European Commission

Study on the need for harmonised rules to support the rise of micro mobility and increased road safety for personal mobility devices

Final Report (1.0)

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Glossary

Acronyms:

EPAC	Electrically Power Assisted Cycle
EMC	Electromagnetic compatibility
ISS	Injury Severity Score
ITF	International Transport Forum
KSI	Killed or Seriously Injured
MAIS	Maximum Abbreviated Injury Scale
OECD	Organisation for Economic Co-operation and Development
PACTS	Parliamentary Advisory Council for Transport Safety
PLEV	Personal Light Electric Vehicle
PMD	Personal Mobility Devices
REESS	Rechargeable Electric Energy Storage System

Country codes:

AT	Austria
BE	Belgium
BG	Bulgaria
CZ	Czechia
CY	Cyprus
DK	Denmark
EE	Estonia
EL	Greece
FI	Finland
FR	France
DE	Germany
HR	Croatia

HU	Hungary
IS	Iceland
IT	Italy
LT	Lithuania
LU	Luxembourg
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
ES	Spain
SE	Sweden

SI	Slovenia
CH	Switzerland
UK	United Kingdom

1. Executive summary

Despite the proliferation of new types of personal mobility devices (PMDs) coming to the market in recent years there is no harmonised European regulations to govern their technical characteristics beyond the general requirements contained in the Machinery Regulation. The aim of this project was to investigate whether the creation of a harmonised European PMD regulation would be feasible and desirable. The key objectives of the work were to:

1. Develop a classification of existing PMDs with a view to determining groups of devices and common criteria based on design elements,
2. Undertake a detailed analysis of the market share and rise of the various PMDs to determine those that would most benefit from EU-wide rules,
3. Undertake an analysis of available data and information on crashes involving PMDs,
4. Assess the impact on market development of the fragmented pieces of legislation in terms of both technical and road traffic rules across the EU
5. Develop regulatory options for common technical safety design requirements on the basis of the obtained classification and interlinks with existing pieces of EU legislation.

A range of investigative methods were employed including stakeholder engagement with representatives from the PMD industry, regional and national regulators and road safety organisations, a review of national and European collision data and research, and a review of relevant European and national regulations and standards.

Four regulatory options were proposed:

1. Do nothing
2. Amend Regulation (EU) No 168/2013 to bring PMDs within its scope
3. Develop a bespoke approval system for specific groups of PMD
4. Develop a universal approval system for all PMDs

Of these, option 4 is recommended as the solution which would provide the greatest benefit with the least disruption.

While Electrically Power Assisted Cycles (EPACs) are a type of PMD, they already have a system of European and national regulations which are functioning effectively and are therefore least in need of a new European regulatory system. While they could be included in in a universal approval framework this should be considered as a latter step once the system is functioning effectively for those PMDs which currently lack effective harmonised regulations.

The PMD industry is highly innovative and is quickly developing novel PMD concepts. With this in mind, no rigid classification system is proposed, instead it is proposed to separate PMDs from L category vehicles based on speed (max 25km/h) and mass (maximum 250kg laden). No power limits are proposed, but instead a maximum acceleration limit of $2m/s^2$ under all load conditions would apply.

Technical requirements are proposed for:

- Maximum permitted mass
- Payload
- Structural integrity
- Battery safety

- Stability and controllability
- Speed regulation
- Maximum acceleration
- Braking
- Lighting
- Audible warning devices
- Anti-tampering
- Electromagnetic compatibility
- Moisture ingress

A graduated approval scheme is proposed in which manufacturers could undertake much of the required testing themselves provided they met requirements for quality assurance requirements. It is foreseen that market surveillance will be required in order to ensure that products placed on the market are safe and of adequate quality. The need for market surveillance is unlikely to be affected significantly by the regulatory option chosen.

2. Introduction

In recent years, there has been the emergence of what are known as micro mobility transport systems, which are characterised by various innovative types of personal mobility devices (PMDs), such as electric bikes, electric scooters and electric skateboards. These devices are growing in popularity in the EU as citizens look for more efficient ways to move around cities and seek to complement traditional forms of transport, such as cars, buses, trains and trams, with these more individualised modes of transport. The rise of PMDs has brought new challenges for policymakers linked to road safety of these devices combined with the need to ensure the safety of their design. An additional complexity for regulators concerns the variety of PMDs which include a broad range of vehicles that vary significantly in their configuration, size, number of wheels, operating principles and purpose of use.

At this stage PMDs are not subject to EU type-approval as they are excluded from the scope of Regulation (EU) 168/2013. Indeed, this Regulation does not apply to vehicles not equipped with at least one seating position or self-balancing vehicles. It does not apply to bicycles with electrical assistance with a rated power of maximum 250W and where the electrical assistance stops when the cycle reaches 25km/h.

PMDs are subject to Machinery Directive (2006/42/EC), which is in the process of being replaced by the Machinery Regulation (EU) 2023/1230, which sets out harmonised requirements related to the safety aspects of their design, manufacturing and placing on the market. Nevertheless, Directive 2006/42/EC is not aimed at addressing road traffic aspects, but the safety of the device itself when is in use, or occupational safety.

The regulatory framework for PMDs (both product regulation and road traffic rules) determines market access in Member States when those devices can be used as vehicles on public roads. There is therefore a need to examine the need for common technical rules to avoid market access barriers within the single market of PMDs. Harmonised product rules could, in turn, facilitate a more harmonised approach to road traffic rules where appropriate. By doing so, safety considerations of the devices might also be reflected in a harmonised way.

Given the importance of the cycling industry's contribution to accelerating the green and digital transition and increasing the resilience of the European mobility ecosystem, the technical support will in addition need to assess the regulatory framework applicable to e-bikes and how it can be improved to foster the swift deployment of and access to e-bikes. This study builds on the findings of a previous study conducted in 2021: 'Study on market development and related road safety risks for L-category vehicles and new personal mobility devices'[1].

2.1. Objectives

The study sought to address the following overarching objectives:

1) Develop a classification of existing PMDs with a view to determining groups of devices and common criteria based on design elements,

2) Undertake a detailed analysis of the market share and rise of the various PMDs to determine those that would most benefit from EU-wide rules,

[1] Link to report for previous study on PMDs for the European Commission: https://op.europa.eu/en/publication-detail/-/publication/b042f558-a319-11eb-9585-01aa75ed71a1/language-en

3) Undertake an analysis of available data and information on crashes involving PMDs,

4) Assess the impact on market development of the fragmented pieces of legislation in terms of both technical and road traffic rules across the EU

5) Develop regulatory options for common technical safety design requirements on the basis of the obtained classification and interlinks with existing pieces of EU legislation.

2.2. What is a personal mobility device?

Personal mobility devices (PMDs) do not yet have a legal definition, but for the purposes of this study we have included any lightweight machine for carrying people or goods that is wholly or partially propelled by an electric motor and is currently excluded from the scope of Regulation (EU) No 168/2013. We have also included pedal cycles with electrical assistance which fall within the scope of sub-categories L1e-A and L1e-B. Thus, for the purposes of this document, PMDs include:

- One-wheel boards
- Powered unicycles
- Hoverboards
- Self-balancing personal transporters (Segways)
- E-scooters with and without seats
- Electric Power Assisted Cycles (EPACs) with a maximum assisted speed of 25km/h and maximum continuous rated motor power of 250W
- L1e-A powered cycles including those with 2, 3 or 4 wheels
- L1e-B cycles designed to pedal

This list is not exhaustive, and for some vehicles, e.g. seated e-scooters, their lack of clear legal definition means that they may overlap with existing vehicle sub-categories (e.g. e-mopeds).

Our definition is deliberately much broader than that used by many authorities in the collection of official statistics, e.g. collision data, and is intended to allow for a wide ranging discussion of the future regulation of all electrically powered, lightweight machines in this rapidly evolving field, unconstrained by existing points of differentiation, which may not always be useful.

3. Stakeholder engagement

A wide variety of stakeholders were engaged as part of this study, including representatives of national and local authorities, manufacturers, importers and distributors, industry bodies and trade associations and operators of shared mobility services.

An online launch event was held on the 15th of December 2023, which was attended by over a hundred attendees. As part of this initial launch presentation, and in a follow-up email to attendees, a request was made for information and engagement relating to PMDs. Specifically, the following information and feedback was sought:

- Market data
- Evidence on the ways in which a lack of harmonised regulations is affecting the micromobility industry
- Collision data – particularly, detailed accounts of collision mechanisms
- Suggestions and feedback on cutoff limits for micromobility (e.g. 25kmh or 30km/h speed limits, 250kg mass limits) – and thoughts on whether factors other than mass and speed should also be considered
- Suggestions and feedback on technical requirements
- Suggestions and feedback on a pragmatic but effective system for self-certification which enables easy enforcement
- Potential unintended consequences of harmonised regulations

This request for information prompted substantial engagement from the PMD stakeholder community, through a range of mediums, including:

- Detailed feedback provided via email
- Submission of relevant reports and technical analysis relating to PMDs
- Individual interviews with representatives of key stakeholder groups
- Presentations and 'Question and Answer' sessions with industry bodies

We also proactively reached out to key stakeholder groups who did not respond to this initial call, to ensure that their suggestions and feedback were also recorded. All feedback has been considered fairly when compiling this report and the recommendations it makes.

The table below summarises which stakeholders were engaged with after the initial presentation.

We would like to thank all those who took the time and effort to contribute to this project.

Table 1: Stakeholder engagement by organisation and stakeholder type

Organisation	Manufacturers, distributors and retailers (and wider supply chain)	National government departments / transport authorities	Regional and local city/transport authorities	Road safety organisations and industry associations
ACEM				✓
Alligt.nl	✓			
Amsterdam municipality			✓	
BASt		✓		
Belgian transport ministry		✓		
Bosch	✓			
CONEBI				✓
Cycling Industries Europe				✓
Dutch Ministry of Infrastructure and Water Management		✓		
FIA				✓
Finnish Transport & Communications Agency Traficom		✓		
Fluctuo	✓			
FPMM				✓
HAN_ University of Applied Sciences				✓
Light Electric Vehicle Association (LEVA)				✓
Micro-Mobility for Europe (MMfE)				✓
RDW		✓		
Riese & Müller	✓			
Speed Pedelec Vlaanderen	✓			
UK Department for Transport		✓		
Zipidi	✓			

3.1. Summary of feedback from stakeholders

Environment, congestion and sustainability

Multiple stakeholders acknowledged that PMDs have potential to have a positive impact on the environment and congestion. At least one stakeholder believed that EPACs in particular should be considered as active travel as they require effort from the user, and therefore should be categorised and regulated in-line with conventional bicycles. However there were differing views among stakeholders regarding other forms of PMD and how much they can create a modal shift away from active travel and public transport options versus a shift away from cars. For example, one report cited by a stakeholder reported a reduction in private car use with e-scooters, but also a reduction in walking. It was also raised that, when estimating the environmental impacts of modal shift to PMDs, the whole life cycle of PMDs, including reparability during their useable life, should be considered, and not just the usage phases.

Design requirements

Some stakeholders had specific concerns and recommendations with regard to design, including recommending a number of areas that should be considered in any regulation, for example, structural integrity, maximum speed and max power-to-mass ratio (PMR). Robust construction of e-scooters was also flagged as important.

Regulation, certification and enforcement

Appropriate regulation, in combination with effective enforcement, was seen as key to the safe integration of PMDs. In particular stakeholders identified harmonisation and consistency across Europe as key to safety and uptake of PMDs, and that a lack of legislation and poor enforcement of what rules there are have an impact on both actual safety and the perception of safety.

Views on self-certification versus type approval were mixed. There was some concern that self-certification may not be sufficient from a safety perspective and that type approval may need to be considered for certain categories of PMD. Other organisations argued that the machinery directive and self-certification should be used where possible for ease of access to this market sector for manufacturers. It was also floated that PMDs that can travel up to 25kph should be able to use the same facilities (cycle lanes etc) as bicycles so should not fall under L-category. One stakeholder recommended a power limit of 1000w, but also noted that the speed limit and the vehicle mass should be the key things that are limited.

Acceleration and kinetic energy were identified as not suitable criteria for regulation by one stakeholder, as acceleration is not measurable in bench testing, and kinetic energy would require individual checking for each type. They also believed that any proposed legislation or regulation should be considered in the context of what effect it may have on uptake of what is fundamentally a more environmentally friendly and sustainable mode of transport.

EPACs

Some stakeholders expressed a desire to maintain a difference between EPACs that required an element of human effort, and other PMDs. They proposed clear differentiation because of health benefits, skill levels required to operate, and current legal positions, including those of EPACs being categorised with pedal cycles. However, they also proposed some new requirements in legislation around EPACs (including maximum power and mass), and a new category of Speed EPACs (featuring higher max power output and top speed than a standard EPAC, but still no throttle) which should fall into a new category of L1e-C (effectively a sub-category of L1e-C). Users of Speed EPACs would be required to have insurance, a driving licence and wear a helmet. Generally EPACs were commented on for their active travel and environmental benefits, and they were thought to be popular because they were the PMD most similar to conventional bicycles. It was also suggested that EPACs and throttle e-bikes should maintain separate categories in order to encourage EPACs on active travel grounds. In addition, a clear distinction should be maintained between EPACs and e-scooters due to the differing dynamics and behaviour of the two types.

Speed-pedelecs and carrier cycles

A major manufacturer in the PMD supply chain believed speed-pedelecs are over regulated relative to their market share, and that a specific L sub-category should be created, featuring requirements including maximum power of 1000w and helmet use when operating. For carrier cycle manufacturers their views centred around mass and power limits with an assist factor of 6 and a 1200w motor power limit for carrier cycles and speed-pedelecs recommended with performance in hilly areas given as one of the main reasons. One manufacturer thought speed-pedelecs should be categorised as micromobility, and that speed, mass and width should be defining characteristics. One stakeholder proposed splitting carrier cycles into two categories, essentially 'light' and 'heavy', with light carrier cycles falling under the same requirements as EPACs, and heavy ones requiring type approval and potentially aligning with some other existing L categories.

Safety

Concerns were raised by a city region authority about how PMDs could be safely integrated into the existing road network. For such an organisation, the safety of all road users and the general public as a whole is seen as a priority over user convenience and the commercial desires of manufacturers. Therefore they found suggestions of increases in speed and power to be highly undesirable, but did believe that harmonisation should focus on things like the safety of charging. Regarding e-scooters, several stakeholders highlighted non-compliance with relevant rules, distraction and drunkenness as examples of the reasons for e-scooter incidents, however one stakeholder felt that safety levels of e-scooters were approaching those of bicycles.

3.2. Safety aspects of shared mobility services – city examples

To help understand how road traffic rules are currently applied to PMDs, and with a particular focus on shared mobility e-scooters, a sample of randomly selected European cities were investigated to establish how they managed the safe integration of shared mobility into their environments and the road traffic rules which applied. Information relating to the following areas was sought:

- Limitations on the number of permitted operators
- Limitations on fleet size
- Requirements regarding geofencing or permitted zones of operation
- Limitations on night time use
- Parking restrictions

The results for each city are presented in Table 2 and Table 3 below.

Table 2: Shared mobility service rules for a sample of European cities (Part 1)

	City				
	Berlin	**Bordeaux**	**Helsinki**	**Lisbon**	**Madrid**
Limiting the number of permitted operators	Limited to four operators	Limited to two operators	No limit	Limited to five operators	Limited to three operators
Limiting fleet size	Max 19,000 scooters split evenly between operators	Max 750 per operator	Max 700 scooters per operator in the city centre/southern inner city.	Winter – max 1500 per operator Summer – 1750 per operator	Max 6000 between the three operators
Geofencing/permitted zone of operation	Cannot be used in pedestrian zones	None	Restricted parking in the city centre and southern inner city	Black zones (parking and prohibited circulation)	None
Limitations on night- time use	None	None	Unavailable weekend nights from midnight to 05:00	None	None
Parking requirements	No parking zones, including around locations used by vulnerable groups	None	Restricted marked parking areas in the city centre and no parking zones outside the city centre	Red zones where scooters can't park. Scooters can be parked in 'hotspots' – physical or virtual parking areas.	Parking in authorised areas only in the city centre. Must park in an authorised spot if one within 50m in rest of the city.
	Source	Source	Source	Source	Source

Table 3: Shared mobility service rules for a sample of European cities (Part 2)

	City			
	Marseille	**Oslo**	**Stockholm**	**Vienna**
Limiting the number of permitted operators	Limited to three operators	No limit to number of operators	No limit to number of operators	Limited to four operators
Limiting fleet size	Max 6,000 scooters, split evenly between operators	Max 8,000 scooters split evenly between operators	Max 12,000 scooters split evenly between operators	Max 500 scooters in city centre, maximum of 1500 across other districts
Geofencing/permitted zone of operation	None	No permitted areas of operation, but scooters must be available in different zones.	None	Red zones where scooters are not permitted
Limitations on night- time use	No rentals allowed between 22:00 – 05:00	No rentals allowed between 23:00 – 05:00	None	None
Parking requirements	Specific parking locations for each operator. Must also not 'obstruct the movement of pedestrians and other vehicles'	Parking allowed on pavements, cycle paths and pedestrian zones 'as long as it does not present a hindrance to those who walk or cycle'	Approved spaces or bike racks only	Must park in an e-scooter parking zone if within 100m of one, otherwise park on street between cars
	Source	Source	Source	Source

4. Classification and identification of Personal Mobility Devices

This chapter provides an update to the PMD inventory provided in the 2021 report. The analysis that was conducted in that earlier report was first checked to identify which products are still available today, with new products that have emerged since being identified and added.

For the purposes of this work, the identified devices have been broadly categorised. This categorisation has been made to separate devices with different characteristics, but is not intended at this stage to indicate any potential future regulatory sub-categories of PMD, or reflect the legal status of existing devices. The categories are as follows:

- **Standing e-scooter**: A device on which the rider stands to ride (does not have a seat). The device has at least two wheels and at least two axles which are separated along the longitudinal axis of the machine, i.e. at least one wheel is “in front” of one of the other wheels. Usually steered using handlebars. Does not have pedals. These machines are specifically excluded from Regulation (EU) No 168/2013 because they do not have a seat.
- **E-moped:** A device on which the rider sits to ride. The device has at least two wheels and at least two axles which are separated along the longitudinal axis of the machine, i.e. at least one wheel is “in front” of one of the other wheels. Usually steered using handlebars. Does not have pedals. May also be referred to as a “seated” e-scooter. These devices fall within the scope of Regulation (EU) No 168/2013, although many of the machines available on the market are not type-approved.
- **EPAC**: A pedal cycle assisted by an electric motor. These devices must have pedals which can be used to propel the machine and which are used to control the speed of the electric motor. Has at least one seat. Has at least two wheels. Has two axles. Maximum continuous rated power 250W, maximum assistance speed 25km/h. Specifically excluded from Regulation (EU) No 168/2013 and covered by separate regulation.
- **Speed Pedelec:** A pedal cycle assisted by an electric motor. Has pedals which can be used to propel the machine. Has at least one seat. Has two wheels. Has two axles. Maximum continuous rated motor power greater than 250W and/or max assistance speed greater than 25km/h and thus excluded from EPAC regulations, but not holding a type-approval under Regulation (EU) No 168/2013.
- **Cycles designed to pedal in L1e-B:** A pedal cycle assisted by an electric motor. Has pedals which can be used to propel the machine and control the speed of the motor. Has at least one seat. Has two wheels. Has two axles. Maximum continuous rated motor power greater than 250W but less than 4,000W. A max assistance speed greater than 25km/h but not more than 45km/h. These machines are type-approved under Regulation (EU) No 168/2013.
- **E-Carrier Cycle**: A pedal cycle assisted by an electric motor specifically intended to cargo or passengers. Has pedals. Has at least one seat. Has at least two wheels. Has two axles. These machines include EPACs and type approved Cycles Designed to Pedal in L1e-B.
- **Self-balancing personal transporter**: A device which the rider stands on to ride. The machine is steered using handlebars. Motor power is used to maintain longitudinal stability. Has two wheels on one axle. Does not have pedals. These

machines are specifically excluded from Regulation (EU) No 168/2013 since they are both self-balancing and lack a seat.

- **Hoverboard:** A device which the rider stands on to ride. Motor power is used to maintain longitudinal stability. Rider stands with feet between the wheels. Has two wheels on one axle. Does not have a seat, handlebars or pedals. These machines are specifically excluded from Regulation (EU) No 168/2013 since they are both self-balancing and lack a seat.
- **E-Skateboard**: A device which the rider stands on to ride. The device has four wheels on two axles. Does not have a seat, handlebars or pedals. The rider steers the device by leaning their body and thus the footplate of the device, which in turn steers the wheels. The rider's feet stand on top of the board (on top of the wheels). These machines are specifically excluded from Regulation (EU) No 168/2013 since they lack a seat.
- **One-Wheel:** A device with a single wheel on which the rider stands with their feet fore and aft of the wheel. The rider stands with their body facing sideways. The speed of the machine is controlled by leaning forwards or back and may thus be considered self-balancing. Does not have seat, handlebars or pedals. These machines are specifically excluded from Regulation (EU) No 168/2013 since they are self-balancing, have only one wheel, and lack a seat.
- **E-Unicycle**: Has one wheel which the rider places their feet either side of. The rider stands or sits with their body facing forward. Could have a seat. Does not have handlebars or pedals. The speed of the machine is controlled by leaning forwards or back and may thus be considered self-balancing. These machines are specifically excluded from Regulation (EU) No 168/2013 because they both have only a single wheel and are self-balancing.
- **E-skates:** Comprises two separate devices. Rider stands with one device on each foot. Has at least two wheels. Has two axles. Does not have a seat, handlebars or pedals. These machines are specifically excluded from Regulation (EU) No 168/2013 because they lack a seat.

Table 4 shows each of these categories and the characteristics of each type of PMD.

Table 4: Description of the characteristics of PMDs reviewed and the manner in which they were grouped

Group name	Fitted with seat	Fitted with handle bars	Fitted with pedals	Number of wheels	Number of axles	Motor used for balance	Max speed (legal)	Max continuous rated power (legal)
Standing E-Scooter	No	Yes	No	2+	2	No	NA	NA
E-moped/seated e-scooter	Yes	Yes	No	2+	2	No	NA	NA
EPAC	Yes	Yes	Yes	2+	2	No	25km/h	250W
Speed Pedelec[2]	Yes	Yes	Yes	2	2	No	>25km/h	Or >250W
Cycles designed to pedal in L1e-B	Yes	Yes	Yes	2	2	No	45km/h	4,000W
E-Carrier cycle	Yes	Yes	Yes	2+	2+	No		
Self-balancing personal transporter	Optional	Optional	No	2	1	Yes	NA	NA
Hoverboard	No	No	No	2	1	Yes	NA	NA
E-Skateboard	No	No	No	4	2	No	NA	NA
One-Wheel	No	No	No	1	1	Yes	NA	NA
E-Unicycle	No	No	No	1	1	Yes	NA	NA
E-skates	No	No	No	2+	2+	Yes	NA	NA

4.1. Inventory

Like that undertaken in the 2021 report, an inventory of PMDs was collated from an extensive internet search. The inventory aimed to capture devices available for purchase within the EU; this includes retailers who would ship to the EU from outside. The aim of this inventory is to expand upon that produced for the 2021 report, providing an up-to-date list of

[2] This group includes any machine with pedals which exceeds the speed or power limits for EPAC and does not hold a type approval under L1e.

the breadth of devices that are available on the market. This inventory is not intended to be an exhaustive list of every available device. The full inventory is provided in the Appendix.

The following parameters have been recorded for each device, where this information is available:

- Continuous rated power (W)
- Maximum design speed (km/h)
- Maximum range (km)
- Dimensions (length, width, height; cm)
- Unladen mass (kg)
- Maximum payload (kg)

The number of PMDs included within the inventory is shown in Table 5.

