United States
Consumer Product Safety Commission

December 11, 2024

CPSC Staff[1] Statement on Euromonitor Consulting report "Micro-Mobility Product Market Research"

CPSC's Directorate for Economic Analysis (EC) began researching market data for micromobility products in preparation for a draft Notice of Proposed Rulemaking (NPR), planned for submission by CPSC staff to the Commission, that would largely codify existing voluntary standards with some adjustments. To support the work of CPSC staff in this regulatory analysis, CPSC awarded contract 61320622A0003 to Industrial Economics, Inc. (IEc), who subcontracted Euromonitor Consulting (Euromonitor), under task order 61320621P0015, to perform a market study on micromobility products.

The report, titled "Micro-Mobility Product Market Research," presents the results of work by Euromonitor. Euromonitor conducted market research for E-Bikes, E-Scooters, E-Segways, E-Hoverboards, and Other Micro-Mobility Devices. From this research, Euromonitor was able to identify key trends for each device market, as well as estimates of revenue and sales. This work assisted CPSC staff to conduct a regulatory analysis for an NPR of micromobility devices.

[1] CPSC staff prepared this statement, and the attached report by Euromonitor Consulting, a subcontractor to Industrial Economics, Inc., for CPSC staff. This statement and report have not been reviewed or approved by, and do not necessarily represent the views of, the Commission.

Micro-Mobility Product Market Research

A custom report compiled by Euromonitor International for the U.S. Consumer Product Safety Commission (CPSC)

Contract No. 61320621P0015

U.S. Consumer Product Safety Commission (CPSC)
February 2022

Project Manager: **Natasha Menon**

+1 312-922-1115

www.euromonitor.com

List of Contents

1. DEFINITIONS & EXECUTIVE SUMMARY

1.1 E-BIKES

For the purposes of this report, e-bikes are defined as open-frame bicycles that are powered by a battery pack and electric motor that may be integrated into the wheel hub, or pedal/crank mechanism. E-bikes may use a throttle control and/or pedal assistance to achieve forward motion.

1.2 E-SCOOTERS

E-scooters for the purposes of this report are defined as two-wheeled devices comprised of a platform (with or without seating) supported by wheels in a longitudinal placement (rather than parallel wheels like Segways), and without pedals. E-scooters also use handlebars which enable users to steer and brake.

1.3 E-SEGWAYS

Segways are defined for the purposes of this report as battery-powered mobility devices having two parallel wheels connected by a platform on which the user stands, which also includes a steering bar that may be operated by hand or leg gestures. These devices overlap in general design with hoverboards, except that hoverboards lack a steering bar. What is referred to as Segways in this segment also includes self-balancing scooters with parallel wheels which are manufactured by companies other than the originator Segway-Ninebot. These include Hiboy, Eco-Glide and Ezscooter. According to Segway-Ninebot, the company's traditional Segway was first marketed in 2001 and ended production in July 2020. Traditional Segways were also known as Segway PTs, used large wheels up to 20 inches in diameter, and had dual electric motors of at least 1000W each. Prices during production ranged from US$4,000 to US$6,000.

1.4 E-HOVERBOARDS

Hoverboards are defined for the purposes of this report as battery-powered mobility devices having two parallel wheels connected by a platform on which the user stands. These devices overlap in general design with Segways, except that hoverboards lack a steering bar. Hoverboards operate by detecting changes in rider position. Generally, these devices require riders to learn a set of gestures in order to turn, stop, and move forward.

1.5 OTHER MICRO-MOBILITY DEVICES (OMDS)

Other micro-mobility devices include e-skateboards and one-wheels. E-skateboards are defined as board platforms supported by four wheels that are powered by electric motors, typically either hub motors or belt drive and gear system. One-wheels are platforms supported by a single wheel, powered by an electric motor.

1.6 EXECUTIVE SUMMARY

Micro-mobility devices, including E-bikes, E-scooters, Segways, Hoverboards and OMD's (other micro-mobility devices), represented approximately 2.5 million units and a market value of US $2.2 billion in 2021. The market value for these devices is expected to increase 12.8% CAGR from 2021-2024, while unit growth is forecast at 9.0% CAGR for the same period. Discussions with industry sources suggest that recreational use is driving demand for micro-mobility devices, with only e-bikes and e-scooters having a presence in ride-sharing applications. Municipal ride-sharing is expected to remain the most important commercial use for micro-mobility devices, as cities look for ways to reduce single-occupant-vehicle use for short trips. Still, commercial use of E-scooters and E-bikes accounted for only 5.2% of the total market value of these devices in 2021, with 94.8% attributed to recreational/private users. COVID accelerated demand for recreational products across many industry segments including micro-mobility, but also created supply chain constraints as manufacturers struggled to replenish inventories and freight costs increased. E-commerce and direct-to-consumer brands played a pivotal role in supplying these devices to end consumers. As more buyers consider a battery-powered scooter or bike, brands are improving the customer experience as well as device safety through smartphone integration. Micro-mobility devices are leveraging this connectivity to offer riding tutorials, alerts for battery life and even adjustable riding modes. Besides improving the riding experience, electronics will continue to optimize device performance and reliability.

2. PROJECT OBJECTIVES

CPSC is charged with protecting the public from unreasonable risks of injury or death associated with the use of thousands of types of consumer products—this includes micro-mobility products that the National Highway Traffic Safety Administration (NHTSA) does not consider to be a "motor vehicle."

CPSC has tasked Euromonitor International with conducting a study to better understand the U.S. micro-mobility market. CPSC is not currently pursuing rule-making activities for the micro-mobility product segments, and will use information gathered from Euromonitor International's research to further inform a cost-benefit analysis on if the agency should undertake rule-making.

The study conducted by Euromonitor International includes:

- the creation of sales estimates (revenue/unit sales) for e-bikes, e-scooters, hoverboards, Segways/Segway-like products, and closely related "Others" micro-mobility products across "commercial use" and "personal use" and key segments (i.e., "adult," "child," and "youth") that are relevant to CPSC activities;
- data collection including 4 defining characteristics (i.e., model number/name, model year, SKU, price, manufacturer name, country and/or place of manufacture, distributor/retailer name, maximum speed, weight, load capacity, number of wheels, tire type and size, battery voltage, number and type of brakes, component cost, etc.);
- an estimate of product service life (as available); and
- sales estimates of calendar year (2021), three previous years (2018–2020), and forecast the next three years (2022–2024) across the defined categories and segments (e.g., "commercial use – adult -e-scooters," "commercial use – child – e-scooters," etc.)

An important aspect of this study is the detailed SKU data collected across a combination of major retailers and manufacturers of varying market sizes using Euromonitor International's website analysis tool, Via. A full list of the websites scraped can be found in the appendix of this report.

3. PROJECT METHODOLOGY

Euromonitor International is a global market research company with over 40 years of experience. With a global network of analysts and market research on every consumer and industrial sectors, Euromonitor International's market research reports empower organizations of all sizes with strategic data, analysis, and consumer and industrial sector trends.

For this study Euromonitor International undertook five key steps to help address the research objectives. The steps include the following:

STEP 1: Project alignment/kick-off
Prior to initiating research, Euromonitor International worked with CPSC COR and project leadership to schedule a project kick-off call. The call brought together the project leadership of CPSC with the Euromonitor International project team to provide an overview of the project, and reiterate and confirm details, processes, objectives, goals, communication responsibilities, and reporting needs.

STEP 2: Secondary research (i.e., "desk" research)
During this step Euromonitor International identified, explored, and gathered data and information from notable resources tracking the micro-mobility industry to help catalogue related data, insights, and sources that met this study's objectives.

STEP 3: Online extraction of e-mobility product and pricing data
As part of this step, Euromonitor International designed "bots" (i.e., programmed software), which continuously combed through the HTML source code of selected websites (see appendix) to gather information pertaining to micro-mobility products to help fill data gaps and achieve this study's research objectives. Bots were scripted to look for specific data (e.g., price, maximum speed, manufacturer, country of origin, etc.). Through this process, Euromonitor International captured massive amounts of data to understand the product landscape, product variety, mean pricing, and numerous other factors.

STEP 4: Primary research (i.e., limited production/trade interviews)
In Step 4, interviews (i.e., "discussions") were conducted with product manufacturers and commercial e-scooter and e-bike share businesses. Interviews were utilized to verify data from previous steps and close any remaining information gaps. Two interview ("discussion") guides—one for use with product manufacturers and the other for use with commercial e-bike and e-scooter share businesses—were created in collaboration with CPSC. The interviews conducted lasted 20 to 30 minutes and addressed outstanding data needs to support elements

such as the estimates of historic/forecast product sales, service life of products, domestic versus international supply splits for products, and key supplying markets across e-scooters, e-bikes, hoverboards, etc. Importantly, the interview guides and related questions were different from each other. As such, questions addressed to product manufacturers were different from those of commercial e-scooter and e-bike share businesses.
For detailed feedback from the interviews conducted, please refer to the supplemental materials which include the interview transcripts.

STEP 5: Analysis and reporting
In the final step, Euromonitor examined the breadth of data and insights collected during the research process and cross-checked inputs to identify any data inconsistencies that required additional examination and refinement. Euromonitor analysed the resulting inputs to produce the market data and analysis in this report. Euromonitor's process of building market sizes is multifaceted. The desk research and the scrapped product data provided a preliminary view of the market and were used to build initial estimates. These estimates were then tested through company research and trade interviews to establish a consensus view of market size and key market trends. Top-down estimates were reviewed against bottom-up inputs and company sales totals to test for accuracy and accountability. This process resulted in sales estimates that were cross-checked and effectively stress-tested against current and anticipated market conditions and purchasing environments.

