companies report trip data to cities as conditions of their permits. In theory, this trip data could be used to calculate incident rates for the communities with shared electric bicycle services. However, that would require data knowing how many incidents involved *shared* electric bicycle users only (vs. users of personally owned devices). None of the datasets we discuss in the previous three chapters differentiate between crashes, injuries, or deaths involving users of shared bicycles versus personally-owned bicycles.

Finally, we identified two national surveys that asked how many people own or use electric bicycles, though the surveys focus on adults only. A 2024 survey of U.S. adults from Consumer Reports found that 11% had ridden an electric bicycle in the previous twelve months (Consumer Reports, 2024). Another 2024 survey of U.S. adults, this one from the Mineta Transportation Institute (MTI), found roughly similar results: 16% of adults had ridden an electric bicycle in the previous 12 months, and 6% rode one at least once a week (Agrawal, Fang, and Nixon, forthcoming). By comparison, 37% of respondents reported they had ridden a bicycle in the preceding year, while 15% rode a bicycle once a week or more.

9.1.5 Evidence about the environmental and behavioral factors correlated with safety incidents is minimal and likely of low accuracy

While knowledge about the extent and severity of electric bicycle incidents is critical to setting good policy, it is also critical to understand what environmental or behavioral factors may increase incident risk. If these factors are well understood, then policymakers can better identify which policy actions are likely lead to significant safety benefits. Two hypothetical examples illustrate this point. If we knew that crashes are more likely among people without training on the rules of the road, that evidence would suggest the value of providing optional or even mandatory education. Also, if we knew that many crashes resulted from motor vehicle drivers colliding with electric bicycles operated in a legal manner, that evidence would suggest the need for actions such as additional education for drivers and changes in street design that reduce the number of potential conflict points between motor vehicles.

Unfortunately, the evidence on these environmental and behavior factors is even more limited than the evidence on the numbers and severity of incidents.

9.2 DRAWING SAFETY CONCLUSIONS FROM THE LIMITED INFORMATION AVAILABLE

In this section we synthesize findings from the many data sources discussed in the preceding three chapters to identify what is known about the safety risks associated with electric bicycles. As noted in the previous section, there are significant limitations to the accuracy of much of the data reported, so findings should be interpreted cautiously.

9.2.1 Electric bicycle incidents are less common than conventional bicycle incidents in most communities

In most of the 11 datasets we analyzed independently that had data for both electric bicycles and conventional bicycles, there were several times more incidents related to conventional bicycles than electric bicycles (Table 55). Across eight datasets, conventional bicycles outnumbered electric bicycle incidents by a ratio ranging from 2.6 to 58.

That said, in three local-government datasets, electric bicycle incidents outnumbered conventional bicycle incidents. New York City reported nearly twice as many electric bicycle rider fatalities as conventional bicycle rider fatalities for 2023 through 2025. Across the country, in Orange County, California, sheriff's department records for 2024 and 2025 identified more than twice as many electric bicycle crashes as conventional bicycles. Also in Orange County, a children's hospital has reported more pediatric trauma activations for electric bicycles than conventional bicycles as of 2023.

Table 55. Comparing the number of electric bicycle incidents to conventional bicycle incidents across multiple datasets

Data source	Time period	Electric/ motorized bicycle value	Conventional bicycle value	Ratio of conventional to electric bicycle values
Crashes				
California – California Crash Data System	2024	961	10,372	10.8
Oregon – Oregon Crash Data Products	2023	60	537	9.0
Maryland – Maryland Automated Crash Reporting System	2024	178	640	3.6
Orange County, CA – Orange County Sherriff's Department	2024 – August 2025	267	112	0.4
Injuries				
National hospital records – NEISS	2020 – 2024	3,179	54,115	17.0
	2024	1,290	10,532	8.2
California Hospital Records – CHHS Open Data Portal	2023	4,757	44,039	9.3
Illinois hospital records – Shannon, et al. (2025)	2021 – 2023	441	25,577	58.0
Pediatric trauma activations – Rady Children's Hospital Orange County	2020 – October 2025	390	279	0.7
	January – October 2025	165	27	0.2
EMS responses – Marin County, CA	October 2023 – October 2025	159	412	2.6
New York City – NYPD TrafficStat	Most of 2023, 2024, and 2025	565	3,014	5.3
Fatalities				
National hospital records – NEISS	2020 – 2024	2	75	37.5
	2024	1	17	17.0
National – Fatality Analysis Reporting System (FARS)	2022 – 2023	154	1,140	7.4
New York City – NYPD TrafficStat	Most of 2023, 2024, and 2025	44	24	0.5

Internationally, published research studies have also generally found substantially more bicycle injuries than electric bicycle injuries (Ghanbari, Agrawal, & Fang, 2025).

The larger number of conventional bicycle incidents that occur does point to a potential for electric bicycle incident numbers to grow considerably if many of the people currently riding conventional bicycles switch to electric ones. A meta-analysis by Bigazzi and Wong (2020), which looked at 35 studies exploring mode shift, estimated that 27% of electric bicycle trips replaced conventional bicycle trips (median value across all studies).

9.2.2 Many but not all sources indicate that incidents involving electric bicycles have more severe outcomes than conventional bicycle and powered scooter incidents

A trend of electric bicycle incidents resulting in more severe injuries than conventional bicycle incidents shows up in several of the datasets we analyzed, as well as in our review of international electric bicycle safety studies (Ghanbari, Agrawal, & Fang, 2025).

The New York City traffic collision reports show markedly more serious outcomes for injured electric bicycle riders than for injured conventional bicycle riders. For conventional bicycles, there was one conventional bicycle fatality for every 528 injuries, as compared to one electric bicycle fatality for every 49 injuries (Table 56). The ratio of fatalities to injuries in New York City for electric bicycles is much closer to motorcycles (one fatality for every 36 injuries) than conventional bicycles.

Table 56. New York City traffic-related injuries and fatalities, by mode, for portions of 2023, 2024, and 2025

	Injuries	Fatalities	Ratio of injuries per fatality
Motorcycle	4,065	112	36
Electric bicycle	2,172	44	49
Pedestrian	24,415	306	80
Off-road device (e.g., dirt bike or ATV)	292	2	146
Moped	6,251	34	184
Stand-up scooter	3,427	17	202
Other motor vehicle	5,149	10	515
Conventional bicycle	12,666	24	528
Car	52,835	95	556
SUV	34,742	43	808
Total	*146,014*	*687*	*213*

Source: Authors' analysis of data from the NYPD TrafficStat Dashboard.
Note: Data covers incidents from January 1, 2023 to December 22, 2023, January 1, 2024 to December 22, 2024, and January 1, 2025 to November 2, 2025.

Emergency room data also indicate a slightly higher rate of hospitalization for electric bicycle patients than conventional bicycle and powered scooter patients. The differences were between 3 and 6 percentage points higher for electric than conventional bicycles (Table 57).

Table 57. Hospitalization rates by mode: Comparing NEISS and California hospital data

Data source	Electric bicycles	Conventional bicycles	Powered scooters
NEISS: injuries occurring in all locations	16%	13%	13%
NEISS: injuries on streets only	17%	18%	16%
NEISS: injuries to device operators only	17%	16%	14%
California hospital data	17%	11%	–

Sources: Authors' analysis of data from the U.S. Consumer Product Safety Commission – National Electronic Injury Surveillance System and of California Health & Human Services data.

That said, analysis of NEISS data also revealed that electric bicycle patients were both older and more frequently injured on streets than conventional bicycle patients. Both age and roadway crash location are factors that tend be associated with more serious injuries. Looking only at injuries that took place on streets, electric bicycle patients actually had a one percentage point *lower* hospitalization rate than conventional bicycle patients.

9.2.3 Most people involved in electric bicycle incidents are adults

Much of the interest in electric bicycle safety in the media and policy debates has focused on risk to minors. In the datasets we were able to access, most people involved in electric bicycle incidents are adults (Table 58).

In the NEISS nationwide emergency department dataset, electric bicycle patients were not relatively more likely to be minors as compared to other devices. Of the nine devices we explored with NEISS data, patients with electric bicycle-related injuries had the oldest median age (34) and second lowest share of patients who were minors (20%).

However, as seen with the overall incident counts in the previous section, incident patterns in electric bicycle hotspots can differ from the national trends. Notably, in Marin County, children aged 10 to 15 were involved in 31% of electric bicycle-related EMS responses, compared to just 10% for conventional bicycles.

Table 58. Share of electric bicycle and conventional bicycles incidents among minor age groups across multiple datasets

Data source	Time period	Age Group	Share of electric bicycle cases	Share of conventional bicycle cases
Injuries				
National hospital records – NEISS	2020 – 2024	0 – 17	20%	43%
Illinois hospital records – Shannon, et al. (2025)	2021-2023	0 – 19	21%	43%
EMS responses – Marin County, CA	October 2023 – October 2025	10 – 15	31%	10%
Fatalities				
National – Fatality Analysis Reporting System (FARS)	2022 - 2023	0 – 17	5%	7%
National – Original search of news articles	2019 - July 2025	0 – 17	17%	–

Available data also point to safety challenges on the other end of the age spectrum, with older adults. In the NEISS injury dataset, electric bicycle patients 65 age and up had both the highest hospitalization rate and highest head injury rate.[10] Several of the medical professionals we interviewed for the study emphasized that older adults are more likely than children or younger adults to suffer serious medical consequences from crashes.

9.2.4 Motor vehicle crashes are a factor in many injuries and most fatalities

In order to set effective policy to improve safety, it is critical to understand the factors leading to crashes and injuries. For example, appropriate policy responses may be quite different if the major causes are unsafe road infrastructure, unsafe electric bicycle riding practices, or unsafe device types. Although there is relatively little research that helps to pinpoint the causes of electric bicycle incidents, we did gather some insight on the contribution of vehicle collisions, which have been a long-running concern in bicycle safety in general.

Vehicle collisions are reported for a notable minority of injuries leading to hospital visits where the cause of the incident is recorded, though more patients are reported injured in solo crashes. It is critical to stress, though, that for a very large fraction of patients the records do not indicate the mechanism of injury. Therefore, it is likely that motor vehicles were involved in a higher proportion of incidents than are reported.

The California and national hospital data we analyzed both point to motor vehicles playing a key role in a modest fraction of crashes (Table 57). In terms of injuries, our analysis of California hospital data indicated that 20% of electric bicycle patients were involved in a vehicle collision. Our analysis of the national NEISS data found motor vehicle crashes contributing to a higher share of injuries; 31% of NEISS electric bicycle patients were in

10 Note: Among patients injured on streets.

a vehicle collision. Again, though, it is important to stress that the data does not provide details on the mechanism of injury for many patients, so the percent of injuries involving a motor vehicle is without question higher than what is reported, though we cannot know how much higher.

Motor vehicle crashes are a much more prominent factor in fatalities than injuries. The analysis of news reports that we conducted, as well as similar studies by the NTSB (2022) and Podsiad, Harmon, and Combs (2023), all found that the majority of fatal incidents involved a motor vehicle collision (Table 59).

Table 59. Share of injuries and fatalities involving a vehicle collision, across multiple datasets

Data source	Time period	Electric bicycles	Conventional bicycles	Powered/ electric scooters
Injuries				
National hospital records – NEISS (injuries to device operators)	2024	31%	24%	24%
California hospital data	2023	20%	18%	–
Fatalities				
Search of news articles by NTSB (2022)	2018 – 2020	57%	–	60%
Search of news articles by Podsiad, Harmon, and Combs (2023)	July 2022 – March 2023	83%	–	–
Original search of news articles	2019 – July 2025	70%	–	–

9.2.5 Men and boys sustain more than two-thirds of electric bicycle injuries and fatalities

One detail routinely collected in medical and traffic collision datasets is patient gender. Four datasets we analyzed that reported gender show that a disproportionate share of electric bicycle injuries and fatalities are sustained by men and boys (Table 60). This is by no means an electric bicycle-specific issue, as the gender shares for electric bicycles were nearly identical to those for conventional bicycles. Males also make up a heavily disproportionate share of fatalities among automobile drivers, passengers, and pedestrians (Insurance Institute for Highway Safety, 2025).

Table 60. Share of injuries and fatalities sustained by men/boys, across multiple datasets

Data source	Time period	Share of electric bicycle cases	Share of conventional bicycle cases	Share of powered scooter cases
Injuries				
National hospital records – NEISS	2020 – 2024	78%	75%	66%
EMS responses – Marin County, CA	October 2023 – October 2025	74%	74%	–
Fatalities				
National – Fatality Analysis Reporting System (FARS)	2022 - 2023	88%	88%	–
National – Original search of news articles	2019 - July 2025	86%	–	–

9.2.6 Pedestrians and other bystanders struck by electric bicycles make up a small but measurable share of electric bicycle-related incidents

In addition to injuries sustained by electric bicycle riders, pedestrians are sometimes struck by electric bicycles. Our detailed reading of the comment lines for NEISS cases in 2024 revealed that 4% of electric bicycle patients were bystanders who were in collisions with an electric bicycle. Our review of news articles found that 3% fatalities related to electric bicycles were sustained by non-riders killed in crashes with electric bicycles.

9.2.7 Data findings summary

It is clearly apparent across multiple datasets that the number of incidents attributed to electric bicycles have risen over the last several years. This notable increase in injuries and deaths clearly warrants careful policy attention. However, while incidents have risen and often at a very fast rate, it is important to consider the incident numbers in a broader context: there are still many more incidents related to conventional bicycles than electric bicycles in most of the data we looked at. This is especially true in datasets covering broader geographic scales (e.g., nationwide, state-level). That said, a few datasets we reviewed that came from local areas where electric bicycles are especially popular shows that electric bicycles have had more reported incidents than conventional bicycles (New York City, Orange County, and Marin County).

In terms of injury severity, most but not all of the published literature and multiple datasets we explored ourselves indicate that electric bicycle-related incidents typically have more severe outcomes than conventional bicycle incidents. The most striking example of this discrepancy in terms of U.S. data comes from New York City police crash report data. Since 2023, there were nearly twice as many electric bicycle fatalities than conventional bicycle fatalities, despite there being fewer overall electric bicycle injuries. Similarly, the international research more often than not reports more severe outcomes from electric bicycle incidents. However, other data tells a more mixed message on injury severity. In the NEISS injury dataset of U.S. hospital patients, the data source with the largest sample size we looked at, electric bicycle patients were hospitalized at only a three-percentage point greater rate than conventional bicycle patients (16% vs. 13%). Also, that gap disappeared when making an apples-to-apples comparison of only those injuries occurring on streets.

A major caveat to the strength of evidence about electric bicycle safety performance is that, as we have discussed at length above, it is highly likely that many of the “electric bicycles” involved in crashes, injuries, and fatalities are not, in fact, legal electric bicycles. The best evidence to support this hypothesis comes from the observation data from several California schools, where only 12% of two-wheeled electric devices were legal electric bicycles as defined by the three-class electric bicycle system used in California.

9.3 KEY GAPS IN THE RESEARCH TOPICS ADDRESSED

The literature review revealed very little or no research at all on many topics that are important to making evidence-based policy. One area that has been largely unexplored is how device design correlates with crash risk and injury severity. Just as the Insurance Institute for Highway Safety conducts crash tests for motor vehicles, researchers can explore questions for electric bicycles such as how crash risk and injury severity relate to the travel speed and weight of an electric bicycle and what device characteristics elevate the risk that a rider will lose of control of the device sufficient to cause a crash. Research on these questions would allow policymakers to establish appropriate minimum standards for device design and performance.

Three other virtually unexplored topics for exploration are:

- What roadway infrastructure designs improve safety where electric bicycles are involved? While this topic has been well studied for conventional bicycles, are different standards or types of infrastructure needed for electric bicycles?

- What are cost-effective methods to educate both electric bicycle riders and the general public about electric bicycle safety?

- What rules for riding electric bicycles lead to better safety outcomes? For example, do rules that prohibit – or allow – sidewalk riding lead to more or fewer crashes and injuries?

10. OPPORTUNITIES FOR CALIFORNIA TO IMPROVE ELECTRIC BICYCLE SAFETY

There are numerous steps that the State of California can take to support e-biking that is safe for all road users. Achieving that vision will require a large number of complementary actions that includes educating all road users about electric bicycle rights and responsibilities, building safe biking infrastructure, re-considering how the California Vehicle Code defines and regulates use of electric bicycles, and improving data collection and analysis of electric bicycle related incidents to inform policy changes.

This chapter begins by reflecting on the role that the state itself can play in achieving the vision of more and safer electric bicycle use. The following sections then elaborate on these specific actions that the state can explore. Given the limited data available, there is little evidence to suggest what specific impact any of the suggested actions would have, but they are opportunities that we concluded are worthy of further exploration.