Table 5: Number of devices in each category of the PMD inventory

PMD Type	Count
Standing e-scooter	141
E-moped	59
EPAC	91
Speed pedelec	7
Cycles designed to pedal in L1e-B	10
E-Carrier cycles	20
Self-balancing personal transporter	3
Hoverboard	22
E-Skateboard	34
One-wheel	10
E-Unicycle	25
E-skates	11
Total	**433**

4.2. Device design power

Table 6 shows the minimum, median, and maximum power of each category of vehicle in the inventory.

Table 6: Minimum, median, and maximum continuous rated power of each device category

PMD Type	Minimum Continuous Rated Power (W)	Median Continuous Rated Power (W)	Maximum Continuous Rated Power (W)
Standing e-scooter	80	500	11,000
E-moped	200	775	3,200
EPAC	250	250	250
Speed pedelec	750	1,000	6,200
Cycles designed to pedal in L1e-B	600	800	940
E-Carrier cycle	250*	250*	250*
Self-balancing personal transporter	2,400	2,400	3,200
Hoverboard	300	700	700
E-Skateboard	125	3,000	11,000
One-wheel	700	750	1,500
E-Unicycle	500	2,800	10,000
E-skates	100	310	400

*Data on motor power was not available for the Riese and Muller Load 75 HS

The median power of each device category is also shown in Figure 1, ordered from highest to lowest median power.

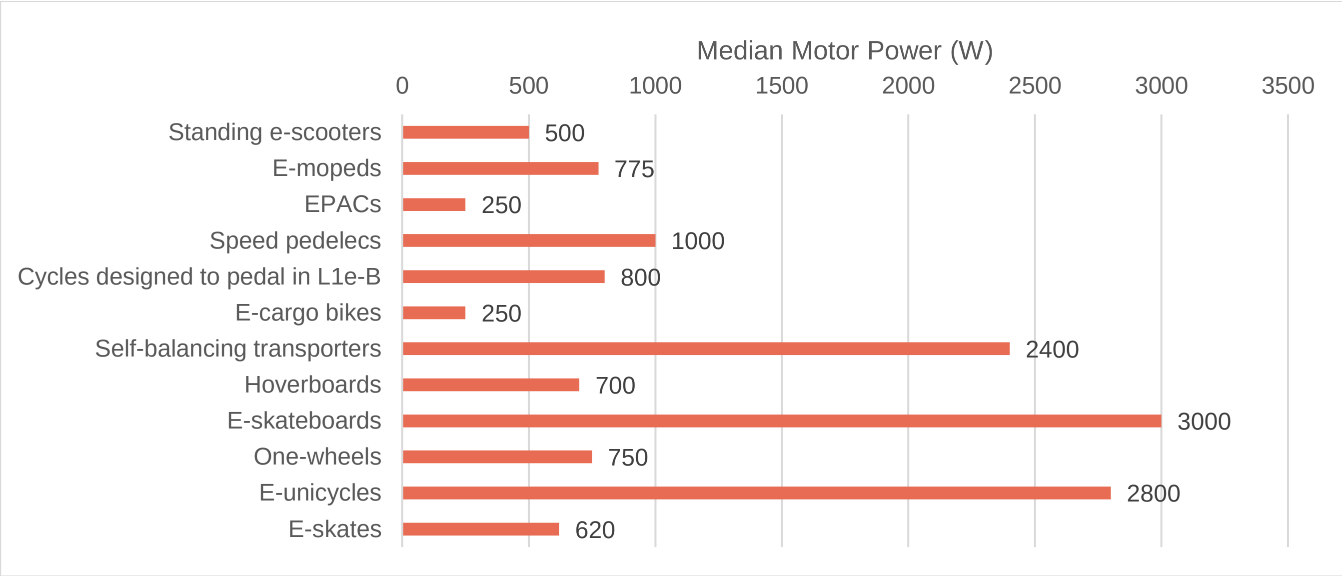

Figure 1: Median power of PMDs by group

In almost all cases, with the exceptions of EPACs, e-carrier cycles, and e-skates, the median power for the various PMDs is greater than that reported in the previous 2021 inventory. In some cases, the difference is substantial; for instance, the median power value for e-skateboards in the 2021 inventory was found to be 250W compared to the 3000W median found here. This may be a result of a greater number of more powerful vehicles (in particular, those intended for off-road use) being available on the market, and thus having been captured in the current inventory.

In many cases (e.g. standing e-scooters, e-skateboards, e-unicycles) the highest maximum power is an outlier caused by – for example – a vehicle intended for off-road use. These outliers can skew average values, hence the decision to present median values here. However, this does not apply to the EPAC category which both show minimum, median, and maximum power values of 250W, as these vehicles are restricted by regulation. This explains the lack of change in the median power rating of EPACs since the 2021 inventory. E-carrier cycles also, for the most part, adhere to the same regulations, but we did find that Riese and Muller now have a range of e-carrier cycles type approved in the Lie-B sub-category.

In the case of e-skates, the median power value is actually lower (310W) than was found in the 2021 inventory (500W). It is unclear why this would be the case, though some speculation could be made. For one, the nature of e-skates being a physically small device (in comparison to all other PMDs discussed here) means that less power overall is required for propulsion. More devices being available on the market (and thus captured in this updated inventory) may have naturally brought the median power rating down. Another explanation could be that skates are likely to be perceived as better targeted towards younger demographics (i.e. children, teenagers), and as such there is less of a need to maximise power ratings for something that may be considered a ‘toy’.

Another point worth bearing in mind is that a higher power rating does not necessarily reflect a higher maximum speed or greater acceleration, as some categories (in particular, self-balancing personal transporters) require additional power to ensure stability, and there is often a lack of clarity regarding whether the power quoted is a continuous or maximum figure.

4.3. Maximum device design speed

Table 7 shows the lowest, median, and highest maximum speeds of each category of vehicle in the inventory.

Table 7: Advertised maximum speeds of each device category

PMD Type	Lowest Maximum Speed (km/h)	Median Maximum Speed (km/h)	Highest Maximum Speed (km/h)
Standing e-scooter	11	25	170
E-moped	13	40	89
EPAC	25	25	25
Speed pedelec	25	59	88
Cycles designed to pedal in L1e-B	45	45	45
E-Carrier cycles	25	25	45
Self-balancing personal transporter	20	20	20
Hoverboard	10	12.5	16
E-Skateboard	16	45	64
One-wheel	20	29.5	40
E-Unicycle	10	60	125
E-skates	10	25	32

The median maximum speed of the various PMDs ranges from 12.5km/h for hoverboards up to 60km/h for e-unicycles. As was the case for power ratings, EPACs are limited to 25km/h by vehicle regulations. Similarly, outliers exist where top speeds have been maximised for off-road use, as can be clearly seen in the standing e-scooter category (Table 7) where one model has a reported maximum speed of 170km/h. It should also be noted that in the case of e-carrier cycles, seven of the 20 models captured in the inventory did not report a maximum speed. However, all those where a maximum speed has been reported were stated as 25km/h (and power rating of 250W) with the exception of Riese and Muller's L1e-B carrier cycle.

The median top speeds of each device category are also shown in Figure 2.

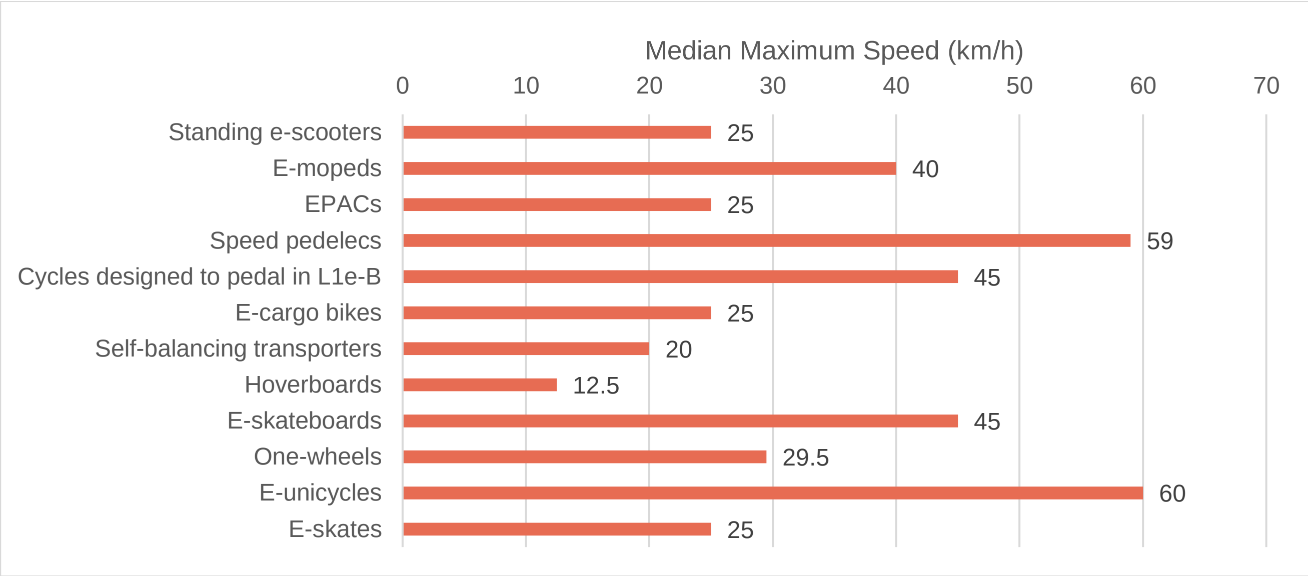

Figure 2: Median maximum speed of PMDs by group

Speed limits often apply to the various PMDs when used in public spaces, dependent on area of operation (e.g. road, footpath). The reported speeds for e-bikes, including EPACs, speed pedelecs, cycles designed to pedal in L1e-B and e-carrier cycles, refer only to the maximum speed that can be achieved with motor assistance, as they can be manually pedalled at faster speeds.

When comparing to the 2021 inventory, we can see a number of categories where there has been an increase in their median maximum speed. Specifically, this is the case with: e-unicycles, e-skateboards, seated e-scooters, and e-skates. As was mentioned in relation to power ratings, this may be explained by a greater number of faster models being available on the market compared to three years ago. This likely does not explain the case for e-skates which, as noted in the previous section, have a lower median power rating compared to the 2021 inventory.

In the speed pedelec category we identified one machine with a maximum speed of 25 km/h, which would normally qualify it to be included in the EPAC category. However, this machine reportedly has a 750W motor, which could qualify it as an L1e-A “Powered Cycle”, although we could find no evidence that this machine has been type approved. Indeed we found no machines advertised as being approved in L1e-A. It may be the case that the manufacturer is actually advertising the peak, rather than continuous rated, power of this machine, which could therefore conceivably still be compliant with EPAC regulations. We found many examples of machines, like this one, whose legal status was not made explicit in their sales material, which clearly has the potential to confuse potential buyers and users who may not be familiar with the nuances of PMD regulations. There was a clear regulatory effect on the way in which retailers advertise motor power, depending on whether that is a regulated characteristic of the category – those required to comply with regulations advertising lower powers than those that are not. This may of course reflect reality, but it seems reasonable to speculate that retailers may either be inflating or restricting power claims depending on the regulatory status of the category.

4.4. Device mass

Table 8 and Figure 3 show the empty masses of each category of vehicle in the inventory.

Table 8: Minimum, median, and maximum empty mass of each device category

PMD Type	Minimum Mass (kg)	Median Mass (kg)	Maximum Mass (kg)
Standing e-scooter	4	20	170
E-moped	11	29	99
EPAC	16	25	58
Speed pedelec	30	35	76
Cycles designed to pedal in L1e-B	24.2	26.9	28
E-Carrier cycle	23	47	90
Self-balancing personal transporters	54	54	54
Hoverboard	6	8.5	14
E-Skateboard	5	10	28
One-wheel	11	15	17
E-Unicycle	10	30.5	60
E-skates	2	2.9	8.1

The median mass of the various PMDs in the inventory ranges from 2.9kg (e-skates) to 54kg (self-balancing personal transporter). A similar pattern can be seen here as with other factors, in that median mass has generally shown an increase across the various PMDs in comparison to the 2021 inventory, with some exceptions.

Where masses have increased (e.g. e-skateboards, e-unicycles, standing e-scooters), this may be explained by the greater number of vehicles designed for off-road use. These are built with large more robust bodies to handle more rugged terrain, as well as house larger motors with greater power ratings.

It is also worth noting that device mass was not always provided on the various product pages.

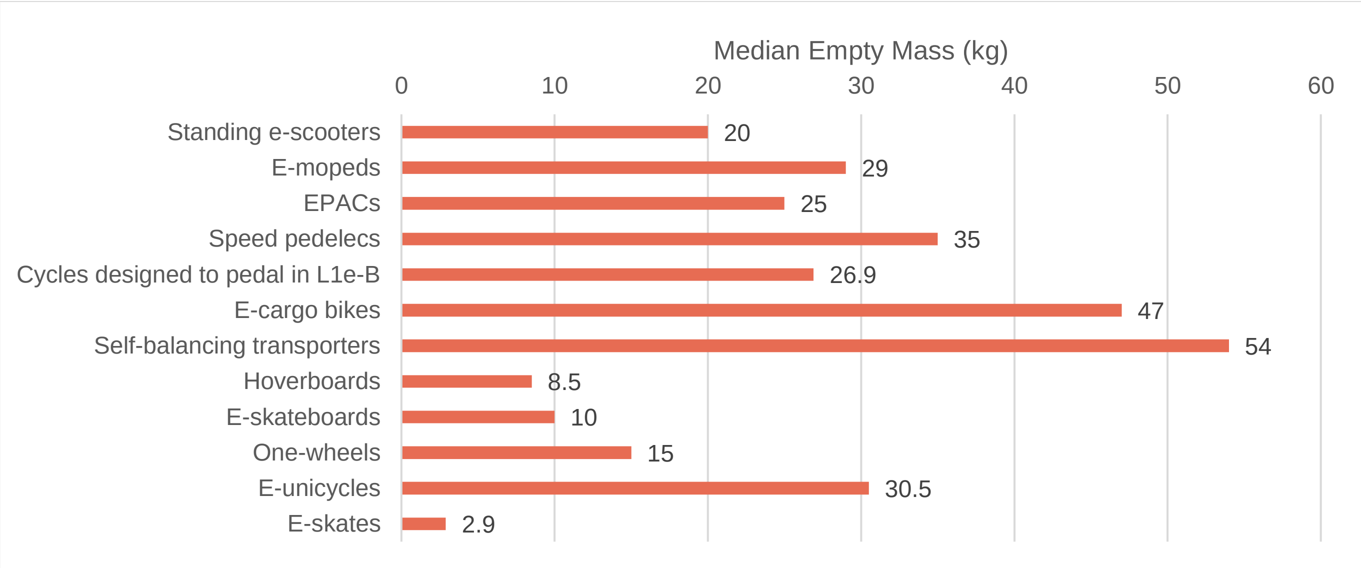

Figure 3: Median unladen mass of PMDs by group

4.5. Maximum payload

Table 9 and Figure 4 show maximum payload of each category of vehicle in the inventory.

Table 9: Advertised maximum payload for each device category

PMD Type	Lowest Payload (kg)	Median Payload (kg)	Highest Payload (kg)
Standing e-scooter	50	120	200
E-moped	77	120	200
EPAC	80	120	150
Speed pedelec	120	120	150
Cycle designed to pedal in L1e-B	120	120	150
E-Carrier cycle	100	150	300
Self-balancing personal transporter	NA	NA	NA
Hoverboard	72	111.5	120
E-Skateboard	65	150	250
One-wheel	100	120	125
E-Unicycle	60	120	150
E-skates	80	100	120

Median maximum payloads for the various devices ranged from 111.5kg (hoverboard) to 150kg (e-skateboard and e-carrier cycle). The e-carrier cycle showing one of the largest maximum payloads would be expected given the nature of these devices being intended for the moving of goods as well as riders.

Similar to the previous point on device mass, maximum payload was not always detailed on product pages. In particular, this detail was not present at all for the three self-balancing personal transporters that were identified in the inventory.

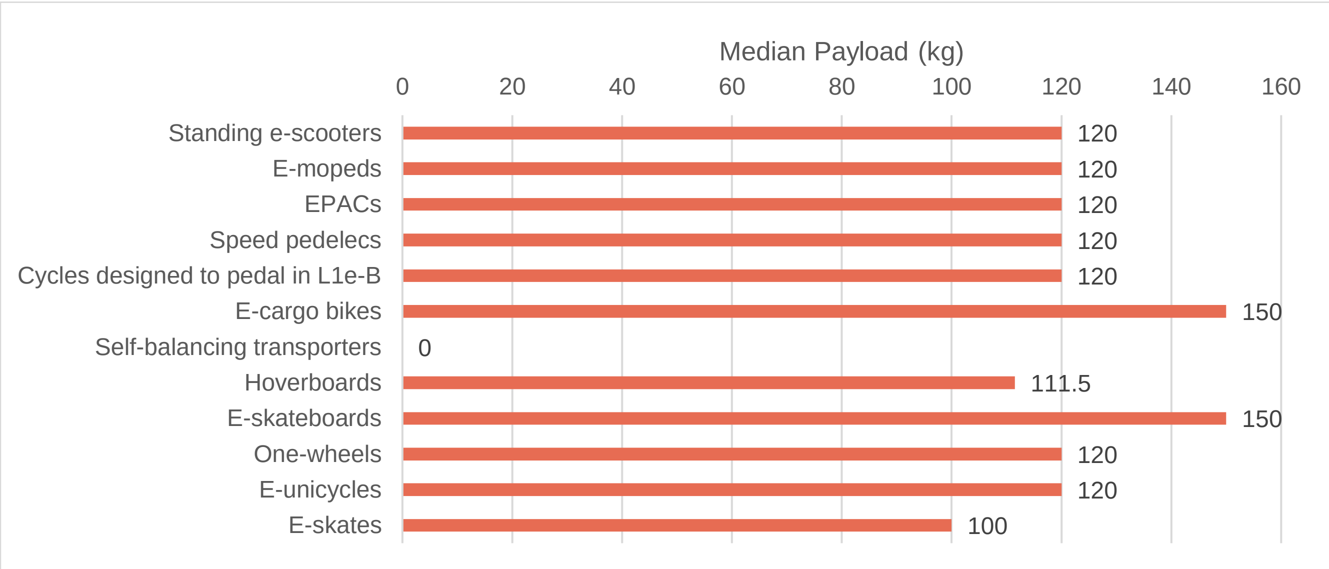

Figure 4: Median maximum payload of PMDs by group

4.6. Maximum gross mass

Table 10 shows the lowest, median, and highest maximum gross mass of each category of vehicle in the inventory. Maximum gross mass in this context refers to the combined mass of the vehicle and its maximum payload.

Table 10: Advertised maximum gross mass of each device category

PMD Type	Lowest Maximum Gross Mass (kg)	Median Maximum Gross Mass (kg)	Highest Maximum Gross Mass (kg)
Standing e-scooter	54	139	226
E-moped	104	156.5	242
EPAC	123	143	185
Speed pedelec	151	171	196
Cycles designed to pedal in L1e-B	148	148	177
E-Carrier cycle	150	197	238
Self-balancing personal transporter	NA	NA	NA
Hoverboard	80	131	134
E-Skateboard	70	160	264
One-wheel	111	135	142
E-Unicycle	70	159.5	180
E-skates	102	102	122

Details for devices maximum gross mass were calculated by combining vehicle's reported device mass (section 4.4) and maximum permissible mass. Where one or both of these figures weren't provided, gross masses were not calculated. As such, the data presented here may not provide the most accurate reflection of reality, though this is likely to still be a close approximation.

As per the previous section, as no details were identified on the maximum permissible masses of self-balancing personal transporters, no details on gross masses can be provided here.

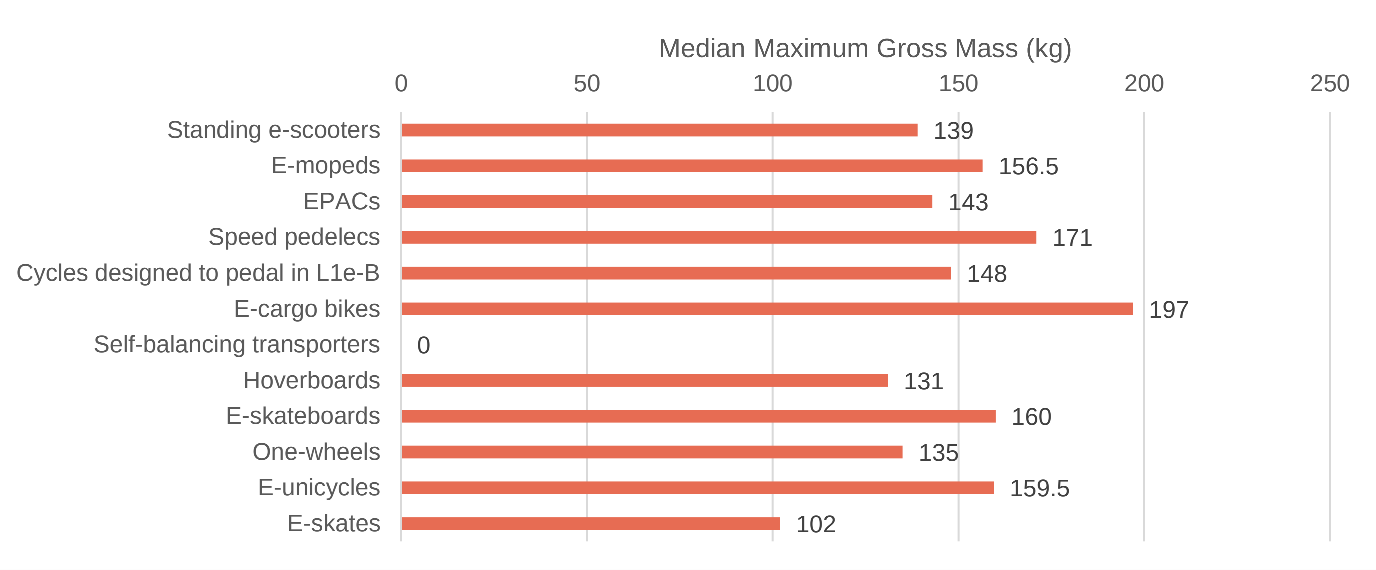

Figure 5: Median maximum gross mass of PMDs by group

4.7. Notable road legal PMDs

While researching the PMD market we came across a number of products which are of particular interest in the approach they have taken to regulatory compliance. The first of these is the Veeley V5 which is an electric moped, type approved under L1e-B. This machine is of particular interest because it has a folding seat, which allows it to be used as a standing e-scooter. Whether this “convertible” machine is in the spirit of the regulation is an open question, but it is clearly sufficiently so to have convinced at least one approval authority.

A second machine in a similar vein is the Swifty Go GT500, which is a standing e-scooter which has been made road legal in the UK, where e-scooters are prohibited from use on the road, through the motorcycle single vehicle approval route. That these machines are currently regulatory outliers suggests that there is minimal appetite in the market for type-approved e-scooters with the additional user requirements that such approval entails. They also demonstrate that there is no entirely impenetrable barrier to legalisation for standing e-scooters given sufficient creativity and will on the part of the manufacturer, although such machines are unlikely to have mainstream appeal in member states which don’t have an outright prohibition on the use in public places of standing e-scooters, as is the case in the UK.

4.8. Summary

In each of the different device categories there are noticeable outliers which are faster, heavier or more powerful than the majority of machines in that category, and very different in character to all other PMDs. For instance, standing e-scooters with considerably greater power and speeds than the median for that category. In terms of speed and power ratings, e-skateboards and e-unicycles in particular appear as outliers compared to other device categories. The median values for these machines appear greater than would be expected of these devices, showing greater median figures compared to devices that would be expected to be more powerful and faster, such as the e-moped. Given the relative size of the device, e-unicycles also appear heavier than would be expected, showing a median mass greater than that of devices such as e-mopeds and EPACs.