4. E-BIKES

4.1 KEY TRENDS IMPACTING THE DEVELOPMENT OF THE E-BIKE CATEGORY

E-bikes are expected to account for a small share of commercial ride-sharing applications, in comparison to the unit volumes sold for private use. Nevertheless, e-bikes will continue to see incremental growth as ride-share expands to more municipalities. E-bike fleet replacement will underpin growth, but e-bikes will also continue to replace conventional bicycles in ride-sharing applications.

Consumer demand for e-bikes will continue to be driven by private users, with around 90% buying them for recreational purposes, and the rest for commuting.

E-bikes are sold through a variety of channels including mass merchandisers, big-box retailers, and independent bike dealers. E-commerce sales through brand aggregators and direct-to-consumer sales are expected to increase into 2024.

4.2 MARKET DATA

E-bike sales amounted to 898.1 thousand units in 2021 and represented US $1,660.1 million on a value basis. The market size for e-bike increased 37.8% CAGR from 2018-2021, while units increased 49.0% CAGR during the same period. Following the rapid sell-out of existing e-bike inventories in 2020, average unit prices for e-bikes increased marginally in 2021 and are expected to follow the same trend in 2022. Surging demand has created short supply of components, from accessories to batteries and motor drive-systems. Ocean freight costs have risen as backlogs and transit time increased; precipitated by COVID. From 2022-2024, e-bike prices are expected to decline as the supply chain adjusts to higher demand, especially for the most popular “entry-level” e-bikes priced around US $1500. According to industry sources, e-bikes will see more service in ride-sharing applications from 2021-2024, but due to their high cost, will lag e-scooters in commercial use. E-bikes are forecast to increase 13.0% CAGR from 2021-2024, reaching US $2,396.5 million in market size. On a volume basis, the devices will grow 16.5% CAGR from 2021-2024 and number 1.4 million units sold annually in 2024.

Table 1 E-bikes 2018–2021 Retail Value (US$ million)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
E-bikes	**Total**	**Total**	**$634.0**	**$646.7**	**$1,374.4**	**$1,660.1**	**37.8%**

Table 2 E-bikes 2021–2024 Forecast Retail Value (US$ million)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24

E-bikes	**Total**	**Total**	**$1,660.1**	**$1,977.6**	**$2,219.0**	**$2,396.5**	**13.0%**

Table 3 E-bikes 2018–2021 Retail Volume (000' Units)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
E-bikes	**Total**	**Total**	**271.7**	**301.6**	**748.4**	**898.1**	**49.0%**

Table 4 E-bikes 2021–2024 Forecast Retail Volume (000' Units)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
E-bikes	**Total**	**Total**	**898.1**	**1,066.4**	**1,242.4**	**1,419.4**	**16.5%**

4.3 COMMERCIAL AND PERSONAL USE

In 2021, e-bikes in private use represented 99.2% of total units, while those in commercial use accounted for a mere 0.8%. By 2024, the expected share of private use e-bikes will reach 99.4% of total units sold. According to discussions with industry executives, ridesharing will remain the leading commercial use-case for e-bikes during the forecast period. Approximately 7.6 thousand e-bikes were added to commercial service in 2021, and that number is set to rise to 8.1 thousand by 2024. Many municipalities that are new to e-bike ridesharing prefer to start with small pilot projects, with provisions for increased units. One reason for this approach is to ensure the ride-share partner can scale-up the fleet size while maintaining safe and reliable e-bikes to users. According to discussions with e-bike retailers, an older demographic of e-bike buyers is driving demand for private use. Typical buyers are 55 years plus who are looking for comfort, ease of riding and some fitness benefits from their e-bikes. More than 90% of these users buy for recreation rather than commuting or daily transportation.

In 2021, e-bikes for adults represented 89.9% of the devices sold for private use, while children aged under 12 accounted for 7.6% and youth (aged 12 to 16) at 2.5%. Industry experts suggest that the typical e-bike buyer is 55–70 years old and buying for recreation. Comfort is the primary concern followed by requirements for performance such as battery and motor size. Most of the e-bikes sold are entry level rather than premium-priced.

E-bikes for children are available for as little as US$440 but most are over the US$500 threshold. Retailers suggest that children will outgrow these bikes quickly, making it an expensive purchase. This same situation applies to e-bikes for youth under 16 years old. It generally makes better financial sense to purchase an adult e-bike for a 17- or 18-year-old.

4.4 MARKET DYNAMICS

Growth in e-bike adoption among ride-sharing programs is being driven by several factors including municipal planning for sustainable transportation solutions, and ride-share partnerships with leading bike-sharing operators. For example, many urban centers look to e-bikes as a solution for reducing carbon emissions and increasing the physical activity of residents. E-bikes will continue to command a growing share of ride-sharing fleets, appealing to many who do not have the fitness levels to ride on hilly terrain or for long distances. While the replacement period for e-bikes in commercial fleets is long and can be a constraint on growth, it is only one part of the story. Ride-share expansion to new cities and a higher mix of e-bikes in fleets remain ongoing trends. For example, Madison WI and Burlington VT cities that have replaced their non-powered bikes entirely with e-bikes, saying the increase in ridership was well worth the extra cost of e-bike purchase and maintenance.

Existing bike-share operators are also keenly aware of the high ridership rates for e-bikes and have positioned themselves to take advantage of higher demand from municipalities. For example, BCycle LLC, a wholly owned subsidiary of Trek Bicycles, continues to launch e-bike share programs in major urban centers including Madison, WI; Fort Lauderdale, FL; Santa Barbara CA; Nashville TN; and more recently, Encinitas CA. According to the company, 21 of the 40 cities in the US using its ride-sharing applications have e-bikes in their fleet.

According to industry sources, in 2021 Lime announced a US$50 million investment to increase its e-bike presence, with new ride-sharing plans for at least a dozen cities in North America. The company's existing Jump-branded e-bikes will also remain in service in bike-sharing applications. The new Lime-branded e-bikes will have interchangeable batteries with the company's e-scooters, making for a more efficient changeover of batteries when required.

Lyft, widely regarded as the largest player in e-bike ride-sharing, will be an important driver of growth during the 2022–2024 forecast period. For example, the company hosts Capital Bikeshare in Washington DC, which currently operates 600 e-bikes in its fleet with plans to expand to 3,500 e-bikes by 2027. Similarly, Chicago's Divvy bike-share system also operated by Lyft subsidiary Motivate added 3,500 e-bikes in 2021 with plans for a total of 6,000 once infrastructure improvements are completed. Other examples of Lyft's incremental growth in e-bike sharing include Portland's Biketown ride-share expansion in the fall of 2021 which added an extra 1,500 e-bikes to the city's fleet.

According to Lyft, consumer preference for e-bikes is one of the main reasons for its investment in e-bikes for ride-share applications. System-wide in 2021, e-bike ridership was two to three times that of its pedal-bikes.

Smaller competitors are also expected to augment the existing e-bike-sharing arrangements in place in major cities. For example, in 2021, ride-sharing company JOCO introduced 300 e-bikes to NYC by locating docking stations in privately owned parking garages throughout the city. According to the company, which plans to increase its New York fleet to 1,000 e-bikes by the end of the year, using docking stations on private property rather than sidewalks means less dependence on the city for planning and infrastructure.

In addition to ride-share systems, other use cases for e-bikes in commercial applications include local courier and food delivery service, security and patrol use, and employee use at some high-tech company campuses. While ride-sharing remains the largest use case according to experts interviewed, there is significant growth potential in urban "last-mile"[1] delivery applications in the coming years.

4.5 CHANNEL DYNAMICS

According to industry feedback regarding sales channels for e-bikes, storefront retailers account for the most volume followed by e-commerce and then fleet sales. E-commerce is expected to be the fastest-growing channel in the next 3-5 years, as it offers unsurpassed product selection and customer reach. For brick-and-mortar retailers, e-bike chain stores and big-box sporting goods stores command the greatest share of sales according to industry data, followed by small independent bike shops and then warehouse club stores.

Large suppliers such as Trek, Giant and Rad Power import e-bikes directly to their warehousing operations in the US, and distribute to dealer networks in some cases (Trek, Giant), while Rad Power and many other specialized e-bike brands sell directly to consumers and fleets via e-commerce. There is also some intermediary wholesale trade from suppliers such as QBP (Quality Bicycle Products), one of the largest importers of bikes/e-bikes that in turn distributes to retailers.

Storefront e-bike retailers play an important role in the supply chain, especially with regard to servicing. For example, many e-bikes purchased online need to be assembled on arrival, and storefront retailers with a are providing this service, in addition to regular maintenance. Stores with physical presence—unlike online retailers—can ensure the e-bike fits the buyer and they are comfortable using it.

4.6 COVID-19 IMPACT

The COVID-fueled surge in e-bike demand resulted in sold-out inventory at most retail bike shops. Asian-based manufacturers struggled to replenish inventories, as parts supplies ranging from batteries and motors to accessories became more

[1] Last mile delivery refers to the last leg of supply chain operations. A product's journey from a warehouse to the doorstep of the end-customer.

difficult to procure. According to interviews with industry experts, at least 80% of e-bike components come from China/Taiwan, where batteries now represent around 40–50% of the cost of parts for an e-bike. Shipping delays made the situation worse. According to e-bike executives, the lack of available inventory was the biggest constraint on e-bike sales in 2021.