1. Integrate work on electric bicycle policy with work on conventional bicycles and other forms of micromobility
2. Create staff positions to coordinate statewide micromobility programs and policies
3. Integrate electric bicycles into relevant state plans and programs
4. Produce high-quality bicycle infrastructure
5. Establish device specifications and standards for electric bicycles
6. Revise the California Vehicle Code to update electric bicycle classes and operating rules
    a. Redefine electric bicycles into two categories: low-power devices regulated like conventional bicycles and high-power devices regulated like mopeds
    b. Clarify the legal status of the many two-wheeled, powered “bicycle-shaped devices” that do not fit into any device category in the California Vehicle Code
    c. Other revisions to the rules for operating electric bicycles
7. Require electric bicycle sellers to disclose relevant state regulations to buyers
    a. Require that sellers disclose the device type they are selling and laws on how that device may be used
    b. Establish clear processes to enforce disclosure laws
8. Improve the organization and expression of California Vehicle Code law related to electric bicycles

9. Provide materials to educate the public on electric bicycle rules and safe riding practices

    a. Produce a plain-language handbook with electric bicycle rules of the road

    b. Add electric bicycle content to DMV materials that educate motor vehicle operators

    c. Develop electric bicycle safety education materials for different age groups

    d. Offer electric bicycle training courses

    e. Produce content for public service announcements

10. Support enforcement of rules for operating electric bicycles

    a. Establish appropriate penalties for illegal operation of electric bicycles

    b. Provide guidance on how to store impounded electric bicycles

11. Collect better data on safety incidents

    a. Improve the quality of electric bicycle incident data already collected

    b. Explore sources of data that have not been used extensively

12. Collect better data on electric bicycle use rates

13. Make data easy to access and analyze

    a. Encourage hospitals, police departments, and other local entities to share detailed electric bicycle data

    b. Create an electric bicycle data repository

    c. Make it easy to extract electric bicycle data in publicly accessible data sets

    d. Facilitate data linkage across sources

    e. Hold a conference to assemble and synthesize electric bicycle data from across California

14. Encourage more extensive analysis of electric bicycle safety data

10.1 CONCEPTUAL APPROACH TO THE ROLE FOR THE STATE OF CALIFORNIA

The State of California is but one actor among thousands of local government entities, nonprofits, and other stakeholders that all have a role to play in creating an environment that supports safe electric bicycle use. Within this constellation of actors, the state can play three key roles:

1. Rationalize the laws that govern the device characteristics and rules of the road for operating bikes and publish a plain-language version of the complete set of rules.

2. Revise existing internal state processes and programs to better incorporate electric bicycle safety into the work already being done, from collecting and analyzing public health and traffic crash data, adding bicycle infrastructure on state highways, offering local governments grants to implement bicycle infrastructure, or developing traffic safety messaging campaigns.

3. Provide a one-stop shop offering guidance and high-quality educational materials that can be used by other entities. The state can produce these materials directly, license them for use by local governments and other entities, and/or fund local entities and nonprofits to develop materials that can be shared statewide.

    a. Produce official state publications with the rules of the road and best safety practices for use by the public, police, transportation planners, etc.

    b. Provide age-appropriate curriculum advice and teaching materials that can be used by schools that wish to offer bicycle education.

    c. Provide content that can be used for public education campaigns by other entities, including posters, flyers, and social media content.

10.2 INTEGRATE WORK ON ELECTRIC BICYCLE POLICY WITH WORK ON CONVENTIONAL BICYCLES AND OTHER FORMS OF MICROMOBILITY

The suggestions in this chapter are primarily described with a focus on electric bicycles. However, we strongly recommend that the state consider electric bicycles in the context of other active travel modes and powered devices. All the recommendations that follow on data collection and analysis, infrastructure improvements, and planning can be adopted to incorporate other light travel modes (e.g., standing electric scooters and powered skateboards). Looking at the set of modes collectively has several advantages:

- Many of the policy changes that can benefit electric bicycle data collection, planning, and policy will be equally important for supporting use of conventional bicycles and powered micromobility. For example, education to improve motorists' understanding of how to share the road safety with electric bicycles would presumably create equal benefits for operators of conventional bicycles, electric scooters, and other small devices.

- It will be more efficient to consider the modes as a group than to consider each one independently. For example, the extensive work needed to adopt changes to procedures for reporting traffic crashes or injuries caused by electric bicycles could easily incorporate other modes as part of the same effort. Conversely, going back again later to make changes related to other modes would require a great deal of work.

- With respect to how the public views and uses micromobility options, it can be more effective to educate and encourage use of the different device types as a whole package. Also, making the rules and policies as consistent as possible across device types will make it easier for the general public (and professionals) to remember rules (Fang, Agrawal, and Hooper, 2019).

10.3 CREATE STAFF POSITIONS TO COORDINATE STATEWIDE MICROMOBILITY PROGRAMS AND POLICIES

We recommend that CalSTA and CalHHS both create staff positions dedicated to coordinating and advocating across the state government all work related to electric bicycles and other forms of powered micromobility. Such coordinating positions are essential to ensuring efficient outcomes across the large network of state departments that conduct electric bicycle-related work. These entities include:

- Departments in the California State Transportation Agency (CalSTA), such as Caltrans, the Office of Traffic Safety, Department of Motor Vehicles, and the California Highway Patrol

- Departments in the California Health and Human Services Agency (CalHHS), such as the California Emergency Medical Services Authority, Department of Health Care Access and Information, Center for Data Insights and Innovation, and Department of Public Health

- The Attorney General's Office in the Department of Justice

- The California Air Resources Board

There are several key reasons that such staff positions would allow the state to effectively support safe electric bicycle use.

Each state department will be more efficient in its work if aware of what other departments are doing. One benefit is that entities will not duplicate each other's work. In addition, departments will be better able to coordinate interrelated projects happening in parallel. Finally, staff will know with whom they can consult on electric bicycle matters at all relevant departments.

Even within a single department or agency, coordination is needed since different divisions will be involved with electric bicycle work. For example, just within Caltrans, electric bicycle work can be found within the scope of the Active Transportation Program (Division of Local Assistance, Office of State Programs), Office of Sustainability, and the Complete Streets Program (Director's Office of Sustainability).

The task force will reduce the likelihood that work related to electric bicycle safety is overlooked in programs or projects where it can easily be added to existing efforts, even where electric bicycles are not a primary focus of the work. Currently, electric bicycles are not a central focus for most state entities, so there is a risk that proposed electric bicycle efforts could easily get sidetracked or overlooked. For departments such as Caltrans or the Office of Traffic Safety, improving safe use of electric bicycles directly rates to their overall missions, but there has historically been very little focus on micromobility across these entities. For other entities, such as the Department of Public Health or Attorney General's Office, electric bicycles and micromobility are an issue that is less obviously central to the entity's core mission, and there is a particularly high risk that electric bicycle issues could get overlooked.

Many stakeholders outside of state government have an active interest in electric bicycle safety, including city and county transportation and police departments, school districts, and pedestrian and bicycle advocacy organizations. A central entity coordinating the state's electric bicycle work will allow these stakeholders to participate in the work the state is doing, as well as to track what the latest resources and policies may be.

While the exact mandate for these staff positions would need to be determined, the responsibilities might be similar to those that have been assigned to the new position of Chief Advisor on Bicycling and Active Transportation, a position established by Senate Bill 538 (2023), to " serve as the department's primary advisor on all issues related to bicycle transportation, safety, and infrastructure." Specific responsibilities for an electric bicycle staff position might include:

- Connect stakeholders from outside the state government with state programs and processes that would benefit from consultation and collaboration.

- Advocate with the leadership of state entities for a meaningful focus on electric bicycle-related work.

- Establish and maintain a comprehensive directory of state entities conducting work related to electric bicycles. This repository would be of value to both state and external stakeholders.

- Establish and maintain a centralized online repository of state programs, plans, datasets, and other materials related to micromobility and electric bicycles. This repository would be of value to both state and external stakeholders.

- Establish a process for encouraging the entities that document and analyze data about electric bicycle use and incidents to coordinate their efforts to the extent possible. One high-priority goal could be to explore opportunities to adopt standard nomenclature for electric bicycle device types, to allow for efficient data linkage across departments.

CalSTA and/or CalHHS could independently choose to establish these positions, or the legislature could direct one of those agencies to create such staff positions, just as Senate Bill 538 created the position of Chief Advisor on Bicycling and Active Transportation. Ideally, both agencies would appoint a staff position, given the many different programs each offers that relate to electric bicycles. However, if only one agency were to create a dedicated staff position, CalSTA may be the most effective entity, for two reasons. First, CalSTA oversees many of the departments most directly involved with electric bicycle policy. Second, the agency's mission directly addresses the twin goals of increasing use of electric bicycles as a low-cost, environmentally friendly mode of active transportation while also protecting public safety. CalHHS's responsibilities are more narrowly focused on public health and safety, without the same emphasis that CalSTA can appropriately place on actively encouraging electric bicycle use.

10.4 INTEGRATE ELECTRIC BICYCLES INTO RELEVANT STATE PLANS AND PROGRAMS

There are numerous departments across the state that produce plans or manage programs which can integrate electric bicycles the next time the materials are revised. Examples of such documents include those listed here. Some mention electric bicycles briefly, but others do not. In all cases, these are plans that the state updates regularly, so electric bicycle safety can be fully integrated into the next iterations:

- *California Strategic Highway Safety Plan, 2020 - 2024 (2023 Update)* (California Department of Transportation, 2023): The plan mentions conventional bicycles briefly but does not mention electric bicycles or lay out plans related to any form of electric micromobility. Caltrans is in the process of developing the 2025-2029 plan, and the department mentions electric bicycles as a "Challenge Areas" the new plan will focus on.

- *California Transportation Plan 2050* (California Department of Transportation, 2021): The plan mentions electric bicycles several times as important components of the state's active transportation system.

- *2021 Interregional Transportation Strategic Plan* and *Interregional Transportation Strategic Plan Addendum 2022* (California Department of Transportation, 2021): Neither plan mentions electric bicycles.

- *2024 - 2026 California Highway Safety Plan* (California Office of Traffic Safety, 2023): The plan mentions electric bicycles only in Chapter 5, within a section on Public Relations, Advertising, and Marketing. The section identifies electric bicycles as one of several strategic focus areas for education, engagement, and outreach, including educating the public about electric bicycle and e-scooter regulations, rules of the road, and best riding practices for safe interactions with drivers and pedestrians. The plan also describes California's efforts to reduce bicyclist fatalities more generally, including detailed data analysis and planned countermeasure strategies.

- *Complete Streets Action Plan 2024-25* (California Department of Transportation, 2015): The current version of this plan does not mention electric bicycles or micromobility.

- *Toward an Active California: State Bicycle and Pedestrian Plan - 2023 Progress Report* (California Department of Transportation, 2023): This plan integrates content related to electric bicycles, including an action item, M2.5: "Support expanded use of electric bicycles in California," a recommendation to "consider expanding active transportation guidance to include micro-mobility, electric bicycles, e-scooters, and green infrastructure" (p. 73).

10.5 PRODUCE HIGH-QUALITY BICYCLE INFRASTRUCTURE

One of the most effective ways to reduce electric bicycle safety incidents is to provide riders with safe bicycling facilities that reduce potential conflict points between bicycles and other road users. The Safe Systems approach to road safety accepts that road users will inevitably make mistakes, so infrastructure needs to be designed so that those mistakes are not fatal. Strategies include physically separating pedestrians and bicyclists from cars and using road design to control speeds, since lower speeds reduce both the likelihood of a crash (road users have increased time to react) and the severity of crash outcomes.

Caltrans could prioritize applying the safe systems approach to building and maintaining bicycle infrastructure on its own rights-of-way, which include many "main streets" that are key community transportation arteries for bicyclists. Although many safety improvements will require major changes to roadways, quick-build projects offer the potential to provide immediate safety benefits until funds are available for more permanent improvements. Legislators may wish to consider reintroducing a bill like AB 891, which failed to make it out of committee this legislative session, that would have directed Caltrans to create a "Quick-Build Pilot Program" to expedite low-cost bicycle and pedestrian improvements.

Caltrans can also support and incentivize local cities and counties to build and maintain bicycle infrastructure by offering technical assistance and more grant funding through programs like Caltrans' Active Transportation Program. In addition, the state can look for opportunities to streamline the environmental clearance process for bicycle/electric bicycle projects.

10.6 ESTABLISH CALIFORNIA'S OWN ELECTRIC BICYCLE SPECIFICATIONS AND STANDARDS

The state should establish standards for appropriate device characteristics for electric bicycles. The existing performance standards for electric bicycles at the national level were established by the Consumer Product Safety Commission (CPSC) in 2003. Since then, battery and motor technology and the capabilities of devices have evolved dramatically. The CPSC has considered new rulemaking on electric bicycles (Docket No. CPSC-2024-

0008), but that effort has been indefinitely postponed. As a result, there is a national need for states to step up and identify new standards suitable for today's electric devices. California, with its high bicycle usage and well-resourced state agencies, could take a national lead on setting new standards.

There are three key reasons that a new set of device standards for electric bicycles is needed:

- The CPSC offers no guidance for devices outside those that meet their specific requirements for a low-speed electric bicycle. The unregulated devices being widely used include not only the types of bicycles that California and many states define as Class 2 and Class 3, but also devices that fall entirely outside the three-class system.

- The current low-speed electric bicycle requirements include some device specifications that may be inappropriate for today's heavy, high-power devices. Many electric bicycles are heavier than were conventional bicycles at the time the original standards were developed, and today's electric bicycle riders often ride much faster than conventional bicycle riders. The CPSC requirements for testing brakes, for example, may not be appropriate for today's electric devices. One test, for example, requires brakes to stop a bicycle traveling 10 mph within 15 feet, yet many electric bicycle riders regularly travel faster than 10 mph.

- The explosion of different types of electric vehicles, as well as greatly expanded use, offers a new understanding of the types of riders and use cases that the regulations would need to account for, permitting regulators to better develop standards that will be appropriate to today's transportation system.

The most effective approach to designing new specifications will be to start from first principles – who will use the devices, where, and for what purposes – and then identify appropriate rules. While it may be that the existing three-class system has attributes that should be continued, the state might decide that a different direction is needed.

As legislators consider new device standards and operating rules, one objective to consider is drawing up standards that are flexible enough to accommodate innovation in device characteristics. The past decade has seen a proliferation of powered micromobility devices with form factors that were not anticipated by product regulators. The state should embrace and encourage such innovation by creating standards that are flexible enough to accommodate unpredictable device types. One strategy for achieving that goal could be to rely more on performance standards than on precise standards for how a device is constructed.

Key specifications particularly relevant to powered devices to be considered include:

- **Battery standards:** California adopted battery safety standards for electric bicycles in 2024 (Senate Bill 1271). These likely do not need revision, but a comprehensive set of electric bicycle specifications could reference the Senate Bill 1271 standards.

- **Maximum power-assisted speed**: California currently allows assistance up to either 20 or 28 mph, but different caps should be considered. The European Union and China, for example, set a maximum assisted speed of about 16 mph (25 kph). If low-speed electric bicycles are to be allowed on sidewalks and in bike lanes, it may be appropriate to lower the assisted speed below the current 20 mph maximum in most states.

- **Maximum rate of acceleration**: Current law does not regulate acceleration, but this performance criteria should be considered, as some of the potential danger from electric bicycles is believed to arise when riders accelerate rapidly. (There is not, however, evidence available that either proves or disproves this belief.) Newer electric bicycles have emerged that use cadence sensors which allow riders to choose power-assist settings that accelerate rapidly with even just a partial rotation of the pedals, effectively blurring the performance difference between throttle and pedal-assist riding. Capping the acceleration rate, especially for the low-speed electric bicycles, could address the increased collision risk that comes from rapid acceleration. Alternatively, electric bicycles could be required to use torque sensors, instead of cadence sensors, as the former do not accelerate as rapidly.

- **Maximum wattage**: California allows motors up to 750 watts for all classes of electric bicycles, but many countries set lower limits. The European Union, for example, set 250 watts as the maximum continuous motor power. If California were to clarify that the current 750 watt maximum is the maximum *peak* power, that would prohibit the more powerful devices that have motors rated for 750 watts of continuous power. Figure 32 illustrates the difference in power between a device with 750 watts of peak power versus one with 750 watts of continuous power. Such a change would also bring the state essentially in line with how many other countries define electric vehicles. Also, if the state were to carve out a class of higher-powered electric bicycles that follow moped rules, those devices could be permitted a much higher maximum wattage.

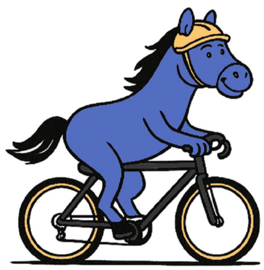
What is peak vs. continuous power?
Peak power is the maximum power that the motor can ever generate. However, a motor cannot sustain this power level over an extended period.

Continuous power is the power level that a motor can generate indefinitely. A motor's continuous power is always much lower than its peak power.

What is 750 watts?
This is 1 horsepower, or the approximate amount of power that one horse produces.

How much power does a rider have with a device that has 750-watt peak power vs. 750-watt continuous power?

An electric bicycle with a motor with 750 watts of peak power will have a continuous power level lower than 750 watts and approximately equal to the power that an elite professional cyclist can maintain over 20 minutes.



An electric bicycle with a motor with 750 continuous power can sustain the power of a horse over time. The motor will have a peak power that is much higher than 750 watts, approximately equivalent to at least 2 horses.

Figure 32. Illustrating the implications of setting a standard of 750 watts of peak power versus 750 watts of continuous power

- **Maximum device weight**: The force exerted during a crash is a function of both speed and weight. Many of today's electric bicycles weigh over 40 pounds without a passenger or cargo (so-called "curb weight"), and some devices are closer to 80 pounds. It may be appropriate to limit the weight of the low-speed devices, especially, to reduce the risk of serious injury to other road users and device riders alike.
- **Maximum footprint:** If low-speed devices are to be allowed on sidewalks and bicycle paths, they will need to be appropriately sized so that they do not block other travelers and can be maneuvered safely. Both a maximum width and length should be considered.
- **Speedometer**: Some but not current electric bicycles include a speedometer. Especially for high-speed electric bicycles, a speedometer would improve safety by allowing riders to maintain speeds under the legal limit.
- **Daytime running lights:** Consider_requiring daytime running lights on electric bicycles, especially for the high-speed devices, to make them more visible and alert road users to expect faster speeds. Switzerland has required this since 2022. (See also Lieswyn, et al. 2017, p. 64.)