Ultimately, what can be drawn from these findings is that even with a universal PMD approval scheme it will not be possible to approve all PMD types. Furthermore, there are some devices that are being marketed as PMDs which already have a category available to them within Regulation (EU) No 168/2013, e.g. the speed pedelecs which currently exceed the limits of Cycles Designed to Pedal in L1e-B, which could be approved within L3. The availability of these currently unapproved products on the open market, under the guise of "off-road" vehicles, is causing considerable concern in a number of member states, where their use on the road and in public places is leading to collisions and serious injuries. Clearly there is a legitimate market for products which will genuinely be used off-road, particularly for motorsport purposes, but this derogation to Regulation (EU) No 168/2013 opens a loophole which is prone to abuse by retailers and users who are able to freely trade in machines which are then used illegally. While road circulation regulations are already in place to prohibit the use of these unapproved machines on the road, this places an additional burden on law enforcement services who lack effective methods for safely stopping such machines when they are encountered. Rectifying this problem is beyond the scope of this project and the situation is unlikely to be improved significantly by the creation of an approval scheme for PMDs. Some measures which could potentially have a positive impact on reducing the illegal use of "off-road only" machines are:

- Requiring retailers to collect the personal details of all purchasers and enter these details onto a central register
- Minimum age limits for purchase
- Mandatory membership for users of a relevant motorsport body

Ultimately though, it will always be difficult to balance the demands of a free market and personal freedom with the measures necessary to control the sale of products which may be used in a dangerous manner. While the distribution of some products, e.g. firearms and drugs are very tightly controlled, they tend to have a unique form that isn't easily confused with another freely tradeable product – a bullet is unlikely to be confused with anything else. The broad spectrum of legal and illegal PMDs and the components used to manufacture them can make it very difficult to determine the legality of a particular machine and even harder to identify a component that could be used to by an end user to build one. Outright prohibition of "off-road only" PMDs is thus undesirable on the grounds that it would disrupt a large, wholly legal, industry serving motorsport users and is unlikely to be feasible in practice. The best that can be hoped for is that the market can be controlled to a degree that reduces the attraction of PMDs to less scrupulous manufacturers and users, which will thus create an evolutionary pressure in favour of safer legal products. It should also be bourn in mind that the illegality of certain products will in itself be attractive some people and will thus be resistant to complete legal control.

5. Analysis of collision data

This section gives an overview of collisions and casualties involving micromobility in various countries, where the data are available.

5.1. Overview/Method/aim/about

Firstly, data were reviewed for the EU from the CARE database. As well as providing information on the number of casualties that were EPAC or PMD users, this also provided information on which countries collect these data.. These were:

- Belgium
- Denmark
- France
- Germany
- Israel
- Italy
- Netherlands
- Poland
- Portugal
- Slovenia
- Spain
- Switzerland
- Austria
- Great Britain (this does not include Northern Ireland, who collate data on road collisions separately from England, Scotland and Wales)

Information from the OECD (see (Table 13 based on OECD's Road Safety Annual Report 2023 report (OECD, 2023) suggested that data were also available for Japan, however; very little information was available in English or readily translatable.

Some limitations with these data should be acknowledged:

- There are differences between the countries in terms of the definitions used for various PMDs and the regulations of their use (e.g. hire schemes, age limits, helmet use).
- There are also differences in the infrastructure present in different countries, and how it is used by different vehicles (for example, presence of cycle lanes and whether PMD users travel on the footway, cycle path or road)
- There are also differences in the reporting of collisions to and by the police, what locations (footway/cycle path) are included and the description of injury levels.
- The data described above did not have any measure of exposure, and therefore relative risks could not be compared.

Given these limitations, literature was also reviewed in addition to the CARE data analysis, to source information on the comparative risks between different modes.

5.2. International data

This section gives an overview of micromobility casualties based on the CARE database for Europe (section 5.2.1) and from selected worldwide countries based on a recent OECD report (section 5.2.2).

5.2.1. CARE database

CARE is a database of road crashes resulting in death or injury which occurred in the EU member states. The variables collected were agreed with the member states and the Commission and each of the member states provides annual data to the database.

5.2.1.1. Limitations/notes

EPACs and PMDs were categories in the CARE database from 2020 onwards (if countries can supply the relevant data). However, the number of casualties and collisions in the 2020 and 2021 data were affected by lockdowns due to Covid. Therefore the analysis shown covers 2022 only, which is the most recent year available.

Data were available for 27 EU countries, plus Norway, Iceland, Switzerland, but not the UK.

Countries record vehicle types differently, in particular:

- Some countries do not collect data for PMDs – they are likely to be recorded as ‘other vehicle’
- Some countries record EPACs separately, whilst in others EPACs are combined with pedal cycles
- Mopeds and L1e-B are not distinguishable in the data
- The data does not include whether a vehicle was personal or part of a hire scheme

Data for serious injuries are very variable between countries due to different definitions and reporting rates. CARE are trying to use consistent definitions using MAIS codes based on hospital ICD codes. Due to the differences in the reporting of injury severity, a CARE expert we consulted with during this project suggested that we focus on analysis of fatality figures, but use the injury figures to understand whether zeros in the data are in fact indicative of zero fatalities or not reported.

A further limitation is that there might be differences between jurisdictions on what constitutes a ‘road collision’ i.e. collisions on footways and cycle paths rather than the road or collisions not involving a registered motor vehicle might be not reported or may be under-reported.

The CARE data dictionary suggests that there is a large volume of data recorded per collision; however, many of the fields are marked as low importance and the data are not completed for many countries. This includes variables such as engine power and alcohol.

There is also likely to be under-reporting, especially of non-fatal collisions involving non-motorised users (see section 5.4.1).

Further, the differences between countries in terms of population, road length, amount of travel, number of vehicles, road safety policies, and any other factors that are known to influence road safety means that the numbers of casualties are not directly comparable between countries.

5.2.1.2. Data

Table 11 shows the total number of fatalities in 2022 recorded in the CARE database and the number of EPAC and PMD fatalities for those countries where these are recorded.

Table 11: Number of fatalities recorded in CARE database in 2022 by road user type and country

Country		EPAC	Moped	PMD	Pedal cycle	Sub Total	All fatalities (including pedestrians and all vehicle types)
AT	Austria	24	8	n/a	20	52	370
BE	Belgium	2	17	1	100	120	540
BG	Bulgaria	n/a	0	n/a	25	25	531
CH	Switzerland	23	6	n/a	19	48	241
CY	Cyprus	n/a	1	n/a	4	5	37
CZ	Czechia	n/a	3	n/a	54	57	527
DE	Germany	208	57	10	266	541	2,788
DK	Denmark	9	9	0	14	32	154
EE	Estonia	n/a	3	1	3	7	49
EL	Greece	n/a	21	n/a	13	34	654
ES	Spain	n/a	36	8	81	125	1,746
FI	Finland	n/a	1	n/a	18	19	196
FR	France	43	124	35	202	404	3,260
HR	Croatia	n/a	8	n/a	9	17	275
HU	Hungary	n/a	12	n/a	42	54	537
IS	Iceland	0	0	1	0	1	9
IT	Italy	20	70	16	185	291	3,159
LT	Lithuania	0	1	0	5	6	120
LU	Luxembourg	1	0	0	0	1	36
NL	Netherlands	77	39	n/a	143	259	655

Country		EPAC	Moped	PMD	Pedal cycle	Sub Total	All fatalities (including pedestrians and all vehicle types)
NO	Norway	n/a	0	n/a	6	6	116
PL	Poland	n/a	53	3	170	226	1,896
PT	Portugal	n/a	35	n/a	31	66	618
RO	Romania	n/a	24	n/a	160	184	1,633
SE	Sweden	n/a	11	n/a	23	34	227
SI	Slovenia	1	3	2	11	17	85
SK	Slovakia	n/a	8	n/a	26	34	266
Total		**408**	**550**	**77**	**1,630**	**2,665**	**20,725**

EPACs were recorded in 12 countries, with 408 fatalities recorded in total; over half of these fatalities were recorded in Germany, accounting for 7% of all fatalities in Germany. The percentage of fatalities that were EPAC users was greatest in the Netherlands, where 12% of all fatalities were EPAC users (77 pedelec fatalities).

PMD casualties were recorded in 12 countries, with 77 fatalities recorded in total. The largest number of these was 35 in France, followed by 16 in Italy; in other countries there were fewer than 10 fatalities each.

The following sections give the distribution of fatalities by various characteristics. These are dominated by the countries where there are high numbers of fatalities recorded i.e. for EPACs half of the fatalities were in Germany and for PMDs just under half of fatalities were in France. Therefore comparing the different vehicle type also includes differences between countries.

5.2.1.3. Road environment

Table 12 shows the road type (motorway, rural or urban) for the fatalities in the CARE database in 2022.

Table 12: CARE fatalities, 2022 by area type for selected road user types

Road type	EPAC	Moped	PMD	Pedal cycle	Sub Total	All fatalities (including pedestrians and all vehicle types
Motorway	0	3	0	19	22	1,795
Rural	205	252	21	657	1,135	10,025
Urban	203	295	56	954	1,508	10,134
Unknown	0	0	0	0	0	1
Total	**408**	**550**	**77**	**1,630**	**2,665**	**21,955**
% in urban areas	*50%*	*54%*	*73%*	*59%*	*57%*	*42%*

Half (50%) of the EPAC fatalities were in urban areas. This figure was slightly higher for mopeds (54%) and pedal cyclists (59%) and highest for PMDs (73%).

The junction type is recorded for most of the countries. The percentage of fatalities that occurred at junctions was:

- EPAC: 27%
- Moped: 26%
- PMD: 29%
- Pedal cycle: 24%

These are all higher than the percentage of all fatalities at junctions (14%); this is likely to be partly due to the higher percentage of these fatalities in urban areas, but also indicates that junctions are a high-risk location for these vehicles.

5.2.1.4. Collision type

Figure 6 shows the percentage of fatalities recorded in the CARE database in 2022 for selected road user types by collision type.

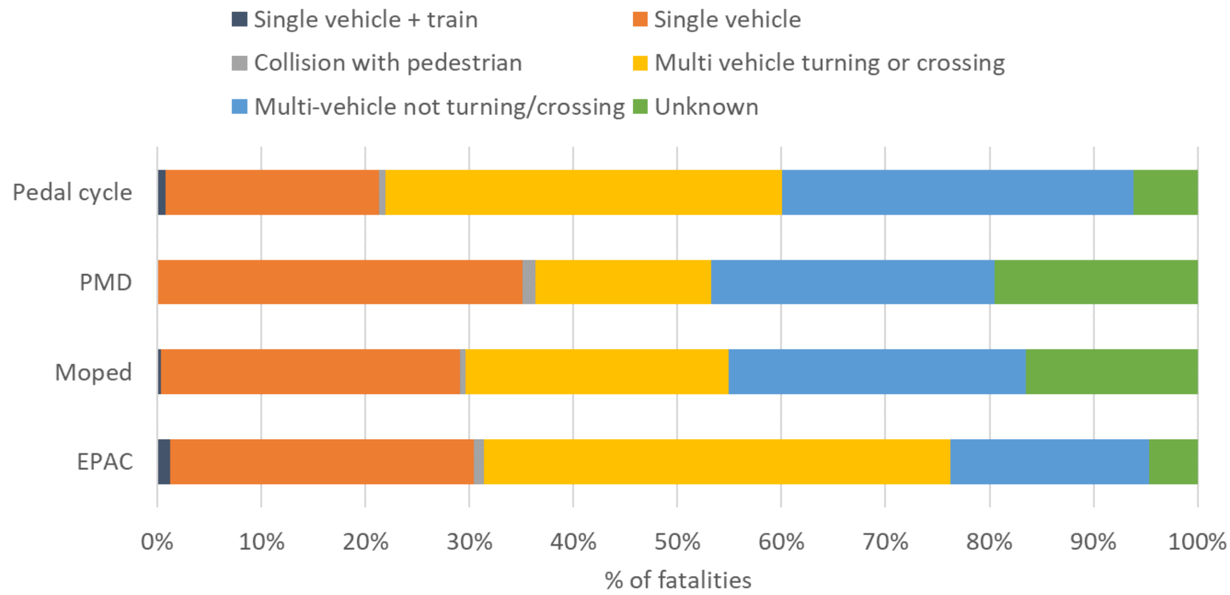

Figure 6: % of fatalities recorded in CARE database by collision type 2022

This shows that there was a higher percentage of EPAC fatalities in collisions involving turning or crossing (45%) compared with the other vehicle types (38% for pedal cycles, 25% for mopeds and 17% for PMDs).

PMDs had a slightly higher percentage of single vehicle collisions (35%) compared with the other vehicle types (29% for EPAC and mopeds, 21% for pedal cycles).

5.2.1.5. Time of day

Figure 7 shows the distribution of fatalities in the CARE database by road user type by time of day.

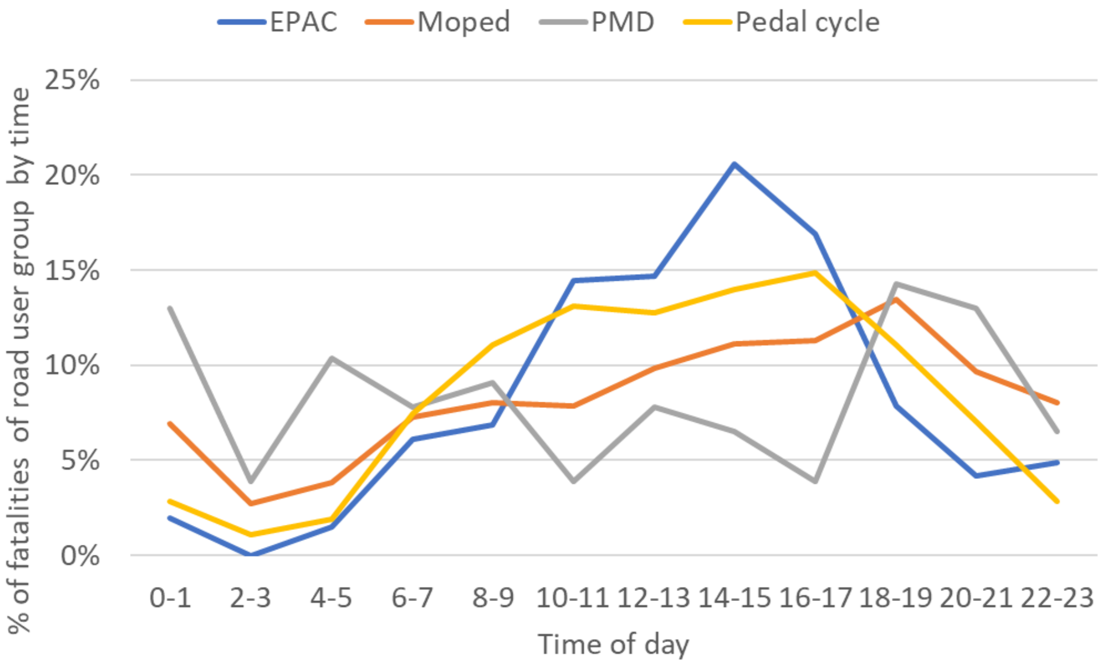

Figure 7: % of fatalities recorded in CARE database by time of day in 2022

EPAC and cycle fatalities were most common between 10am and 6pm, accounting for 67% and 55% of fatalities respectively.

PMD fatalities were less common between 10am and 6pm (22%), but more common in the morning (44%) and the evening (34%).

5.2.1.6. Age and gender

Figure 8 shows the percentage of fatalities recorded in CARE database by age group for selected road user types in 2022 and Figure 9 shows the distribution by gender.

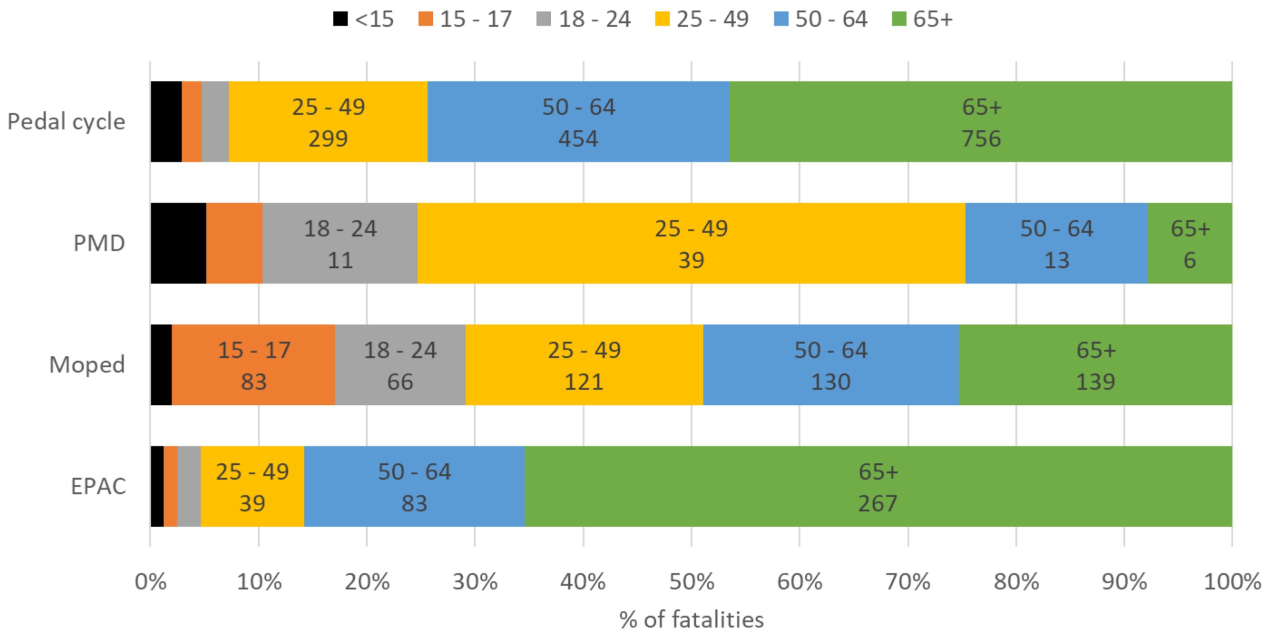

Figure 8: % of fatalities recorded in CARE database by age in 2022

Figure 9: % of fatalities recorded in CARE database by gender in 2022

This shows that fatalities using PMDs were generally younger than the other vehicle types, with 75% of fatalities aged less than 65 and 25% less than 25. The male:female ratio was similar to that for pedal cyclist.

EPAC fatalities were generally older; 65% were aged 65 or older compared with 46% for pedal cycles. There was a slightly higher proportion of females compared with pedal cycles and PMD users.

5.2.2. OECD report

OECD's Road Safety Annual Report 2023 report (OECD, 2023) stated that there were growing concerns regarding the safety of EPACs. Their increased use has led to an increased share in fatalities among cyclists. Data were available from ten countries, which showed that the proportion of cyclists fatalities that were EPAC users has grown over the last few years (Table 13). These figures are mostly similar to those extracted from CARE in Table 11, with the exception of Belgium, Portugal and Slovenia which have higher percentages shown in the OECD report than from CARE; the source of these differences is unknown. In Israel and Switzerland, which are not included in the CARE data, over half of cyclist fatalities in 2022 were EPAC users. Some of these countries are explored in more detail in the following sections.

Table 13: Percentage share of cyclist fatalities that were EPAC users (OECD, 2023)

	2017	2018	2019	2020	2021	2022
Belgium	28%	23%	27%	35%	47%	38%
Denmark		21%	30%	30%	12%	39%
France			8%	9%	11%	18%
Germany	18%	20%	27%	33%	35%	44%
Israel			47%	81%	52%	55%
Italy					6%	10%
Japan	7%	9%	12%	12%	13%	15%
Netherlands	28%	25%	32%	32%	39%	34%
Portugal	4%	0%				26%
Slovenia	25%	0%	0%	0%	0%	13%
Switzerland	19%	29%	38%	31%	41%	55%

The report did not include data on PMDs. However, it was reported that in countries where these data are collected, for example, France, there has been an increase in the number people killed whilst using these vehicles.

5.3. Summary data for individual countries

5.3.1. Belgium

Road casualty statistics in Belgium (STATBEL, 2023) include separate reporting of PMDs and EPAC casualties. Table 14 shows the number of casualties by severity and road user type for 2022.

Table 14: Number of reported road deaths for bicycles, EPAC and PMDs in 2022 by age group (Belgium, 2022)

Road user type	Killed (30 days)	Seriously injured	Slightly injured
Bicycle	62	716	8,136
PMD (<=18km/h)	1	9	194
E-bike (not specified)	9	82	717
EPAC	28	302	2,427
L1e-A	1	19	95
L1e-B	2	67	575
Total bicycles, e-bikes and PMDs	103	1,195	12,144
All road casualties	**540**	**3,400**	**42,134**

There were 62 people riding cycles killed in 2022, 38 e-bike riders killed and two speed pedelec riders killed. In total these road user groups accounted for 19% of all road fatalities in Belgium in 2022.

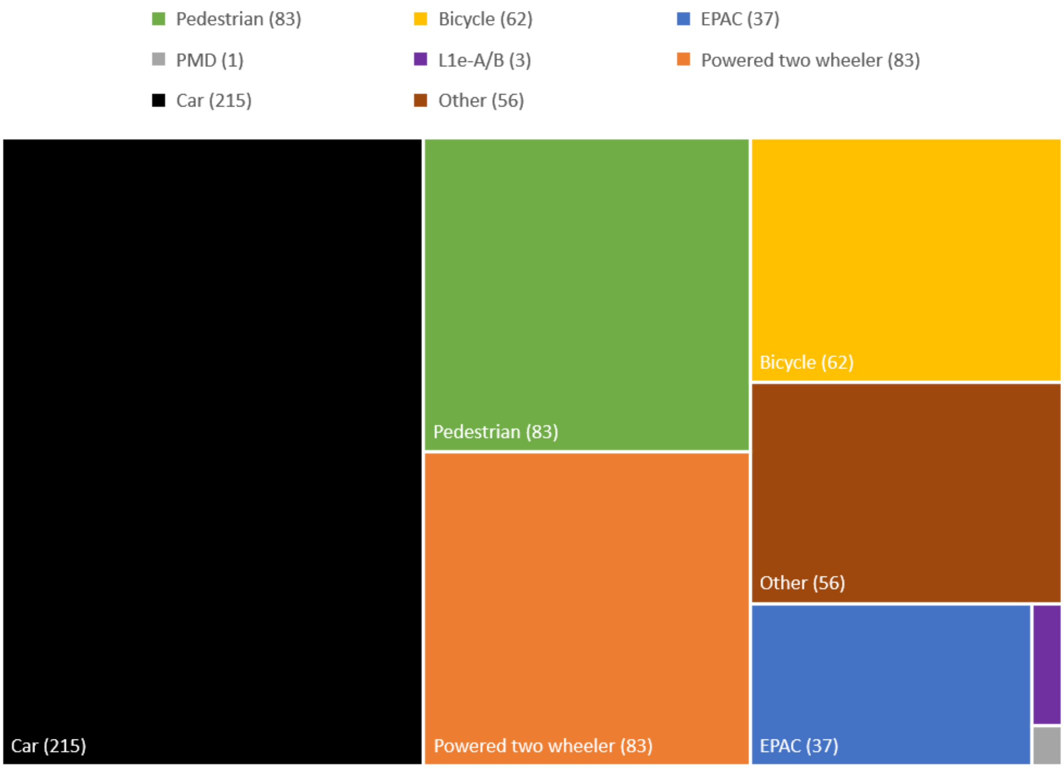

Figure 10: Road collision fatalities by road user group, Belgium, 2022

Figure 11 shows the age distribution of bicycle, PMD, L1e A/B and EPAC user victims in 2022. This shows that PMD users are most commonly younger adults (aged 20-29), although there were also some casualties aged 10-19. Cyclists were commonly aged 10-39, with EPAC casualties being more commonly older adults.