Feedback from trade sources suggests that e-bike brands that relied on e-commerce as their primary sales channel were much better prepared than independent bike shops for the increased demand. Industry data suggests than the number of e-bike importers more than doubled in 2021, suggesting that more direct-to-consumer brands are entering the market.

While COVID-19 created the need for restrictions on social gatherings, consumers looked for alternative ways to safely enjoy recreational activities. E-bike demand certainly benefited from higher personal disposable income, as consumers spent less on travel and entertainment.

4.7 SUPPLY CHAIN

Discussion with e-bike retailers suggests that more than 90% of e-bikes are imported from China or Taiwan, while a small percentage is sourced from the EU. China is the dominant manufacturing center, where a fragmented collection of parts suppliers specializes in specific components for assembly. Besides having a dominant position in lithium-ion battery development, the domestic Chinese market accounts for around 85% of worldwide demand for e-bikes, according to bike supplier Juiced.

Tariffs and skyrocketing costs for ocean freight could shift some e-bikes to US production in the coming years. Bike maker Cannondale (Pon Holdings), a major supplier of conventional bikes and e-bikes, announced its plans for US production starting in Q3 2022. While future production plans have not been released by the company, it appears that at the outset, the US factory will be an assembly plant, where components are sourced from Asian-based suppliers. Other US-based manufacturers are low-volume producers such as Vintage Electric and Optibike that handcraft e-bikes using a combination of local and foreign-manufactured parts.

> "COVID induced rapid sell out of retail inventories, then supply became much more difficult to procure due to long lead time, shipping delays. Online benefited the most as a retail channel during this time due to broader reach with consumers, and much more selection and price points compared to retail brick- and-mortar stores."
>
> *– Executive, E-bike manufacturer*

4.8 PRODUCT CHARACTERISTICS

According to industry experts, the most popular e-bikes retail for approximately US$1,500. Common equipment for that price includes a hub motor or mid-drive system with a 500-750 Watt/Hr battery and an electric motor ranging from 250-500 watts. They come with disc brakes and pedal assist up to 20 mph and a range of 30-40 miles, at a weight of approximately 40 lb. Premium e-bikes are commonly equipped with a mid-drive system rather than a wheel hub-based motor, resulting in improved center of gravity and stability. E-bikes are nearly all made with both wheels receiving power, as this helps with traction and steering feel. Premium e-bikes start at around US$2,500 and go up to US$5,000 and more. These offer a more powerful motor (750 Watt/Hr and up) bigger disc brakes and lighter/stiffer material such as aluminum or carbon fiber for the frameset.

The longevity of an e-bike is limited by the durability of the battery pack, according to trade sources. An e-bike battery can last from 500-800 charge/discharge cycles, but performance and degradation can vary depending on operating temperatures, battery storage condition, and frequency of charging. Trade interviews suggest that would translate to a battery life of 24 to 36 months, though the remaining components of the e-bike are far more long-lasting. Battery replacement, while expensive, is the best way to minimize the long-term cost of these devices. Trade sources suggest the average warranty period for e-bikes is around 1 year.

According to a 2019 survey by TREC, the Transportation Research and Education Centre, 70% of e-bike owners had not required any service repairs to their devices. Of those who did, the most frequently cited repairs were for electronic display, battery, and motor. E-bikes do require regular maintenance inspections and may cost US$200 to US$300 per year to ensure that consumables such as brake pads and tires are replaced as needed.

E-bikes for children were a small subset of the online sample. The most important channel is Walmart, but some direct to consumer present was noted by Swagtron. Prices ranged from US$439-999, with most in the US$500-600 slot. NHT Sports, Swagtron and MotoTec were the most frequently noted manufacturers of popular brands for this market segment. Kent Bicycles is another brand, which offers a small 125 Wh battery and starts at US$499. Typical specifications of children's e-bikes include 125–360 Wh battery and 10–15 mph top speed. Cruising range is from 9 to 20 miles. Front and rear disc brakes are used on these models. A number are off-road (e-dirt bikes) would probably appeal to children over 10 years old as well as the youth market, but they are priced over US$900 and likely represent very small volumes.

E-bikes recommended for the youth segment include brands such as Sailnovo, which packs a 374 Wh battery and is made by Shenzhen Chirrey Technology Co. Ltd. Cruising range extends up to 30 miles, while top speed is 18.6 mph. This model was positioned as a mid-priced e-bike for children up to 16 years old, for US$739. Youth-oriented e-bikes get a bump up in performance compared to children's bikes with 360-480 Wh batteries commonplace, and top speeds spanning 14–20 mph. Prices generally fell within the range of US$449 to US$900. Dual disc brakes are standard, except in the sub-$500 price point in which dual mechanical brakes are quite common. Important manufacturers include Guangzhou Plenty Bicycle Co, Ltd, MotoTec, and Swagtron.

Not surprisingly, adult e-bikes come in a vast array of price and performance levels. The adult category accounts for nearly 90% of sales volumes, and industry sources suggest that most e-bikes purchased are entry-level bikes priced under US$2,000. Major e-bike market players include Rad Power Bikes, Van Moof, Schwinn (Pacific Cycles, Inc.), Trek Bicycles, Nakto EBikes, Pedego, Inc., Lectric eBikes, Giant Manufacturing Co., Ltd., Aventon, Electric Bike Technologies, Inc., and Alta Cycling Group. Hundreds of e-bike brands exist in the US market, each positioned to serve a specific market segment. For example, at the lower end of the market, US$900–US$2,000, Lectric Bicycles and Rad Power Bike are important direct-to-consumer brands, while Taosun Ltd. is sold through Walmart. Entry-level e-bikes such as these specify batteries between 320–700 Wh and are capable of a top speed of 20 mph and a cruise range of 30–50 miles. According to the online data sample, Walmart, BikeBerry and Amazon represent the most important e-commerce channels for entry-level e-bikes. However, direct-to-consumer sales are also hugely important and represent the fastest-growing channel for the e-bike category.

Adult e-bikes positioned as mid-market and higher start at US$2,500 and can go as high as US$15,000. Important brands including Trek, Specialized, and Cannondale are sold through an extensive dealer network that offers high levels of service and expertise in matching the buyer to the right bike.

4.9 SAFETY AND RELIABILITY

E-bikes in commercial ride-share applications use a host of design features aimed at improving safety and reliability. Ride-share startup JOCO's e-bikes feature puncture-proof airless tires and state-of-the-art bike tracking provided by their software partner Vulog. Lyft's newest e-bike provides an LCD screen and speaker system that can guide users on how to unlock the devices and where to park. According to the company, battery range has increased to 60 miles, meaning less downtime for battery swaps. Other safety improvements include top-tier rear hydraulic brakes, LED lights and reflective paint for visibility, and an advanced sensor system that alerts technicians if any of the bike's systems need maintenance.

According to discussions with e-bike executives, e-bikes in commercial use are designed specifically for longevity, and are much heavier and more durable than e-bikes in private use. New York City's CitiBike e-bikes average 10 rides per device per day, yet many of these devices are still in operation after 10 years of service, according to industry experts.

For e-bikes in private use, there are some enhancements to safety and reliability for more expensive brands, which use better-quality components including batteries capable of more charge cycles before replacement is needed. Upgraded tires and hydraulic brakes are typically part of the premium that users pay for these devices. Enhanced electronics, including phone connectivity and tracking features for location and remaining range, are also the norm for higher-end e-bikes. According to a leading e-bike retailer, manufacturing standards such as ASTM are well adhered to by reputable e-bike manufacturers, but there is an occasional shipment of (low-end) e-bikes that probably do not follow such standards.

> "We know our e-scooters are great at moving people a mile, two miles, but if you need to go five miles, or bring a load of groceries home, an e-bike is probably a better option.
>
> *– Head of Public Relations, Ride-share Operator*

5. E-SCOOTER CATEGORY

5.1 KEY TRENDS IMPACTING THE DEVELOPMENT OF THE E-SCOOTER CATEGORY

The evolution of the ride-sharing model from government-subsidized to for-profit has meant a shift in e-bikes and e-scooters demanded for fleet use. More demand will prevail for e-scooter units in fleets as the unit cost is lower than e-bikes, but there will also be a general shift to smaller, lighter e-bikes.

Category consolidation will continue in the ride-sharing space due to Lyft and Lime which have the funding to play for the long term. They will focus on partnering with municipalities, while managing their ride-share fleets to maximize customer satisfaction and profitability.

Consumer demand for e-scooters will continue to be driven by the need for fast and economical transportation solutions in urban settings, where most trips are only a few miles—too far to walk but not far enough to take public transit.

Durability and safety will remain key considerations for micro-mobility devices, especially given the very high usage rates in urban centers. At the same time, the US is lagging other countries in providing the road infrastructure to support this growing demand.

5.2 MARKET DATA

E-scooter sales amounted to 177,500 units in 2021 with a market value of US$148.3 million. The market size for e-scooters increased at a 27.7% CAGR from 2018–2021, while units increased at a 9.8% CAGR during the same period. Average unit cost for the devices has increased due to several factors, including a higher mix of premium e-scooters in use in ride-sharing applications, and higher costs for components and shipping which were accelerated by COVID-19. Certain design innovations such as the move from front drive to all-wheel drive, and comfort improvements to cater to an older buyer demographic, have also added to the unit cost of these devices.