- **Passenger seats:** Clarify what constitutes a passenger seat. Both California law and the CPSC state that electric bicycles must a "separate seat" for each passenger, but a number of electric bicycles (both those that are legal and not) have a motorcycle-style banana seat that is widely understood to accommodate a second rider, even though there are not two physically separated "seats." Figure 33 shows an example from a website selling the Soletan M-66X that advertises a "banana seat" that is "spacious enough for two riders."

Figure 33. Advertisement for Soletan M-66X that describes a banana seat for 2 riders

Source: Screenshot from https://www.addmotor.com/products/soletan (accessed 24 November 2025)

- **Prominent labeling, markings, or other device design characteristics that clearly indicate to other road users whether the device is low-speed or high-speed**. The ability to easily identify the device type helps other road users to understand what rates of speed to anticipate from a particular device, as well as allowing police to effectively enforce rules for operating the devices. The current class labels required on electric bicycles are too small to be visible on a moving device. One option would be to rely on prominent colored stickers (or colored plates, if plates are required) that indicate the device class from a distance.

- **Clearly communicate expected device service needs and maximum expected service life**. China, for example, now requires this information to be clearly identified on a device's plate and certificate.

- **Establish a system of device identification numbers**: Currently, electric bicycles are not required to be stamped with a device identification number (DIN), similar to the Vehicle Identification Numbers (VINs) stamped on motor vehicles. Benefits of a required DIN include making it feasible to require device registration for high-speed electric vehicles and allowing purchasers of used devices to look up the device history. The Society of Automotive Engineers (SAE) has developed an identification scheme for powered micromobility devices in their SAE J3272 technical standard (2025). The proposed system captures manufacturer, year of manufacture, model, vehicle type, weight, width, speed, and power source. While the standard proposes a numbering system, the "location for placement of these identifiers on the vehicle, type of label, permanence, and visibility are out of scope for this document."

- **Establish separate performance standards for electric cargo bicycles**. Many performance standards, like lighting requirements, will be identical for bicycles designed to carry a single rider and possibly a second passenger on a seat and larger electric bicycles designed to carry cargo or multiple children. However, because these larger bicycles are designed to move much more weight that a single passenger, the state should consider whether to set different cargo bicycle standards for factors like wattage and weight. The Netherlands has been developing standards that could offer California a useful template (Netherlands Ministry of Infrastructure and Water Management, 2022).

10.7 REVISE THE CALIFORNIA VEHICLE CODE TO UPDATE ELECTRIC BICYCLE CLASSES AND OPERATING RULES

We recommend that the California legislature revise the state vehicle code to establish simple and intuitive definitions for what devices should be classified as electric bicycles and the rules for using two-wheeled powered devices. An integral part of the legislative reforms should be to clearly define what the rules are for any two or three-wheeled light-weight electric devices that fall outside the device and vehicle classifications specified in the California Vehicle Code.

A key justification for such an immediate change in how electric bicycles are defined is that the current system is confusing to most people. Many people will follow reasonable rules, *but only if they understand and remember those rules.* And the key to making rules that people understand and remember is to establish rules that are *simple and intuitive*, something that is currently far from the case. Virtually every interviewee emphasized that the current electric bicycle class system is confusing and understood by almost nobody, whether that be members of the general public or professionals whose work relates to electric bicycles, including police officers enforcing rules of the road. Therefore, a primary objective in revising the rules should be to create rules that are simple and intuitive enough to be easily understood.

10.7.1 Redefine electric bicycles into two categories: low-power devices regulated like conventional bicycles and high-power devices regulated like mopeds

A key strategy to create device categories that the public will understand and remember is for the legislature to reduce the number of electric bicycle classes from three to two. Devices that fall into a low-speed electric bicycle classification could be regulated like conventional bicycles: all rules that currently apply to conventional bicycles and conventional cyclists would also apply to these devices and their riders. More powerful or otherwise riskier devices could be defined as “high-speed electric bicycles” and subject to the same rules that currently apply to motorized bicycles and mopeds. This change would mirror the regulatory scheme used in most countries around the world.

The proposed change will be simple – just two categories to remember. In addition, rules for the two categories could mimic rules that have been in place for many years for other devices, so there is no additional set of rules that must be learned by the public, law enforcement officers, or anyone else. Finally, the two categories will offer alternatives that provide reasonable accessibility for people with very different needs and abilities.

- The proposed low-power category offers a powered travel option for everyone, including anyone who does not have a driver's license, whether children, adults with medical conditions that prevent operating a motor vehicle safely, or adults who simply prefer not to drive motor vehicles.

- The high-power category preserves an option for people to ride faster or more powerful devices, but accounts for the greater risk these devices impose on riders or other road users by adding requirements similar to those placed on other high-speed devices, including motorcycles and motor vehicles.

Table 61 outlines key differences that would be established for operating low-speed and high-speed devices, assuming the state chooses to treat them as comparable to conventional bicycles and mopeds. Key differences relate to age minimums, helmet use, riding on sidewalks and shared-use or bike facilities, licensing, and vehicle registration. These requirements include holding a driver's license (to ensure that the rider knows the rules of the road) and keeping the devices off the facilities where they put vulnerable road users at greatest risk—sidewalks, bikeways, and shared-use paths. Since the current class-3 bicycles are designed to provide motor assist up to 28 mph, it makes conceptual sense to treat the devices as more akin to a motor vehicle (i.e., requiring a license) than to a human-powered device. One core component of the federal definition of a motor vehicle is that the device is capable of exceeding a maximum speed of 25 mph, which supports the principle that high-speed electric bicycles ought to be regulated as a type of vehicle.

Table 61. *Examples* of key device standards and operating rules that California could establish for low-power vs high-power electric bicycles[a]

Requirement	Low-power category	High-power category
Comparable mode used to establish operating rules	Conventional bicycles	Moped/motorized bicycle
Maximum *peak* motor power	750 watts	3000 watts
Maximum assisted speed	15 mph	30 mph
Age minimum	None	16 years
Helmet required	Only for riders under 18 Must meet Consumer Product Safety Commission certified	For everyone Helmets must meet standards established by Dutch National Technical Agreement (NTA) 8776[b] or be U.S. Department of Transportation (DOT) compliant
Riding on sidewalks, bicycle facilities, and shared-use paths	Yes	No
Driver's license required	No	Yes
Device registration required	No	Yes (one time only)
Insurance required	No	No

[a] Table content provided as a sample of differences that could be established, not as a specific recommendation.
[b] Confederation of the European Bicycle Industry (2016).

10.7.2 Clarify the legal status of the many two-wheeled, electric-powered "bicycle-shaped devices" that do not fit into any device category in the California Vehicle Code

There are many devices ridden on California streets that do not meet the legal definition of an electric bicycle, moped, or any other device codified into state law. Typically, these devices can travel faster than 28 miles per hour and/or have more powerful motors than are allowed under current electric bicycle definition. Some of these devices were sold with advertised speed and power maximums above the California legal limit, while other devices have been modified by users to exceed speed and power limits. These devices pose a special challenge for policy because so many of them have been sold in the state, yet they pose greater risks than legal electric bicycles.

It will be critical to directly state if and how these devices may be used. California Senate Bill 455 (2025) proposed to make it a crime to use any 2 or 3 wheeled device on any public right-of-way if the device does not meet the definition of one of the devices authorized for use in the California Vehicle Code. The devices could only be used on private property or other off-highway environments. Variations to that approach that would accommodate people who have already purchased the devices could be to provide legacy permission to ride on public right-of-way only with devices that had been purchased before some cut-off date and/or to classify the devices as high-speed electric bicycles that must follow the rules that currently apply to motorized bicycles/mopeds).

10.7.3 Other revisions to the rules for operating electric bicycles

Some additional changes the state could consider include:

- Codify that people have the right to travel safely throughout their communities on electric bicycles and other powered micromobility devices. As part of this, prohibit local governments and private entities from banning electric bicycle use in areas where (non-freeway) motor vehicle traffic is allowed. The state could mimic the way the California Vehicle Code currently affirms the value of travel by electric personal assistive mobility devices (California Vehicle Code Section 21280):

  > (a) The Legislature finds and declares all of the following:
  >
  > (1) This state has severe traffic congestion and air pollution problems, particularly in its cities, and finding ways to reduce these problems is of paramount importance.
  >
  > (2) Reducing the millions of single passenger automobile trips of five miles or less that Californians take each year will significantly reduce the pollution caused by fuel emissions and aggravated by automobile congestion.
  >
  > (3) Electric personal assistive mobility devices that meet the definition in Section 313 operate solely on electricity and employ advances in technology to safely integrate the user in pedestrian transportation.
  >
  > (4) Electric personal assistive mobility devices enable California businesses, public officials, and individuals to travel farther and carry more without the use of traditional vehicles, thereby promoting gains in productivity, minimizing environmental impacts, and facilitating better use of public ways.
  >
  > (b) The Legislature is adding this article as part of its program to promote the use of no-emission transportation.

- Codify that the state's intention that rules for operating micromobility devices, including electric bicycles, should be standardized statewide, with only minimal local limitations where these are necessary in specific contexts to protect public safety, such as banning use on sidewalks where pedestrians are common. Such standardization is essential to public understanding of the rules. Further, require that if local governments ban bicycles or electric bicycles from sidewalks or bike facilities, or add speed limits for micromobility devices, then these rules must be prominently signed at any location where a rider would enter the sidewalk or path. An example from the rules of the road for driving illustrates the importance of prioritizing statewide rules and requiring adequate signage for any variations: if each city in California made its own decision on whether right hand turns are permitted at a red light, drivers would face a near-impossible task of knowing where they could or could not turn right on red, unless all signalized intersections were signed.

- Establish that electric bicycles and conventional bicycles have an affirmative right to use sidewalks at prudent speeds, where this is not banned. Currently, the California Vehicle Code does not directly affirm that bicycles (and by extension electric bicycles) may ride on the sidewalk. Instead, the code says that local governments may ban sidewalk riding, implying that sidewalk riding is permitted except where prohibited. The Code could pair a direct statement that bicycles may ride on the sidewalks unless prohibited by local law with language describing the types of dangerous and reckless riding prohibited. The latter statement could mimic the approach taken with electric personal assistive mobility devices (EPAMD) (California Vehicle Code Section 21281.5):

> (a) A person shall not operate an EPAMD on a sidewalk, bike path, pathway, trail, bike lane, street, road, or highway at a speed greater than is reasonable and prudent having due regard for weather, visibility, pedestrians, and other conveyance traffic on, and the surface, width, and condition of, the sidewalk, bike path, pathway, trail, bike lane, street, road, or highway.
>
> (b) A person shall not operate an EPAMD at a speed that endangers the safety of persons or property.
>
> (c) A person shall not operate an EPAMD on a sidewalk, bike path, pathway, trail, bike lane, street, road, or highway with willful or wanton disregard for the safety of persons or property.
>
> (d) A person operating an EPAMD on a sidewalk, bike path, pathway, trail, bike lane, street, road, or highway shall yield the right-of-way to all pedestrians on foot, including persons with disabilities using assistive devices and service animals that are close enough to constitute a hazard.

- Establish speed limits for power-assist on shared-use facilities like bicycle paths and lanes, and sidewalks, but require that these be signed, just as streets have posted speed signs.

- Require that electric bicycles have a speedometer, so that riders can monitor their speeds anywhere with speed limits, whether that be on the road or on sidewalks or paths.

- State directly that reckless riding of electric bicycles and other micromobility devices is prohibited. Currently, reckless riding is prohibited, but in a roundabout way; the vehicle code does not directly state that riders can be convicted of reckless riding, just as they can be convicted of reckless driving. The California Vehicle Code does not directly state that reckless riding is prohibited. However, the code does prohibit this behavior in a two-step process: bicyclists have the duties or motor vehicle operators (California Vehicle Code Section 21200 (a) (1)) and reckless driving by motor vehicle operators is prohibited (California Vehicle Code Section 23103).

- Consider establishing penalties for electric bicycle riders who violate Rules of the Road that are commensurate with the risk imposed on other road users. Currently, the California Vehicle Code implies that many of the penalties imposed on motor vehicle drivers would also apply to bicycle riders and, by extension, electric bicycle riders. In some cases, the equivalent penalty may be appropriate, but in other cases a lesser penalty may be appropriate where there is less risk of harm to others. Enforcement and penalties are discussed further in Section 10.11.

- Create new performance-based mobility device categories that encompass electric bicycles, other forms of powered and unpowered micromobility, and even travel devices whose users are currently defined in state law as "pedestrians":

  - *Simplify the various device categories for 2-wheeled powered devices*. It may be appropriate to consolidate high-speed electric vehicles with motor driven cycles, motorized bicycles, mopeds, and motorized scooters into a single class of "high-speed personal mobility devices." The state should also consider defining this group of devices as motor vehicles, to align with a core component of the federal definition of a motor vehicle, that the device can propel itself faster than 25 mph (Title 40 of the Code of Federal Regulations, Section 85.1703).

  - *Consolidate other types of micromobility devices into a class together with low-speed (and perhaps higher-speed electric bicycles)*. Candidates for this include powered skateboards and unicycles. All devices in the class would be expected to meet performance standards, such as maximum assisted speeds and braking standards. Grouping multiple vehicle types into such a class change would enhance public understanding of the rules by reducing the number of device classifications (Fang, Agrawal, & Hooper, 2019).

    The Society of Automotive Engineers offers one option for defining micromobility categories that could fall under a common set of regulations: Technical Standard J3194 (2019), Taxonomy and Classification of Powered Micromobility Vehicles (Society of Automotive Engineers, 2025).

10.8 REQUIRE SELLERS OF ALL ELECTRIC "BICYCLE-SHAPED DEVICES" TO DISCLOSE RELEVANT STATE REGULATIONS TO BUYERS

There are two key elements to preventing buyers from unwittingly purchasing devices that are not legal to ride on public streets: alerting potential buyers to the laws, and providing an enforcement mechanism to deter retailers from breaking the law.

10.8.1 Require that sellers disclose the device type they are selling and laws on how that device may be used

California may wish to adopt laws that provide purchasers with clear information about whether or not the device they are buying is a legal electric bicycle in the state, as well as how an electric bicycle can be legally used in the state. Such legislation would, in essence, transfer from buyers to sellers the requirement to educate buyers about the devices they buy.

Currently, the California Vehicle Code requires some disclosure, but it is limited. As of January 1, 2025, California law places two requirements on manufacturers and retailers of electric bicycles: (1) they may not advertise as an electric bicycle any device that does not meet the state's legal standards and (2) all electric bicycles sold must have a label affixed with the class number, top assisted speed, and motor wattage (California Vehicle Code, Section 312.5).

A stronger disclosure rule could add two additional requirements for manufacturers and retailers that would allow buyers to make a truly informed purchase decision:

- If the device is *not* a legal electric bicycle but buyers might assume it to be one, the purchaser must be clearly advised that the device is not a legal electric bicycle. Further, buyers must be advised what device or vehicle classification the item does fall under, if there is one. If the device does not meet the standards in the California Vehicle Code for any device or vehicle that is legal to ride on public roads or lands open to the public, then the buyer should be informed of this fact.

- Potential buyers must be furnished with a copy of relevant state laws about how the device may be legally ridden in California.

Such a disclosure requirement would mimic the spirit of California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop 65), which requires sellers to disclosure to buyers if a product contains chemicals that have been found to cause cancer or reproductive harm.

Other states have proposed and/or adopted disclosure laws that might prove useful models for California. In 2024, Utah adopted a law requiring retailers to label the legal electric bicycles sold with class information and, for any device that is not street legal, to disclose in a conspicuous manner a warning that the bicycle is not street legal and that insurance policies may not provide coverage if the device is involved in a collision. Section 41-6a-1115.5.8 of the Utah Code reads:

> (d) Beginning May 1, 2024, a seller of any new or used vehicle with less than four wheels that is powered by an electric motor that is not an electric assisted bicycle shall clearly and conspicuously provide the following disclosure to a prospective purchaser at the time of sale and in any advertising materials, online website, or social media post promoting the vehicle: "THIS VEHICLE IS NOT AN "ELECTRIC ASSISTED BICYCLE" AS DEFINED BY UTAH MOTOR VEHICLE CODE AND IS INSTEAD A TYPE OF MOTOR VEHICLE AND SUBJECT TO APPLICABLE MOTOR VEHICLE LAWS IF USED ON PUBLIC ROADS OR PUBLIC LANDS. YOUR INSURANCE POLICIES MAY NOT PROVIDE COVERAGE FOR ACCIDENTS INVOLVING THE USE OF THIS VEHICLE. TO DETERMINE IF COVERAGE IS PROVIDED YOU SHOULD CONTACT YOUR INSURANCE COMPANY OR AGENT."
>
> (e) For a disclosure described in Subsection (8)(d), the seller shall ensure that the disclosure appears in bold, capital letters at least the same font size as the description of the vehicle.
>
> (f) A person's actions to knowingly advertise, offer for sale, or sell a vehicle that is not an electric assisted bicycle as an electric bicycle, electric assisted bicycle, electric bike, or e-bike without making the disclosure described in Subsection (8)(d) constitutes prima facie evidence of a deceptive trade practice under Section 13-11a-3.