Overall, approximately 60% of victims for these vehicle types were male, this was higher for L1e A/B vehicles (75%) and lower for e-bikes (50%).

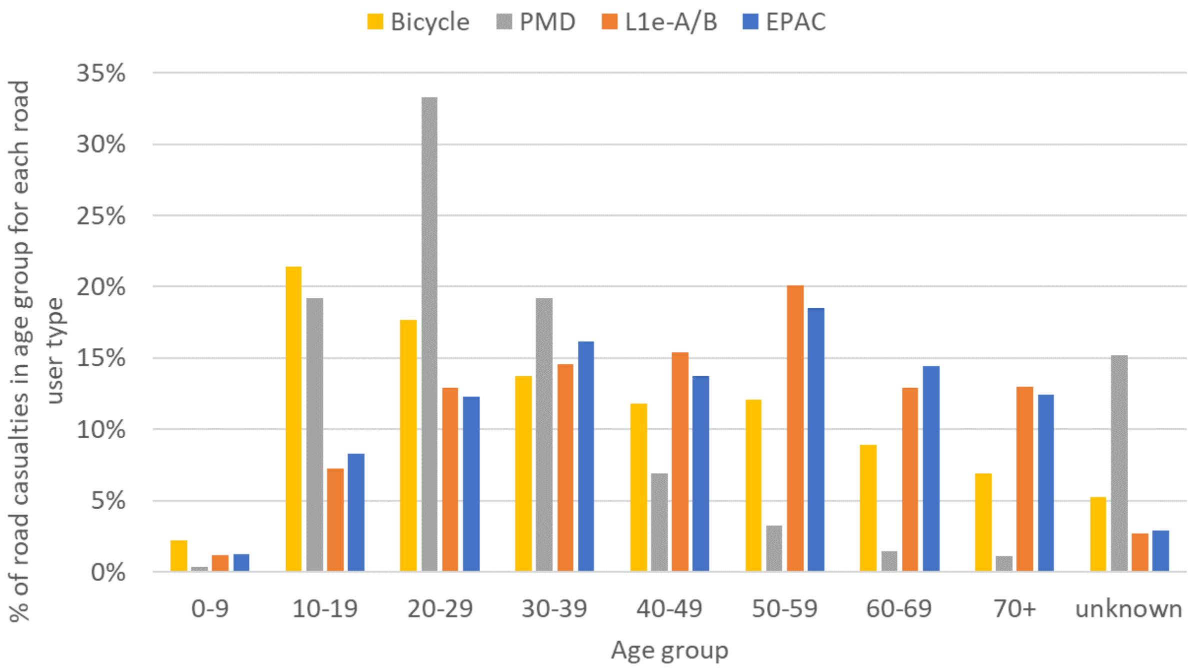

Figure 11: Road collision victim distribution by age group, Belgium, 2022

Analysis by time of day (Figure 12) shows that L1e-A/B victims had peaks in the morning and evening, whereas the other road user types had a gradual increase throughout the day, with a peak between 4pm and 6pm (and up to 8pm for PMDs).

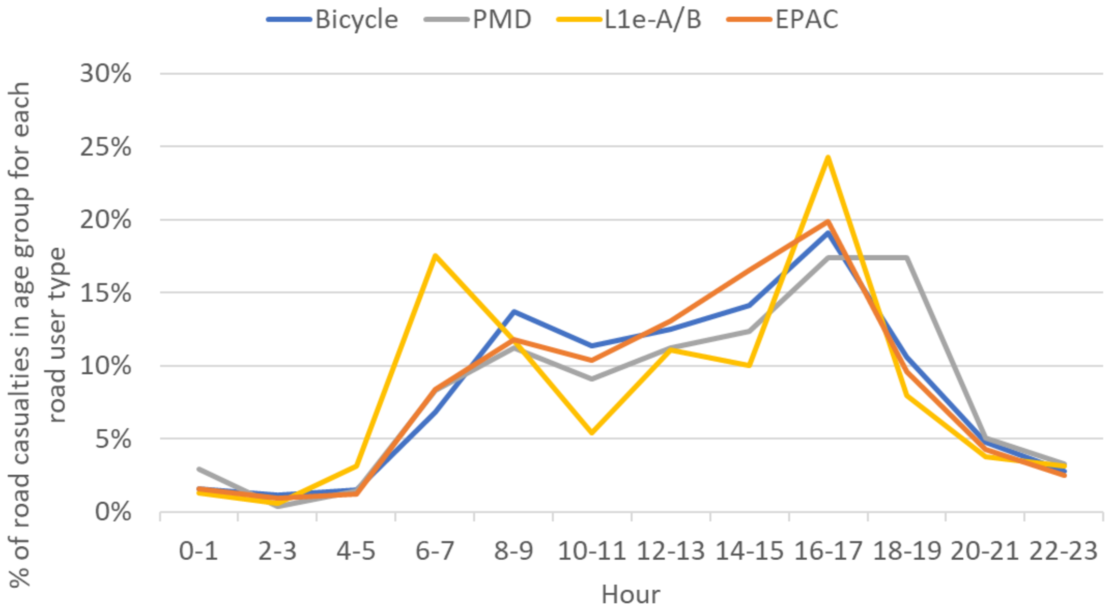

Figure 12: Road collision victim distribution by hour, Belgium, 2022

5.3.1. Denmark

In Denmark, road user types recorded in collisions include motorcycle, moped, bicycle and EPACs. The summary publication (Danmarks Statistik, 2023) gives the number of casualties reported by the police between 2020 and 2022 (Table 15).

This shows that approximately 5% of police reported casualties were electric bike users in 2022. The 2021 data also gives the number of total injuries, this includes both police reported and hospital reported and gives approximately ten times as many casualties overall. For cyclists there were approximately 20 times as many total casualties compared with those reported by the police, and for e-bikes approximately five times as many.

Table 15: Personal injuries by means of transport by year, Denmark, 2020-2022 (Danmarks Statistik, 2023)

	Injuries recorded by police, 2020	Injuries recorded by police, 2021	Total injuries 2021 (police + hospital departments)	Injuries recorded by police, 2022
Car, van, lorry, bus, tractor	1,239	1,142	10,354	1,245
Motorcycle	268	204	848	228
Moped	226	190	1,989	200
Bicycle	708	721	14,052	695
EPAC	91	132	693	138
Pedestrians	372	338	789	407
Other or unknown	10	10	1,367	4
Total	**2,914**	**2,737**	**30,092**	**2,917**

Table 16 shows the split of injuries recorded by the police in 2022 by means of transport and severity.

Table 16: Personal injuries by means of transport, Denmark, 2022 (Danmarks Statistik, 2023)

Injuries recorded by police, 2022	Car, van, lorry, bus, tractor	Motorcycle	Moped	Bicycle	EPAC	Pedestrians	Other or unknown	Total
Killed	78	18	7	14	9	28	-	**154**
Seriously injured	618	174	128	438	86	270	4	**1,718**
Slightly injured	549	36	65	243	43	109	-	**1,045**
Total	**1,245**	**228**	**200**	**695**	**138**	**407**	**4**	**2,917**

Analysis by age group shows that injured moped riders were most commonly younger (aged 15-17), injured cyclists were most commonly aged 25-64, and those injured whilst riding an EPAC were most commonly 45-64 or 65+.

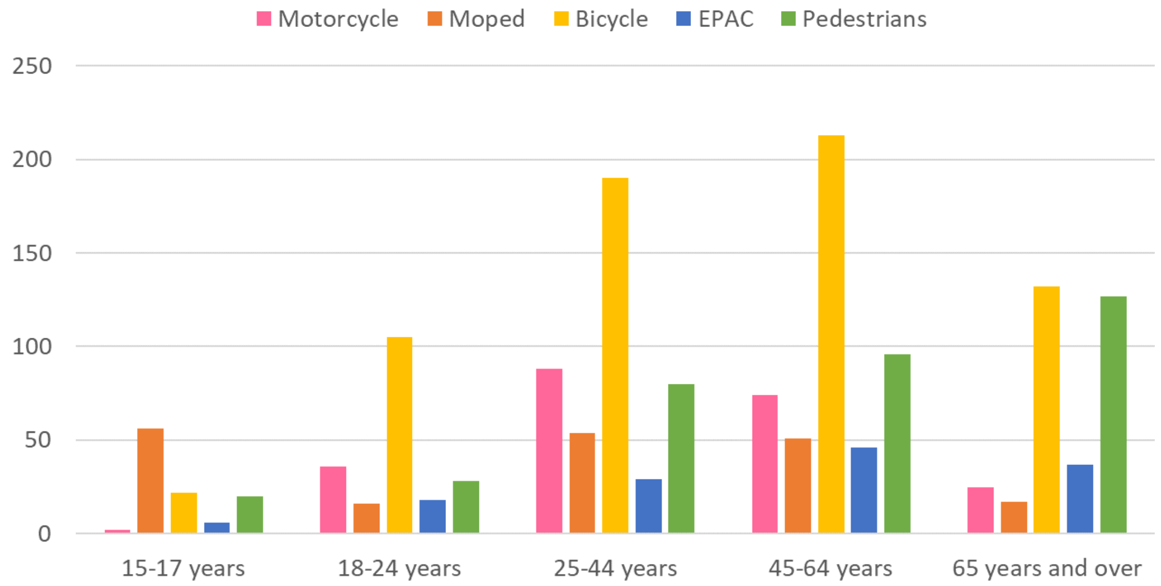

Figure 13: Age distribution of injuries recorded by the police by vehicle type, 2022, Denmark (not including cars etc)

More detailed data was available from an online database up to 2021 for injuries reported by the police and hospitals[3].

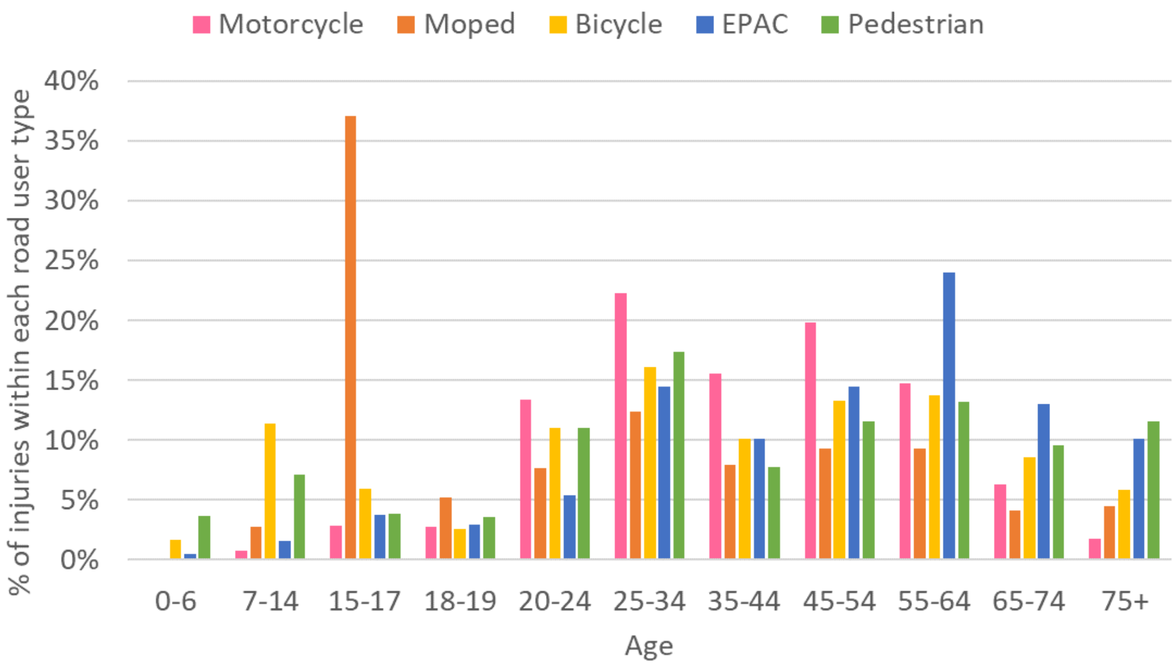

Figure 14: Age distribution of injuries recorded by the police and hospitals by vehicle type, 2021, Denmark (not including cars etc)

The type of injuries recorded was available from the database split into four main categories (head/neck, body, arm, leg). This shows that the injury patterns for cyclists and e-cyclist were similar, with arm injuries the most common, followed by leg. This is in contrast to pedestrians

[3] https://www.statistikbanken.dk/moerke

who were more commonly had leg or other injuries. Cyclists and e-cyclists and pedestrians had a higher level of head/neck injuries compared with motorcycles and mopeds.

Table 17: Type of injuries recorded by the police and hospitals by vehicle type, 2021, Denmark (not including cars etc)

	Motorcycle	Moped	Bicycle	Electric bicycle	Pedestrian
Skull fracture, whip lash, concussion	44	147	2,295	104	102
Injury of chest, abdomen, spine, pelvis	94	143	770	52	48
Injury of shoulder, arm, hand	267	701	6,206	266	143
Injury of hip, leg, foot	233	626	2,720	159	261
the rest	210	372	2,061	112	235
Total	**848**	**1,989**	**14,052**	**693**	**789**

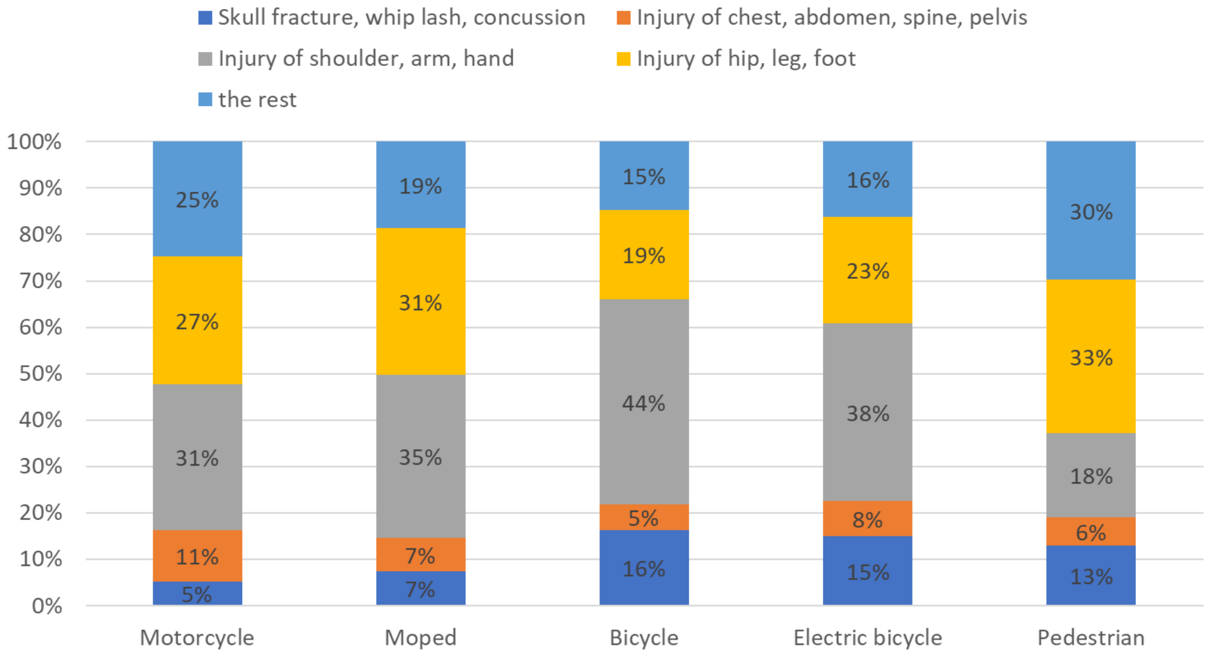

Figure 15: Type of injuries recorded by the police and hospitals by vehicle type, 2021, Denmark (not including cars etc)

5.3.2. France

5.3.2.1. Definitions

In France, a personal injury collision is defined as one which involves certain types of road users. These are classified according to the severity of injuries as follows:

- uninjured people: those involved who are not deceased and whose condition does not require any care medical due to the accident,

- the victims: involved not unharmed.
- people killed: people who die as a result of the accident, instantly or within thirty days following the accident,
- injured people: victims not killed.
    - so-called “hospitalized” injured: victims hospitalized for more than 24 hours,
    - lightly injured: victims who have received medical care but have not been admitted as patients to the hospital for more than 24 hours.

5.3.2.2. Casualty data from annual report

The annual report on road safety in France (Observatoire national interministériel de la sécurité routière (ONISR), 2024) includes analysis by road user group which includes PMDs. Between 2019 and 2022, 15% of fatalities were pedestrians, 0.6% were PMD users and 7% were cyclists (Figure 16).

Since 2020, the proportions of vulnerable road users (pedestrians, cyclists, users of powered mobility devices and powered two-wheelers) among those killed or seriously injured has increased, especially PMDs (as shown in Figure 17).

Table 18: Mainland France reported road casualties by year and injury level (France, 2020-2022

Severity	Year	Pedestrian*	PMDs†	Cycles	Powered two and three wheelers	Passenger Vehicles	Other	Total
Killed	**2019**	483	10	187	749	1,622	193	**3,244**
	2020	391	7	178	579	1,243	143	**2,541**
	2021	414	24	227	668	1,414	197	**2,944**
	2022	488	35	245	718	1,565	216	**3,267**
	2019-2022	1,776	76	837	2,714	5,844	749	**11,996**
	%	*14.8%*	*0.6%*	*7.0%*	*22.6%*	*48.7%*	*6.2%*	***100.0%***
Estimated injuries with injury 3+ according to MAIS (Maximum Abbreviated Injury Scale)	**2019**	2,315	158	2,314	5,742	5,173	547	**16,248**
	2020	1,720	211	2,314	4,751	3,898	443	**13,337**
	2021	1,967	413	2,709	5,653	4,670	531	**15,944**
	2022	1,996	604	2,628	5,346	4,807	576	**15,956**
	2019-2022	7,997	1,386	9,966	21,492	18,547	2,096	**61,485**
	%	*13.0%*	*2.3%*	*16.2%*	*35.0%*	*30.2%*	*3.4%*	***100.0%***

Severity	Year	Pedestrian*	PMDs†	Cycles	Powered two and three wheelers	Passenger Vehicles	Other	Total
Estimated injuries with injury 1 or 2 according to MAIS scale	**2019**	17,705	4,261	35,411	56,231	102,190	6,999	**222,797**
	2020	12,842	5,785	35,986	45,336	78,672	5,463	**184,084**
	2021	15,184	10,843	41,439	54,154	96,236	6,186	**224,042**
	2022	15,059	15,281	39,886	50,056	93,895	6,701	**220,878**
	2019-2022	60,790	36,171	152,722	205,778	370,993	25,348	**851,802**
	%	***7.1%***	***4.2%***	***17.9%***	***24.2%***	***43.6%***	***3.0%***	***100.0%***

** Pedestrians includes those on skateboards, rollerblades etc*

† PMDs includes e-scooters, monowheels, hoverboards etc

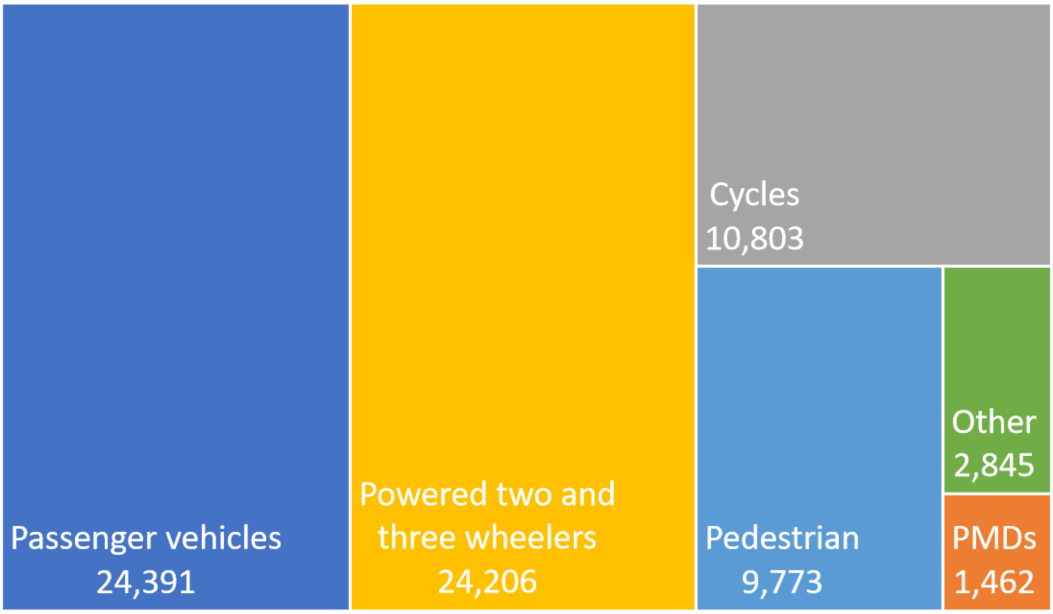

Figure 16: Number of killed and MAIS3+ injuries by road user type, France, 2019-2022

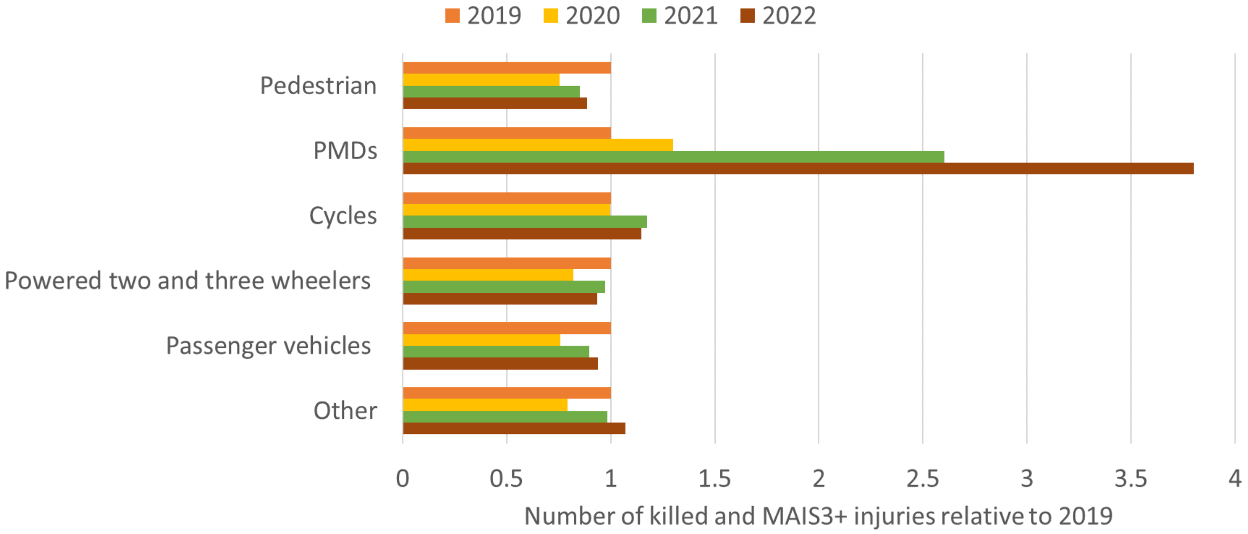

Figure 17: Number of killed and MAIS3+ injuries by road user type relative to 2019, France, 2019-2022

In 2022 35 people were killed whilst using a PMD. PMD users represented 1% of fatalities and 5% of injuries. The majority of casualties in collisions involving PMDs were the PMD users; there were 2 pedestrians killed in collisions involving a PMD.