According to industry sources, e-scooter penetration in ride-sharing applications is expected to increase from 2021–2024 as these devices have inherent advantages compared to e-bikes. For example, unit costs for commercial e-scooters are estimated to be between 40–50% that of e-bikes, and thus offer a faster return on investment or ride-share companies. In aggregate, e-scooters are forecast to increase at a 19.1% CAGR from 2021–2024, reaching a market value of US$250.3 million. On a volume basis, e-scooters are expected to increase at a 13.2% CAGR from 2021–2024 and amount to 257,500 units by 2024.

Table 1 E-scooter 2018–2021 Retail Value (US$ million)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
E-scooters	**Total**	**Total**	**$71.3**	**$85.7**	**$118.0**	**$148.3**	**27.7%**

Table 2 E-scooters 2021–2024 Forecast Retail Value (US$ million)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
E-scooters	**Total**	**Total**	**$148.3**	**$181.6**	**$215.6**	**$250.3**	**19.1%**

Table 3 E-scooter 2018–2021 Retail Volume (000' Units)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
E-scooters	**Total**	**Total**	**134.3**	**126.6**	**150.0**	**177.5**	**9.8%**

Table 4 E-scooters 2021–2024 Forecast Retail Volume (000' Units)

Category	Subcategory	Channel	*2021*	*2022*	*2023*	*2024*	CAGR 2021–24
E-scooters	**Total**	**Total**	**177.5**	**206.0**	**232.7**	**257.5**	**13.2%**

5.3 COMMERCIAL AND PERSONAL USE

In 2021, e-scooters in private use represented 67.6% of total units, while those in commercial use accounted for 32.4%. Both personal and commercial use of these devices is expected to increase at approximately the same rate through 2024 with personal use edging up to 67.8% and commercial falling slightly to 32.2% share of total units. According to discussions with industry experts, ride-sharing applications represent most of the commercial user base, but other use cases include on-site patrol vehicle for security personnel and delivery/courier services in urban settings. In addition, ride-sharing is an important gateway whereby consumers can experience the devices first-hand and may subsequently decide to purchase their own e-scooter for personal use.

In 2021, adults accounted for 63.7% of e-scooters in private use, with children aged under 12 at 27.7% and youth (aged 12 to 16) at 8.7%. Stand-up e-scooters appeal mainly to the 18–25 age group, but older consumers are also underpinning higher demand, looking for no-effort transportation rather than pedal-powered bikes. In the case of e-scooters, both the traditional "stand-up" design and newer "seating" versions are catering to consumer demand for simplicity and comfort. According to a leading e-scooter retailer, the typical age profile of a buyer is 20-40–years old.

Most of the children's e-scooters are recommended for those 8 years old and over, although electrified scooters for 3-5–year-old riders were evident from the Huffy Corporation and limited to a 2 mph top speed. As with children's bicycles, e-scooters

are positioned so that two or three devices are purchased by the time the user has reached the age of 15 or 16, at which time they may graduate to an adult scooter.

5.4 MARKET DYNAMICS

E-scooters, along with e-bikes, represent the primary categories in commercial ride-sharing. The main reason is an intuitive riding experience and lower insurance requirements in comparison to one-wheeled devices and e-skateboards. More specifically, the aforementioned present a steep learning curve for the operator, higher risk of accidents, and are prone to theft. Discussions with industry executives suggest that insurance premiums for ride-share companies can be prohibitively expensive and represent a significant portion of operating costs.

The presence of e-scooters received a boost with their introduction as a ride-sharing solution in Santa Monica CA, in 2018. There has been wide adoption among ride-sharing companies since then. Venture capital backing of ride-share programs has focused on gaining traction in cities. More specifically, the strategy of ride-sharing programs is to grow their user base and geographic footprint as quickly as possible. Subsequently they position themselves as takeover targets when industry consolidation occurs. The largest ride-share companies employing e-scooters include Lime, Bird, and Lyft.

According to industry sources, more e-scooters are expected to gain legal status among large urban centers such as New York City in the next 2–3 years. This will shift the mix of e-bikes and e-scooters in commercial service, with e-bike fleets remaining approximately the same, while e-scooters are expected to increase 10–15% in 2021. One reason is the lower unit cost of e-scooters which is significantly less than e-bikes in commercial use.

Despite a growing presence and carbon-free transportation solution, e-scooters in ride-share applications face several constraints. For example, many cities are limiting e-scooter operation to daylight hours as they are inherently less stable than e-bikes and due to their small wheels are much more sensitive to the quality of pavement. Visibility issues at night make it harder for riders to gauge obstacles and bad pavement.

Some municipalities and state governments are putting caps on the number of shared devices that can be deployed. This can be explained in part by a shift in the way municipalities are addressing micro-mobility ride-sharing proposals. According to the National Association of City Transportation Officials, cities are evolving in their approach to engaging with micro-mobility ride-share companies. They are moving away from a permit model to a collaborative model, where requests for information are circulated and qualified companies are invited to submit proposals for consideration. One benefit of the new approach is better clarity for the

municipality on ride-share planning. For the ride-sharing companies, the process facilitates strategic planning for expected ridership and competitor presence.

5.5 CHANNEL DYNAMICS

E-scooters are sold at mass market retailers with both storefront and online presence including Walmart, Costco and Dick's Sporting Goods. Online specialists such as Urban Scooters and Amazon are important retailers of e-scooters for all age groups, but there are some differences in retail presence regarding children's and youth e-scooters. For example, Walmart has a much higher retail presence in e-scooters for younger users, whereas e-scooters for the adult market are more apt to be sourced from Amazon, BestBuy, or online specialists that carry several e-scooter brands. Brand-specific, direct-to-consumer sites such as Segway and Okai continue to represent a large share of sales volumes in the category.

According to industry sources, approximately 85% of e-scooters are sold via online retail channels rather than brick-and-mortar retailers. One reason is that, unlike e-bikes, there is no established retail or dealer network for e-scooters. However, this is starting to change as some well-known and successful e-scooter brands have opened "flagship" stores in major cities in order to better connect with buyers, and to provide service for these devices. For example, in 2020, Unagi e-scooters opened retail locations in Venice CA and Brooklyn NY to showcase its products. As online e-scooter brands look to differentiate themselves from competitors, an omni-channel marketing approach is likely to become more prevalent. Growing demand for e-scooters will make it more cost-efficient for leading brands to maintain a limited store presence in major urban centers, but industry consensus is that online sales will continue to represent the vast majority of sales volumes in the category.

5.6 COVID-19 IMPACT

The pandemic's impact on micro-mobility devices is evident across the sales channel and supply chain. and through changes in consumer behavior.

COVID-19 accelerated the shift from storefront to e-commerce sales across many retail categories including micro-mobility. For the e-scooter category, however, direct-to-consumer e-commerce already represented the leading channel before the pandemic, as it offered unsurpassed selection and the most cost-effective way to reach a broad user base. According to industry sources, the e-commerce model is likely to remain firmly entrenched through 2024, with some rebalancing towards storefronts if continued strong demand persists. Examples of e-scooter retailers using a direct-to-consumer sales model include Unagi, Segway, and Okai, but many other leading brands follow the same sales strategy.

The rapid influx of demand for e-scooters in the wake of the pandemic placed additional strain on the product's supply chain. According to discussions with a

leading e-mobility distributor, battery components were among the most heavily impacted. For example, pre-COVID-19, batteries represented approximately 15% of the cost of an e-scooter, but that figure jumped to approximately 35–40% of the total cost in 2021. Nearly all the industry experts interviewed also mentioned backlogs and delays in delivery of e-scooters and other micro-mobility devices and a tenfold increase in the cost of ocean freight post-COVID-19. The result has been a shortage of inventory, and long lead times for delivery of these devices.

In addition to channel and supply-chain effects, COVID-19 also accelerated demand for e-scooters as consumers sought to avoid public transportation, and even automobile-based ride-sharing programs in order to maintain social distancing. Free cash flow among US consumers increased as they spent less on entertainment, in-person dining, and travel, while government stimulus also fueled spending on alternative goods and services. Micro-mobility devices such as e-scooters and e-bikes fulfilled a need for recreation amidst the many restrictions brought on by the pandemic. According to discussions with a leading e-scooter retailer, growth slowed in the category marginally in 2021 as many consumers returned to work and pandemic restrictions eased.

5.7 SUPPLY CHAIN

Discussion with e-scooter industry executives indicates that essentially all these devices are imported from China or Taiwan. Lithium-ion battery technology is also dominated by the Chinese, though increasing world-wide demand for lithium-ion battery cells has impacted pricing for e-scooters and e-bikes alike.

Tariffs and shipping costs would be the most important reasons for any expected shift from overseas to US production in the next 2–5 years. Sourcing important components, particularly the battery and electric motors, would be from Asian-based suppliers for the foreseeable future. The rationale is that US suppliers are not set up for manufacturing these battery/e-motor components, so there are few options other than continuing to source from the leading Chinese suppliers.

> The biggest thing in e-mobility is battery power. China owns like 95%-97% of the global lithium control right now. They make all of the cells. They may not have automated factories domestically, but they also own facilities in Korea and others. The US is starting to realize the importance of lithium rechargeable requirements, but if China controls the supply, they are going to have power over the supply chain.