In Hawaii, a similar bill (HB 958 bill) almost passed in 2025 and is expected to pass in the coming year. This bill went farther than Utah's law by requiring retailers to post warnings about legal limits on electric bicycle use and to provide a booklet outlining the state's electric bicycle laws:

> (b) Distributors of electric bicycles shall place a sign at or near the point of sale with wording substantially similar to the following in all capital letters and printed in no less than fourteen-point font:

> "THE SALE AND OPERATION OF ELECTRIC BICYCLES IS REGULATED UNDER CHAPTER 291C, HAWAII REVISED STATUTES. CERTAIN USES AND RIDERS MAY BE RESTRICTED BY LAW."
>
> (c) Distributors of electric bicycles shall provide to the purchaser of an electric bicycle a booklet or pamphlet detailing the associated state laws regulating the use of electric bicycles in this part.
>
> (d) Sellers and distributors, including online or third-party platform sellers and distributors delivering or offering for delivery to the State, of electric bicycles shall verbally and in writing disclose whether the electric bicycle being sold is legal for use on public roads, sidewalks, or bike lanes. Disclosures shall include registration, equipment, helmet, and age requirements.

10.8.2 Establish clear processes to enforce disclosure laws

Disclosure laws will be more effective if the state establishes clear enforcement practices that do not require solely on consumers to sue retailers who fail to follow the requirements. Ideally, local and state entities will partner on enforcement.

At the state level, the legislature could amend the Vehicle Code to specify penalties for retailers who do not comply with disclosure laws and direct the Attorney General to investigate whether manufacturers and retailers have been misleading buyers about devices marketed as electric bicycles that may be ridden on public streets and roads. A recent precedent where the Attorney General investigated and prosecuted false advertising is the investigation into misleading advertisement by plastic bay producers, which resulted in a lawsuit and settlement (Office of Attorney General Rob Bonta (CA), 2025).

In addition to directives to the Attorney General, the legislature could grant local authorities to authority impose fines for noncompliance. Hawaii's HB 958 bill offers an example of how a state could establish fines for noncompliance grant both state agencies and counties the power to assess fines on violators:

> (e) The department of transportation, department of commerce and consumer affairs, or a county may impose administrative fines not to exceed $500 per violation of noncompliance with this section. The department of transportation, department of commerce and consumer affairs, or a county may inspect premises or investigate complaints to ensure compliance with this section.
>
> (f) The department of transportation, department of commerce and consumer affairs, and each county shall adopt rules pursuant to chapter 91 to carry out the purpose of this section.

10.9 IMPROVE THE ORGANIZATION AND EXPRESSION OF CALIFORNIA VEHICLE CODE LAWS RELATED TO ELECTRIC BICYCLES

The legislature can direct the California Law Revision Commission to improve the organization and clarify of laws that relate to the use of electric bicycles, bicycles, and other micromobility modes. The earlier sections of this chapter suggest specific changes to the laws related to electric bicycles, but those changes would not address a related problem: that it is very difficult to find and understand the laws. This confusion arises from many factors, such as complex language, references to other sections of the vehicle code, and the fact that many of the laws governing electric bicycle are only implied rather than directly stated. The example given earlier about reckless riding of electric bicycles illustrates the problem: reckless riding of electric bicycles is prohibited, though the code never states this directly. Instead, the code states that electric bicycle operators have the duties of bicycle operators, who have the responsibilities of vehicle operators, and the code prohibits reckless operation of vehicles. As a result, electric bicycle operators are also prohibited from reckless riding.

The Commission's task could for clarifying the vehicle code could mirror the directives that the legislature gave for work to recodify California's toxic substances statutes (Senate Concurrent Resolution 91, 2018). The Commission was directed to recommend revisions to the Health and Safety Code that would:

> …improve the organization and expression of the law. Such revisions may include, but are not limited to, grouping similar provisions together, reducing the length and complexity of sections, eliminating obsolete or redundant provisions, and correcting technical errors. The recommended revisions shall not make any substantive changes to the law. The commission's report shall also include a list of substantive issues that the commission identifies in the course of its work, for possible future study.

10.10 PROVIDE MATERIALS TO EDUCATE THE PUBLIC ON ELECTRIC BICYCLE RULES AND SAFE RIDING PRACTICES

If Californians are to follow electric bicycle rules and best practices for maintaining their devices safely and riding safety, they need to know what these rules and best practices are. Similarly, if other road users are to be safe, they need to know where and how to expect electric bicycles to be ridden. Currently, there is no easy way for residents to find the information they need, including information on the state's own rules. The state can therefore play a critical role in promoting safety by developing materials that state agencies and other partners can use to educate Californians.

This education could be designed to target three key areas:

1. Educating the public about which types of devices are legal electric bicycles, appropriate for on-road use. The discussion about disclosures by retailers, discussed above, is one key component of education, but the rules should be widely available outside of the retail environment.

2. Educating all road users, not just electric bicycle riders, on the rules of the road for operating electric bicycles. While it is self-evident that electric bicycle riders need to know the rules, creating a safe road environment requires that other road users, especially motor vehicle drivers, know what behaviors to expect from electric bicycle riders.

3. Educating electric bicycle riders about electric bicycle maintenance and safe riding practices. Many people who purchase electric bicycles are unaware that these devices require more maintenance than conventional bicycles, especially with respect to the brakes and batteries. In addition, because electric bicycle riders may be traveling at higher speeds than do most conventional cyclists, it is critical to teach skills for riding safely in mixed traffic. This education is similar to that needed by moped and motorcycle riders. Topics include proper positioning on the road (e.g., which lane to take and where to ride within the lane), avoiding driver blind spots, making sure to be seen, and signaling turns.

Key strategies for educating the public are producing a handbook that presents in plain English (and other common languages) all electric bicycle rules of the road, adding more content about electric bicycles to DMV materials for motor vehicle drivers, producing electric bicycle safety education materials targeted at different ages (e.g., tweens, high-school students, and older adults), and producing public information campaign materials.

10.10.1 Produce a plain-language handbook with electric bicycle rules of the road

It is almost certain that most Californians are not aware of the rules of the road for electric bicycle riders, and one key reason is that the state does not provide, in writing, a complete set of the rules for operating either conventional or electric bicycles that is both written in everyday language and easy for the public to find.

Numerous problems arise when the public is not aware of the laws where they live. Most obviously, electric bicycle riders cannot be expected to follow laws they do not know about. There is also a higher risk of crashes when *other* road users, from drivers to pedestrians, do not know what behaviors to expect from electric bicycle riders. Further, a lack of clarity can lead either to ticketing of electric bicycle riders for behaviors that are in fact legal—or a lack of enforcement of the rules that do exist. Finally, the lack of clarity around rules for riding electric bicycles can also scare off potential riders who are worried about inadvertently running afoul of the law.

The DMV, Caltrans, and the CHP all provide some written information relevant to electric bicycle riders, but none of the departments provides complete information about the rules of the road, and in many cases the information is also not easy to find.

The DMV covers some electric bicycle rules in handbooks for the public that are written in plain language and are accessible online and in print at DMV offices, but the handbooks do not cover electric bicycle laws thoroughly. The California Motorcycle Handbook (2024) covers some electric bicycle rules but has two critical limitations: it does not provide a full set of the rules for operating electric bicycles (which includes the rules for operating conventional bicycles), and it seems highly unlikely that electric bicycle riders would think to look for rules in a document whose title speaks only of “motorcycle” riders. As for the DMV’s materials for motor vehicle drivers, neither the California Quick Reference Driver’s Handbook nor the California Driver’s Handbook have any information about legal operation of electric bicycles. Further, the information provided about rules of the road for conventional bicyclists is problematic in many ways: the handbooks do not cover all rules of the road for bicycle riders; the bicycle information is hard to find because it is scattered throughout the handbook; the text is sometimes phrased as a guide help drivers know what to expect from bicycle riders, rather than as a guide to what electric bicycle riders should do; and, in at least one case that we identified, the information is incorrect. Finally, the DMV's webpage "Bicyclists and Pedestrians" presents only a partial list of the relevant rules of the road for cyclists and has no information on riding electric bicycles.

As for Caltrans, its Bike Program has a webpage titled "Codes, Laws, and Regulations" that links to some informal documents presenting information on bike laws, but these materials are incomplete, even for conventional bicycles, and the documents do not cover electric bicycle-specific rules. Further, the public is unlikely to find the materials because of their location on the Caltrans website.

The CHP provides information about some rules for operating electric bicycles in its "Electric Bicycle Safety and Training" course" (California Highway Patrol, n.d.) but this information is unlikely to function well as a reference for riders for a number of reasons:

- A person must *take* the course to find the rules of the road. (There is no reference document available, such as for a refresher.)
- The course presents the rules of the road using the language in the California Vehicle Code, which is not always easy to understand.
- The section that presents the "Rules of the Road" for electric bicycle operators misses some rules that apply to electric bicycles indirectly because they apply to operators of bicycles or vehicles. For example, the course does not explain when electric bicycles can ride on sidewalks or that reckless riding is prohibited.

Currently, the only way to find a state-produced set of the complete rules of the road for electric bicycles, bicycles, or any form of micromobility, is to read the California Vehicle Code. This is a complex task that it is obviously not reasonable to expect of the public, or even of professionals who need to know the rules, whether law enforcement officers or transportation engineers and planners. The following example illustrates the complexity of trying to learn directly from the California Vehicle Code. The fact that electric bicycle riders are prohibited from reckless riding requires tracing a three-step journey through three different sections of the California Vehicle Code: that electric bicycle riders have the rights and responsibilities of bicyclists (California Vehicle Code, Section 312.5), that bicyclists have the rights and responsibilities of motor vehicle drivers (except where these cannot apply) (California Vehicle Code, Section 21200), and that motor vehicle drivers are prohibited from reckless driving on the road (California Vehicle Code, Section 23103).

We recommend that the State of California produce an *Electric Bicycle Rider's Handbook* that covers the complete set of state rules for riding electric bicycles. (Ideally, California would also produce handbooks for conventional bicycles and all other legal micromobility device types, such as electric kick-scooters and skateboards.) California Senator Boerner has twice introduced legislation that would have directed the California Transportation Agency to produce such a handbook for bicycles and electric bicycles, Assembly Bill 1188 (2023) and Assembly Bill 2259 (2024).

To be most effective at educating the public, the handbook should be written in simple language and available in the same languages as the *California Driver's Handbook*. Critically, the handbook should provide the complete set of the rules that electric bicycle riders must follow: electric bicycle-specific rules, plus rules written for conventional bicycles or motor vehicle drivers that apply to electric bicycle operators, such as the prohibitions on reckless riding and riding under the influence of alcohol or drugs(California Vehicle Code, Section 21200). The handbook should also provide basic information about the penalties for violating the rules, such as this example from the Massachusetts Registry of Motor Vehicles handbook, *Sharing the Road: A User's Manual for Public Ways* (2023, p. 44) (Massachusetts Registry of Motor Vehicles, 2023).

> If a police officer sees a bicyclist commit a traffic violation, the officer can issue a citation the same way they would for a motorist. The bicyclist can be fined, but it will not affect their driving record. A bicyclist must give the officer their true name and address when asked and can be fined for not doing so. A bicyclist can also be arrested for refusing to give their name.

While the state may also wish to include safe riding and maintenance tips in the handbook, that information could also be hosted elsewhere and linked from the handbook with the rules of the road. Alternatively, the material could be added to an Electric Bicycle Rider's Handbook at a later date, if the state wishes to quickly produce a handbook with just the rules of the road, which would require less time to develop. Examples of the safety topics to cover are how to check and maintain brakes and batteries, ride defensively, and ride with courtesy for pedestrians and other road users.

Opportunities to alert the public to the handbook including requiring that electric bicycle retailers provide the printed handbook or a flyer with a link to anyone who purchases an electric bicycle, as posters in bicycle shops and DMV offices, and in materials that the state produces which may be read by people seeking information about electric bicycles, such as the handbooks the DMV produces for the public (*California Quick Reference Driver's Handbook*, *California Driver's Handbook*, *California Motorcycle Handbook*), through education materials and public service announcements that the state disseminates, and through any state agency webpages that cover electric bicycle use and safety, such as the CHP's Electric Bicycle Training and Safety course, the OTS page on electric bicycle safety, CARB's electric bicycle incentive program, and DPH's Active Transportation Resource Center.

10.10.2 Add electric bicycle content to DMV materials that educate motor vehicle operators

The materials that the DMV produces for motor vehicle drivers could be updated to include more content on electric bicycles. The California Quick Reference Driver's Handbook and California Driver's Handbook should include basic information about electric bicycle operations so that motor vehicle drivers know what behaviors to expect from electric bicycles, and a link could be provided to the full set of bicycle/electric bicycle rules of the road handbook once this is produced.

10.10.3 Develop electric bicycle safety education materials for different age groups

The state may wish to consider requiring electric bicycle and road safety curriculum in schools as a long-term strategy, something that is now required by law in the State of Minnesota. However, any change to the state's curriculum rules would likely take years, so the state could explore short-term options as well.

The state could aim to quickly develop and disseminate high-quality road safety curriculum that schools, universities, community groups, and others can voluntarily adopt. Currently the CHP produces some education materials through its California Pedestrian and Bicyclist Enforcement and Education Project and its online "Electric Bicycle Safety and Training" course" (California Highway Patrol, n.d.). These materials are a useful starting point, but there is considerable room for refining and expanding them to create age-appropriate variations, providing text materials to use with or instead of the video course, and creating lesson plans for school teachers and bike instructors.

It is critical that the education materials produced are age-appropriate. The content, instructional medium, and language will all likely need to be somewhat different for elementary school, middle-school, high-school students, college students, and adult learners.

The curriculum developed should cover who is permitted to ride electric bicycles of different types, the rules of the road for electric bicycle riders, electric bicycle safety checks, defensive riding techniques that help electric bicycle riders stay visible to motorists, and safe riding practices for locations where vulnerable road users like pedestrians are present.

While CHP may be an appropriate state agency to manage the development and dissemination of electric bicycle education curriculum, it is recommended that CHP partner with bicycle education organizations or other stakeholder groups that have already developed extensive curriculum materials. Examples of organizations with a history of offering quality bicycle education include the Marin County Bicycle Coalition, League of American Bicyclists, American Bicycle Education Association (ABEA), Bicycle Alliance of Minnesota, and PeopleForBikes. The state could contract with such organizations to produce new, California-specific curriculum, or the state could license curriculum that has already been developed. For example, UC Davis has licensed the ABEA's Cycling Savvy online program, making it freely available to the entire campus community.

10.10.4 Offer electric bicycle training courses

CHP or another state entity could make available free or low-cost statewide hands-on training courses, on a model similar to the California Motorcyclists Safety Course. Ideally, the course would be taught in versions appropriate for both children and adults. A state department could directly provide the training or contract with another entity to run the courses, such as one or more of the bicycle advocacy organizations that already have expertise in teaching safe bicycling.

10.10.5 Produce content for public service announcements

While a full curriculum is ideal for teaching electric bicycle riders safe and legal riding practices, the state can also develop materials about electric bicycle safety to educate the many Californians who will never be reached with formal education offered through schools, driver's education classes, or electric bicycle training workshops. The campaign could include posters, billboards, social media videos, and public service advertisements. The state could encourage local governments and other stakeholders to display the materials.

Some of the materials could be developed to communicate directly with electric bicycle riders on topics such as respecting pedestrians, device safety checks, and wearing a helmet. Other materials could target all road users (electric bicycle riders and others). For the latter, messaging could include topics such as reminders that motor vehicle drivers must act responsibly around electric bicycles and other vulnerable road users and rules about where electric bicycles may be ridden.

Appropriate state departments to participate in such a public education campaign include the Office of Traffic Safety (OTS) and the Department of Public Health. OTS has a public information campaign, Go Safely, California, that could be expanded with a suite of electric bicycle specific materials. Currently the program offers two flyers about electric bicycle safety, but no electric bicycle materials suitable for billboards, posters, or social media posts and videos. A key partner in such an effort, or possibly the lead department, could be the California Department of Public Health, which has developed expertise in public service messaging over decades of campaigns such as anti-smoking campaign.

10.11 SUPPORT ENFORCEMENT OF RULES FOR OPERATING ELECTRIC BICYCLES

Although enforcement is only one among many government levers to achieve compliance with the rules on how electric bicycles may be operated, it is nevertheless a key component along with education of users and requiring retailers to accurately disclose what type of device they are selling. Enforcement efforts by the police can both educate the public who may not understand electric bicycle rules and also create a disincentive for those riders tempted to ride recklessly or on devices that are not street-legal. Key components of enhancing enforcement activities are to give the police the needed training and other resources, as well as ensuring that the California Vehicle Code provides reasonable tools for enforcement.

10.11.1 Establish appropriate penalties for illegal operation of electric bicycles

The California Vehicle Code could be amended to establish appropriate penalties for reckless electric bicycle riding or other dangerous violations of the California Vehicle Code. Given an electric bicycle's lower potential for harming others as compared to motor vehicles, it will likely be appropriate to define violations as infractions and restrict the penalties to less severe options such as fines, diversion to electric bicycle safety classes, and/or impounding devices. It will be important to ensure that the penalties are not unreasonably severe, such as the decision in New York City to issue criminal summonses for infractions like speeding that would merit only a summons for motor vehicle drivers (Duggan, 2025). As one NYC bicycle advocate put it, "If you're driving a two-ton SUV at 40 mph, you get a traffic ticket, but if you're riding an e-bike at 16 mph, you are summoned to criminal court."