Over the period 2019 to 2022:

- Among 76 recorded as killed in PMD collisions, 5 were electric wheelchair users
- Half of those killed in PMD collisions were aged between 18 and 34 years old.
- Among the 76 people killed in PMD collisions, 63 were men, 13 were women,
- Victims in PMD collisions were primarily in urban areas: 60 deaths out of 76 (2019-2022),
- 45 of the 76 killed in PMD collisions were at night. This is even more marked among people aged 18 to 34 in PMDs who are more often killed at night than cyclists, but less than pedestrians of the same age group.
- 37% of PMD riders for whom screening was able to be carried out had a blood alcohol level higher than the legal rate.
- Among the 76 PMD users killed in 2019-2022, 25 were in collisions with a single car, 23 had no other parties involved and 3 were in collisions with another PMD.
- Over the more recent period 2021-2022, in urban areas, mortality of 18-34 year olds in PMD collisions (20 killed) was similar to that of cyclists of the same age (22 killed).

Data files for collisions, vehicles and users are available as downloads for each year from Observatoire national interministériel de la sécurité routière (ONISR), but have not been analysed here as the summary above was considered enough detail.

5.3.3. Germany

5.3.3.1. definitions

The database of collisions in Germany is available online (Statistisches Bundesamt (Destatis), 2024). The road user types recorded include:

- motorcycle with insurance plate (proof of insurance for the vehicle, typically bought annually from an insurer, applicable for mopeds under 45km/h and L6e quadricycles)
- motorcycle with official number plate
- cycle without auxillary motor
- pedelecs (EPACs) (from 2014)
- small electric vehicles (e-scooters). from 2021

The severity of casualties in Germany is recorded in three categories:

- Killed - all persons who died within 30 days as a result of the accident.
- Seriously injured - all persons who were immediately taken to hospital for inpatient treatment (of at least 24 hours).
- Slightly injured - all other injured persons.

5.3.3.2. Road user casualties by severity and mode

Table 19 shows the number of people killed and injured in Germany in 2021 and 2022 by road user type.

Table 19: Number of people injured by severity, year and road user type, Germany 2021 and 2022 (Statistisches Bundesamt (Destatis), 2024)

Road user type	Killed		Serious		Slight		Total	
Motorcycle with insurance plate	113	2.1%	4,230	3.7%	19,438	3.4%	23,781	3.4%
Motorcycle with official number plate	965	18.0%	16,000	14.2%	34,109	6.0%	51,074	7.4%
E-scooters	15	0.3%	1,886	1.7%	10,413	1.8%	12,314	1.8%
Cycle without auxiliary motor	507	9.5%	22,158	19.6%	120,026	21.0%	142,691	20.7%
Pedelecs (EPACs) (<250W, <25 km/h)	339	6.3%	8,849	7.8%	30,576	5.4%	39,764	5.8%
All road users (100%)	5,350	100.0%	112,864	100.0%	571,399	100.0%	689,613	100.0%

This shows that over the two years there were 339 EPAC users killed (6.3%) and 15 (0.3%) e-scooter users killed. Motorcycles with official number plates had the highest proportion of casualties that were killed or seriously injured (33%). This figure was 23% for EPAC users, 18% for motorcycles with insurance plate, 16% for bicycles and 15% for PMD users. The severities are likely to be influenced by the speed of vehicle and the types of roads that are used by these vehicles. This is explored in the next section.

Figure 18 shows how the percentage of killed and serious casualties that are these road user groups have changed over time. Note that EPACs were only recorded from 2014 and PMDs from 2021. This shows that EPAC casualties increased steadily between 2014 and 2019 and then saw a large increase in 2020, and have since shown a steady increase. This is likely to be due to increased use of these vehicles, particularly during the COVID-19 pandemic.

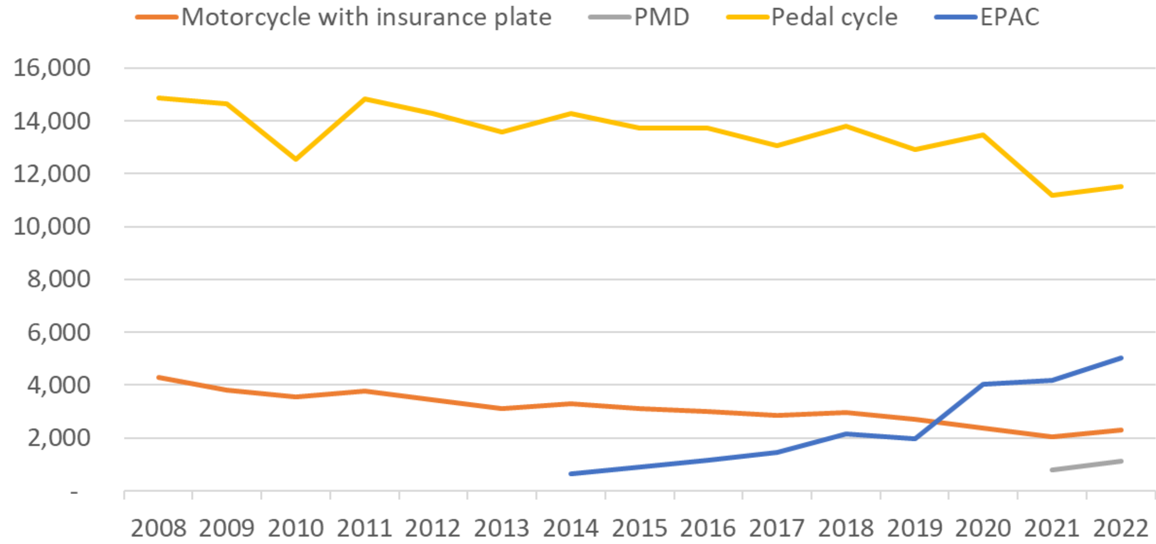

Figure 18: Percentage of killed and seriously injured casualties by road user type (Germany, 2008-2022) (Statistisches Bundesamt (Destatis), 2024)

5.3.3.3. Road type

Table 20 shows the casualties split by road type. For seriously and slightly injured, for motorcycles with insurance plates, EPACs, PMDs and cycles, the majority of injuries occurred inside built-up areas; this is likely to reflect where these vehicle are used. In contrast, motorcycles with official number plates were more likely to be injured outside of built-up areas. For fatalities there was a higher proportion outside built-up areas than for serious injuries; this is likely to reflect higher speeds resulting in more severe injuries.

Table 20: 2021+2022 number and % by road type, Germany (Statistisches Bundesamt (Destatis), 2024)

		Inside built-up areas		Outside built-up areas *		On motorways/ freeways		Total (100%)
Motorcycle with insurance plate	killed	52	46%	61	54%	-	0%	113
	seriously injured	3,144	74%	1,083	26%	3	0%	4,230
	slightly injured	16,502	85%	2,930	15%	6	0%	19,438
	Total	19,698	83%	4,074	17%	9	0%	23,781
Motorcycle with official number plate	killed	156	16%	747	77%	62	6%	965
	seriously injured	6,336	40%	9,058	57%	606	4%	16,000
	slightly injured	20,602	60%	12,672	37%	835	2%	34,109

		Inside built-up areas		Outside built-up areas *		On motorways/ freeways		Total (100%)
	Total	27,094	53%	22,477	44%	1,503	3%	51,074
E-scooters	killed	9	60%	6	40%	-	0%	15
	seriously injured	1,767	94%	119	6%	-	0%	1,886
	slightly injured	10,085	97%	325	3%	3	0%	10,413
	Total	11,861	96%	450	4%	3	0%	12,314
Pedal cycles	killed	327	64%	180	36%	-	0%	507
	seriously injured	18,124	82%	4,031	18%	3	0%	22,158
	slightly injured	109,574	91%	10,431	9%	21	0%	120,026
	Total	128,025	90%	14,642	10%	24	0%	142,691
EPACs (<250W, <25km/h)	killed	149	44%	190	56%	-	0%	339
	seriously injured	6,324	71%	2,525	29%	-	0%	8,849
	slightly injured	25,578	84%	4,992	16%	6	0%	30,576
	Total	32,051	81%	7,707	19%	6	0%	39,764

** outside urban areas does not include motorways/freeways*

5.3.3.4. Age/sex of people involved (2021-22)

Figure 19 shows the split of KSI road users by gender. For all of the vehicle categories shown there were more male casualties than female casualties.

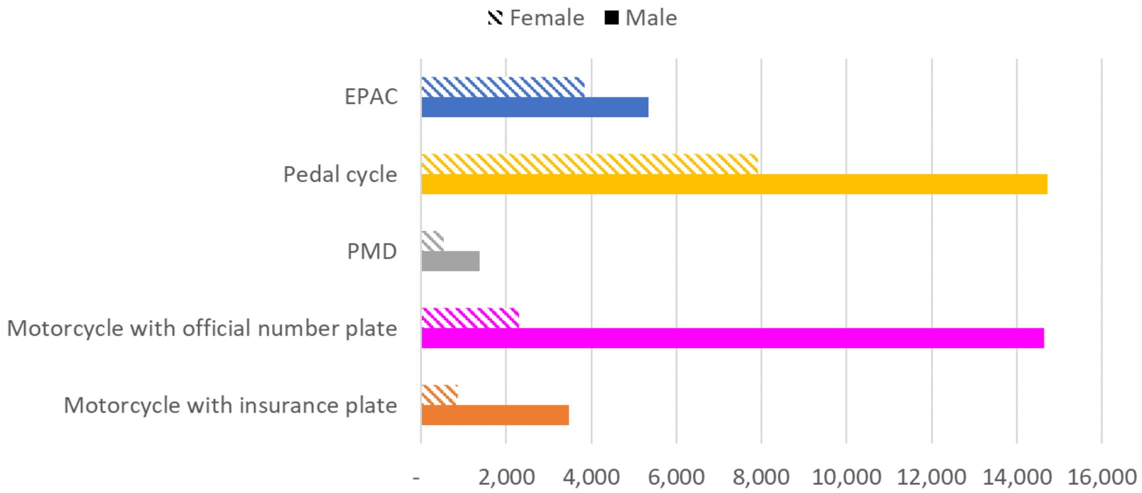

Figure 19: Male and female split of KSI road users by vehicle type, 2021+2022, Germany (Statistisches Bundesamt (Destatis), 2024)

The distribution by age Figure 20 shows that the most common age groups for KSI injuries were

- Motorcycle with insurance plate: 15 to 19 years (22%), followed by 55-65 (18%) and 45-55 (11%)
- Motorcycle with official number plate: 55-65 years (21%) followed by 45-55 (16%)
- Small electric vehicles: 25-35 years (24%) followed by 35-45 (18%)
- Cycle without auxiliary motor: 55-65 years (20%) followed by 45-55 (15%)
- EPACs: 55-65 years (26%) followed by 65-75 (22%)

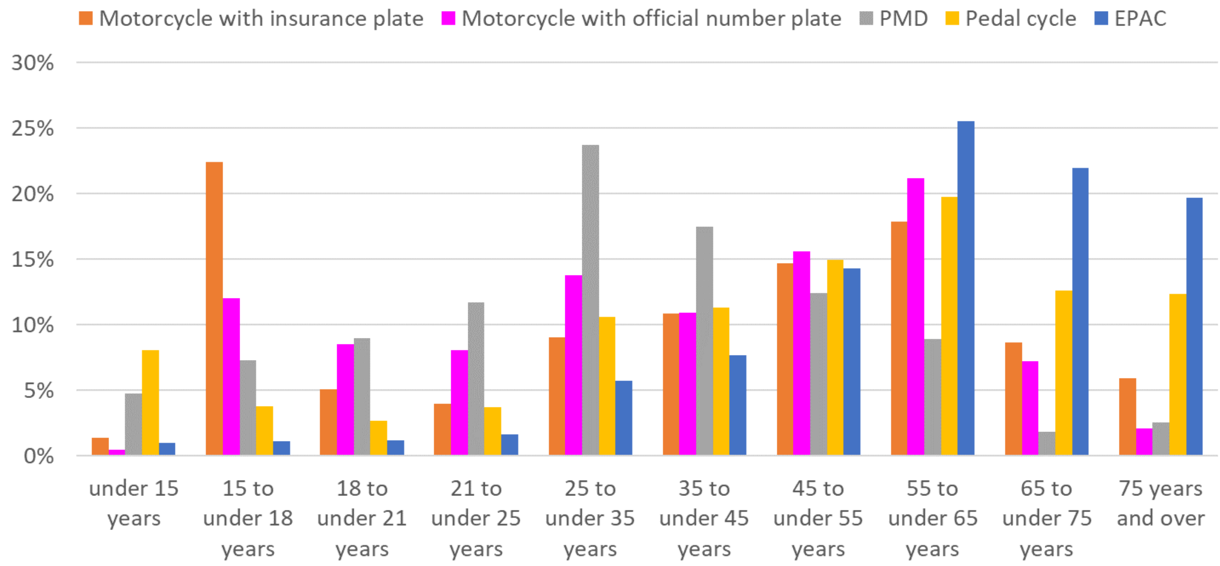

Figure 20: Age distribution of KSI road users by vehicle type, 2021+2022, Germany (Statistisches Bundesamt (Destatis), 2024)

Figure 21 shows the split of road user group KSIs for each age group; the other road user types, which would make each bar up to 100% are not shown. This shows that children aged under 15 years represented the largest proportion of KSIs involving bicycles (29%). The next age group (15 to 18) had a smaller proportion of KSIs involving bicycles, but the largest proportion of KSIs involving motorcycles with insurance plate (18%) and motorcycles with official number plate (37%). The age groups from 18 years onwards have a much lower percentage of KSIs involving motorcycles with insurance plate. The proportions of KSIs involving pedelecs increases from 2% of 21-25 year olds, up to a maximum of 17% for ages 65-75.

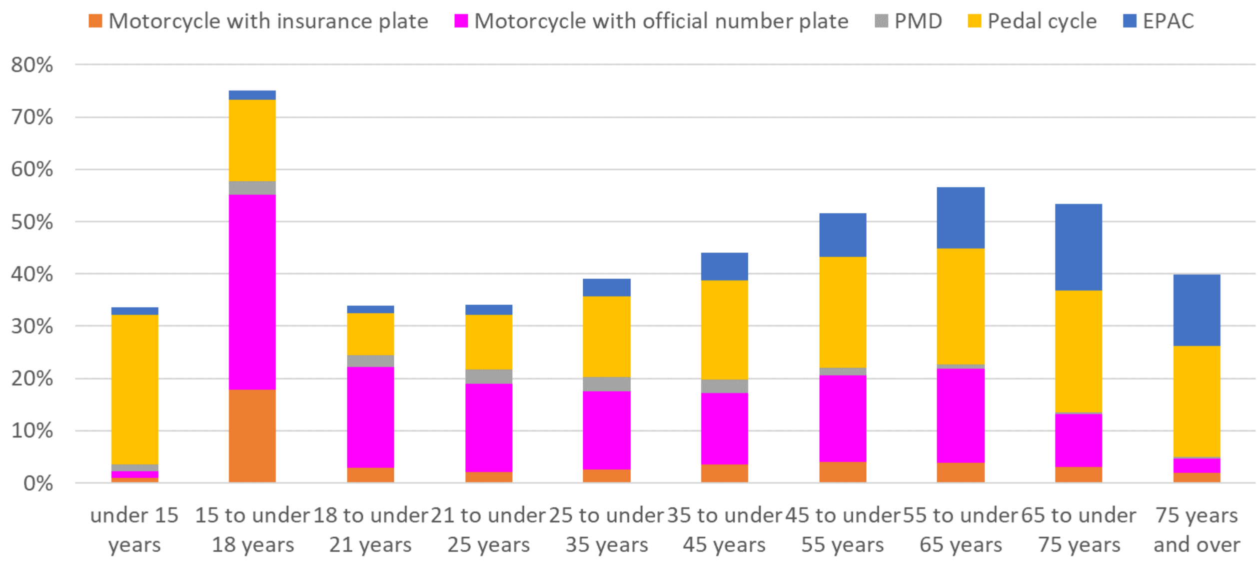

Figure 21: Road user type distribution of KSI road users by age group, 2021+2022, Germany (Statistisches Bundesamt (Destatis), 2024)

5.3.3.5. Causes

The database includes the misconduct of drivers and pedestrians in collisions, based on the judgment of the reporting police officer. Up to three causes can be reported for up to two road users involved (in addition to two general causes such as road conditions, weather, obstacles, etc) per collision.

Table 21 shows the misconduct of drivers and pedestrians for collisions involving motorcycles, cycles and small electric vehicles. The most common three are highlighted in darker green, next three in lighter green.

- For cycles and EPACs
  - the most common three causes were ‘incorrect road use’, ‘inappropriate speed for the conditions’ and ‘other driver errors’.
- For motorcycles (with insurance plate and with official number plate)
  - the most common three causes were ‘inappropriate speed for the conditions’, ‘distance error’ and ‘other driver errors’.
- For e-scooters
  - the most common three causes were ‘influence of alcohol’, ‘incorrect road use’ and ‘other driver errors’.

Table 21: 2021+2022 causes by parties involved in injury collisions, Germany (Statistisches Bundesamt (Destatis), 2024)

Misconduct of drivers and pedestrians	Motorcycle with insurance plate	Motorcycle with official number plate	Small electric vehicles	Cycle without auxiliary motor	Pedelcs (EPACs)
Influence of alcohol	1,289	830	2,630	7,788	2,594
Influence of other intoxicating substances (e.g. drugs)	342	254	265	645	152
Fatigue, other physical/mental problems	147	168	52	1,013	362
Distraction	277	506	163	2,078	616
Incorrect road use	976	1,586	2,667	17,175	3,741
Inappropriate speed for the conditions	3,096	11,159	1,061	8,356	3,052
Distance error	1,802	4,721	376	4,581	1,151
Error when overtaking/being overtaken	589	2,995	136	2,538	665
Error when passing	42	46	10	241	61
Error when travelling side by side	178	286	20	318	52
Failure to observe right of way, priority	985	924	736	7,837	1,750
Error when leaving a road, reversing etc	1,173	1,148	820	8,583	1,522
Incorrect behaviour towards pedestrians	169	156	537	2,445	389
Not permitted stopping/parking inadequate road safety measure	7	19	20	66	22
Failure to comply with lighting rules	15	3	4	230	30
Excessive load or passengers. overload, inadequately, secured cargo	14	14	226	412	49
Other driver errors	5,178	8,753	4,831	37,247	12,677
Technical faults	300	501	128	2,114	301
Incorrect behaviour of pedestrians cross. the road	0	0	0	0	0
Other pedestrian errors	0	0	0	0	0

The main party responsible for the accident was also recorded (see Table 22). Small electric vehicles had the highest percentage of collisions-involved road users who were reported as responsible for the collision (68%). For pedelecs and cycles this proportion was slightly lower (53% and 49% respectively).

Table 22: 2021 + 2021 personal injury accidents parties involved in the accident and main party responsible, Germany (Statistisches Bundesamt (Destatis), 2024)

Vehicle type	Parties involved in the accident	Main party responsible for the accident	% responsible
Motorcycle with insurance plate	23,757	13,165	55%
Motorcycle with official number plate	51,095	28,886	57%
E-scooters	14,058	9,543	68%
Cycle without auxiliary motor	155,620	76,457	49%
EPACs	41,963	22,090	53%
Total	**1,016,411**	**548,659**	**54%**

5.3.1. Italy

In the CARE database, data for e-bikes/PMDs were available for Italy. The summary of collisions in 2022 (Istat, 2023) shows that there were 3,159 victims, split by road user type as shown in Table 23.

Table 23: Road collision victims in Italy, 2022 (Istat, 2023)

Road user type	% of victims, 2022
Cars	43.5%
Motorcycles	24.7%
Pedestrians	15.4%
EPACs and pedal cycles	6.5%
Trucks	5.3%
Mopeds	2.2%
Electric scooters	0.5%
Other road users	1.9%
Total (100%)	**3,159**

The figures for EPACs and bicycles were not separated in the 2023 annual report above, together accounting for 6.5% of victims. E-scooters were reported separately, accounting for 0.5% of victims.

Further data on e-scooters, EPACs and pedal cycles for 2021 and 2022 from the annual reports ((IStat, 2022) and (Istat, 2023)) is shown in Table 24. This shows that the majority of injured (97% overall) in these collisions were the e-scooter, EPAC or pedal cycle rider (or passenger). In 2022, 4.5% of injuries in e-scooter collisions were pedestrians, compared with and 3.1% for e-bikes and 2.4% for pedal cycles.

Table 24: Road collision e-scooter data in Italy, 2022

Year	Vehicle type	Collisions involving	Injured riders and passengers	Killed riders and passengers	Injured pedestrians	Killed pedestrians
2021	e-scooter	2,101	1,980	9	127	1
2021	EPAC	691	671	13	408	5
2021	Pedal cycles	15,771	15,386	207		
2022	e-scooter	2,929	2,787	16	131	0
2022	EPAC	1,113	1,077	20	34	1
2022	Pedal cycles	15,981	15,600	185	378	2

5.3.1. Netherlands

In the Netherlands, the largest share of fatalities in 2022 was cyclists (39%) (SWOV, 2023), and at least one in three of these fatalities were pedelec riders. About 7% of fatalities were (light) moped riders, including microcars or speed pedelecs.

A SWOV factsheet on electric bicycles and speed pedelecs (SWOV, 2022) states that in 2020 there were 229 cyclist fatalities, of which almost one in three were pedelec riders (although for some cyclists it was not known whether the cycle was electric or not, and therefore this should be considered a lower limit). There were about 12,000 serious injuries to cyclists registered in hospitals, but the number of these who were pedelec riders could not be ascertained. More than a quarter of the total cycling distance travelled in 2020 was ridden by electric bicycle; cyclists aged 65 and older in particular opt for an electric bike.

No further information was published about the pedelec casualties.

5.3.2. Poland

The data from CARE showed that some data were available on PMDs and electric scooters in Poland. The annual reports produced by Polish Police Statistics (Statistics - Polish Police Portal, 2024) show the number of collisions and casualties by vehicle type (see Table 25).

Table 25: Road collisions and casualties by vehicle type, Poland, 2023 (Statistics - Polish Police Portal, 2024)

Vehicle type	Accidents	%	Killed	%	Injured	%
Passenger car	14,013	73.5%	1,152	71.0%	16,981	76.1%
Bicycle	1,313	6.9%	75	4.6%	1,282	5.7%
Moped	308	1.6%	29	1.8%	298	1.3%
Motorcycle	592	3.1%	104	6.4%	571	2.6%
Motorcycle up to 125cm^3	155	0.8%	13	0.8%	158	0.7%
Bus	350	1.8%	19	1.2%	440	2.0%
Truck	1,481	7.8%	193	11.9%	1,714	7.7%
Agricultural tractor	97	0.5%	13	0.8%	94	0.4%
Four wheeler	43	0.2%	8	0.5%	38	0.2%
Light quadricycle	20	0.1%	4	0.2%	18	0.1%
Tram/trolleybus	38	0.2%	-	-	54	0.2%
Electric scooter	264	1.4%	3	0.2%	269	1.2%
PMD	8	<0.05%	-	-	8	0.0%
Other	38	0.2%	2	0.1%	49	0.2%
Unknown	338	1.8%	7	0.4%	354	1.6%
Total	**19,058**	**100.0%**	**1,622**	**100.0%**	**22,328**	**100.0%**

There were 264 collisions involving an e-scooter and a further 8 involving a PMD. The e-scooter collisions resulted in 3 fatalities and 269 injuries.

There were 49 collisions where an e-scooter hit a pedestrian, resulting in 1 pedestrian fatality and 45 pedestrians injured. There were 24 collisions which involved a cyclist and an e-scooter, resulting in 16 cyclist injuries

68 of the e-scooter collisions involved the rider under the influence of alcohol, resulting in 71 injuries.

Two of the PMD collisions were with bicycles, resulting in one injury.