5.8 PRODUCT CHARACTERISTICS

The service life of an e-bike or e-scooter is limited by the life of the battery pack, according to trade sources. A typical battery would be good for 500-800 charge/discharge cycles, but performance and lifespan are also dependent on other factors such as operating temperature, quality of weather-sealing, and device usage. Pre-COVID-19, ride-share companies required that an e-scooter be in service for at least 6 months in order to turn a profit on the asset, at prevailing usage rates. In general, e-scooters have improved in terms of durability since their first use in ride-share fleets in 2018, with lighter but stronger construction, and more efficient battery and software management systems. According to Okai e-scooters, batteries may last 3-4 years under optimal conditions, but they recommend battery replacement every 2–3 years for the best performance.

E-scooters for the children's market begin at very modest levels of performance and sub-US$100 price, especially for products geared to those under 8 years of age. Typical battery specifications for such devices range from 50-75 Wh but can be 155 Wh or more for e-scooters recommended for 12–14-year-olds. E-scooters for children and youth are mostly limited to 8–10 mph top speed, and a range of 4–10 miles. Load capacity for these devices begins at 50 lb for the smallest scooters and extends to around 150 lb. Solid wheels are most common for the least expensive scooters priced at less than US$150, where 5–6 inch diameter wheels prevail. Higher-end models for 10–16-year-olds normally have pneumatic tires 8–10 inches in diameter and offer better stability. Braking for child- and youth-oriented e-scooters is accomplished via hand brakes, or in the lower-priced variants, a foot-operated braking system. Generally, there is only one brake for these devices. The most popular brands, as inferred from the analysis of online retailers, come from Segway Inc., Razor USA LLC, Hover-1™ and MotoTec Inc. Of the e-scooters that specified an age range for children or youth, the average product price was US$188 and ranged from US$79 to US$333.

When moving up to adult-oriented e-scooters, performance and prices increase considerably. Batteries for e-scooters averaged approximately 360 Wh in the sample taken. Top speed ranged from 12–24 mph, with most falling in the 15–19 mph bracket. Cruising range on average was around 25 miles, with most mid-priced e-scooters capable of going 15–35 miles before a recharge is needed. Many of the e-scooters in the adult category provide two brakes, but there was a wide variance in braking components specified. For example, brakes varied from mechanical hand-operated brakes, electronic-assisted disc brakes and even regenerative braking that helps to charge the battery on the go. Unagi e-scooters, a mid-priced brand starting at around US$700, was notable in providing an anti-lock feature to its braking system to further improve stability. The adult-e-scooter market is more fragmented than the child/youth segment as evidenced by the large number of unique manufacturers. Important manufacturers include Segway Inc., Unagi, Schwinn Inc.,

Shenzhen FWZZ Technology Co Ltd, Hilboy, Shenzhen Tomoloo Technology Industrial Co Ltd, IZIP and MotoTec. E-scooters in the adult segment averaged US$780 in the online sample, and ranged from $499 to more than $2,000 for devices capable of speeds greater than 30 mph.

5.9 SAFETY AND RELIABILITY

E-scooters are widely considered much less durable than e-bikes in ride-share usage but have improved compared to the first generation from 2018. E-scooters are subject to very frequent redesign cycles according to trade sources, where two or three new e-scooter designs per year are commonplace. This impacts the useful life of these devices, especially in the context of commercial applications. For example, industry sources suggest that e-scooters may last up to 36 months in a ride-sharing application, but most will be retired between 18 and 24 months in order to keep the fleet current and appealing to users.

Regarding e-scooters and e-bikes, industry standards for materials and manufacturing (e.g., ASTM) are widely followed according to industry sources. One expert noted the importance of durability and weather-resistance as a point of differentiation among the leading e-scooter and e-bike brands.

Device safety and reliability is being enhanced by app connectivity of some e-scooters, such as the Segway-Ninebot S Max that can receive firmware updates via a smart phone application. In ride-share usage, device connectivity would enable faster adoption of artificial intelligence-enabled cameras and on-board sensors that can track usage and position. Industry feedback suggests that such regulation is becoming more common as municipalities look to implement micro-mobility solutions and protect riders at the same time.

An equally important consideration that directly impacts e-mobility device safety and reliability is device maintenance. Expert interviews suggest that within micro-mobility ride-sharing applications, there remains a high prevalence of usability-issues such as discharged batteries, or equipment in need of maintenance and adjustment. Effective fleet maintenance is an important consideration for ride-share companies seeking to deliver the best user experience. With regards to e-scooters in private use, the after-sales and servicing network is still quite undeveloped and could impact consumer demand and product lifespan. Many electrical components present on electric powered micro-mobility devices are not easily serviced by traditional bike repair facilities.

> I recently visited NYC, in Manhattan and Brooklyn, and I didn't see a single shared e-scooter anywhere, but that was expected, they are not legal yet. But I was surprised to see a ton of personal e-scooters on the streets, and many brands that I don't see in the rest of the US. Popular and robust personal devices from Chinese companies, and even one Israeli company that just went public, and will be opening a storefront in the West Village.
>
> *– Head of Alliance and Partnerships, E-scooter manufacturer*

6. E-SEGWAYS

6.1 KEY TRENDS IMPACTING THE DEVELOPMENT OF THE E-SEGWAY CATEGORY

Consumer demand for Segways will be driven in part by the novelty of the design, which was first introduced in 2001 as a US$5,000 alternative mobile device that used battery-power gyroscopes and parallel wheels to self-balance. While the original Segway was never widely adopted due to its high price and was discontinued in 2020, the originator Segway-Ninebot and several Chinese manufacturers have introduced much less expensive versions starting at US$300 and going as high as US$1,000.

Segways offer a unique rider experience, requiring more rider skill than e-scooters, but are not as difficult to master as hoverboards or e-wheels. However, Segways are less stable than e-scooters or e-bikes, making them suitable only for recreational use rather than ride-share applications.

Devices for the children's and youth markets will continue to be the major driver of market demand, but Segways face competition from other e-mobility options that are easier to ride and less expensive to purchase.

Durability and safety considerations continue to be top-of-mind for manufacturers of Segways. Software for the management of the device's electrical systems and smartphone-app connectivity is now commonplace even for low-priced brands. Premium brands such as Segway-Ninebot have added voice commands and rider alerts to their array of safety features.

6.2 MARKET DATA

Segway sales amounted to 86,200 units in 2021 and represented a market value of US$50.0 million. The market size for Segways increased at a 4.3% CAGR from 2018–2021, while units increased at a 1.7% CAGR during the same period. As is the case for other small mobility devices, the cost for Segways has increased as batteries and electric motors jumped in price due to COVID-19. Segways are not a factor in ride-sharing applications as they are not as user-friendly as e-bikes or e-scooters in terms of ease of riding and stability. Segway sales are forecast to increase at a 4.3% CAGR from 2021–2024, reaching US$56.8 million in market size. Volume sales are expected to increase at a 1.3% CAGR from 2021–2024, reaching 89,700 units by 2024.

Table 1 Segway 2018–2021 Retail Value (US$ million)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
Segways	**Total**	**Total**	**$44.1**	**$46.0**	**$47.9**	**$50.0**	**4.3%**

Table 2 Segway 2021–2024 Forecast Retail Value (US$ million)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
Segways	**Total**	**Total**	**$50.0**	**$52.2**	**$54.4**	**$56.8**	**4.3%**

Table 3 Segway 2018–2021 Retail Volume (000' Units)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
Segways	**Total**	**Total**	**81.9**	**84.0**	**86.5**	**86.2**	**1.7%**

Table 4 Segway 2021–2024 Forecast Retail Volume (000' Units)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
Segways	**Total**	**Total**	**86.2**	**86.7**	**88.0**	**89.7**	**1.3%**

6.3 COMMERCIAL AND PERSONAL USE

According to industry sources, Segways are for personal use as they have inherent disadvantages which limit their usefulness in commercial applications. Most significantly, Segways and other parallel-wheel self-balancing scooters for adults rely on dual electric motors of at least 300 W each in order to make ongoing, small corrections in position needed for device stability. Competing e-mobility devices such as e-scooters are inherently more stable and can use much lower-powered motors and batteries to achieve forward motion.

In 2021, children's Segways accounted for 42.7% of the devices in private use, followed by devices for adults at 31.3% and youth (aged 12 to 16) at 26.0%. Children's Segways are widely availability in mass-market retail channels for less than US$300 which positions them as a high-tech alternative to a bicycle, scooter or skateboard. There is considerable overlap between user groups, however, with numerous products in the category recommended for children to adults. Nearly all of the devices can support up to 225 lb, but the few that are child-only ranged from 132–187 lb.

Segways remain an interesting and popular device but only represented 3.4% of the total micro-mobility universe on a unit basis. Due mostly to the steering control bar included with these devices, they are easier to ride in comparison to hoverboards and e-wheels but require skills not transferable from bicycle or scooter riding.

6.4 MARKET DYNAMICS

According to industry sources, parallel-wheel devices such as Segways are still too risky for use in ride-sharing applications. Despite having a steering control bar, these devices require users to learn and practice new skills in order to operate safely. For example, users need to feed in gradual movements in order to change direction, or to slow down. Because these devices use regenerative braking, they need a long distance to stop without upsetting a rider's balance. This is generally not compatible with riding in traffic, where quick braking and steering corrections are often needed. A further constraint to commercial use is the high level of recommended safety gear including helmets, wrist guards, knee pads, and tailbone protectors. As such, these devices as well as hoverboards, e-wheels, e-unicycles, and e-skateboards are best enjoyed in recreational pursuits.