Penalties that may provide an optimal balance of deterrence and education include impounding the device and requiring electric bicycle safety education. Assembly Bill 875 (2025) provides one model. The bill allows local governments to adopt ordinances that would permit police to confiscate certain kinds of devices that do not meet the definition of an electric bicycle. To reclaim the device, the ordinance can require the rider to pay a fee and/or attend safety training. The City of Santa Cruz Police Department has adopted a similar enforcement approach. In the fall of 2025, police reported to a city commission that in the past year officers have stopped minors riding electric bicycles that were not street legal, impounded the devices, required parents to pay both an impound fee, and considered fining the parents for allowing a minor to operate a "motor vehicle" (Kathan, 2025).

To deter reckless riding, the state could use a similar approach: granting local authorities the right to adopt ordinances that grant policies the power to impound devices, levy fines, and/or mandatory education for reckless riders. Some California local governments, such as the City of San Jose, have already adopted ordinances that allow local police to impound bicycles for reckless riding (San Jose Municipal Code Section 11.72.150).

The state could consider amending the California Vehicle Code to add a prohibition of reckless riding on an electric bicycle on public rights of way and associated penalties. Adding this content to the state code would remove the need for every city to pass its own ordinance and would ensure standardized definitions of reckless riding and penalties across the state.

If the California Legislature decides to establish penalties for reckless and dangerous use of electric bicycles, it will be important to balance the likely safety benefits against the social costs, which include the risk of over-policing and discriminatory policing, as well as issuing citations to generate revenue. Policymakers can also consider the evidence about what types of penalties have been found effective at achieving behavioral change (Barajas, 2021; Elvik, 2016; Fry, 2023; Livingston & Ross, 2022; Luca, 2015). Provide guidance on how to store impounded electric bicycles

The CHP could provide guidance to local police departments on how to store impounded electric bicycles. Most critical will be advice on how to store the devices safety, given the fire risk from lithium batteries. It may be appropriate to train officers how to evaluate a battery for damage and recommend purchase of a fire-resistant cabinet designed to store lithium-ion batteries. The guidance can also help police departments determine if they can store the devices at the impound yards used to store motor vehicles or if the (relatively smaller) electric bicycles should instead be stored in police department facilities, something law enforcement agencies have traditionally done on the rare occasions when bicycles are impounded.

10.12 COLLECT BETTER DATA ON SAFETY INCIDENTS

As discussed above, the existing data on electric bicycle incidents is neither reliable enough[11] nor extensive enough to offer clear insights into the questions needed to make policy, such as the risks associated with different types of electric bicycles and causes of incidents. That said, numerous data sources already collect electric bicycle information and, with modest refinements, could provide much more useful data. In addition, the state can explore new sources of data on bike incidents.

10.12.1 Improve the quality of electric bicycle incident data already collected

The state can work to support improvements in data on electric bicycle related data collected from the four main sources: police collision reports, EMS patient records, hospital patient records (both outpatient and inpatient), and death certificates. Because each data source has different strengths, it is important to improve all of them. For example, a comparative study of 2018 North Carolina trauma and crash data found that hospital patient records were more complete for injury severity ratings, while crash reports were more accurate for identifying minor injuries (Taylor, Fliss, Schiro, & Harmon, 2024). In addition, police crash reports are the best option to collect data on crash circumstances and characteristics.

In order to improve the quality of all four types of data, one of the state's primary efforts can be to create new data intake standards, forms that incorporate the information needed to understand electric bicycle incidents, and training materials for the professionals who record the data. The need for these changes was highlighted in a 2022 safety research report from the National Transportation Safety Board, Micromobility: Data Challenges Associated with Assessing the Prevalence and Risk of Electric Scooter and Electric Bicycle Fatalities and Injuries.

For all four types of data, the state either mandates or requests minimum standards for how this data is reported. Two key types of changes in the reporting standards would be particularly valuable:

- Capture precise details on device types in all records. When possible, records should include the device brand, model, DIN, and class sticker or other identification. Where possible, this information should be documented in both writing and photographic evidence.

11 A key problem with data quality is that incidents labeled as "electric bicycle" ones may not involve devices that meet the legal definition of an electric bicycle.

- Capture more information about the circumstances of the incident, including the cause of the incident and details of the place where it occurred.

However, while developing data reporting procedures to collect the information needed is a critical first step, even the most complete reporting forms will be of little use if data reporters do not complete them accurately. One strategy to improve data quality is to create electronic forms that allow reporters to easily search by keywords and/or suggest appropriate codes based on other details in the records. A second essential strategy is to educate data reporters – police officers, EMS technicians, emergency medical staff, and hospital registrars – on how to complete the forms. Especially important will be to train reporters to accurately record details about the device type and characteristics, since as discussed above the phrase “electric bicycle” or “e-bike” is often used to describe devices that are not legal electric bicycles in California. Perhaps the most effective strategy for reaching data reporters is to collaborate with their industry associations, such as the Commission on Peace Officer Standards and Training (POST), California Police Chiefs Association, California Ambulance Association, California Nurses Association, and American College of Surgeons.

Finally, in addition to improving data quality, the state could work with data reporters and aggregators to submit and share data much more quickly. Currently, health and traffic data is often years old by the time it is analyzed and shared publicly. One opportunity for the state to speed up data sharing is through the California Syndromic Surveillance (CalSys) program. CA Senate Bill 159 (2024), which was approved by the Governor in 2024, authorizes the Department of Health to create and administer a syndromic surveillance program and require local health departments to submit patient records (California Health & Safety Code, Section 131365).

Traffic crash reports

Police traffic crash reports are a particularly valuable source of data on one subset of electric bicycle incidents: crashes that occur on public roadways; involve a motor vehicle; and lead to serious injury or death, or major property damage. While these criteria exclude the great majority of electric bicycle crashes, many of the incidents with the most serious outcomes will be recorded.

The CHP and California Department of Technology are currently beginning work on the California Crash Data System Modernization Program, a federally funded program to update the template of minimum information that police departments must collect in traffic crash reports. Thus, the coming year is an ideal time to develop new data fields and procedures relevant to reporting electric bicycle crashes. The new template will be electronic (many police departments in California still use paper forms), creating new opportunities to improve the accuracy and detail of reports that involve electric bicycles (Nie, et al., 2021).

As part of the grant, CHP will have to create a reporting system that captures all data required by the National Highway Traffic Safety Administration’s 6th edition of the Model Minimum Uniform Crash Criteria (MMUCC). The latest edition of the MMUCC, released in

February 2025, includes new reporting requirements for crashes involving electric bicycles and other micromobility devices.

Options for the CHP to consider for data collected about electric bicycle crashes in TCRs include:

- Require crash reports from electric bicycle incidents that do not involve a motor vehicle or do not occur on public roadways.
- Require police departments to document electric bicycle crashes that are reported, even when these do not involve a serious injury.
- In the device-type form field, add a device type for electric-bicycle-like devices that are not legal electric bicycles in California. Provide linked definitions of each device type, including images.
- Add prompts to help crash reporters select the correct device type for both legal and illegal electric bicycles. For example, the application could prompt with questions to ensure that the correct device type is selected. If a reporter selects “bicycle,” the application could request that the reporter verify if the bicycle is human-powered or electric.
- Add form fields to record the device manufacturer, a model number or name, presence or absence of a throttle, whether the device had an electric bicycle class number (and what class is on the sticker), and whether the device appears to have any after-market modifications.
- Request that police at the scene of the crash take photos of the electric bicycle to document the brand and model, class sticker, and any other details relevant to later identifying the exact type of device and possible after-market modifications. The data collection form could be designed to accept photo uploads.
- Revise the form to collect additional details about the crash circumstances and outcomes that are to be reported. Reports on all types of bicycle crashes often miss key details because the crash reporting forms were designed to capture data on motor vehicle crashes. The new crash form could be designed to remedy this historic problem by incorporating more details needed for crashes with bicycles, electric bicycles, and other micromobility devices (Beck, 2007; Lusk, Asgarzadeh, & Farvid, 2015; Thomas, et al., 2022).
- Educate law enforcement officials about how to conduct investigations of bicycle crashes. In addition to educating officers about how to complete the forms, officers can be trained to conduct a forensic analysis on any electric bicycle in a crash. This analysis can be an important step to determine if the device’s factory-installed settings had been tampered with or after-market equipment added.

Emergency Medical Services (EMS) patient data

Unlike many states, the State of California does not require all EMS services to collect a minimum set of information. Instead, the state's 34 Local EMS Agencies (LEMSAs) establish their own data collection procedures and then may voluntarily share their data with the state's California EMS Information System (CEMSIS), managed by the California Emergency Medical Services Authority (CEMSA) (California Emergency Medical Services Authority, 2025).

The following are opportunities for CEMSA to improve electric bicycle data collection with internal actions that the agency could undertake on its own, without legislation. Such actions would fit within CEMSA's program responsibilities related to Pre-Hospital Data, Injury Prevention, and Public Education (California Emergency Medical Services Authority, 2025). One goal of this work is to improve EMS data, which includes working to standardize patient record data and reduce traffic-related deaths and injuries.

- Create an appropriate set of "Cause of Injury" codes for electric bicycle incidents and requesting that EMS providers use the codes. The current list of recommended codes only includes one code, related to electric bicycles: "V29.881: electric (assisted) bicycle drive injury in other specified transport accident." This code misses many possible scenarios where the cause of injury may include an electric bicycle, from solo crashes by electric bicycle riders, to patients injured as an electric bicycle passenger, to pedestrians injured by an electric bicycle. The National Emergency Medical Services Authority (NEMSA) recommends only one electric bicycle code in its Cause of Injury List, but this at least captures more of the possible scenarios: "V29.91: Electric (assisted) bicycle rider (driver)(passenger) injured in unspecified traffic accident." To date, Marin County appears to have the only public health department in California that requires EMS reports to document the involvement of an electric bicycle (County of Marin, 2023).

- Request that EMS providers record the electric bicycle device make and model information with both text and photographs, and provide a recommended template for collecting the information.

- Request that EMS providers provide photographic documentation of the device position at the scene of the incident.

- Prepare training materials to teach EMS responders how to complete the electric bicycle related documentation, including instructions on what device types are or are not electric bicycles.

In addition, the state may wish to consider new requirements, such as to:

- Require all EMS providers in the state to submit patient records. In 2024, for the first time ever, CEMSA received patient data from all 34 LEMSAs. However, only around 560 of the more than 700 EMS providers in the state submitted patient data (California Emergency Medical Services Authority, 2024).

- Require all LEMSAs to collect a minimum set of data established by CEMSA, and in a format that maps to the state's National Emergency Medical Services Information System (NEMSIS) database. The 2024 Annual EMS Report notes that not all EMS providers submit data that maps directly to the state's database.

Hospital patient injury data

Similar to the discussion of data on traffic crashes and EMS patients, the state can work with public health departments and hospitals to improve the quality of data related to electric bicycle patients. Patient health records are reported to not only the California health agency, but also the CDC's National Syndromic Surveillance Program (NSSP).

As with traffic crash reports and EMS patient data, the state can help to improve data accuracy by educating trauma medical staff to collect more detailed information about the type of electric bicycle involved in the injury and circumstances of the injury, and educating the hospital registrar staff who assign ICD-10-CM codes to each patient record how to choose accurate ICD-10-CM codes for electric bicycle injuries.

Fatality data

The California Department of Public Health – Vital Records (CDPH-VR) maintains death certificate records for every person who dies within the state. These records include a brief narrative statement describing the cause of injury, including brief details if a vehicle, bicycle, or other transportation device was involved as a cause of death, and the ICD-10-CM cause-of-injury codes, which now include codes for injuries related to electric bicycles (National Center for Health Statistics, 2024). One advantage of death certificate data compared to the federal FARS data is that death certificates are reported for anyone who died in an electric bicycle incident, whereas FARS only reports deaths on the public right-of-way that involved a motor vehicle.

As with patient records, the state can improve the accuracy of how electric bicycle crashes are reported by collaborating with partner organizations that can train the reporters who complete the certificates to understand how to code and describe electric bicycle deaths.

10.12.2 Explore sources of data that have not been used extensively

Although the data sources discussed above are some of the most powerful, they have inevitable limitations. The state can encourage research that explores new types of data such as:

- *Medical records from injured patients who received treatment outside hospitals*. While many of the most serious injuries will be treated at hospitals, the great majority of injuries will be missed if one looks only at hospital records. Many patients must be seeking treatment from their primary doctors or an urgent care facility for injuries such as sprains, broken bones, concussion, or skin abrasions.

- *Surveys of the general public or population subgroups, such as families with children*. Such surveys can complement the medical and crash records by providing different types of details and capturing more incidents. Most critically, surveys can gather information about crashes or injuries never formally reported to police or medical staff. Researchers might even want to ask about events the respondents perceived as “near missed.” Also, surveys can ask questions about the cause of the incidents. While a survey will not collect precise details, it is nevertheless possible to ask respondents to recall factors like what kind of device was ridden, where the crash happened (on a street, a recreational trail, etc.), to whom the incident was reported (if at all), and the severity of the injury.

- *Survey the numbers and types of electric devices parked at schools*. Many of the electric bicycle safety concerns relate to devices ridden by children and teenagers, and surveys at school parking lots are an excellent and inexpensive way to capture information about the types of electric devices being ridden. The potential for this method has been demonstrated by unpublished surveys

10.13 COLLECT BETTER DATA ON ELECTRIC BICYCLE USE RATES

Currently the state collects data on the numbers of electric bicycle incidents, but not on the numbers of people who ride the devices, how many unique trips or miles of travel are completed by electric bicycle riders, or other travel behavior factors such as trip purpose or rider demographics. As a result, it is impossible to calculate the “rate” of electric bicycle incidents. The state has seen increasing numbers of electric bicycle incidents, but it is impossible to know the risk of using an electric bicycle versus other travel modes without a measure of overall device use.

The state has a number of opportunities to collect bicycle usage data itself or to encourage other local stakeholders doing travel behavior research to do so. Examples that would apply to both the state’s own work and local government work include:

- Ensure that statewide and regional household travel surveys collect data on electric bicycle trips and report the findings. The most recent such statewide survey, the California Add-On to the National Transportation Survey, did not ask respondents to report bicycle and electric bicycle trips separately, and much of the reporting on the findings lumps bicycle travel into an “other modes” category that includes not only bicycles and other micromobility modes, but also ferries (Federal Highway Administration, 2024).

- Encourage the local entities that contract with bike-share firms to require that the firms provide detailed, trip-level electric bicycle data, including speed profiles, numbers of trips, length of trips, and reported crashes. Some of this information is already shared publicly, but other details are either not shared or not even collected, such as reported crashes. For example, the Bay Area bike-share program Bay Wheels publishes trip level data and codes each trip as either an electric or conventional bicycle. A number of cities share aggregated trip information through the shared mobility management platform Ride Report's Global Micromobility Index, which does allow users to sort by electric bicycle trips when cities report this.

- Explore the potential to collect high-quality electric bicycle data through contracts with technology firms like Replica and Streetlight that estimate travel behavior based on traces from connected devices like mobile phones and health trackers (Barman, et al., 2024). Caltrans and many local entities contract for data services with these types of firms, and electric bicycle data could be required as part of larger contracts for multi-modal data. Now is an ideal time to look into these opportunities, as the California Transportation Commission recently released a report on how the state can implement AB744 (2023), which directs the CTC to develop plans for implementing advanced data and analysis tools to support transportation policy development (Ennes, 2025).

- Collect data on near misses. Collecting data on near misses can help to identify dangerous electric bicycle riding practices, dangerous behaviors by electric bicycle riders, and dangerous locations. Near miss data creates the opportunity to identify the greatest risks before serious crashes occur, so that local authorities can prioritize these locations or road user behaviors for safety improvements. The increasing numbers of public-sector cameras at intersections and on transit vehicles create a practical opportunity to screen camera feeds for near misses.

10.14 MAKE DATA EASY TO ACCESS AND ANALYZE

10.14.1 Encourage hospitals, police departments, and other local entities to share detailed electric bicycle data

While a statewide database of all incidents would be particularly valuable, it is also very useful to make local data available for researchers to use. The state can encourage California hospitals, public health departments, and local police departments that are already collecting data on electric bicycle incidents to make this data public. Marin County, for example, has created a Bicycle Safety dashboard that presents EMS patients who were injured in bicycle vs. electric bicycle incidents. Also, NYC publishes weekly summary crash statistics and a real-time data dashboard that break out collisions, fatalities, and moving summonses for electric bicycles.

As part of this effort to allow public health researchers to learn from data that is already being collected at the local level, the state could recommend standards for releasing the data to maximize the value for public health research, including releasing incident-level data (when this doesn't violate privacy laws), providing details on how the data was collected, defining terms used in the records shared, and providing the data in formats that facilitate analysis by other researchers (e.g., a spreadsheet rather than a pdf). Some organizations doing important research on electric bicycle incidents publish summary findings but not the detailed set of data that was analyzed.

10.14.2 Create an electric bicycle data repository

Create a web-based repository of data related to electric bicycles, to facilitate research. The repository could share state, local, and national data produced by government entities, researchers, nonprofits, and firms.