5.3.3. Portugal

No published statistics were found relating to e-bikes or PMDs on the national website (ANSR, n.d.).

5.3.4. Slovenia

The 2023 annual report on collisions in Slovenia (Public Agency of the Republic of Slovenia for Traffic Safety, 2024) includes figures for e-bikes and PMDs.

There were 82 fatalities in 2023; none were e-scooter users and two were e-cyclists. In both cases the e-cycles were in collisions with no other vehicle. No further information was provided about the circumstances of the collisions or the users involved.

5.3.5. Spain

Victims of road accidents statistical tables for Spain for 2022 (DGT, 2024) provides the number of road users in fatal and injury collisions involving (Table 26).

This shows that there were 91 bicycles and 10 PMDs involved in fatal collisions in 2022 (13% and 0.3% of all road user fatalities, respectively).

Table 26: Vehicles by type and pedestrians that have been involved in accidents depending on their severity. Spain, 2022 (DGT, 2024)

	Total number of injury collisions	Number of fatal collisions		Collisions with injured	
		Number	%	Number	%
Pedestrian	13,802	394	13.4%	13,408	7.4%
Bicycle	8,673	91	3.1%	8,582	4.8%
PMD	4,724	10	0.3%	4,714	2.6%
Moped	5,751	39	1.3%	5,712	3.2%
Motorcycle	28,120	432	14.7%	27,688	15.4%
Car	100,240	1,299	44.2%	98,941	54.9%
Van	11,419	278	9.5%	11,141	6.2%
Truck	3,708	284	9.7%	3,424	1.9%
Agricultural	415	37	1.3%	378	0.2%
Bus	2,304	42	1.4%	2,262	1.3%
Quadricycle	285	5	0.2%	280	0.2%
Train/subway/tram	74	4	0.1%	70	0.0%
Other	2,342	18	0.6%	2,324	1.3%
unknown	1,221	7	0.2%	1,214	0.7%
Total	**183,078**	**2,940**	**100.0%**	**180,138**	**100.0%**

The vast majority (97%) of PMD victims were in collisions in urban areas (70% for bicycles, 88% for mopeds, 75% for motorcycles).

Table 27 shows the split between males and females. At least 75% of cyclists, moped users and motorcyclist victims were male; for PMDs the percentage of victims that were males was lower (59%) and 39% were female.

Table 27: Cycle, PMD, moped and motorcycle victims by gender Spain, 2022 (DGT, 2024)

	Bicycle	PMD	Moped	Motorcycle
Male	6,823	2,768	4,296	23,640
Female	1,665	1,856	1,400	4,134
unknown	90	77	14	72
Total	**8,578**	**4,701**	**5,710**	**27,846**

Figure 22 shows the age distribution of victims by vehicle type. For mopeds, the most common age group for victims was 15-20 years, accounting for 31% of victims, with reducing percentages for older age groups. For PMDs, the most common age group was 21-29 years, accounting for 26% of victims, with reducing percentages for each older age group. Motorcyclists and cyclists were generally older, with peaks for ages 30-39 and 40-49 years, respectively.

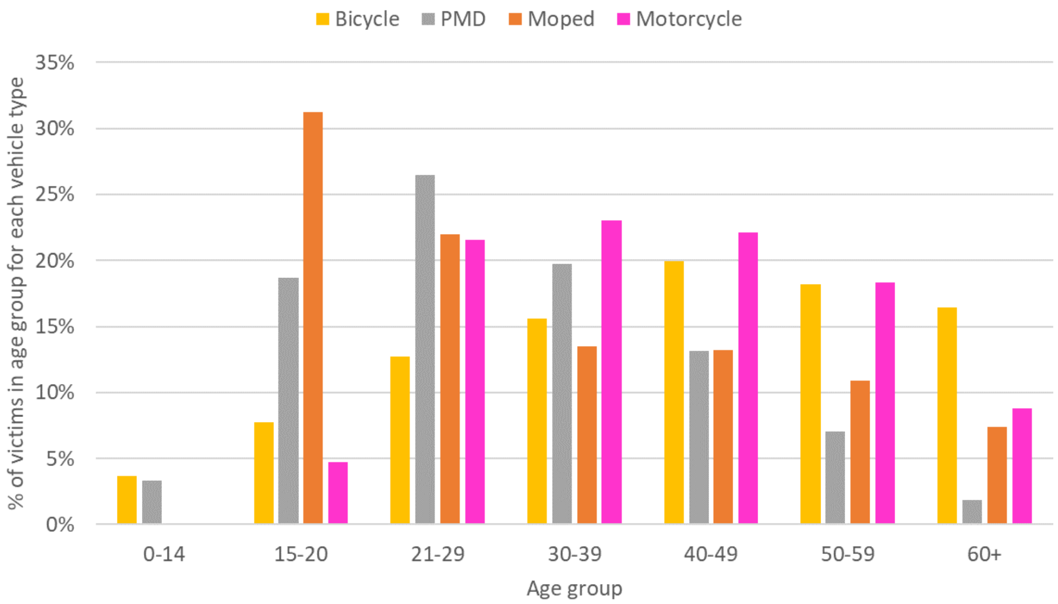

Figure 22: Distribution of victims by age group by road user type, Spain, 2022 (DGT, 2024)

The table below shows the violations recorded for collision-involved vehicles. In all categories there are large number of unknowns. A collision might also involve road users who committed more than one violation. Overall, where known, PMD riders had a higher level of violations (53%) compared with users of other vehicle types (bicycles-40%, moped-45%, motorcycle-43%)

Table 28: Vehicles by type and pedestrians that have been involved in accidents depending on their severity. Spain, 2022 (DGT, 2024)

Type of violation	Bicycle		PMD		Moped		Motorcycle	
	Number	*% of knowns*	Number	% of knowns	Number	% of knowns	Number	% of knowns
SPEED VIOLATION								
Speed violation	287	*6.8%*	170	*7.5%*	256	*9.1%*	1,464	*12.2%*
Slow movement hindering circulation	3	*0.1%*	1	*0.0%*	5	*0.2%*	9	*0.1%*
No speed violation	3,900	*93.1%*	2,089	*92.4%*	2,540	*90.7%*	10,567	*87.8%*
DRIVER VIOLATIONS								
Failure to respect STOP sign	84	*1.6%*	56	*1.6%*	71	*0.6%*	88	*1.7%*
Failure to respect pedestrian crossing	56	*2.1%*	65	*1.4%*	45	*1.4%*	175	*1.1%*
Not respecting other priority regulations	354	*10.1%*	320	*8.6%*	306	*6.1%*	830	*7.2%*
Driving in the opposite direction or in a prohibited place	260	*12.9%*	416	*1.1%*	45	*0.9%*	135	*5.3%*
Partially invade the opposite direction	108	*1.4%*	47	*1.1%*	59	*0.8%*	224	*2.2%*
Overtaking illegally	74	*2.1%*	65	*3.3%*	113	*3.4%*	543	*1.5%*
Not maintaining the safety gap	211	*2.2%*	71	*7.2%*	256	*7.4%*	1,310	*4.3%*
Other violation	96	*1.8%*	60	*2.6%*	101	*2.0%*	305	*2.0%*
No infringement	3,680	*65.7%*	2,037	*73.2%*	2,653	*77.4%*	11,569	*74.8%*
DOOR OPENING VIOLATIONS								
Opening doors without caution	0	*0.0%*	0	*0.0%*	0	*0.0%*	0	*0.0%*

Type of violation	Bicycle		PMD		Moped		Motorcycle	
	Number	*% of knowns*	Number	% of knowns	Number	% of knowns	Number	% of knowns
No infringement	3,770	*100.0%*	1,937	*100.0%*	2,575	*100.0%*	11,340	*100.0%*
LIGHTING VIOLATIONS								
Incorrect use of lighting	87	*1.3%*	27	*0.4%*	12	*0.3%*	33	*2.3%*
No infringement	3,770	98.7%	1,937	99.6%	2,575	99.7%	11,340	97.7%
VEHICLE LOADING VIOLATIONS								
Excess, poor conditioning or load shedding	7	*0.5%*	9	*0.1%*	2	*0.2%*	15	*0.2%*
No infringement	3,770	*99.5%*	1,937	*99.9%*	2,575	*99.8%*	11,340	*99.8%*
SUMMARY OF VIOLATIONS								
No infringement	1,707	*59.7%*	1,340	*46.8%*	1,301	*55.1%*	5,364	*57.4%*
Any violation	4,321	*40.3%*	2,166	*53.2%*	2,807	*44.9%*	15,246	*42.6%*

The Spanish data also included some information about the condition of collision-involved vehicles (Table 29). In 51 cases (1%) a PMD had some anomaly in terms of vehicle condition. There were 13 PMDs that were reported to have anomalies with brakes. Defects with tyres, blow outs or steering were less common, with less than three cases each.

Table 29: Number of vehicles in collisions by vehicle condition and type of vehicle Spain, 2022 (ref)

	Bicycle	PMD	Moped	Motorcycle
VEHICLE CONDITION				
No abnormality	8,531	4,673	5,683	27,925
With some anomaly	142	51	68	195
TYRES				
Very worn or defective tyres	21	3	17	71
Without anomalies or with others different from the previous ones	8,652	4,721	5,734	28,049

	Bicycle	PMD	Moped	Motorcycle
BLOWOUT				
Blowout	7	1	1	10
Without anomalies or with others different from the previous ones	8,666	4,723	5750	28,110
STEERING				
Previous steering anomalies	3	2	4	12
Without anomalies or with others different from the previous ones	8,670	4,722	5,747	28,108
BRAKES				
Previous brake anomalies	45	13	18	16
Without anomalies or with others different from the previous ones	8,628	4711	5733	28,104
OTHERS				
Other anomalies	72	34	33	91
Without anomalies or with others different from the previous ones	8,601	4,690	5,718	28,029
TOTAL	**8,673**	**4,724**	**5,751**	**28,120**

5.3.1. Austria

The annual report for road casualties in Austria 2021[4] states that 50 people were killed and 9,617 injured whilst riding a bicycle (includes e-bicycle and e-scooter) on Austria's roads in 2021. 24 of these fatalities were riding an e-bike (including e-scooters). Casualties were most commonly males for both e-bikes and conventional cycles, but males were relatively less common casualties for e-bikes. E-bike victims were on average 5 years older than conventional cyclists. There was a higher severity of injuries for e-bikes compared with conventional cyclists (this is likely to be due to the difference in age profiles). The main cause of collisions was reported as carelessness/distraction. No further data was available.

5.3.1. Israel

The 'Trends in Road Safety in Israel 2013-2022' report (Israel National Road Safety Authority, 2023) showed that there was an increase in the number of scooter riders killed or

[4] https://www.statistik.at/fileadmin/publications/Strassenverkehrsunfaelle-2021-barrierefrei.pdf

seriously injured from 8 in 2015 to 323 in 2022. Killed or seriously injured e-bike riders increased from 128 in 2015 to 302 in 2022. There was no further published data available.

A review of electric scooter collisions (Soroker, 2020) stated that the increase between 2018 and 2019 was due to both an increase in the number of privately owner e-scooters and the start of shared e-scooter schemes in cities. The majority of e-scooter casualties were riders aged between 25 and 54.

5.3.2. Switzerland

Up to 2011, electric cycles in collisions were included in the cycle category, but are now available separated (Office fédéral de la statistique, 2023). Table 30 shows the number of casualties by means of transport in 2022.

Table 30: Casualties by means of transport, in 2022 Switzerland (Office fédéral de la statistique, 2023)

	Killed	Seriously injured	Minor injuries	Total	% of total
Passenger car	87	768	7,936	8,791	40%
Motorcycle	46	1,063	2,642	3,751	17%
EPAC	23	560	1,501	2,084	9%
Bike	19	769	2,415	3,203	14%
Walk	36	445	1,465	1,946	9%
Machines assimilated to vehicles. **Scooters (without electric scooters), skateboards, rollerblades, etc.**	4	52	173	229	1%
Other	26	345	1,764	2,135	10%
Total casualties	**241**	**4,002**	**17,896**	**22,139**	**100%**

The trend in casualties in serious road accidents by mode of transport (Figure 23) shows an upward trend in e-scooter casualties since recording of these began in 2011.

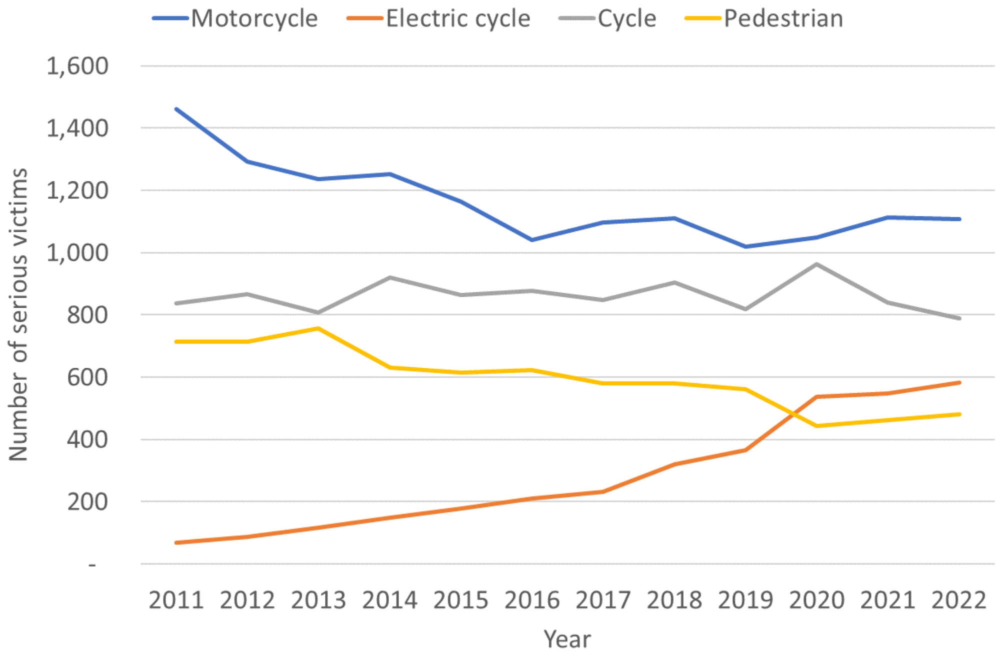

Figure 23: Victims of serious road accidents according to the means of transport used, Switzerland (Office fédéral de la statistique, 2023)

5.3.3. Great Britain

In STATS19, the collision reporting database for Great Britain, electric bikes are not recorded separately from non-electric bikes. Historically, PMDs including e-scooters have been recorded under the 'other vehicle' category (along with many other vehicle types) and, ideally, a free-text description is included to specify details on the vehicle (though this is not always included) which has been used to identify e-scooters. Following a government consultation in 2018 on the STATS19 data collection form, it was agreed to include a new 'powered personal transporter' (PPT) category. Data from 2024 onwards should make use of this separate PPT category, however limitations will remain in that PPT serves as a bit of a catch-all for various types of PMD.

Table 31 shows the number of casualties in collisions that were identified to involve an e-scooter in 2020, 2021 and 2022 (DfT, 2023).

Table 31: Reported casualties in collisions involving an e-scooter, GB 2020-2022 by year (DfT, 2023)

Year	Number of reported casualties in e-scooter collisions
2020	484
2021	1,434
2022	1,492
Total	3,410

Factsheets provided by the Department for Transport (DfT) for 2020 (DfT, 2021), 2021 (DfT, 2022) and 2022 (DfT, 2023) breakdown the number of casualties by road user group (Table 32). Factsheets provided by the Department for Transport (DfT) for 2020 (DfT, 2021), 2021

(DfT, 2022) and 2022 (DfT, 2023) broke down the number of casualties by road user group (Table 32). This shows that the majority (77%) of casualties in e-scooter collisions were e-scooter users, and 15% were pedestrians. There were 22 e-scooter users and one pedestrian killed.

Table 32: Reported e-scooter casualties, GB 2020-2022 by road user type and severity

Road user type	Killed	Serious (Adjusted)	Slight (Adjusted)	Total
E-Scooter users	22	792	1,821	2,635
Pedestrian	1	140	378	519
Pedal cyclist	0	44	92	136
Car Occupant	0	4	39	43
Motorcyclist	0	6	46	52
Van occupant	0	0	8	8
Bus occupant	0	0	10	10
Other vehicle occupant	0	1	6	7
Total	23	989	2,398	3,410

From the 2022 factsheet, other key points included:

- Of the 1,401 collisions involving e-scooters in 2022, 341 included no other vehicles (or pedestrians)
- 77% of the e-scooter casualties were male; most commonly aged between 10 and 39 years
- The most common serious injuries were ‘other head injury’, ‘fractured arm, collarbone, hand’ and ‘fractured lower leg, ankle foot’

A study by the Parliamentary Advisory Council for Transport Safety (PACTS) (PACTS, 2023) compared police recorded collision data (STATS19, as reported above) with hospital data and found that:

- Fewer than 10% of casualties with any level of injury from a collision involving an e-scooter presenting to emergency departments were recorded in the official data, and;
- Around a quarter of those most seriously injured in collisions involving e-scooters were recorded by both the police and at hospitals.

In addition to the STATS19 data for road casualties. Coroners in England and Wales can also produce a ‘Prevention of future deaths report’ if, in their opinion, there are issues of concern raised by the circumstances of the collision. These reports are sent to relevant stakeholders for a response and reports from July 2013 are searchable online (Courts and Tribunals Judiciary, n.d.). Searches for ‘unicycle’, ‘hover’, ‘mobility’, ‘device’, ‘e-bike’, ‘pedelec’, ‘electric bicycle’ and ‘skateboard’ gave no results. The search term ‘scooter’ gave three reports, shown in the table below.

Table 33: Summary of prevention of future deaths reports in England and Wales involving 'scooter'

Circumstances	Coroner's concerns
Child aged 12 using hired e-scooter as part of pilot scheme inadvertently collided with a pedestrian and fell into path of a bus travelling at slow speed	Hire scooters designed to be used by adults 18+ with driving licence. However, precautions at the time were not effective in preventing children from using them.
Child aged 14 using a private e-scooter on the pavement not wearing safety equipment, entered carriageway against traffic flow, collided with minibus	Illegal use of private e-scooter on the road Lack of safety equipment (helmet)
Mobility scooter user was hit by a car driver aged 95 whilst crossing at a pedestrian crossing (green for pedestrians) (driver pleaded guilty to dangerous driving)	Related to controls for older car drivers

As can be seen, one of the three cases was in relation to a mobility scooter (device intended for use by disabled people), outside of the scope of PMDs. Of the other two cases, neither included concerns related to the design of the scooter itself, though concerns on road user regulations were raised. The coroner's concerns for the first case related to ensuring that hire scheme scooters designed for adult use could not be accessed by children. However, the child inadvertently fell into the path of another vehicle, which could indicate either issues with the design of the vehicle, or poor use by the rider.

5.4. Literature review on PMD usage and safety

While there is a significant body of data collected by shared micromobility operators, there is little data available on the exposure of road users to privately owned micromobility devices, i.e. little data on number of these vehicles, population who own or use a vehicle or number of trips or kilometres travelled. Therefore, the number of casualties in each country analysed above and the number of casualties for different road users cannot be compared.

In an attempt to address this gap, literature was reviewed to find studies where the relative risks of these modes were compared. Literature was sought on the relative risks of these vehicles by conducting a Google Scholar search for the previous 5 years. References and citations of relevant papers were also reviewed. Literature also provided information on the characteristics of collisions, behaviour of riders, vehicle features and types of injury incurred. The literature review was not systematic in nature, instead it focussed on identifying key sources of the most relevant data on relative risks between PMDs. The main findings from this literature review are summarised below.

5.4.1. Underreporting of collisions involving cyclists, e-bikes, e-scooters or other PMDs

There is evidence that collisions involving cycles, e-bikes, e-scooters and other PMDs are under-reported in official police statistics. This means that the risks might be greater than those calculated using police collision data.

In a summary report following an International Transport Forum (ITF) roundtable on cycling safety (Santacreu, 2018), it was recommended that, due to under-reporting in official statistics, cycling safety performance should be monitored using hospital data in addition to police reports.

A Belgian study (Geus, et al., 2012) analysed a sample of 1,087 regular adult cyclists over a year in order to calculate the bicycle injury rate and showed that only 7% of collisions were recorded in police statistics, 36% attended hospital and 30% were reported via insurance. This highlighted that collecting data through police, hospital or insurance companies will underestimate the number of cycle collisions.

A study involving an international online survey of cyclists (Shinar, et al., 2018) collected data for approximately 7,000 adult cyclists over 17 countries. Overall an average of 10% of bicycle crashes were reported to the police; ranging from 0% (Israel), 2.6% (Croatia) to a maximum of 35% (Germany). Crashes with a motor vehicle were more likely to be reported (24.9%) compared with bicycle-pedestrian crashes (4.3%) and incidents of falling off a bicycle (2.6%). Crashes that involved a person being admitted to hospital were more commonly reported to the police (37.6%), compared with those that required medical attention (but did not involve admission to hospital) (12.8%) and those that did not require medical attention (3.9%). The type of cycle (e-bike, road, city/hybrid, mountain, other) was not a significant predictor of whether or not the collision was reported to the police.

A study in Ireland (Gildea & Simms, 2021) distributed a survey to cyclists who had been involved in a collision in the previous five years. In total, data on 860 collisions were gathered for analysis. Analysis showed that, overall, 23% of injury collisions were reported to the police, with a higher level of reporting for collisions with a motor vehicle than those involving only cyclists and pedestrians. 30% of collisions involved hospital attendance.

A study in the UK by PACTS (PACTS, 2023) compared police and hospital e-scooter datasets for a snapshot in October and November 2021. Overall just over a quarter of those who were most seriously injured were recorded by the police and fewer than 10% of casualties with any level of injury presenting to emergency departments were recorded.

Also in the UK, the Department for Transport compared police and hospital data for serious e-scooter casualties (DfT, 2023). 428 e-scooter casualties were identified in the TARN (Trauma Audit and Research Network) dataset between 2020 and June 2022, of which 33% were linked to the police reported casualty database (STATS19). The level of under-reporting in the police data was slightly lower for pedal cycles (26%) and higher for motorcyclists (56%). E-scooter and pedal cyclist casualties involved in single vehicle collisions, lower severity level incidents or those that occurred not on the road were less likely to match with the police recorded data.

5.4.2. Relative risks

(ITF, 2018) reviewed e-bike safety based on reports from several European countries. This included a report (Schepers, Wolt, & Fishman, 2018) that showed that, in the Netherlands, once age, gender and cycling frequency were accounted for, pedelec users were equally likely to be admitted to hospital as a conventional bike. However, this study did not use travel data as exposure data to compare the risks. A study from Switzerland (Uhr & Hertach, 2017) used travel census data and casualty data from 2015 and showed that there was a higher number of injuries per 100 million passenger km of travel with e-bikes compared with conventional cycles for all age groups (reproduced in Figure 24).