6.5 CHANNEL DYNAMICS

Big box retailers Walmart and Best Buy are the most significant sales channels for Segways. Walmart, due to its high share of children's recreational product sales, remains as a key sales partner for Segway manufacturers offering both economy-level and premium-priced devices. Purely e-commerce retailers include Amazon and e-mobility specialists such as Urban Scooters and EZ Scooter Depot. As is the case with many micro-mobility devices, e-commerce sales direct to consumers also represent a high percentage of sales. Manufacturers such as Segway-Ninebot and Hiboy maintain their own e-commerce sales channels where consumers can purchase devices and accessories directly.

As is the case with much of the e-mobility market, online sales are expected to retain in excess of 80% of unit sales. This is appropriate for devices such as Segways which remain a niche product in comparison to e-scooters and e-bikes. This is further evidenced by the small set of manufacturers offering Segways. Even the device's originator, Segway-Ninebot, offers a wide choice of alternative devices in their product lineup in order to appeal to a broad audience.

6.6 COVID-19 IMPACT

The pandemic delivered a boost in demand for Segways and similar self-balancing scooters as consumers gained interest in recreational mobility solutions. With close to 70% of unit demand in the child and youth segment, Segways offer a unique alternative to electrified skateboards and hoverboards but are considered safer alternatives for novice riders because of their integrated steering mechanism.

Segways were mainly a direct-to-consumer purchase prior to COVID-19, therefore retailers were already well prepared to meet growing online demand. Sales are a mix of well-known e-commerce retailers such as Walmart and Amazon, and direct-to-consumer selling. Examples of device retailers using a direct to consumer model include Hiboy and Segway-Ninebot.

6.7 SUPPLY CHAIN

Discussions with trade sources indicates that Segways are sourced from Chinese factories. Up until mid–2020, Segway-Ninebot maintained a factory located in Bedford NH which assembled the Segway PT sub-brands. Other self-balancing scooter manufacturers such as Cozyswan and Hiboy import their devices from Chinese suppliers. The Asian manufacturing base for Segways has broadened their appeal by positioning them as much more affordable alternatives to the original Segway design. Segways are still expensive compared to e-scooters, as they require high-powered electric motors to maintain stability.

> Segway has set a sunset date for them (original Segway PT), and I don't see any significant commercial usage except for occasional university or corporate security. Interestingly though, Segway as a company has pivoted, and they are now one of the leading suppliers of e-scooters in both personal and shared device categories.
>
> *– Head of Alliance & Partnerships, E-scooter manufacturer*

6.8 PRODUCT CHARACTERISTICS

According to Segway-Ninebot and other self-balancing scooter manufacturers, batteries commonly last 300–500 charge/discharge cycles before starting to lose capacity, but some degradation in performance may be noticed after 200–300 charge cycles. As with any lithium-ion battery, lifespan is also dependent on operating temperature and device usage. Replacement batteries for these devices are available with prices ranging from US$150–US$180 in most cases. According to trade sources, the battery in Segways is usually the first major component to wear out, adding that modern brushless electric motors are long-lived and have low failure rates. In a review of three major brands, a 12-month warranty is the most typical of these products. However, electrical components including batteries and motors typically carry a 6-month warranty on devices under US$300.

Segways specific to the children's market range in price from US$299 to $499 according to the online sample. The devices can travel 8–10 miles on a single charge and have a load capacity of around 130 lb. Batteries of 72Wh capacity are most common, and top speed falls between 8.7 and 10 mph. Wheels are most often 8.5–10–inch in diameter, with pneumatic or solid tires. Examples of children's Segways include Segway-Ninebot S Kids and EZ Scooter.

Higher-end models for teens and adults have pneumatic tires of 8-11 inches, and slightly higher top speeds at 12–13 mph. Device range improves to 11–25 miles, owing to much stronger batteries averaging approximately 300Wh, and dual 300W brushless motors. Segways use regenerative braking to gradually slow without upsetting the rider's balance. The most popular brands include Segway-Ninebot as well as less costly lookalikes from Cozyswan, Hiboy and Smart brands. Prices range from US$299 to $950.

6.9 SAFETY AND RELIABILITY

Segways employ a host of safety-related technology to manage their electrical systems, alert riders to dangerous situations, and help with rider training. Even Segways at the low-end of the price scale, such as Smart brand, use sophisticated battery management software to protect from overcharging and overheating. Smartphone app-connectivity enables the devices to receive firmware updates on the go. LED lighting front and rear is a feature on most devices. Category leader Segway-Ninebot introduced a kid's-only device in 2021 which comes with even more safety gear including audible alerts when speeding, reversing or if the battery is low. Many of the Segways in the sample also use a tiered riding mode which limits top speed to 4–6 mph as riders learn basic gestures and maneuvers.

> "The product (Segway-Ninebot Kids S), comes with more than a dozen safety features, yet is not complicated to ride and children as young as 8 can experience the thrill of riding self-balancing scooters"
>
> *– VP Sales, Segway-Ninebot*

7. HOVERBOARDS

7.1 KEY TRENDS IMPACTING THE DEVELOPMENT OF THE HOVERBOARD CATEGORY

Demand for hoverboards will be driven by the children's market, where the devices are popular toys, and by the adult market segment where they represent one of the most affordable micro-mobility devices.

Hoverboards are widely considered by industry sources to require a moderately high level of rider skill to operate safely, and they are best used as a recreational device on smooth pavement or in open spaces. Their design requires smooth and slow gestures in order to maintain device stability on the move.

Despite the low price, many hoverboards can connect to smartphone apps for controlling device speed while learning to ride, and monitoring battery charge. The vast majority of hoverboards sold in the US comply with UL2272 safety standards for the device's electrical systems.

7.2 MARKET DATA

Hoverboard sales registered 1.2 million units in 2021 with a market value of US$195.2 million. The market size for these devices increased at a 5.1% CAGR from 2018–2021, while units increased at a 2.5% CAGR during the same period. Hoverboard prices have increased marginally because of higher global demand for batteries, but increases have been low to date owing to the large economies of scale and unit production surpassing millions per year. Electric motors for hoverboards tend to be very small, fitting within the wheel hub assembly of the typical 6.5-inch wheel. Hoverboard demand is from recreation users and the devices are not a factor in ride-sharing applications due to the high level of rider skill required and a long list of recommended safety gear. Hoverboards are forecast to increase at a 5.1% CAGR from 2021–2024, reaching US$226.9 million in market size. Market volume is expected to increase at a 2.1% CAGR from 2021–2024, reaching 1.3 million units by 2024.

Table 1 Hoverboard 2018–2021 Retail Value (US$ million)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
Hoverboards	**Total**	**Total**	**$167.9**	**$176.5**	**$185.6**	**$195.2**	**5.1%**

Table 2 Hoverboard 2021–2024 Forecast Retail Value (US$ million)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
Hoverboards	**Total**	**Total**	**$195.2**	**$205.2**	**$215.8**	**$226.9**	**5.1%**

Table 3 Hoverboard 2018–2021 Retail Volume (000' Units)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
Hoverboards	**Total**	**Total**	**1,146.6**	**1,184.1**	**1,229.9**	**1,235.4**	**2.5%**

Table 4 Hoverboard 2021–2024 Forecast Retail Volume (000' Units)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
Hoverboards	**Total**	**Total**	**1,235.4**	**1,252.5**	**1,280.9**	**1,316.5**	**2.1%**

7.3 COMMERCIAL AND PERSONAL USE

Hoverboards are for personal use as they have inherent disadvantages which limit their usefulness in commercial applications. Similar to Segway's, hoverboards rely on electric motors within each wheel, and make constant small corrections in position required to maintain device stability. Competing e-mobility devices such as e-scooters and even Segways are easier to ride, but since more than half of the demand for hoverboards is in the children and youth market segment, the excitement of learning to ride the devices is often a more important consideration for the user.

In 2021, children's hoverboards accounted for 53.7% of the devices in private use, followed by devices for adults at 43.8% and youth (aged 12 to 16) at 2.5%. Hoverboards positioned for children are widely available in mass-market retail channels starting at less than US$90 which makes them affordable recreational alternatives to other children's mobility devices, whether electrified or not. Many hoverboards models in our survey are recommended for both teens and adults. Nearly all of the devices can support up to 240 lb, but weight capacity for child-only hoverboards ranged from 130–160 lb. Hoverboards remain a very popular device, representing around 49% of the total micro-mobility universe on a unit basis. They are the most affordable micro-mobility device category in the sample and offer a level of fun and excitement that is difficult to match at the price level.

7.4 MARKET DYNAMICS

Hoverboards are seen as a "kid's toy" and not a viable micro-transportation solution in the view of experts interviewed. Like e-skateboards and one-wheel e-devices, they are considered niche products with essentially no use cases in ride-sharing applications. Hoverboards are seen to pose a high risk of injury to riders and are prone to theft, further constraining their use in commercial applications.

7.5 CHANNEL DYNAMICS

Big-box retailers and mass-merchandisers such as Walmart are the most significant sales channels for hoverboards. Thanks to its high share of children and adult recreational product sales, Walmart remains as the key sales partner for hoverboard manufacturers. Purely e-commerce retailers include Amazon and e-mobility specialists such as Urban Scooters and Hoverboards.com. As is the case with many micro-mobility devices, e-commerce sales direct to consumers also represent a high percentage of sales. Manufacturers such as Swagtron and Razon USA are examples of major hoverboard manufacturers selling direct to consumers.