10.14.3 Make it easy to extract electric bicycle data from publicly accessible data sets.

In all cases where a dataset includes electric bicycle specific data, documentation can clearly explain how to identify electric bicycle incidents and the public interface can be designed to make it easy to filter for electric bicycle incidents. One example of a data source that would benefit from such a change is the California Department of Public Health’s EpiCenter, where the drop-down menu for “Injury Mechanism” searches does not include electric bicycles among the options, even though the data is discoverable by someone expert in using the dataset.

10.14.4 Facilitate data linkage across sources

The different data sources discussed are most powerful when linked together so that researchers can look for links between crash circumstances and medical outcomes. California has begun the process of linking crash and medical data through the Crash Medical Outcomes Data Project implemented by the California Department of Public Health, Injury and Violence Prevention Branch, work that the Office of Traffic Safety helps to fund. However, according to the most recent OTS annual report (Fiscal Year 2023/2024), this project has successfully linked data only through 2020.

More current linked data is needed to help the state set effective policy, given the rapid change in the number of people riding electric bicycles, the characteristics of the devices, and the ways the devices are used. The state could fast-track linking past years of data and also explore data fusion technologies that would allow for much faster data linkage in future.

10.14.5 Hold a conference to assemble and synthesize electric bicycle data from across California

One strategy to help assemble findings from the many local state hospitals, law enforcement agencies, EMS departments, and researchers would be to convene a conference that encourages wide participation from all these organizations. Such a gathering might well be the most efficient way to assemble a wide set of local data on crashes and patient injuries.

To encourage participation, it would be useful to have the conference co-hosted by a team of both public health and transportation researchers, as each set of experts contributes different insights and data. Further, the conference organizers could collaborate with the major industry organizations that work with medical professionals and law enforcement as a strategy to encourage widespread participation from individuals and organizations that might not typically submit research to a conference. Key organizations to include are the American College of Surgeons, California Emergency Nurses Association, and California Police Chiefs Association.

10.15 ENCOURAGE MORE EXTENSIVE ANALYSIS OF ELECTRIC BICYCLE SAFETY DATA

The state can support more frequent and extensive analysis of electric bicycle incident data by having its own departments conduct and publish the work; encouraging hospitals, county public health departments, and police departments to analyze their own data on electric bicycle incidents and sharing the findings publicly; and funding research conducted by experts at universities, hospitals, or other external organizations.

Options for the state's own departments to produce insights based on recent data include:

- Have state public health researchers analyze death certificates to track electric bicycle related deaths. There is typically only a month or two lag time between the date of death and recording of the death certificate, so researchers would be able to provide very more timely findings on changing numbers of deaths. To the best of our knowledge, the state has not been analyzing death certificates with a focus on electric bicycle deaths.
- Have state public health researchers analyze data from the California Syndromic Surveillance program (CalSys). This program run by the California Department of Public Health is part of the CDC's National Syndromic Surveillance Program (NSSP), which aggregates emergency department patient health records from hospitals that volunteer to participate. A key element of NSSP is that data is aggregated quickly, often within a few days of a patient's hospital admissions. In California, participating hospitals submit their records to the California Department of Public Health, which forwards them to the NSSP. As a result, DPH has access to data that allows its researchers to assess injury trends virtually in real time. The data is relatively easy to analyze by searching the "cause of injury" ICD-10-CM codes and text in the "chief complaint" field. As of 2024, only 30% of California 340 emergency departments were submitting data to the program, but the California Department of Public Health has been encouraging more hospitals to participate (CDPH webpage).
- The state can request an EpiAid from the CDC's Epidemic Intelligence Service. This program assigns CDC researchers and subject matter experts to complete an intensive investigation of a pressing public health crisis within just a few weeks. The CDC conducted a 2018 investigation for the Austin Public Health Department, *Dockless Electric Scooter Related Injuries Study* (Austin Public Health, 2018), but to date there has not been an EpiAid for electric-bicycle injuries and deaths.

Finally, the state can also consider using its public health and transportation research funding to support external researchers to conduct desired research using available data.

11. CONCLUSION

The story of electric bicycles that unfolded over the preceding chapters is one of nuance and complexity. For example, the concept of an electric bicycles might seem simple—a bicycle with an electric motor—but Californians do not have a shared understanding of what devices are legal electric bicycles. In addition to devices sold as "e-bikes" that would never meet the state regulations, some device owners use simple software or hardware changes to increase their device's power or speed about the legal limits.

The definitional confusion leads to an unsatisfying uncertainty surrounding electric bicycle safety. Perhaps foremost among uncertainties is the question of the extent to which data on "electric bicycle" safety incidents actually measures problems with legal electric bicycles versus problems with a different set of more powerful devices. Also, while we have data on electric bicycle incidents, there is little data on electric bicycle use beyond those sales numbers, so we cannot produce reliable estimates of the incident risk on a per trip, per distance, or per rider basis.

Taking action is also complicated. There are interwoven layers of regulations from the local, state, and federal government levels. Even within one level of government there are numerous agencies with relevant information, expertise, and jurisdiction over electric-bicycle related issues. Furthermore, actions could be directed at governments, manufacturers, and/or individual riders. Policy changes are likely needed across numerous domains, from refining a wide variety of technical requirements for electric bicycles, to changing rules for operating the devices, to developing better data collection and analysis practices, to identifying strategies for educating electric bicycle riders and the general public alike on safe and legal riding practices.

Finally, there is a one other critical question that no amount of data can answer: what levels of risk justify a policy response? For instance, if electric bicycle riders in a crash are at a five percentage point higher risk of hospitalization than conventional bicycle riders, is that added risk sufficient to justify regulating electric bicycles differently than conventional bicycles? Some people may believe that such a difference calls for a strong policy response, while others may consider the difference too small to warrant major efforts. Additionally, the safety data currently available has so many caveats and limitations that Californians will disagree about whether we have sufficient certainty to warrant strong action. Along with the problem of knowing if many of the reported safety incidents involve legal electric bicycles, we have very little information about the infrastructure context or other factors that may contribute to serious incidents. Does this uncertainty mean we should wait for more information before investing significant financial resources or limiting use of a popular travel mode? Or are the many conceptual arguments and scattered evidence of significant problems in a few communities sufficient to justify immediate action? These are normative questions that policymakers and the public at large will ultimately need to answer.

REFERENCES

Agrawal, A. W., & Nixon, H. (Forthcoming). *What Do Americans Think About Federal Tax Options to Support Transportation? Results from Year Sixteen of a National Survey.* San Jose: Mineta Transportation Institute.

American Bicycling Education Association. (2025, August 27). Kids modifying ebikes: why these dangerous bike hacks put teens at risk. *Ebike Training for Teens*. Retrieved from https://teenebiketraining.com/kids-modifying-ebikes-why-these-dangerous-bike-hacks-put-teens-at-risk/

American College of Surgeons. (2025, June 6). Statement on electric bicycle safety and injury prevention. Retrieved from https://www.facs.org/about-acs/statements/statement-on-electric-bicycle-safety-and-injury-prevention/

Arbel, S., et al. (2022). Maxillofacial Injuries Sustained by Riders of Electric-Powered Bikes and Electric-Powered Scooters. *International Journal of Environmental Research and Public Health, 19*(22). doi:10.3390/ijerph192215183.

Austin Public Health. (2018). *Dockless Electric Scooter-Related Injuries Study.* Retrieved from https://www.austintexas.gov/sites/default/files/files/Health/Epidemiology/APH_Dockless_Electric_Scooter_Study_5-2-19.pdf

Barajas, J. M. (2021). Biking where Black: Connecting transportation planning and infrastructure to disproportionate policing. *Transportation Research Part D: Transport and Environment, 99*. doi:10.1016/j.trd.2021.103027

Barman, S., Levin, M. W., Lindsey, G., Petesch, M., Scotty, S., & Stern, R. (2024). *Mobile-Device Data, Non-Motorized Traffic Monitoring, and Estimation of Annual Average Daily Bicyclist and Pedestrian Flows.* Minnesota Department of Transportation. Retrieved from https://cts-d10resmod-prd.oit.umn.edu/pdf/mndot-2024-19.pdf

Beck, K. (2007, August 15). Bicycle crash investigation. *IPMBA News*. Retrieved from https://ipmba.org/blog/comments/bicycle-crash-investigation

Berk, T., et al. (2022). Switzerland, increased injury severity and hospitalization rates following crashes with e-bikes versus conventional bicycles: an observational cohort study from a regional level II trauma center in. *Patient Safety in Surgery, 16*(11). doi:10.1186/s13037-022-00318-9

Bigazzi, A., & Wong, K. (2020). Electric bicycle mode substitution for driving, public transit, conventional cycling, and walking. *Transport Research Part D: Transport and Environment, 85*. doi:10.1016/j.trd.2020.102412

Bozick, J. S. (2023, February 12). E-bike batteries: volts, amps, & watt hours explained. *Electric Bike Report*. Retrieved from https://electricbikereport.com/electric-bike-battery-basics-what-are-these-volts-amp-hours/

Bureau of Transportation Statistics. (2025). *Transportation Economic Trends*. Retrieved from https://data.bts.gov/stories/s/28tb-cpjy

California Department of Motor Vehicles. (2025). *Off-Highway Vehicle Registration*. Retrieved from https://www.dmv.ca.gov/portal/vehicle-registration/new-registration/register-an-off-highway-vehicle-ohv/

California Department of Transportation. (2015). *Complete Streets Action Plan 2024-25.* Retrieved from https://dot.ca.gov/-/media/dot-media/programs/esta/documents/complete-streets/2024-25_completestreetsactionplan_publicdraft-a11y.pdf

California Department of Transportation. (2021). *California Transportation Plan 2050.* Retrieved from https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/ctp-2050-v3-a11y.pdf

California Department of Transportation. (2021). *Interregional Transportation Strategic Plan 2021.* October. Retrieved from https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/system-planning/systemplanning/2021-itsp-oct21-a11y.pdf

California Department of Transportation. (2023). *Strategic Higway Safety Plan*. Retrieved November 1, 2025, from https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/shsp/2023-shsp-full-report-2020-2024-a11y.pdf

California Department of Transportation. (2023). *Toward an Active California: State Bicycle Pedestrian Plan - 2023 Progress Report.* Retrieved from https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/active-transportation-complete-streets/2023-sbpp-progress-report-v2-a11y.pdf

California Emergency Medical Services Authority. (2024). Emergency Medical Services Authority: Annual EMS data report, calendar year 2024. Retrieved from https://emsa.ca.gov/wp-content/uploads/sites/71/2023/10/2024-Annual-EMS-Data-Report-V2.pdf

California Emergency Medical Services Authority. (2025). About the EMS Authority. Retrieved from https://emsa.ca.gov/about_emsa/

California Highway Patrol. (n.d.). Electric bicycle safety and training. Retrieved November 15, 2025, from https://rise.articulate.com/share/yB3Hip8AYzOGdY0dqnd42mQ3k0c6Jza1#/

California Office of Traffic Safety. (2023). *2024-2026 California Highway Safety Plan.* Retrieved from https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-10/CA_FY24HSP-tag.pdf

California State Parks - Off-Highway Motor Vehicle Recreation Division. (2024, April 22). Off-highway electric motorcycles classification, registration, and operation. *Off-Highway Motor Vehicle Information Bulletin for California Law Enforcement, 24*. Retrieved from https://ohv.parks.ca.gov/pages/1234/files/OHMVR%20Electric%20Off-Highway%20Motorcycle%20Bulletin%20Volume%2024%20Number%201-Final.pdf

Cha Sow King, C., Liu, M., Patel, S., Goo, T. T., Lim, W. W., & Toh, H. C. (2020). Injury patterns associated with personal mobility devices and electric bicycles: an analysis from an acute general hospital in Singapore. *Singapore Medical Journal, 61*(2), 96-101. doi:10.11622/smedj.2019084

Chan, W. (2023, June 22). Four more people just died in an e-bike fire. If nothing changes, they won't be the last. *The Guardian*. Retrieved from https://www.theguardian.com/us-news/2023/jun/22/ebike-battery-fire-new-york-gig-workers

Chapekis, A., Bestvater, S., Remy, E., & Rivero, G. (2024). *When Online Content Disappears.* Washington, DC: Pew Research Center. Retrieved from https://www.pewresearch.org/data-labs/2024/05/17/when-online-content-disappears/

City of Carlsbad. (2025, September 16). Staff report to the Traffic Safety and Mobility Commission: Consideration of a minimum age requirement for e-Bike operation in Carlsbad. Retrieved from https://www.carlsbadca.gov/home/showpublisheddocument/21854/638932107829384726#page=7

City of Folsom. (2025, November 16). *Know before you go: e-bikes, e-scooters, and e-motorcycles*. Retrieved from https://www.folsom.ca.us/government/police/serving-our-community/youth-programs/e-scooters

Confederation of the European Bicycling Industry. (2016, August 8). New Dutch standard for speed-EPAC helmet published. Retrieved from https://www.conebi.eu/new-dutch-standard-for-speed-epac-helmet-published/

Consumer Product Safety Commission. (2024, March 15). Electric bicycles; advance notice of proposed rulemaking; request for comments and information. Retrieved from https://www.federalregister.gov/documents/2024/03/15/2024-05472/electric-bicycles-advance-notice-of-proposed-rulemaking-request-for-comments-and-information

Consumer Product Safety Commission. (n.d.). Coding options. Retrieved July 27, 2024, from Consumer Product Safety Commission: https://www.cpsc.gov/NEISS/Coding-Options

Consumer Reports. (2024). American experience survey: February 2024 omnibus results. Retrieved from https://article.images.consumerreports.org/image/upload/v1710449643/prod/content/dam/surveys/Consumer_Reports_AES_February_2024.pdf

Consumer Reports. (2024, February). American experiences survey: a nationally representative multi-mode survey (February 2024 Omnibus Results). Retrieved from https://article.images.consumerreports.org/image/upload/v1710449643/prod/content/dam/surveys/Consumer_Reports_AES_February_2024.pdf

County of Marin. (2023, November 13). News release- New data prompt e-bike safety alert. Retrieved from https://www.marincounty.gov/news-releases/new-data-prompt-e-bike-safety-alert

Danville Safety Advocates. (2025, November 1). E-moto safety assessment - San Ramon Valley Unified School District. Retrieved from https://bikedanville.org/e-moto-safety-assessment-san-ramon-valley-middle-schools/

DiMaggio, C. J., Bakur, M., Wall, S. P., Frangos, S. G., & Wen, A. Y. (2020). Injuries associated with electric-powered bikes and scooters: analysis of US consumer product data. *Injury Prevention, 26*, 524-528. doi:10.1136/injuryprev-2019-043418

DiscerningCyclist.com. (2023, September 28). Electric bikes laws USA: state-by-state e-bike rules explained. Retrieved from https://discerningcyclist.com/electric-bikes-laws-usa/#california

Duggan, K. (2025, May 2). Policy change: NYPD will write criminal summonses, not traffic tickets, for cyclists. *Streetsblog NYC*. Retrieved from https://nyc.streetsblog.org/2025/05/02/policy-change-nypd-will-write-criminal-summonses-not-traffic-tickets-for-cyclists

Duque and Price Injury Attorneys. (2025, November 16). California state electric bike laws. Retrieved from https://www.duquelaw.com/articles/california-state-electric-bike-laws/

E-Bike Access (Marin County). (2025, October 27). The “e-bike’’ problem is an e-moto problem: our solutions. Presentation to San Mateo Coalition for Safe Schools and Communities.

eCycle Electric. (2025, February 12). How big is the USA e-bike market in 2024-25? Retrieved from https://www.ecycleelectric.com/blog/2025/2/12/how-big-is-the-usa-e-bike-market-in-2024-25

Elvik, R. (2016). Association between increase in fixed penalties and road safety outcomes: A meta-analysis. *Accident Analysis & Prevention, 92*, 202-210. doi:10.1016/j.aap.2016.03.028

Ennes, S. (2025). Final Proposal: Assembly Bill 744. Sacramento: California Transportation Commission. Retrieved from https://dot.ca.gov/-/media/ctc-media/documents/programs/ab-744/ab-744-final-tdp-proposal-approved-aug-2025-a11y.pdf

Fang, K. (2022). Micromobility injury events: Motor vehicle crashes and other transportation systems factors. *Transportation Research Interdisciplinary Perspectives, 14*. doi:10.1016/j.trip.2022.100574

Fang, K., Agrawal, A. W., & Hooper, A. (2019). *How and Where Should I Ride This Thing? "Rules Of the Road" for Personal Transportation Devices.* San Jose: Mineta Transportation Institute. Retrieved from https://transweb.sjsu.edu/sites/default/files/1713-Fang-Agrawal-Hooper-Rules-Personal-Transportation-Devices.pdf

Fernandez, A. N., Li, K. D., Patel, H. V., Allen, I. E., Ghaffar, U., Hakam, N., & Breyer, B. N. (2024). Injuries with electric vs conventional scooters and bicycles. *JAMA Network Open, 7*(7). doi:10.1001/jamanetworkopen.2024.24131

Fernandez, E. (2024, July 23). Electric scooter and bike accidents are soaring across the U.S. UCSF news. Retrieved from https://www.ucsf.edu/news/2024/07/428096/electric-scooter-and-bike-accidents-are-soaring-across-us

Fishman, E., & Cherry, C. (2016). E-bikes in the mainstream: reviewing a decade of research. *Transport Reviews, 36*(1), 72-91. doi:10.1080/01441647.2015.1069907

Frank, A. (2016, Decmeber 8). Could you power your home with a bike? *NPR*. Retrieved from https://www.npr.org/sections/13.7/2016/12/08/504790589/could-you-power-your-home-with-a-bike

Fry, J. M. (2023). Mobile phone penalties and road crashes: Are changes in sanctions effective? *Journal of Safety Research, 84*, 384-392. doi:10.1016/j.jsr.2022.12.001

Gehlert, T. (2017). Accident analysis and comparison of bicycles and pedelecs. *International Cycling Conference.* Manheim.