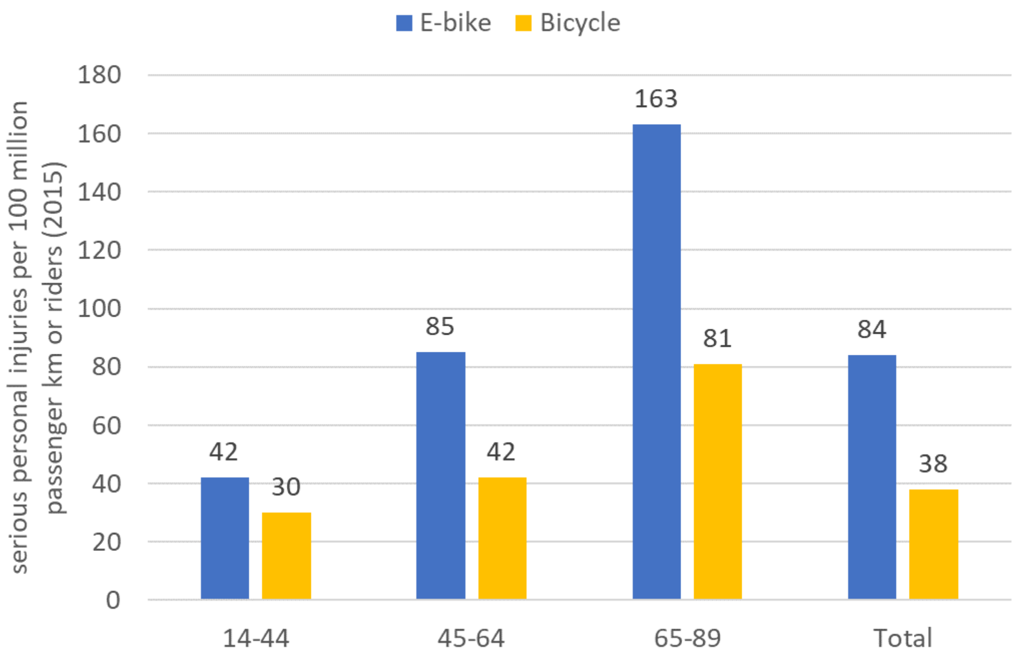

Figure 24: Serious injured per 100 million passenger km by age group, Switzerland, 2015 based on (Uhr & Hertach, 2017)

The fatality risk for conventional and electric bicycle was calculated from Statistics Netherlands (Westerhuis, Velasco, Schepers, & de Waard, 2024). The summary table below shows that there were more fatalities for conventional bicycles than electric bicycles. However, the number of owners and the distance travelled by conventional bicycles was also higher, meaning that when calculating the rate of fatalities, we see that the number of bicycle fatalities per million bicycle owners was higher for e-bikes than for conventional cycles, and the rate was also higher in terms of per billion cycled kilometres. This is shown in Table 34.

Table 34: Number of fatalities, owners, distance travelled for conventional and electric bicycles, Netherlands, 2022 (Westerhuis, Velasco, Schepers, & de Waard, 2024)

	Conventional	Electric
Fatalities	127	80
Owners (millions)	10.2	3.1
Distance travelled (billion km)	16.68	5.38
Fatalities per million owners	12.4	25.5
Fatalities per billion km travelled	11.9	14.9

However, a further review of the travel data showed that the percentage of overall cycle travel that was with an e-bike increases with increasing age, and there are also differences in travel patterns between males and females. This means that the simple comparison between conventional and electric cycles above is not comparing like-for like; this is an example of the Simpson's paradox which can lead to misleading conclusions from statistics.

To correct for this, the table below shows the fatalities per billion km travelled for each age group and for males and females separately. This shows that for both conventional and electric bikes there is a higher fatality risk for older age groups. For the majority of age groups, and for both males and females, the fatality rate for electric cycles is actually lower than that for conventional cycles.

Table 35: Fatalities per billion km travelled for conventional and electric bicycles, Netherlands, 2018-2021) (Westerhuis, Velasco, Schepers, & de Waard, 2024)

Age group	Sex	Conventional	Electric
0-50	Male	5.2	5.5
	Female	3.7	2.7
50-60	Male	13.9	6.7
	Female	5.6	4.6
60-70	Male	20.4	8.9
	Female	9.3	7.2
70-80	Male	56.9	23.3
	Female	39.6	20.5
80+	Male	299.3	117.9
	Female	191.7	96.5

(Gaster & Gehlert, 2022) reviewed the mileage-based risks of EPAC riders in Germany (Figure 25). This showed that EPAC riders between the ages of 18 and 24 had the highest mileage-based risk of being involved in a collision, 3 times higher than the average risk. The second highest risk was for riders aged 80 and older, who had approximately twice the average risk. For ages 18-34 and 80+ the risk was higher for EPACs compared with conventional cycles. Riders between 35 and 74 did not have a higher risk of EPACs collision than convention cycle collisions.

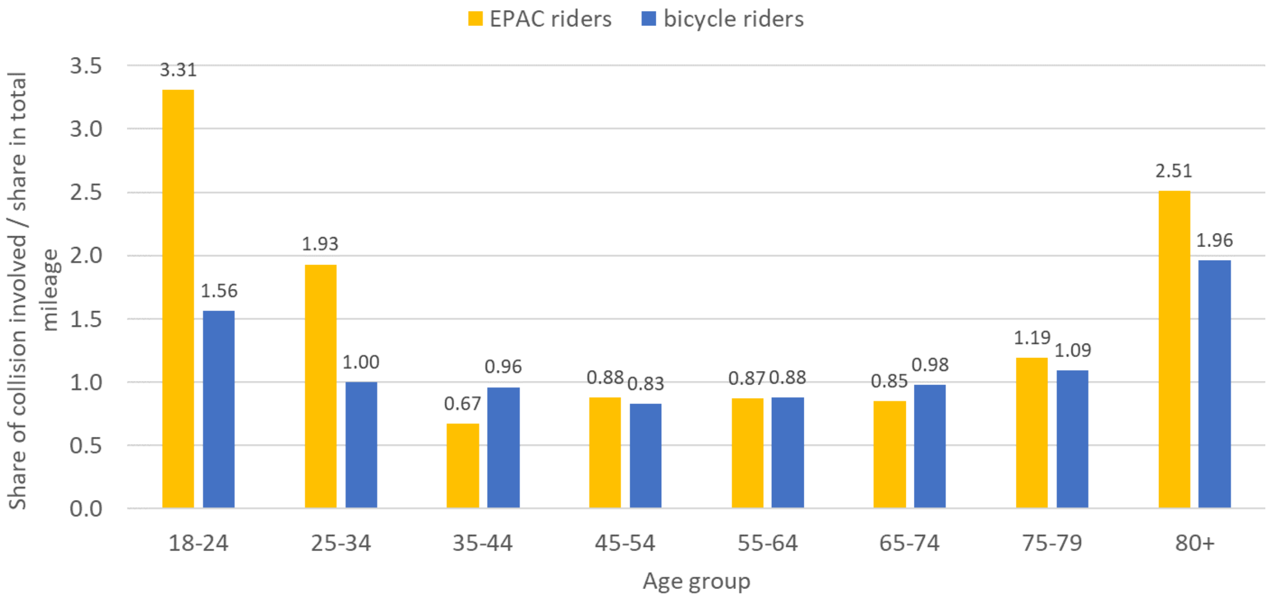

Figure 25: Mileage based risk of being involved in an injury collision for pedelec and bicycle riders of different age groups , (Germany, 2017) based on (Gaster & Gehlert, 2022)

(Santacreu, 2018) stated that riding an EPAC limited to a maximum speed of 25 km/h is no more dangerous according to research in the Netherlands and in Switzerland, but other studies found that EPAC users can have a higher risk. Therefore more research is required.

A report based on data from Oslo, Norway (Bjerkan, Engebretsen, & Steinbakk, 2021) calculated the risks based on attendance at emergency department in Oslo and survey data on travel. The results in Table 36 show the risks by severity for bicycles, e-scooters and EPACs based on traffic accidents i.e. collisions that occurred on a path or off-road were excluded. The risk per million person km for cycling was 10.6 and for e-scooters the risk was 113, approximately ten times higher risk. For severely, moderately and slight injuries separately the risks for e-scooters were also calculated to be approximately ten times greater than for bicycles. The highest risk age group for cycling was ages 25-34. The risks for EPACs were approximately half of that for conventional bikes.

Table 36: Risk of injury to bicycle, e-scooter and EPAC users, Oslo, 2019 (Bjerkan, Engebretsen, & Steinbakk, 2021)

	Bicycle injuries per million person km	E-scooter injuries per million person km	EPAC injuries per million person km
Risk of injury (all severities)	**10.628**	**112.969**	**5.710**
Risk of slight injury	6.898	76.754	3.930
Risk of moderate injury	2.574	27.161	1.780
Risk of severely injured	0.796	9.054	0.370

The ITF report on safer micromobility (ITF, 2024)) provided the number of shared e-scooter casualties per trip, reproduced in Table 37. This shows both wide variation between countries and also different trends between 2021 and 2022. Note that this data is for shared e-scooters only and does not reflect all uses. Differences in e-scooter regulations, reporting of injuries and levels of use are likely to contribute to the variable trends in the data. The authors noted that decreases in casualties (e,g. in Austria and Italy) can be partially attributed to increased attention to safety and the uptake of a ‘safety culture’ among operators and users. In particular, the ITF suggest the decrease seen in Italy can be credited to the recent mandatory enhancements in e-scooter features, such as the incorporation of front and rear brakes along with direction indicators.

Table 37: Shared e-scooter casualties requiring medical treatment per Mio trips (ITF, 2024)

Country	2021	2022
Austria	4.1	1.5
Belgium	7.1	7.0
Czech Republic	9.2	15.6
Denmark	8.6	14.8
Finland	5.0	2.9
France	9.0	12.1
Germany	4.3	4.0
Italy	12.1	4.4
Norway	3.2	2.7
Poland	4.9	4.5
Portugal	22.3	25.0
Spain	22.4	14.8
Sweden	5.2	5.3
Switzerland	2.2	4.4
UK	31.9	20.6

The report noted that data on casualties and exposure data beyond shared schemes is sparse. Some micromobility operators report that e-scooter risk levels are 32% lower than e-bike risk, while other studies indicate that e-scooter risk levels are up to four times higher than for bicycles.

The monitoring report for the UK e-scooter trial evaluation (Dillon M, 2022)) gives that on average, e-scooters were used for trips of 2.2km. Therefore the 20.6 injuries per million trips shown in the table above is equivalent to 9.4 injuries per million km, which is approximately four times greater than the risk for reported pedal cyclists casualties (all severities) in official STATS19 statistics of 2.5 casualties per million vehicle km. However, the reporting of casualties might be different for the two data sets.

5.4.2.1. Summary of relative risks

A summary of the studies which have compared the risks for e-bikes, conventional cyclists and e-scooters is shown below. Due to the different age distributions the studies need to account for casualty rates for each age group.

Table 38: Summary of studies comparing collision risk of e-bikes, conventional cycles and e-scooters

Country or city	reference	Main findings
Switzerland	(Uhr & Hertach, 2017)	Higher number of injuries per 100 million passenger km of travel with e-bikes compared with conventional cycles for all age groups.
Netherlands	(Westerhuis, Velasco, Schepers, & de Waard, 2024)	For ages 50+, the fatality rate was lower for e-bikes than conventional cycles. For ages less than 50, there were similar fatality rates between e-bikes and conventional cycles.
Germany	(Gaster & Gehlert, 2022)	For ages 18-34 and 80+ had a higher collision involvement rate for e-bikes than for conventional cycles. For ages 35-79, the rates were similar between e-bikes and conventional cycles.
Oslo	(Bjerkan, Engebretsen, & Steinbakk, 2021)	There is an approximately 10 times higher road collision risk for e-scooters compared with cycling. The risk for e-bikes was approximately half that for conventional cycles.
GB	Data calculated for this report	Injury risk for e-scooter shared scheme users is approximately 4 times that for pedal cycles.

In summary, the studies identified in this review were from different countries, used different proxies for safety (fatalities or injuries – police reported or hospital reported) and different measures of travel and give somewhat conflicting results on whether e-bikes have a higher risk than conventional cycles. The two, relatively small, analyses of e-scooter safety suggested that e-scooters have a higher risk than cycles.

5.4.3. Regulation

Literature was sought on the safety impacts of regulation. (European Platform on Sustainable Urban Mobility Plans) provided recommendations for safer micromobility in cities. The recommendations for vehicles included allowing only devices with a maximum motorised speed of 25 km/h and that European institutions and standardisation bodies should agree on the classification and safety standards for the devices themselves. There were also recommendations related to infrastructure and regulating rental operations. It recommended that cities should define maintenance and inspection schedules and requirements on vehicle characteristics as part of contracts with micromobility providers.

A comparative analysis of regulatory models for shared scooters (Flynn, Vandeweyer, & Boschmans, 2023) compared regulations in different cities and classed these as ‘light’, ‘medium’ or ‘heavy’. Light regulation consists of open markets with standard regulations, whereas high regulation, in which cities invite operators to submit proposals to run a scheme. Since 2021 there has been a growing trend among European cities to shift from open markets toward stricter regulation. Interviews with city officials and survey results indicated that this was because more stringent regulation should enable better monitoring and management, thereby improving the quality of the service. Control measures available include:

- Parking measures;
    - Mandatory parking areas
    - No parking zones
    - Technological requirements
    - Regular data sharing
    - Possible fleet caps
- Safety measures
    - Speed limits
    - Slow-speed and no-riding zones
    - Hardware requirements
    - Training and communication

Several studies have reviewed regulation of e-scooters and other PMDs (refs (Sobrino, Gonzalez, Vassallo, & Baeza, 2023) (Zhang, Nelson, & Corinne Mulley, 2024)). These studies commonly considered the regulations, requirements or training/communications for e-scooter users; for example, what is the minimum age requirement, should helmets be mandatory, alcohol use, carriage of passengers, etc. Papers also considered infrastructure, in terms of what parts of the road, footway, cycle paths or other areas that e-scooters should be permitted on and what speeds they could travel. There was also considerations of shared schemes in cities in terms of how these are regulated

For example, (Zhang, Nelson, & Corinne Mulley, 2024)) compared the regulations of e-scooters in Australian states and territories and aimed to identify policy implications for jurisdictions such as New South Wales. The recommendations in terms of safety were:

- There should be a regulatory framework which should:
    - have a definition and categorisation of standard micromobility vehicles
    - clearly outline responsibilities and obligations of micromobility riders and other road users
    - align with existing and future road infrastructure facilities
    - be supported with sufficient enforcement
    - share consistency between shared and private use e-scooters
- Consider mandatory safety education and skill training; this could be training test within an app, ‘beginner mode’ or school education programmes and media messaging. Rider licencing could be considered, but would be a barrier
- Policy making should rely on new ways of collecting and analysing data, for example, using vehicle data directly.
- Safety management should be user, location and time-based.

(Sobrino, Gonzalez, Vassallo, & Baeza, 2023) identified the key regulatory aspects for shared electric kick scooter services (SEKS) in Spain using a collaborative approach with stakeholders from public authorities, SEKS companies and researchers/consultants. Stakeholders were asked to select which regulatory aspects they felt were the most important. 4 out of 25 public authorities, 4 out of 33 researchers and 1 out of 4 SEKS companies stated that defining the technical characteristics of scooters was important; the authors noted that these low values were likely because these are already set by State regulation. The authors also concluded that further research was needed on the influence of certain regulatory aspects (such as speed, helmets and types of road) on road safety.

A UK parliament Transport Select Committee report (House of Commons Transport Committee, 2020)considered the safety risks and the role of regulation. In other countries, governments have introduced regulations aimed to ensure safety such as:

- Speed limits (sometimes set using geofencing)
- Power and mass
- Mandating certain safety features (such as lights and reflectors)
- Restricting e-scooters to roads and/or cycle lanes (and not pavements)
- Requirements for users to wear helmets
- Bans on wearing headphones

Various stakeholders (82 written submissions to the committee from a range or organisations and individuals, plus two oral evidence sessions with transport policy academics, road and pedestrian user groups, disability charities, e-scooter rental companies and representatives from the Department for Transport) commented about the design of e-scooters; power limits, smaller wheels making the vehicles less stable than bicycles and at risk from uneven surfaces, audible bell or horn and two independent brake systems. The conclusions and recommendation included:

- Re-assess the legal status of e-scooters
- Understand how the growth of e-scooter use has affected other modes
- Ensure that the trial schemes are accessible to a range of people
- Safety risks and regulation
    - A ‘one size fits all’ approach is unlikely to work – local authorities need to be involved in regulating schemes, including setting of appropriate speed limits in different locations
    - The rental trial data should be used with international evidence to determine e-scooter design requirements
    - E-scooter trial operators should encourage users to wear helmets
    - Use of e-scooters on pavements should be monitored and discouraged
    - The trials should be monitored to understand where e-scooters are left on pavements and whether they contribute to ‘street clutter’

There was less literature available on the case for regulating vehicles and how regulations affecting the vehicle itself contributed to safety. There was some discussion about maximum speed limits and acceleration (Kazemzadeh, Haghani, & Frances Sprei, 2023) and wheel design and braking ((Lee, Yun, & Yun, 2021) and (Siebert, et al., 2021)).

In a review of shared e-scooter policies: (Zhang, Nelson, & Corinne Mulley, 2024) noted that e-scooters, like bicycles, lack lateral stability when stationary, and can only be balanced when moving. However, e-scooters have smaller, more rigid wheels and a standing position rather than sitting which means that the ergonomics of the vehicle design needs further exploration. It was noted issues focused on the braking and wheel design.

An observational study of shared e-scooter riders in Berlin (Siebert, et al., Braking bad – Ergonomic design and implications for the safe use of shared E-scooters, 2021) investigated users' hand and feet positions in relation to the brakes, based on video observation, and also users' knowledge about the vehicle and regulations from a survey. The results indicated that shared e-scooter riders did not have knowledge of which levers applied which brakes, but users hand position was more commonly ready to use the left hand brake lever in comparison to the right hand lever or footbrake – probably due to the right thumb being used for the throttle and the greater effort required to operate the foot brake (e.g. it requires a change in balance). It was therefore suggested that it would be advisable to link the left hand brake lever to the front wheel rather than the rear wheel, though it was also advised that further research might be required in relation to braking and stability.

A study in South Korea (Kyung-Jun Lee, 2021) analysed reported behaviours and risk episodes of 21 e-scooter users over three weeks. The most commonly reported factors relating to the vehicle for the risk episodes were related to the 'wheels', 'brake', or 'main body'. When combined with environmental factors, the most common was 'wheels' with 'road surface' followed by 'wheels' with 'road type' or 'obstacles'.

5.4.4. Vehicle features

E-scooters, e-bikes and conventional cycles have different vehicle designs which can have implications for safety (ITF, 2024). Key points reported by the ITF included:

- E-scooter riders stand whereas cyclists sit; this means that when a rider falls from an e-scooter there is nothing to absorb some of the impact of the fall. The seated position on a cycle offers improved braking and handling performance.
- Studies show that e-scooters are less stable at lower speeds compared with cycles.
- E-scooters have a slightly higher and more forward centre of mass which has an impact on forward obstacle crashes as riders can pivot over the steering bar.
- E-scooters which have larger wheels and place weight to the rear of the scooter tend to have improved stability.
- Narrower foot platforms are more hazardous; fracture rates were higher for foot behind foot position compared with a side by side position.
- Larger wheels were found to be safer; larger wheels such as those on bicycles have a shallower angle of attack than smaller e-scooter wheels and therefore are more stable when encountering obstacles such as potholes.
- Air chambered tyres were found to provide more stability than solid or honeycomb tyres.
- E-scooters typically required longer braking distances than bikes.
- E-scooters have a shorter wheelbase and can exhibit superior steering manoeuvres; therefore it was suggested that steering could be a better collision avoidance strategy for e-scooters than braking.

- Motor driven acceleration on e-scooters is more rapid and responsive than pedal powered acceleration (including pedal assist on e-bikes).
- Visibility – bikes might have both front and rear lights, as well as pedal reflectors. E-scooters often only have a front light, and any reflectors on the side are not very visible.
- Riders risk instability when using hand signals due to no indicators, this is compounded by the smaller wheels.
- E-scooters with higher mass are more stable, and typically offer better braking

5.4.5. Characteristics of collisions

Poor road infrastructure (where the surface is poorly maintained and has potholes and other discontinuities) was found to be responsible for 30-40% of e-scooter crashes (ITF, 2024). Pavements and traffic lanes were found to have a higher risk than separated bicycle tracks; junctions were noted to have a high incidence of micromobility crashes.

The higher typical age of e-bike riders contributes to causes of e-bike collisions, including falling whilst getting on or off and lack of experience using the e-bike. A SWOV factsheet on pedelecs (SWOV, 2022) suggested that factors such as the vehicle weight distribution might make single vehicle crashes more likely. However, a Swiss study (Uhr & Hertach, 2017)suggests that only a small proportion of such crashes are due to the electrically assisted nature of the vehicle. Various evidence indicates that e-bike riders are more at risk of having their right of way disregarded; this might be because, from their appearance, other road users underestimate their travelling speed.

The ITF report into micromobility (ITF, 2020) includes a review of a study of media reports of standing e-scooter fatalities. The main conclusions were that pedestrian fatalities are rare, and most of the fatalities were the e-scooter riders themselves, often as a result of collisions with heavier vehicles.

Analysis of collision types in various studies (ITF, 2024) showed that many involved a single vehicle only (93% of all injuries from meta-analysis of multiple studies (Toofany M, 2021)), often a fall or a loss of control. The national collision database for the UK (STATS19), for example, shows a much smaller percentage of e-scooters in single vehicle collisions, this is likely to be due to under-reporting of collisions involving non-motorised users – as discussed in section 5.4.1.

In terms of factors influencing the road user risk, there was general agreement over several studies that suggested that e-scooters were more likely than conventional bikes and e-bikes to be involved in collisions at nighttime, users were less likely to be wearing a helmet and more likely to be influenced by alcohol. There was some evidence that ‘double riding’ and lack of experience were key risk factors.

Analysis of bicycle and e-scooter collisions from those attending hospital in Oslo (Bjerkan, Engebretsen, & Steinbakk, 2021) reported that approximately 75% of bicycle accidents were single vehicle accidents, whereas for e-scooters this figure was lower at 40%. In both cases, the single vehicle accidents were mostly categorised as ‘lost balance, not distracted’ (41.6% for bicycles, 17.5% for e-scooters); for e-scooters 4.3% were categorised as having a technical failure. 44% of injured cyclists described their speed as low speed, 46% medium and 10% high. For e-scooters 14% indicated high speed and 52% medium. It was also estimated that the accident risk for bicycles was highest at nighttime (between midnight and 5am) and for e-scooters the risk of an accident was three time higher during nighttime compared with daytime.

Collisions in Switzerland in 2011 and 2012 involving 504 e-bikers and 871 bicyclists were analysed (Weber, Scaramuzza, & Schmitt, 2014). Most of the e-bikers were aged 40-65 (57%) or 66+ (22%). The most common collision type for e-bikes was single vehicle collisions (42%), followed by crossing collisions (29%). For conventional crossing collisions were most common (31%) and 24% were single vehicle collisions.

A review of e-scooter safety (Janikian GS, 2024)) examined studies based on hospital data showed that:

- Males ride e-scooters more often and are injured more frequently than females.
- 56 studies analysed age of injured riders and found that the mean and median age was approximately 30 and approximately two-thirds of injured riders were aged between 15 and 44.
- Ten studies recorded observations of helmet use and 36 studies recorded helmet use in hospital-based injury studies. Low frequencies of helmet use were noted, apart from in Brisbane, where helmets are required.
- Several studies noted the presence of drugs and/or alcohol amongst e-scooter casualties.
- Some studies also noted that some of the casualties were below the age for which use of e-scooters was permitted, and some studies noted that there had been multiple riders on an e-scooter.
- Rider distraction was observed or described in five studies; this included using mobile phone, taking photos/videos/selfies, eating/drinking or carrying a load
- Eight studies observed or measured or inferred that speed was a contributing factor in injury crashes. Speed varied according to location, with speeds on streets higher than those on footways, and males riding at higher speeds than females. One of the studies estimated that excessive speed contributed to 37% of e-scooter crashes in Austin, Texas. In London, 42% of private e-scooters were identified as riding above the legal limit of 25 km/h.

5.4.6. Rider behaviour

Analysis of cyclists and e-scooter riders attending hospital in Oslo (Bjerkan, Engebretsen, & Steinbakk, 2021) showed that 62% of cyclists wore a helmet, compared with only 2.2% of e-scooter riders. 5% of males and 2% of females injured and attending hospital were impaired by alcohol. For e-scooters, the incidence of alcohol impairment was much higher (41%).