As is the case with much of the e-mobility market, e-commerce is expected to represent a minimum of 75% of unit sales for hoverboards. This figure is lower than niche devices such as Segways due to the presence of big-box retailers such as Dick's Sporting Goods and Best Buy in addition to mass retailers Walmart and Target which have a huge presence in toys and recreational products.

7.6 COVID-19 IMPACT

The pandemic delivered a boost in demand for hoverboards. Consumers gained interest in recreational mobility solutions for several reasons including wanting to keep their children busy and active despite travel restrictions and social distancing. Young adults and teens also viewed electronic "rideable" as an easy and fun way to explore nearby surroundings or trails; or as a quick way to travel a mile or two.

Electric rideable such as hoverboards were primarily an e-commerce purchase prior to COVID-19, therefore retailers were already well prepared to meet growing online demand. Sales remain a mix of well-known e-commerce retailers such as Walmart and BestBuy, and also direct-to-consumer selling. Examples of device retailers using a direct to consumer model include Swagtron and Hover 1, but many other manufacturers with a US design and marketing base also participate in direct-to-consumer selling.

7.7 SUPPLY CHAIN

According to online sampling and discussions with industry executives, hoverboards are ubiquitously sourced from Chinese factories. Several brands including Swagtron note that their devices including hoverboards are designed in the US, but contract manufacturing takes place in China. The large number of Chinese hoverboard manufacturers, and their proximity to an ecosystem of parts and components suppliers makes for a highly competitive and efficient manufacturing environment that will be difficult to replicate domestically.

> "Hoverboards are gimmicky kid's toys, I don't see them as viable transportation alternatives for adults or even teens."
>
> *– Head of Alliance & Partnerships, E-scooter manufacturer*

7.8 PRODUCT CHARACTERISTICS

According to Gyroor and other hoverboard manufacturers, batteries commonly last up to 500 charge/discharge cycles before starting to lose capacity, but some loss of performance may be noticed before this time. Razor USA suggests that battery life will be impacted by rider weight, road conditions, and battery maintenance. In a review of major brands, a 3-month warranty is the most typical of these products.

Hoverboards for the children's market range in price from US$89 to $370 according to the online sample. The devices can travel 5–9 miles on a single charge, and have a load capacity of 130–200 lb. Batteries of 72Wh capacity are most common, but some of the cheaper devices make do with batteries less than 50Wh. Top speed generally falls between 6 and 9 mph. Wheels are most often 6.5 inches in diameter, with pneumatic or solid tires. Hoverboards are light in order to make the most of the available battery power, and a typical weight range is between 14–20 lb. According to the online sample, there are more than 30 unique manufacturers of these devices. Some of the largest, inferred from the extent of their product lines, include Shenzhen Uni-sun Electronics Co., Ltd., Razor USA LLC, GoTrax, Shenzhen Uni-mobility Intelligent Technology Co., Ltd, Yongkang Dingchang Industry & Trade Co., Ltd. and Hover-1 Inc.

Hoverboards for youth are generally the same devices marketed to adult users and can support up to 220 lb. These devices feature solid or pneumatic tires of 6.5–10 inches, with around 20% of samples having all-terrain tires designed for moderate off-road use. Device top speed was still low at 6-10 mph, but travel range increased to 10–15 miles, owing to much stronger batteries averaging approximately 110 Wh. Hoverboards use regenerative braking to gradually slow without upsetting the rider's balance. Youth and adult-oriented hoverboards are produced by a smaller set of manufacturers in comparison to kid's models. The most popular brands include Hover-1 Inc., Swagtron (DGL Group), Hoverboard Inc. and MotoTec. Prices were still affordable, with most devices priced from US$150 to US$399.

7.9 SAFETY AND RELIABILITY

According to UL (Underwriters Laboratory), a US-based product testing agency, the first hoverboards received the UL2272 safety requirement for electrical systems beginning in 2016. In 2021, the UL certification is widely adopted among hoverboards sold in the US. According to industry sources, major retailers would almost certainly require this type of certification for any device sold within its channel. The safety certification is prominently used in online marketing for major hoverboard brands. Some manufacturers such as Swagtron have adopted lithium-polymer batteries that are non-combustible in order to further protect users and their property from electrical fire risk. Most hoverboards feature a user-adjustable riding mode which limits the top speed to 4-6 mph as riders learn basic gestures and maneuvers. Smartphone app connectivity is available on many brands, with the ability to monitor the state of battery charge, remaining range and other parameters.

8. OTHER MICRO-MOBILITY DEVICES (OMDS)

8.1 KEY TRENDS IMPACTING THE DEVELOPMENT OF THE OMD CATEGORY

No use cases exist in ride-sharing for e-skateboards and one-wheels, as the risks of personal injury and theft are considered too high.

E-skateboards are the only OMD device that is also marketed to children. The low cost of these devices has made them very popular recreational products/toys for this market.

OMDs for the adult market are split between entry-level devices costing between US$200 and US$650 and higher-performance varieties at more than double these prices. Most premium-priced OMDs easily exceed the 20 mph speed limit set by legislators in some states such as California.

OMDs have a steep learning curve and require riders to be aware of the safety alerts and feedback these devices offer as they approach their design limits.

8.2 MARKET DATA

OMD sales amounted to 124,100 units in 2021 with a market value of US$138.0 million. Market value for these devices increased at a 13% CAGR from 2018–2021, while units increased at a 15.3% CAGR during the same period. The average unit cost for the devices was US$1112.4 in 2021. OMDs are forecast to increase at a 15.6% CAGR from 2021–2024, reaching a market value of US$213.2 million. On a volume basis, they are forecast to increase at a 13.8% CAGR from 2021–2024 and reach 182,900 units by 2024.

Table 1 OMD 2018–2021 Retail Value (US$ million)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
OMD	**Total**	**Total**	**$95.5**	**$106.4**	**$120.4**	**$138.0**	**13.0%**

Table 2 OMD 2021–2024 Forecast Retail Value (US$ million)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
OMD	**Total**	**Total**	**$138.0**	**$159.9**	**$187.0**	**$213.2**	**15.6%**

Table 3 OMD 2018–2021 Retail Volume (000’ Units)

Category	Subcategory	Channel	2018	2019	2020	2021	CAGR 2018–21
OMD	**Total**	**Total**	**80.9**	**90.4**	**103.2**	**124.1**	**15.3%**

Table 4 OMD 2021–2024 Forecast Retail Volume (000' Units)

Category	Subcategory	Channel	2021	2022	2023	2024	CAGR 2021–24
OMD	**Total**	**Total**	**124.1**	**141.5**	**162.7**	**182.9**	**13.8%**

8.3 COMMERCIAL AND PERSONAL USE

In 2021, OMDs were only used as personal devices, and this is expected to remain so during the forecast period. OMDs require a very steep learning curve to ride and the devices are deemed too risky for commercial ride-share applications, according to industry sources.

In 2021, adults accounted for 82.8% of OMDs in private use, with children under 12 at 13.0% and youth (aged 12 to 16) at 4.2%. Adults are a target market for both e-skateboards and one-wheels, according to the online data sample. However, one-wheels were not evident for children or youth, but both age groups do participate in e-skateboard use. OMDs, in particular e-skateboards, offer an affordable entry into the world of micro-mobility devices. According to trade sources, they are a popular and requested gift for children. For young adults who were skateboarders, the battery-powered devices have sparked a renewed interest in the sport. One-wheels appeal mainly to 20–30-year-olds according to trade interviews. Overall, OMDs are available at affordable prices, ranging from under US$100 for a children's e-skateboard to around US$400 for a quality e-skateboard for adults. One-wheel OMDs are far more expensive, starting at around US$1,000. These would be most appealing to sports enthusiasts and older adults who can afford the starting price.

8.4 MARKET DYNAMICS

OMDs do not have a use case in ride-sharing applications. They are however defined as electrically motorized boards by legislation in California, provided that the devices adhere to the following criteria: a) they are powered by motors under 1000 Watts, b) they carry only one person; c) adhere to a maximum 20 mph speed limit and d) do not exceed dimensions of 60 by 18 inches. If the devices meet all of the criteria they can be legally ridden on certain low-speed limit roadways (typically roads limited to 35 mph). The legislation also stipulates that riders must be 16 years or older, wear protective gear (helmet) and not be under the influence of drugs or alcohol.

In the context of OMDs, most of the e-skateboards and one-wheels captured in the data set would fit the legislative definition noted above. Exceptions would be some e-skateboards that can exceed the 20 mph limit, and premium-priced one-wheels that are powered by electric motors greater than 1,000 Watts. Since California is among the most progressive states in regulating micro-mobility devices, it can be

inferred that these devices are in use on public roadways, and this use can be expected to increase in step with the forecast growth in units through 2024.

As suggested earlier, while e-skateboard demand will be driven primarily by the children and young adults, one-wheel OMDs are widely considered high-performance devices and appeal to adults looking for riding excitement. One-wheel manufacturers have taken notice, and nearly every major brand offers a model that can exceed 45 mph. These would appeal to buyers who enjoy other vehicles purchased for riding thrills, including motorcycles or power-sports equipment.