Ghanbari, A., Agrawal, A. W., & Fang, K. (2025). E-bike rider safety: a literature review on numbers, outcomes, & causes of crashes, injuries, and deaths. Transportation Research Board Anual Meeting. Washington, DC.

Global Market Insights. (2025, July). US e-bike market size - by product, by battery, by motor, by propulsion, by ownership, by power output, by application, by sales channel, by price range, growth forecast, 2025 - 2034. Retrieved from https://www.gminsights.com/industry-analysis/us-e-bike-market

Goodman, L. F., et al. (2023, August). Electric bicycles (e-bikes) are an increasingly common pediatric public health problem. *Surgery Open Science, 14*, 46-51. Retrieved from https://www.sciencedirect.com/science/article/pii/S2589845023000349?via%3Dihub

Government of British Columbia. (2025, June 10). E-bike requirements. Retrieved from https://www2.gov.bc.ca/gov/content/transportation/driving-and-cycling/cycling/cycling-regulations-restrictions-rules/e-bikes

Guy, I. (2019, July). *Study on the Assistance Factor (Auxiliary Propulsion Power and Actual Pedal Power) for Cycles Designed to Pedal of Vehicle Sub-Category L1e-B.* Luxembourg: Publications Office of the European Union. doi:10.2873/085443

Hashavia, E., Shimonovich, S., Shopen, N., Finkelstein, A., & Cohne, N. (2024). Secular trends in the incidence and severity of injuries sustained by riders of electric bikes and powered scooters: The experience of a level 1 adult trauma center. *Injury, 55*. doi:10.1016/j.injury.2023.111293

Hassanpour, A., & Bigazzi, A. (2024). Operating speed distributions in off-street cycling facilities by vehicle type and motorization. *Journal of Cycling and Micromobility Research, 2*. doi:10.1016/j.jcmr.2024.100021

Hawkins, A. J. (2022, January 12). Lime launches its new electric bikes in Washington, DC as part of $50 million blitz. *The Verge*. Retrieved from https://www.theverge.com/2022/1/12/22878726/lime-ebike-specs-hands-on-micromobility-scooter

Hendriks, B., Köhler, D., & Schmidt, R. (2023). Where are speed pedelecs used? Regulations and experiences with speed pedelecs in Germany, Belgium, Denmark, the Netherlands and Switzerland. Berlin: ZIV: German Bicycle Industry. Retrieved from https://www.ziv-zweirad.de/wp-content/uploads/2023/12/ZIV-Study-Where-are-Speed-Pedelecs-used_Nov23.pdf

Hill, R. (2025, September 9). San Diego County law enforcement stress e-bike safety and what's not street legal to ride. *ABC 10 News San Diego*. Retrieved from https://www.10news.com/news/local-news/san-diego-county-law-enforcement-stress-e-bike-safety-and-whats-not-street-legal-to-ride

Hu, F., Lv, D., Zhu, J., & Fang, J. (2014). Related risk factors for injury severity of e-bike and bicycle crashes in Hefei. *Traffic Injury Prevention, 15*, 319-323. doi:10.1080/15389588.2013.817669

Hughes, J. (2025, November 18). Parents are accidentally buying their kids electric motorcycles instead of e-bikes. *Jalopnik*. Retrieved from https://www.jalopnik.com/2029807/parents-accidentally-buying-electric-motorcycles-instead-of-ebikes/

Insurance Institute for Highway Safety. (2025). Fatality facts 2023: males and females. Retrieved from https://www.iihs.org/research-areas/fatality-statistics/detail/males-and-females

Japan National Police Agency. (n.d.). Traffic rules for specified small motorized bicycles. Retrieved November 10, 2025, from https://www.npa.go.jp/english/bureau/traffic/document/Traffic_Rules_for_Specified_Small_Motorized_Bicycles.pdf

Jiang, S. H., Davison-Kerwood, M., & Gonzalez, M. H. (2022). Increased rate of fracture injuries associated with alternative modes of transportation during COVID-19. *Journal of the American Academy of Orthopedic Surgeons, 6*(9). doi:10.5435/JAAOSGlobal-D-22-00147

Karlamangla, S. (2023, June 21). Teens are dying on e-bikes. Should California regulate. *The New York Times*. Retrieved from https://www.nytimes.com/2023/08/02/us/california-ebikes-legislation.html

Karoly, S. (2023). *What's in the Bike Lane? A Study of the Factors Leading to Bike Lane Obstructions in Two Bay Area Cities.* Master's Thesis, San Jose State University Urban Planning. Retrieved from https://www.sjsu.edu/urbanplanning/docs/honors-reports/2023_2024_Karoly.pdf

Kathan, J. (2025, September 16). Is your e-bike street legal? How to avoid a ticket or tow in Santa Cruz. *Santa Cruz Local*. Retrieved from https://santacruzlocal.org/2025/09/16/is-your-e-bike-legal-how-to-avoid-a-ticket-or-tow-in-santa-cruz/

Lieswyn, J., Fowler, M., Koorey, G., Wilke, A., & Crimp, S. (2017). *Regulations and Safety for Electric Bicycles and Other Low- Powered Vehicles.* New Zealand Transport Agency. Retrieved from https://www.nzta.govt.nz/assets/resources/research/reports/621/621-regulations-and-safety-for-electric-bicycles-and-other-low-powered-vehicles.pdf

Lin, S., Goldman, S., Peleg, K., & Levin, L. (2020). Dental and maxillofacial injuries associated with electric-powered bikes and scooters in Israel: A report for 2014-2019. *Dental Traumatology, 36*, 533-537. doi:10.1111/edt.12562

Liptak, A., & Montague, Z. (2025, July 23). Supreme Court lets Trump fire consumer product safety regulators. *The New York Times*.

Livingston, J., & Ross, A. (2022). *Cars and Jails: Freedom Dreams, Debt and Carcerality.* New York City: OR Books.

Luca, D. L. (2015). Do traffic tickets reduce motor vehicle accidents? Evidence from a natural experiment. *Journal of Policy Analysis and Management, 34*(1), 85-106. doi:10.1002/pam.21798

Lusk, A. C., Asgarzadeh, M., & Farvid, M. S. (2015). Database improvements for motor vehicle/bicycle crash analysis. *Injury Prevention, 21*, 221-230. doi:10.1136/injuryprev-2014-041317

Lyft. (2025). Lyft Multimodal Report 2025. Retrieved from https://www.lyft.com/impact/multimodal-report#lmr_form

Maa, J., Doucet, J. J., Ignacio, R., & Alfrey, E. (2024). Electric bikes are emerging as public health hazard. *American College of Surgeons Bulletin, 109*(7). Retrieved from https://www.facs.org/for-medical-professionals/news-publications/news-and-articles/bulletin/2024/julyaugust-2024-volume-109-issue-7/electric-bikes-are-emerging-as-public-health-hazard/

Marcius, C. R., & Hu, W. (2021, November 8). As e-scooter and e-bike use grows, so do safety challenges. *The New York Times*. Retrieved July 27, 2024, from https://www.nytimes.com/2021/10/11/nyregion/electric-scooters-bikes-new-york.html

Mariano, F. (2025, August 19). Opinion: too-fast riders could be the downfall of e-bike culture. *Streetsblog USA*. Retrieved from https://usa.streetsblog.org/2025/08/19/opinion-too-fast-riders-could-be-the-downfall-of-e-bike-culture

Marin County Bicycle Coalition. (2023, November 27). Buyer's guide: power up with an e-bike. Retrieved from https://marinbike.org/news/e-bike-buyers-guide/

Massachusetts Registry of Motor Vehicles. (2023, July). *Commonwealth of Massachusetts - Sharing the Road, A User's Manual for Public Ways*. Retrieved from https://www.mass.gov/doc/english-drivers-manual/download

McCoy, D. (2025, January 2). California-based SUPER73 sued over the questionable legality of its e-bikes. *BikeMag*. Retrieved from https://www.bikemag.com/news/super73-faces-lawsuit-for-selling-illegal-e-bikes

McKibben, B. (2025, July 9). 4.6 billion years on, the sun is having a moment. *The New Yorker*. Retrieved from https://www.newyorker.com/news/annals-of-a-warming-planet/46-billion-years-on-the-sun-is-having-a-moment

McLeod, K. (2024, May 6). A rare opportunity to weigh in on e-bike safety rules. Retrieved from https://bikeleague.org/a-rare-opportunity-to-weigh-in-on-e-bike-safety-rules/

National Center for Health Statistics. (2023, September). *Physician's Handbook on Medical Certification of Death: 2023 Revision*. Hyattsville, MD. doi:10.15620/cdc:131005

National Center for Health Statistics. (2024, June 7). ICD-1-CM. Retrieved from https://www.cdc.gov/nchs/icd/icd-10-cm/index.html

National Center for Health Statistics. (n.d.). ICD-10-CM tabular list of diseases and injuries 2023 addenda.

National Fire Protection Association. (n.d.). Safety with e-bikes and e-scooters. Retrieved from https://www.nfpa.org/education-and-research/electrical/ebikes

National Highway Traffic Safety Administration. (2025, April). Early estimate of motor vehicle traffic fatalities in 2024. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813710

National Highway Traffic Safety Administration. (2025, August). *Fatality Analysis Reporting System Analytical User's Manual, 1975-2023.* Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813706

National Highway Traffic Safety Administration. (2025, November 16). Importation and Certification FAQs. Retrieved from Information for Importing a Vehicle: https://www.nhtsa.gov/importing-vehicle/importation-and-certification-faqs-0

National Highway Traffic Safety Administration. (n.d.). Motor assisted bicycles. Retrieved November 8, 2025, from https://www-fars.nhtsa.dot.gov/Common/MotorAssistedBicycles.html

National Safety Council. (2025). Bicycle deaths. https://injuryfacts.nsc.org/home-and-community/safety-topics/bicycle-deaths/

National Standardization Administration (China). (2024, December 31). Safety technical specification for electric bicycle (GB 17761-2024).

National Transportation Safety Board. (2022). *Micromobility: Data Challenges Associated with Assessing the Prevalence and Risk of Electric Scooter and Electric Bicycle Fatalities and Injuries.* Washington, DC. Retrieved from https://www.ntsb.gov/safety/safety-studies/Documents/SRR2201.pdf

Netherlands Ministry of Infrastructure and Water Management. (2022). *Dutch Framework for Light Electric Vehicles (LEVs).* Retrieved from https://www.government.nl/documents/publications/2021/05/10/the-netherlands-and-light-electric-vehicles-levs

Nie, Q., et al. (2021). Electronic crash reporting: implementation of the Model Minimum Uniform Crash Criteria (MMUCC) and crash record life cycle comparison. *Transportation Research Interdisciplinary Perspectives, 9*. doi:10.1016/j.trip.2021.100318

North American Bikeshare and Scootershare Association. (2025). Shared Micromobility State of the Industry Reports. Retrieved from https://nabsa.net/about/industry/

Office of Attorney General Rob Bonta (CA). (2025, October 17). Plastic bag manufacturers investigation concludes: Attorney General Bonta announces settlement, files lawsuit. Retrieved from https://oag.ca.gov/news/press-releases/plastic-bag-manufacturers-investigation-concludes-attorney-general-bonta

Ontario Minitstry of Transportation. (2024, July 19). *Riding an e-bike*. Retrieved from https://www.ontario.ca/page/riding-e-bike

Otte, D., & Facius, T. (2019). Accident typology comparisons between pedelecs and conventional bicycles. *Journal of Transportation Safety & Security*. doi:10.1080/19439962.2019.1662530

PeopleForBikes. (2020, January). Model electric bicycle law with classes. Retrieved from https://peopleforbikes.cdn.prismic.io/peopleforbikes/3686d20b-5695-47c1-b0c7-ffe06402be55_Model-eBike-Legislation-Jan2020.pdf

PeopleForBikes. (2024, July 8). Electric bicycle market insights from industry experts. Retrieved from https://www.peopleforbikes.org/news/electric-bicycle-market-insights-2024

PeopleForBikes. (2025, September 26). CPSC update from PeopleForBikes — Understanding the Prospects for Federal Lithium-Ion Battery Regulations. Retrieved from https://www.peopleforbikes.org/news/cpsc-update-from-peopleforbikes--understanding-the

PeopleForBikes. (2025, September 18). The e-bike problem is an e-moto problem. Retrieved from https://www.peopleforbikes.org/news/the-e-bike-problem-is-an-e-moto-problem

Pike, S., & Handy, S. (2022). The mode is not the methods: assessing changes in biking, walking and transit in California using the 2012 CHTS and 2017 NHTS. *Transport Findings*. doi:10.32866/001c.37777

Podsiad, K., Harmon, K., & Combs, T. (2023). *A Surveillance Tool for E-Bike Fatalities.* Retrieved from https://cdr.lib.unc.edu/concern/masters_papers/3b591k54j

Qian, Q., & Shi, J. (2023). Comparison of injury severity between E-bikes-related and other two-wheelers-related accidents: Based on an accident dataset. *Accident Analysis and Prevention, 190*. doi:10.1016/j.aap.2023.107189

Rauer, T., Aschwanden, A., Rothrauff, B. B., Pape, H.-C., & Scherer, J. (2023). Fractures of the lower extremity after e-bike, bicycle, and motorcycle accidents: a retrospective cohort study of 624 patients. *Environmental Research and Public Health,* 20 (3162).

Reilly, R. (2025, October 2). Opinion: E-bikes are an e-menace. *The Washington Post*. Retrieved from https://www.washingtonpost.com/opinions/2025/10/02/electric-bikes-speed-injuries/

Reynolds, G. (2020, August 19). E-bikes are all the rage. Should they be? . *The New York Times*. Retrieved July 27, 2024, from https://www.nytimes.com/2020/08/19/well/move/e-bike-safety-exercise.html

Richtel, M. (2023a, July 29). What is an e-bike, and how safe are they? *The New York Times*. Retrieved from https://www.nytimes.com/2023/07/29/health/ebikes-safety-regulation.html

Richtel, M. (2023b, July 30). “A dangerous combination”: teenagers’ accidents expose e-bike risks. *The New York Times*. Retrieved from https://www.nytimes.com/2023/07/29/health/ebikes-safety-teens.html

Richtel, M. (2023c, July 31). Is it an e-bike, or a motorcycle for children? *The New York TImes*. Retrieved from https://www.nytimes.com/2023/07/31/health/ebikes-super73-motorcycles.html

Richtel, M. (2023d, August 29). As teens take to e-bikes, parents ask: is this freedom or a danger. *The New York Timea*. Retrieved from https://www.nytimes.com/2023/08/29/health/ebikes-teens-parents.html

Savitsky, B., et al. (., & Bodas, M. (2021). Electric bikes and motorized scooters - Popularity and burden of injury. Ten years of National trauma registry experience. *Journal of Transport and Health, 22*. doi:10.1016/j.jth.2021.101235

Shannon, B., Ni, N., Ehsani, J., & Friedman, L. S. (2025). Injuries from electric bikes and scooters: Illinois, U.S., 2021−2023. *American Journal of Preventive Medicine, 69*(6). doi:10.1016/j.amepre.2025.108065

Simon-Tov, M., Radomislensky, I., Group, I. T., & Peleg, K. (n.d.). The casualties from electric bike and motorized. *Traffic Injury Prevention, 18*(3), 318-323. doi:10.1080/15389588.2016.1246723

Singapore Land Transport Authority. (2021). *Power-Assisted Bicycle: Official Handbook for Mandatory Theory Test.* Retrieved from https://www.lta.gov.sg/content/dam/ltagov/getting_around/active_mobility/rules_public_education/rules_code_of_conduct/pdf/pab_english_20210428.pdf

Society of Automotive Engineers. (2025, February 24). J3104 - taxonomy and classification of powered micromobility vehicles. Retrieved from https://www.sae.org/standards/j3194_202502-taxonomy-classification-powered-micromobility-vehicles

Spörri, E., Halvachizadeh, S., Gamble, J. G., Berk, T., Allemann, F. A., Pape, H.-C., & Rauer, T. (2021). Comparison of injury patterns between electric bicycle, bicycle and motorcycle accidents. *Journal of Clinical Medicine, 10*(3359). doi:10.3390/jcm10153359

Stewart, D. (2024, May 28). Have e-bikes made New York City a "Nightmare"? *The New York Times*. Retrieved July 27, 2024, from https://www.nytimes.com/2024/05/27/nyregion/street-wars-e-bikes.html

Tark, J. (2024). *Micromobility Products-Related Deaths, Injuries, and Hazard Patterns: 2017–2023.* Washington, DC: US Consumer Product Safety Commission. Retrieved from https://www.cpsc.gov/s3fs-public/Micromobility-Products-Related-Deaths-Injuries-and-Hazard-Patterns_2017-2023.pdf

Taylor, N. L., Fliss, M. D., Schiro, S. E., & Harmon, K. J. (2024). Comparative analysis of injury identification using KABCO and ISS in linked North Carolina trauma registry and crash data. *Traffic Injury Prevention, 25*(7). doi:10.1080/15389588.2024.2361052

Thomas, L., Levitt, D., Vann, M., Blank, K., Nordback, K., & Alyson, W. (2022). *PBCAT Pedestrian and Bicycle Crash Analysis Tool Version 3.0 User Guide.* Federal Highway Administration. Retrieved from https://rosap.ntl.bts.gov/view/dot/63514

Toll, M. (2023, July 30). The 'New York Times' attacks e-bikes while ignoring the real danger all around us. *Electrek*. Retrieved from https://electrek.co/2023/07/30/the-new-york-times-attacks-e-bikes-while-ignoring-car-danger/

Travers, N. S., Reed, K. J., Winters, M., Kwan, G., & Park, K. (2024). Moral panic and electric micromobilities: seeking space for mobility justice. *Sociological Perspectives, 67*(1-3), 83-108. doi:10.1177/07311214231193355

Tucker, S. (2025, September 15). Is now the time to buy, sell, or trade in a car? *Kelley Blue Book*. Retrieved from https://www.kbb.com/car-advice/is-now-the-time-to-buy-sell-or-trade-in-a-used-car/

U.S. Department of Energy - Vehicle Technologies Office. (2022, March 21). FOTW #1230: More than half of all daily trips were less than three miles in 2021. Retrieved from https://www.energy.gov/eere/vehicles/articles/fotw-1230-march-21-2022-more-half-all-daily-trips-were-less-three-miles-2021

United States Consumer Product Safety Commission. (2022, January). *NEISS Coding Manual.* Retrieved from https://www.cpsc.gov/s3fs-public/January-2022-CPSC-Only-NT-NEISS-Coding-Manual.pdf?VersionId=KSUolSeeOpWoGAXtq0Zb_EVaHSiOdzFe

Valenzuela, P. L., et al. (2022). The Record Power Profile of Male Professional Cyclists: Normative Values Obtained From a Large Database. *International Journal of Sports Physiology and Performance, 17*, 701-710. doi:10.1123/ijspp.2021-0263

van der Zaag, P. D., Rozema, R. R., Poos, H. P., Kleinbergen, J. Y., van Minnen, B., & Reininga, I. H. (2022). Maxillofacial fractures in electric and conventional bicycle-related accidents. *Journal of Oral and Maxillofacial Surgery, 80*, 1361-1370. doi:10.1016/j.joms.2022.03.020

Verbeek, A. J., de Valk, J., Schakenraad, D., Verbeek, J. F., & Kroon, A. A. (2021). E-bike and classic bicycle-related traumatic brain injuries presenting to the emergency department. *Emergency Medicine Journal, 38*(4). doi:10.1136/emermed-2019-208811

Verstappen, E. M., Vy, D. T., Janzing, H. M., Janssen, L., Vos, R., Versteegen, M. G., & Barten, D. G. (2021). Bicycle-related injuries in the emergency department: a comparison between E-bikes and conventional bicycles: a prospective observational study. *European Journal of Trauma and Emergency Surgery, 47*, 1853-1860. doi:10.1007/s00068-020-01366-5

Verzoni, A. (2022, August 3). Emerging issues: full throttle. *NFPA Journal*. Retrieved from https://www.nfpa.org/news-blogs-and-articles/nfpa-journal/2022/08/04/e-bikes

Vlakveld, W., Mons, C., Kamphuis, K., Stelling, A., & Twisk, D. (2021). Traffic conflicts involving speed-pedelecs (fast electric bicycles): A naturalistic riding study. *Accident Analysis and Prevention, 158*. doi:10.1016/j.aap.2021.106201

Williams, L. C., Kafle, S., & Lee, Y. H. (2024). Trends in head and neck injuries related to electric versus pedal bicycle use in the United States. *The Laryngoscope, 134*(6), 2734–2740. Retrieved from https://pubmed.ncbi.nlm.nih.gov/38053413/

Wilson, K. (2023, August 9). Four ways to spot a bad e-bike Article. *Streetsblog USA*. Retrieved from https://usa.streetsblog.org/2023/08/09/four-ways-to-spot-a-bad-e-bike-article

Wilson, M. (2021). *Bicycling Facilities, Crash Types, & Bicyclist Risk.* Orlando, FL: MetroPlan Orlando. Retrieved from https://cyclingsavvy.org/wp-content/uploads/2022/04/Bicyclist-Crash-Types-and-Risk-White-Paper-July-2021.pdf

Wright, A. (2025, October 15). CalBike launches statewide working group to study e-bikes and electric mobility devices. Retrieved from https://www.calbike.org/press-release-electric-mobility/

Yeager, S. (2015, July 30). Cool things we learned from Tour de France Strava files. Retrieved from https://www.bicycling.com/racing/a20041587/cool-things-we-learned-from-tour-de-france-strava-files/

Younes, H. (2025). Comparing injuries from e-scooters, e-bikes, and bicycles in the United States. *Journal of Cycling and Micromobility Research, 4*. doi:10.1016/j.jcmr.2025.100061

Younes, H., & Noland, R. B. (2025). Crash data availability and best practices across the United States. *Traffic Injury Prevention*, 1-10. doi:10.1080/15389588.2025.2466201

ZIV: German Bicycle Industry. (2025, April 7). ZIV position: e-bikes - active mobility as success factor. Retrieved from https://www.ziv-zweirad.de/en/e-bikes-active-mobility-crucial/

Zmora, O., Peleg, K., & Klein, Y. (2019). Pediatric electric bicycle injuries and comparison to other pediatric traffic injuries. *Traffic Injury Prevention, 20*(5), 540-543. doi:10.1080/15389588.2019.1608361

APPENDIX A: EXPERTS INTERVIEWED

Jim Baross
California Association of Bicycling Organizations, President

Vaughn Barry, PhD
Centers for Disease Control and Prevention, Health Scientist

Alyssa Begley
Caltrans Division of Transportation Planning, Chief of Office of Complete Streets Planning

Beth Black
American Bicycling Education Association, Board of Directors
The Bellemont Project, Founder

Clarrissa Cabansagan
Silicon Valley Bicycle Coalition, Executive Director

Keri Caffrey
American Bicycle Education Association, Curriculum Director
CyclingSavvy, Co-Founder

Rachel Carpenter
California State Transportation Agency, Acting Deputy Secretary for Transportation Safety and Enforcement

Joshua Cohen
Cohen Law Partners, Partner

Paige Colburn-Hargis
Scripps Memorial Hospital La Jolla -Trauma Services, Injury Prevention Community Outreach Program Coordinator

Stephanie Dougherty
California Office of Traffic Safety, Director

Lieutenant David Fawson
California Highway Patrol, Collision Investigation Unit, Commander

Gwen Froh
Marin County Bicycle Coalition, Program Director - SRTS

Captain Darren Greene
California Highway Patrol, Research and Planning Section

Dorian Grilley
Bicycle Alliance of Minnesota, Executive Director (retired)

Melinda Hanson
Brightside Strategies, Founder

Ria Hutabarat Lo, PhD
City of Mountain View, Transportation Manager

Stephanie Jenson
California Emergency Nurses Association, Chair of Committee on Government Affairs
Inland Valley Hospital, Injury Prevention Coordinator, Trauma Services

Alan Kalin
Danville Safety Advocates, Co-Founder

Jason Kligier
City of Santa Monica, Chief Planning Officer

Tarrell Kullaway
Mayor of the City of San Anselmo
Marin County Bicycle Coalition, Executive Director

Isabel LaSalle
California Senate Transportation Committee, Assistant Consultant

Susan Lindsey
Caltrans, Lead Advisor for Complete Streets (Acting)

John Maa, MD
American College of Surgeons, Governor
Chinese Hospital (San Francisco), Staff Surgeon

Ramses Madou
City of San Jose, Department of Transportation, Division Manager of Planning, Policy, and Sustainability

Silvia Casorrán Martos
European Cyclists' Federation, Board Member
Red de Ciudades y Territorios por la Bicicleta (Spain), Secretary General

Ken McLeod
League of American Bicyclists, Policy Director

Bob Mittelstaedt
E-Bike Access (Marin County), Board Member

Matt Moore
PeopleForBikes, General and Policy Counsel

Susie Murphy
California Mountain Biking Coalition, Board Member
San Diego Mountain Biking Association, Executive Director (former)

Angela Olson
Minnesota Bicycle Alliance, Deputy & Education Director

Brittany Rawlinson, PhD
National Transportation Safety Board, Safety Research Division, Statistician

Jared Sanchez
CalBike, Policy Director

Clint Sandusky
Riverside Community College District Police Department, Police Officer (retired)
California POST-Certified Bicycle Patrol Instructor

Nathan Schmidt
City of Carlsbad, Transportation Planning and Mobility Manager

Tejus Shankar
Lyft, Policy and Strategy

Steven Sheffield
Bosch eBike Systems, Team Leader - Product Management and Business Development

Calvin Thigpen, PhD
Lime, Director of Policy Research (former)

Hannah Walter
Caltrans, Division of Transportation Planning, Deputy Division Chief

Karen Wiener The New Wheel, CEO
Chris Wilson Lime, Director of Trust & Safety
Mighk Wilson MetroPlan Orlando, Bicycle and Pedestrian Planner

APPENDIX B: CALIFORNIA VEHICLE CODE SECTIONS

This appendix presents a selection of the text from the California Vehicle Code that relates to electric bicycles.

B.1. DEFINITION OF ELECTRIC BICYCLES

The complete definition for electric bicycles in California is located in the California Vehicle Code Section 312.5 and reads as follows, effective January 1, 2025:

> (a) An “electric bicycle” is a bicycle equipped with fully operable pedals and an electric motor that does not exceed 750 watts of power.
>
> (1) A “class 1 electric bicycle,” or “low-speed pedal-assisted electric bicycle,” is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, that is not capable of exclusively propelling the bicycle, except as provided in paragraph (4), that ceases to provide assistance when the bicycle reaches the speed of 20 miles per hour, and that is not capable of providing assistance to reach speeds greater than 20 miles per hour.
>
> (2) A “class 2 electric bicycle,” or “low-speed throttle-assisted electric bicycle,” is a bicycle equipped with a motor that may be used exclusively to propel the bicycle, and that is not capable of providing assistance when the bicycle reaches the speed of 20 miles per hour.
>
> (3) A “class 3 electric bicycle,” or “speed pedal-assisted electric bicycle,” is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, that is not capable of exclusively propelling the bicycle, except as provided in paragraph (4), and that ceases to provide assistance when the bicycle reaches the speed of 28 miles per hour, and equipped with a speedometer.
>
> (4) A class 1 or class 3 electric bicycle may have start assistance or a walk mode that propels the electric bicycle on motor power alone, up to a maximum speed of 3.7 miles per hour.
>
> (b) A person riding an electric bicycle, as defined in this section, is subject to Article 4 (commencing with Section 21200) of Chapter 1 of Division 11.
>
> (c) On and after January 1, 2017, manufacturers and distributors of electric bicycles shall apply a label that is permanently affixed, in a prominent location, to each electric bicycle. The label shall contain the classification number, top assisted speed, and motor wattage of the electric bicycle, and shall be printed in Arial font in at least 9-point type.
>
> (d) The following vehicles are not electric bicycles under this code and shall not be advertised, sold, offered for sale, or labeled as electric bicycles:
>
> (1) A vehicle with two or three wheels powered by an electric motor that is intended by the manufacturer to be modifiable to attain a speed greater than 20 miles per hour on motor power alone or to attain more than 750 watts of power.
>
> (2) A vehicle that is modified to attain a speed greater than 20 miles per hour on motor power alone or to have motor power of more than 750 watts.
>
> (3) A vehicle that is modified to have its operable pedals removed.
>
> (Amended by Stats. 2024, Ch. 791, Sec. 2. (SB 1271) Effective January 1, 2025.)

B.2. A SELECTION OF RULES OF THE ROAD FOR ELECTRIC BICYCLES

Electric bicycles follow the rules of the road for bicycles

Section 231 of the California Vehicle Code defines the term “bicycle.” Notably, the section states that “an electric bicycle is a bicycle.” Therefore, electric bicycles have the rights and responsibilities of bicycles unless where the law establishes a specific difference. Section 231 reads as follows:

> A bicycle is a device upon which a person may ride, propelled exclusively by human power, except as provided in Section 312.5, through a belt, chain, or gears, and having one or more wheels. A person riding a bicycle is subject to the provisions of this code specified in Sections 21200 and 21200.5. An electric bicycle is a bicycle.
>
> (Amended by Stats. 2021, Ch. 311, Sec. 1. (SB 814) Effective January 1, 2022.)

Bicycle operators have the same rights and responsibilities as drivers of vehicles

Bicyclists, which includes riders of electric bicycles, have the same rights and responsibilities as other drivers. This is specified in Section 21200 of the California Vehicle Code which reads as follows:

> (a) (1) A person riding a bicycle or operating a pedicab upon a highway has all the rights and is subject to all the provisions applicable to the driver of a vehicle by this division, including, but not limited to, provisions concerning driving under the influence of alcoholic beverages or drugs, and by Division 10 (commencing with Section 20000), Section 27400, Division 16.7 (commencing with Section 39000), Division 17 (commencing with Section 40000.1), and Division 18 (commencing with Section 42000), except those provisions which by their very nature can have no application.
>
> (2) A person operating a bicycle on a Class I bikeway, as defined in subdivision (a) of Section 890.4 of the Streets and Highways Code, has all the rights and is subject to all the provisions applicable to the driver of a vehicle pursuant to Section 20001, except those provisions which by their very nature can have no application.
>
> (Amended by Stats. 2018, Ch. 139, Sec. 1. (AB 1755) Effective January 1, 2019.)

Age limits and helmet requirements for Class 3 electric bicycles

Two regulations specific to electric bicycle operators are age and helmet requirements for Class 3 electric bicycles. Section 21213 of the California Vehicle Code specifies that a rider must be age 17 or older to ride a Class 3 electric bicycle. Additionally, riders of all ages on Class 3 devices are required to wear a helmet. The text of Section 21213 reads as follows:

> (a) A person under 16 years of age shall not operate a class 3 electric bicycle.
>
> (b) A person shall not operate a class 3 electric bicycle, or ride upon a class 3 electric bicycle as a passenger, upon a street, bikeway, as defined in Section 890.4 of the Streets and Highways Code, or any other public bicycle path or trail, unless that person is wearing a properly fitted and fastened bicycle helmet that meets the standards of either the American

Society for Testing and Materials (ASTM) or the United States Consumer Product Safety Commission (CPSC), or standards subsequently established by those entities. This helmet requirement also applies to a person who rides upon a class 3 electric bicycle while in a restraining seat that is attached to the bicycle or in a trailer towed by the bicycle.

(Added by Stats. 2015, Ch. 568, Sec. 6. (AB 1096) Effective January 1, 2016.)

Electric bicycles not subject to licensing, registration, and insurance

Section 24016 of the California Vehicle Code includes several provisions related to electric bicycle equipment. Notably, subsection B states that operators of electric bicycles do not need a driver's license or to carry insurance. Further, electric bicycles do not need to be registered with the state or carry license plates. Other subsections require compliance with CPSC equipment and manufacturing requirements, prohibit certain modifications, and as previously mentioned, prohibit the sale of switchable devices. Section 24016 reads as follows:

(a) An electric bicycle described in subdivision (a) of Section 312.5 shall meet the following criteria:

(1) Comply with the equipment and manufacturing requirements for bicycles adopted by the United States Consumer Product Safety Commission (16 C.F.R. 1512.1, et seq.).

(2) Operate in a manner so that the electric motor is disengaged or ceases to function when the brakes are applied, or operate in a manner such that the motor is engaged through a switch or mechanism that, when released or activated, will cause the electric motor to disengage or cease to function.

(b) A person operating an electric bicycle is not subject to the provisions of this code relating to financial responsibility, driver's licenses, registration, and license plate requirements, and an electric bicycle is not a motor vehicle.

(c) Every manufacturer of an electric bicycle shall certify that it complies with the equipment and manufacturing requirements for bicycles adopted by the United States Consumer Product Safety Commission (16 C.F.R. 1512.1, et seq.).

(d) A person shall not tamper with or modify an electric bicycle described in subdivision (a) of Section 312.5 so as to change the speed capability of the bicycle, unless the bicycle continues to meet the definition of an electric bicycle under subdivision (a) of Section 312.5 and the person appropriately replaces the label indicating the classification required in subdivision (c) of Section 312.5.

(e) A person shall not sell a product or device that can modify the speed capability of an electric bicycle such that it no longer meets the definition of an electric bicycle under subdivision (a) of Section 312.5.

(Amended by Stats. 2024, Ch. 55, Sec. 1. (AB 1774) Effective January 1, 2025.)

ABOUT THE AUTHORS

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Dr. Fang is an Associate Professor of Environmental Studies, Geography, and Planning at Sonoma State University and a Research Associate with the Mineta Transportation Institute. He has been an early researcher in the realm of micromobility, exploring safety, travel behavior, and policy issues surrounding electric scooters, electric bicycles, skateboards, and other emerging modes. Dr. Fang holds a BA in Integrative Biology from the University of California, Berkeley, a Master of Urban Planning and MSc in Engineering [specialization in Transportation Planning] from the California Polytechnic State University, and a PhD in Transportation, Technology, and Policy from the University of California, Davis.

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