8.5 CHANNEL DYNAMICS

OMDs are sold in a variety of channels including mass-market retailers, e-commerce brand aggregators and manufacturers selling directly to consumers via e-commerce. For the children's and youth segment, e-skateboards at a low price-point are mainly sold at Walmart due to its dominant market share in recreational devices and toys. Moving to higher-cost e-skateboards aimed at youth and adults, online brand aggregators such as Urban Scooters are significant players in the category, along with manufacturer-direct sales from BackfireBoards USA and Evolve Skateboards USA Inc. The data sample suggests that brand-specific, direct-to-consumer sales and brand aggregators are the primary channels for one-wheels. E-wheels and EUCO.us are examples of such aggregators, but specific brands such as InMotion Technologies and Onewheel USA also sell direct to consumers.

Industry sources suggest that more than 80% of OMDs are sold via online retail channels rather than brick-and-mortar retailers. One reason is the lack of a dealer network for these devices. Growing demand for OMDs may justify leading brands to maintain a limited store presence in major urban centers, but for expensive niche products like one-wheels, online sales will continue to lead sales volume in the category.

8.6 COVID-19 IMPACT

The pandemic's impact on OMDs centered on supply chain effects and some changes in consumer behavior. Demand for children's recreational products and toys was boosted by the pandemic, as parents looked for ways to keep them occupied close to home. Higher disposable income due to stimulus checks and a curb on travel and dining/entertainment spending also increased consumer disposable income. As such, many families had the means to purchase OMDs as gifts for their children.

Discussions with experts in the micro-mobility industry suggest that adults also demanded more devices, both for recreational use and as a short-range travel solution. Most experts agree that OMDs are not typically used for commuting or short trips as they are prone to theft, but they do provide an unparalleled sense of

freedom and riding pleasure. OMDs became a recreational pursuit that could be enjoyed safely, despite restrictions on social gatherings and activities.

COVID-19 certainly created bottlenecks for lithium-ion batteries due to surging global demand for e-scooters and e-bikes, and niche segments such as OMDs did experience price increases accordingly. Many of the electrical components such as hub-motors, however, were in strong supply as they are made in vast quantities in Asian factories for other devices such as hoverboards. OMDs did experience delays as seen with most oversea ocean freight, and shipping costs increased substantially during the pandemic.

8.7 SUPPLY CHAIN

Discussion with industry executives indicates that essentially all OMD devices are of Chinese origin. As is the case with hoverboards, the economies of scale and the parts ecosystem are extremely well developed and efficient in Chinese manufacturing hubs. Asian dominance of lithium-ion battery manufacturing and raw materials inputs is another reason for the development of such as diverse and expansive production network for micro-mobility devices. This can also be explained in part by the vast market demand by Chinese-domestic consumers of these products.

8.8 PRODUCT CHARACTERISTICS

The service life of OMDs is limited by the life of the battery pack according to trade sources. According to information from leading OMD brands such as Onewheel and BackFireBoards, a typical battery would be good for approximately 500 charge/discharge cycles, but performance and lifespan is also dependent on other factors such as operating temperature, charging frequency, and device usage. Batteries can be replaced in many OMDs thanks to a modular design. Since the battery in OMDs—especially one-wheels—is crucial in providing enough energy to maintain device stability, some manufacturers recommend replacement of the batteries when they fall below 70% of design capacity. This can range from 300–500 charge cycles.

E-skateboards for the children's market begin at around US$100, but most are priced between US$150 and US$200. Battery specifications for such devices range from 55–160 Wh, with the average at approximately 80 Wh. Boards for children and youth are mostly limited to 9–12 mph top speed and offer a cruising range of 6–10 miles. Load capacity for these devices begins at 130 lb for the smallest boards and extends to around 200 lb. Solid wheels 2–3 inches in diameter are most common, although some off-road e-skateboards use wheel diameters up to 5 inches or more. E-skateboards use a regenerative braking system that transfers kinetic-energy from device motion to recharge the battery. Riders use a handheld remote control to control forward motion, braking, and to monitor battery range. Important

manufacturers of children's e-skateboards include Shenzhen Lantusi Technology Co., Ltd, and Swagtron.

Adult-oriented e-skateboards bring an increase in performance and price, as these products are capable of speeds as high as 31 mph and can cost as much as US$3,150 for premium versions. Most adult e-skateboards cost between US$250 and US$450, can travel 15–20 mph and have a cruising range of 10–12 miles. Important manufacturers include Evolve Skateboards, Swagtron, MotoTec, Guangzhou Plenty Bicycle Co. Ltd, and Wuyi Oukai Electric Equipment Co., Ltd.

One-wheels were evident only for the adult market segment in the online sample. Well-known manufacturers include Inmotion Technologies, Solowheel, King Song and Begode. Entry-level one-wheels start at US$650 but the average price in the sample was US$1,335. Battery capacity ranged from 320Wh to 3600Wh and device top speed generally fell between 15 and 50 mph. Tire sizes varied from 10 inches for "low platform" one-wheels to 20-inch tires commonplace on "unicycle platform" designs. One-wheels offers a very long cruising range, ranging from 20–75 miles in the online brand sample.

8.9 SAFETY AND RELIABILITY

OMDs are inherently risky to ride and therefore all manufacturers recommend a minimum list of safety gear including riding helmet (preferably ANSI-certified), non-slip shoes, and elbow and knee pads. One-wheels are nearly all smartphone compatible and allow users to monitor device performance in addition to selecting from a range of pre-set or customizable riding configurations. For example, riders can select a setting than optimizes device performance on sand if riding on the beach, or another setting that generates maximum power for climbing hills. One-wheels have a set of safety features such as audible alarms and "tilt back" when the device is nearing the limits of its performance. Tilt back refers to the device pushing back against the rider's forward lean as speed increases. The reason for this is that some of the device's battery power is needed to make balance corrections. If the rider is at or near the battery limit (due to excess speed or a low battery) there will be insufficient power remaining to make these balance corrections, and the result is instability or device failure which can result in serious injury. Part of learning to ride one-wheels is recognizing these safety features and backing off the power. While this feature is not applicable to e-skateboards, which do not tilt back when near their designed speed limit, several boards provide a vibration signal that tells the rider the limit is approaching. Other brands use an alert on the remote controller to alert the rider of any safety-related issues.

> "One wheel is really interesting too, but they are very expensive, $1,000 and up. I think those have more of a reach than you might think though... They've got a cult following. But these too will not be ride-share solutions. There's a big learning curve and I could only image that accidents and liability risks would be too high to make it a viable ride-share solution.
>
> *– Manager, E-scooter Manufacturer*

9. APPENDIX

9.1 SOURCES

For the full list of sources please reference the 'sources tab' found in the Euromonitor International Micro-Mobility Market Sizing Excel

Name	Website
Spectrum News	https://spectrumnews1.com/ca/orange-county/business/2021/08/02/pedego-reports--121-million-in-sales-as-coronavirus-pandemic-fuels-e-bike-boom
Bicycle Retailer	https://www.bicycleretailer.com/opinion-analysis/2021/10/28/rad-power-800-pound-gorilla-e-bike-world https://www.bicycleretailer.com/opinion-analysis/2021/06/15/vosper-despite-challenges-bike-shops-emerge-fastest-growing-e-bike https://www.bicycleretailer.com/industry-news/2020/01/12/customs-ruling-means-e-bikes-excluded-tariffs#.YfdhFOrMLIV
Portland State University – A North American Survey of Electric Bicycle Owners	https://www.calbike.org/wp-content/uploads/2019/02/A-North-American-Survey-of-Electric-Bicycle-Owners.pdf
Geek Wire	https://www.geekwire.com/2021/rad-power-bikes-raises-massive-150m-round-scale-e-bike-business-across-globe/
Electrek	https://electrek.co/2021/03/01/lime-unveils-slick-new-automatic-transmission-electric-bike-will-drop-50-million-into-them/
REACT and SCARP	https://civil-reactlab.sites.olt.ubc.ca/files/2021/01/Ebike-Incentive-Program-Development-Victoria_FinalReport_March-2019.pdf
City/County Association of Governments (CCAG)	https://ccag.ca.gov/wp-content/uploads/2021/09/Micromobility_RFP_Final.pdf
Swagtron	https://swagtron.com/faq/hoverboards/are-hoverboards-legal-in-the-us/
California Legislative Information	https://leginfo.legislature.ca.gov

Unagi	https://unagiscooters.com/articles/the–2021-comprehensive-guide-to-electric-scooter-laws/

9.2 LIST OF WEBSITES SCRAPED

Larger retailers:

1. Amazon - www.amazon.com
2. Target - www.target.com
3. Best Buy – www.bestbuy.com
4. Walmart – www.walmart.com
5. Segway - www.segway.com

Smaller retailers:

6. Wheel & Sprocket - https://www.wheelandsprocket.com/
7. Crazy Lennys - https://crazylennysebikes.com/
8. Hoverboards.com - https://hoverboards.com
9. Urban Scooters - https://www.urbanscooters.com/
10. Swagtron - https://swagtron.com/
11. Trek Bikes - https://www.trekbikes.com/us/en_US/new-to-e-bikes/
12. BikeBerry.com - https://www.bikeberry.com/pages/about-bikeberry
13. Bicycle Warehouse - https://bicyclewarehouse.com/
14. Mike's Bikes - https://mikesbikes.com/
15. eWheels.com - https://www.ewheels.com/
16. Dick's Sporting Goods - https://www.dickssportinggoods.com/

Other sites that have more of a limited offering but reflect a greater breadth of what is happening in the market include:

- Evolve Skateboards - https://evolveskateboardsusa.com/collections
- Backfire Skateboards - https://backfireboardsusa.com/
- eBikes USA - https://www.ebikesusa.com/
- Specialized - https://www.specialized.com/