Helmet use by casualties and the relationship with injury severity was also studied in Switzerland (Weber, Scaramuzza, & Schmitt, 2014). E-bike riders more commonly wore cycle helmets then conventional cyclists; for e-bikes 63% wore helmets in rural environments and 37% in urban environments, compared with 40% and 30% for conventional cyclists, respectively.

Analysis of trauma casualties in France (James, et al., 2023) shows that e-scooter users had a higher incidence of alcohol levels above the 0.5 g/dL threshold (29%) compared with motorbikes (21%) and bicycles (11%). E-scooter casualties were half as likely as bicycle riders to wear a helmet (22.5% compared with 49.3%). Casualties from e-scooters had injuries as severe as those from motorbikes and bicycles; 58.5% of e-scooter casualties had brain injuries of any severity, which was similar to bicycle casualties (63.7%) and higher than for motorbikes (34.5%). The length of hospital stay and the in-hospital mortality rate were similar for all three groups.

Another study (Haustein & Møller, 2016) surveyed 685 e-bike users in Denmark to examine the factors which contribute to perceived e-bike safety and involvement in incidents. Most participants agreed they rode faster on an e-bike than on a conventional bike, which was considered fun or exciting, but that the speed sometimes surprised other road users. E-bike owners felt safer on an e-bike, whereas those with limited access to an e-bike felt safer on a conventional bike. 29% of e-bike users reported that they had been involved in a crash or safety critical incident that they thought would not have arisen on a conventional bike. 186 incidents had text descriptions, of which the most common incident category was ‘other road users underestimate the speed of e-bike’ (74), followed by ‘regulation of speed’ (34), road grip/surface (22) and e-bike mass/balance (19). The latter was more commonly reported by older people.

An evaluation of e-scooter trials in Great Britain (Dillon M, 2022)) found that e-scooter users were predominately male (71%) and under the age of 35 (74%). Men and younger people were also more likely to rent e-scooters frequently. Users chose e-scooters due to time and cost savings, convenience and enjoyment. A survey of residents in areas with e-scooter trials found that 63% did not have interest in using an e-scooter while 46% cited safety concerns with using an e-scooter. Many of those who rented an e-scooter (69%) said that they would consider purchasing their own in the future. 29% of users said that the reason for their most recent journey on an e-scooter was travelling to or from a leisure activity, 22% said it was for fun, and 14% said it was for commuting. In some areas, some users said that the absence of indicators felt unsafe as they had to remove their hands from the handlebars in order to signal. Some users had issues with acceleration or power, for example a loss of power when travelling uphill or difficulties in controlling the acceleration. Users reported that uneven road surfaces affected the riding experience. For those that experienced a collision, the most common reason reported was user error, and collisions most often only involved the e-scooter. In serious scooter collisions upper limb injuries were more common than lower limb injuries. Users stated that infrastructure changes, promoting helmet use or increased visibility would improve safety.

A narrative review (Laverdet C, 2023)examined various literature to investigate the behaviour of e-scooter riders. It was found that common behaviours of e-scooter drivers included more than one person on a scooter, lack of helmets, consuming alcohol or drugs, using mobile phone, using footways or travelling against the vehicle flow. However, most of these observations were from very small studies. In terms of ePMD injuries, some studies found crashes with other vehicles were common, whilst other studies found that falling was the main mechanism of injuries. Both were mostly head, upper or lower limb injuries.

A retrospective study (Vallmuur K, 2023)was conducted of injuries of people attending emergency departments at three hospitals in Brisbane. Of the 1,048 cases reviewed, 91% were e-scooter riders, (4% e-skateboards, 4% e-bikes, segways (!%) hoverboards (<1%). Overall, across all devices, helmet use, alcohol use, and speed were poorly recorded. However, 28% of cases were reportedly wearing a helmet (16% not wearing a helmet), and 27% were reported to be under the influence of alcohol. Overall results showed over one-third reported travelling at speeds of 20 km/h or higher. Across all devices, fractures accounted for 37% of presentations, and lacerations accounted for 23%. The body regions most commonly injured were the head and face (27%) and the upper extremities (arms 23%, hands/wrists 12%).

5.4.7. Types of injury

ITF’s safer mobility report (ITF, 2024) reviewed various studies which explored the injuries of cyclists and e-scooter riders. As shown in Table 39, the overall levels of severity were similar for e-scooters and e-bikes. E-scooter rider collisions often resulted in head, face or neck injuries or upper extremity injuries.

However, differences in collision types might account for some of the differences observed between different road user types.

Table 39: Synthesis of findings on injury severity and type of injury for e-scooters, e-bikes and conventional bikes (ITF, 2024)

		E-scooters	E-bikes	Conventional bikes
% of casualties by severity	Minor injury	56-70%	65-70%	No data
	Severe injury	8-13%	5-17%	No data
	Fatally injured	<1%	<1.3%	<0.2%
% of casualties injured body region	Upper extremity	25-55%	No data	No data
	Lower extremity	23-45%	No data	No data
	Head	18-41%	35%	20-24%
	Face	30-60%	No data	20%

A meta-analysis of 19 studies (Niemann, et al., 2023), which included 843 scooter, 3,000 e-scooter and 5,694 e-bike casualties, found that:

- e-scooter riders had a 1.69 times higher incidence, of head and neck injuries than cyclists and a 1.41 times higher incidence of lower extremity injuries, but lower incidence for upper extremity, thorax injuries and spine injuries
- Comparing e-bike and conventional cyclists:
  - e-bikers more commonly had spine injuries (1.71 times higher)
  - e-bikers more commonly had injuries to lower extremities (1.28 times higher)
  - similar incidence of head, neck, face, thorax, abdomen injuries
  - e-bike riders had a higher mean Injury Severity Score (ISS)[5] (by a difference of 1.2 units).

Most of the other studies involved reviewing injuries for e-scooters or e-bikes at a single hospital or city and are therefore not as robust. For example, some of the larger studies included:

- A study which reviewed 256 injuries to e-scooter riders in Melbourne (Cevik, et al., 2024) found that Injuries most commonly affected the upper limb (53%) and head (50%), with abrasions (75%) and fractures (48%) being the most common type of injury sustained.
- A study in Lithuania (Suslavičius, Utkus, Uvarovas, Sveikata, & Ryliškis, 2024) reviewed 1,036 injuries to e-scooter riders based on a trauma centre. 87% had minor NISS (1-8), 12% had moderate (9-14) and 1% had high (>14), Injury characteristics revealed fractures in 35% of cases, primarily affecting upper limbs (53 %). Soft tissue trauma was prominent (65%), with lower limbs being significantly impacted.

[5] The injury severity score is a measure of trauma severity. It is the sum of the squares of the injury severities (measured on a scale of 1 to 6) for the three body parts with the highest levels of injury. It has a maximum value of 75.

- A study in Oslo (Bjerkan, Engebretsen, & Steinbakk, 2021) compared injuries of 1,594 e-scooter users with 2,184 cyclists in Oslo. They found that The type of e-scooter collision injuries most frequently reported were head injuries (34%) followed by injuries in the arms (31%) or feet/legs (26%); bicycle collisions most frequently involved arm injuries (45%) followed by head injures (23%).
- A study in Israel (Siman-Tova, Radomislenskya, & Peleg, 2017) reviewed injuries for 663 e-bike riders and 63 motorised scooters. 67% of e-bike riders had an ISS less than 9 (mild),24% moderate (ISS 9-14), 7% severe (ISS 16-24) and 3% critical (ISS 25-75) There were similar proportions for motorised scooter riders and pedestrians hit be either vehicle type.

The differences in the age distribution and use of helmets means that any differences observed in the above studies might be due to these differences, rather than a difference in the injury mechanism. One study (Verbeek, Valk, Schakenraad, Verbeek, & Kroon, 2021) compared injuries between 379 e-bike users and 455 conventional cyclists attending a trauma centre in the Netherlands, After allowing for differences in age, gender, speed, anticoagulation use and alcohol intoxication, the severity of injuries was found to be similar. The main determinants of the risk of traumatic brain injury were speed, alcohol, and anticoagulant use regardless of the type of bicycle used.

5.5. Summary and discussion

5.5.1. Summary of data

Data from EU and from the individual countries studied showed that:

- Number of casualties that were riding e-bikes or personal mobility devices has increased in recent years, likely to be due to an increase in the number of users of these vehicles
- Cyclist, e-bike and PMD collisions were mainly in urban areas
- Single vehicle collisions accounted for a large proportion of cyclist, e-bike and PMD fatalities – PMDs had the highest percentage of single vehicle collisions (35%)
- Fatalities in collisions involving multi-vehicles turning or crossing were also common and accounted for a high percentage of e-bike fatalities (45%).
- e-bikes user casualties are more likely to be older than conventional cyclists
- PMD users tend to be younger than conventional and e-bike cyclists
- Most commonly PMD user is injured in a PMD collision
- Some evidence for higher alcohol impairment for PMD users
- PMD users were more likely to be recorded as responsible for collision (compared with motorcycles, cycles and pedelecs)
- There are many more cyclists, e-bike and PMD injuries in hospitals than reported by police
- E-bike injury types are similar to cycles

5.5.2. Summary of literature

There is high levels of under-reporting for road casualties using cycles, e-bikes and PMDs, especially for collisions that did not involve a motor vehicle. Therefore to assess the risks of these modes police data should be used in conjunctions with hospital data.

A few studies compared the relative risks of different modes. Comparing e-bikes with conventional bikes appears initially to show that e-bikes have a higher risk of injury in terms of per km travelled; however, e-bikes are more commonly ridden by older users, and once the different age distributions are accounted for, e-bikes do not have a higher risk than conventional cycles.

The risks per trip for shared e-scooters showed large variation between countries; this could be due to differences in regulation of shared schemes, the road user behaviour, different average trip lengths or differences in infrastructure. One study in Oslo, based on a sample of hospital attendees suggested that the risk in terms of distance travelled for e-scooters was approximately ten times the risk for cycling.

Literature on regulation was mainly focussed on regulating shared schemes and users, for example, what parts of the road infrastructure can e-scooters use and at what maximum speed limits and minimum ages of users and whether helmets are mandated. There was less literature regarding regulating the design of the vehicles and how this affects safety.

The design of e-scooters, with smaller wheels, a standing position and a forward centre of mass means that they are less stable than cycles or e-bikes. E-scooters with larger wheels, air-chambered tyres and with higher mass were more stable. In addition, riders risk instability when arm-signalling.

There were several studies that analysed rider behaviour or characteristics of e-bike users in collisions. These often found that e-bike users were generally older than conventional cyclists. E-bikers were more likely to wear helmets than conventional cyclists. Some studies suggested that falls were due to inexperience of using the e-bike, but otherwise the collision circumstances were similar to those of conventional cycles. E-bikes travel faster than conventional cycles, which might be unexpected, given the appearance of the rider, which may contribute to collisions at junctions.

E-scooter riders were less likely to wear a helmet, more commonly involved in collisions at nighttime (which could be due to differences in travel patterns, or an increased risk due to visibility and rider behaviour e.g. alcohol). There was also evidence that alcohol impairment, ‘double riding’ and inexperience were risk factors.

There is some evidence from the literature reviewed that the most common types of injuries sustained in PMD collisions are head injuries (most common for cyclists and e-scooters), face/jaw injuries, leg injuries, arm and upper extremity injuries. However it is important to consider differences in age groups, users, comorbidities and the challenge of under-reporting.

5.5.3. Discussion

In recent years there has been an increase in the number of road casualties that were e-bike or PMD users. This increase is due to the increase in the amount of travel using these modes, either as personal vehicles or as part of shared schemes.

The police reports of road casualties do not always distinguish e-bikes from conventional bikes, and PMDs are not always recorded (sometimes recorded as ‘other vehicle’. There is also under-reporting of these modes in police road casualty statistics, especially of crashes that did not involve a motor vehicle or took place away from a traffic lane (for example on a footway, cycle path or pedestrianised area).

It is important to know the exposure of road users to risk so that the casualty numbers can be compared between countries, modes and over time. However, the amount of travel by cycles, e-bikes and PMDs is not generally well-established. Travel metrics are usually estimated through surveys (localised observational studies or questionnaires to samples of people (sometimes households, people who are known to use these modes or surveys for those involved in collisions) or based on data for trips made using shared schemes.

The data analysis and review of literature did not give much evidence about vehicle design contributing to collisions, or the role of vehicle design, ergonomics or regulation for safety. The literature regarding regulations was more focussed on:

- regulating users, for example, age limits, alcohol limits, whether helmets are required
- regulations related to road infrastructure or locations and speeds of vehicles, for example, whether users should use the pavement, cycle path or road and the maximum permitted speed limit for different road environments
- regulations for shared scheme operators, including regulations for users and locations, also on where vehicles are docked/left

The age profile of e-bike users is older than conventional cyclists, and therefore the increased fragility of older ages needs to be accounted for in the comparison of risks. The data analysis and the review of literature showed that for most age groups there is not an increase road casualty risk for e-bike users, once age is accounted for (although data from Germany suggested that there was a slightly higher risk for e-bikes for the youngest and oldest riders). This suggests that the existing regulation of e-bikes is sufficient and there are not any issues relating to the design of e-bikes that gives an increased collision risk.

The high casualty rate for PMDs (and likely to be under-reported) suggests that these modes have a higher risk than conventional and e-cycles. The high incidence of single vehicle collisions suggests that users are losing control or falling off; this suggests that there might be issues with the handling of the vehicle, which could be due to the design of the vehicle or lack of user experience or user error/impairment.

There was a high incidence of collisions at night – this might be related to when they are used, but could also be due to increased impairment (e.g. alcohol) at night or poor lighting (headlights so users can see where they are going and the terrain and/or lighting so other road users can see PMDs).

6. National technical requirements

The results were derived from a document (LEVA, 2023) and refer to several national regulations: Germany (Verordnung über die Teilnahme von Elektrokleinstfahrzeugen am Straßenverkehr und zur Änderung weiterer straßenverkehrsrechtlicher Vorschriften), Spain (Resolución de 12 de enero de 2022), Austria (31. StVO Novelle), Belgium (Koninklijk besluit van 1 december 1975 houdende algemeen reglement op de politie van het wegverkeer en van het gebruik van de openbare weg), the Czech Republic (Decree No. 341/2014 Coll.), Denmark (BEK no 40 of 14/01/2019, BEK no 41 of 14/01/2019), France (Code de la Route), Italy (Highway Code) and Luxembourg (Code de la Route).

Certain countries did not provide a legal source for some requirements and in this instances, common practice was summarised in the LEVA document. This was the case for Finland, Italy, Lithuania, Norway, Spain, Sweden and Switzerland. In the UK, trial guidance for shared e-scooters defines requirements which are also summarised in this section.

6.1. General and Electrical Characteristics

Table 40: Overview of identified general and electrical characteristics (mandatory, M / optional, O / not specified, -) based on LEVA-EU Briefing and national legislation documents (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Design Speed	0	0	15			X			X			X			X			X			X			X			X			X			X			X			X			X			X			X
Power	0	0	14			X			X			X			X			X						X			X			X			X			X			X			X			X			X
Electrical	0	0	1																																				X									
Power (Shutdown)	0	0	1																																				X									
EMC	0	0	1																																				X									
Anti-tampering	1	0	1																																		X		X									

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Electrical (Battery)	1	0	1																																		X		X									

Table 40 shows the identified general and electrical characteristics for countries with known legislation. Spain (ES) defines one electrical requirement relating to the “adequacy” of the electrical components’ mechanical strength. Personal mobility devices must also comply with section 9 of EN 17128 relating to electromagnetic compatibility (EMC). Anti-tampering measures, typical of electrically assisted cycles (EPAC), must demonstrate compliance with the EN 15194 standard. The power (shutdown) requirement is that the vehicle cannot start moving while it is being loaded, even if the engine control is activated. The activation of an anti-theft system while driving should not prevent normal use of the brake, nor lead to sudden decelerations (greater than 2 m/s^2).

Design speed and rated power are further described in Figure 26. The majority of legal requirements reviewed allow design speeds of up to 25 km/h, which is also the maximum identified design speed. National documents from Germany, Italy, Spain, Switzerland and the UK trial guidance for shared e-scooters allow a maximum continuous rated power of 500W; the most common power limit applied. In Germany, this may be increased to 1,400W if 60% of the power is used for self-balancing. Spain allows maximums of 2,500W and 1,000W for vehicles with and without self-balancing systems, respectively, whilst vehicles for the transport of goods or other services may have 1,500W.

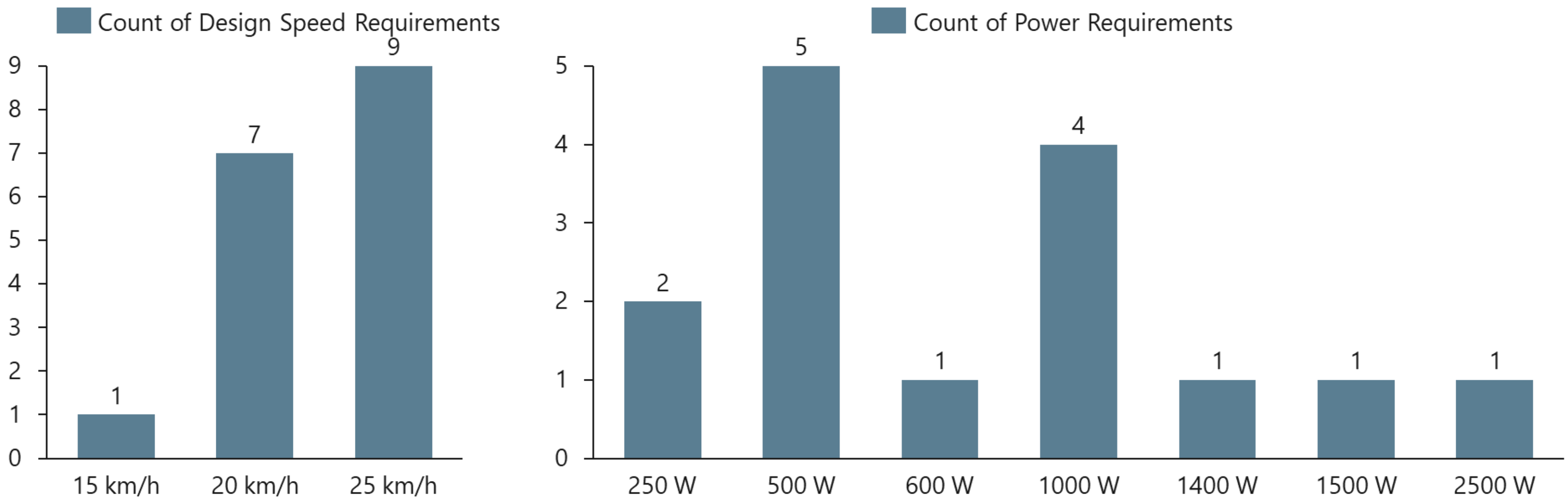

Figure 26: Detailed view of speed and power requirements

A recently completed Member State survey by the European Commission discussed in Section 7.2.9 confirmed that Belgium, Denmark and Hungary do not currently regulate power of PMDs and that they have no plans to do so in the future. This survey and aspects entailed are detailed in Section 7.1.1.

6.2. Physical Characteristics

Table 41: Overview of identified physical characteristics (mandatory, M / optional, O / not specified, -) (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Seating	1	3	3												X		X							X								X		X				X								X			
Dimensions	1	0	10			X			X						X			X			X			X						X			X			X			X							X		
Mass	1	0	5												X									X												X			X						X	X		

Table 41 shows the identified physical characteristics for countries with known legislation. A breakdown of the seating and dimension requirements is shown in Figure 27. Denmark and Luxembourg forbid the installation of seats on certain vehicles, however Luxembourg mentions e-scooters specifically in this context. Norway and Spain also allow only self-balancing vehicles to be installed with a seat. Finland generally bans seats unless the vehicle is intended for use off-road or on unpaved roads or intended exclusively for use by persons with reduced mobility. In this figure, dimensions requirements are also summarised. These generally pertain to at least the length (L) and/or width (W), however in two cases there is no limit. Spain requires the R point or "seating reference point" (defined in EU Regulation No 168/2013) to be 540 mm and the handlebars must have a minimum height of 700 mm.

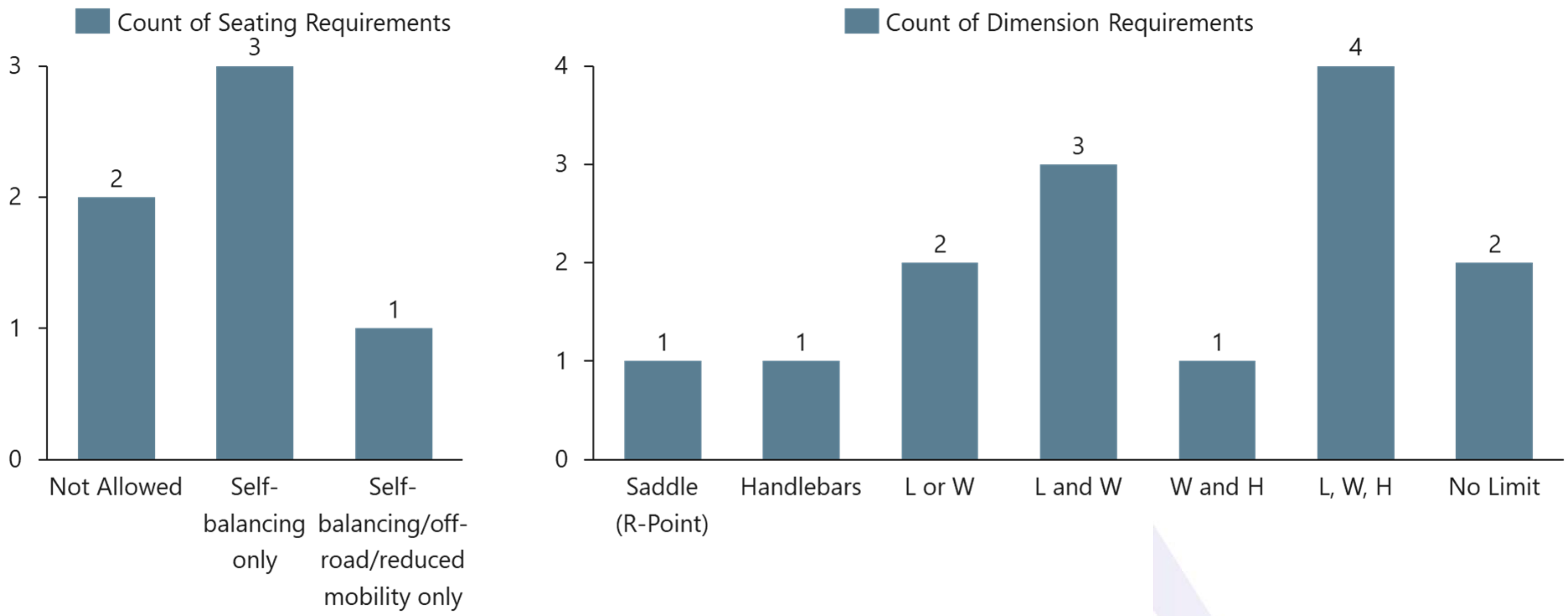

Figure 27: Detailed view of seating and dimension requirements

Figure 28 and Figure 29 show a breakdown of maximum width values. Denmark (DK) defines a maximum width of 700mm for electric scooters, self-balancing vehicles and electric skateboards. The length of electric scooters may be 2m whereas self-balancing vehicles and electric skateboards are limited to 1.2m. Finland (800mm), Norway (850mm), France (900mm) and Belgium (1m) have progressively larger width limits. Spain allows widths of 750mm for personal transport and 1m for vehicles used for transport of goods or other services.

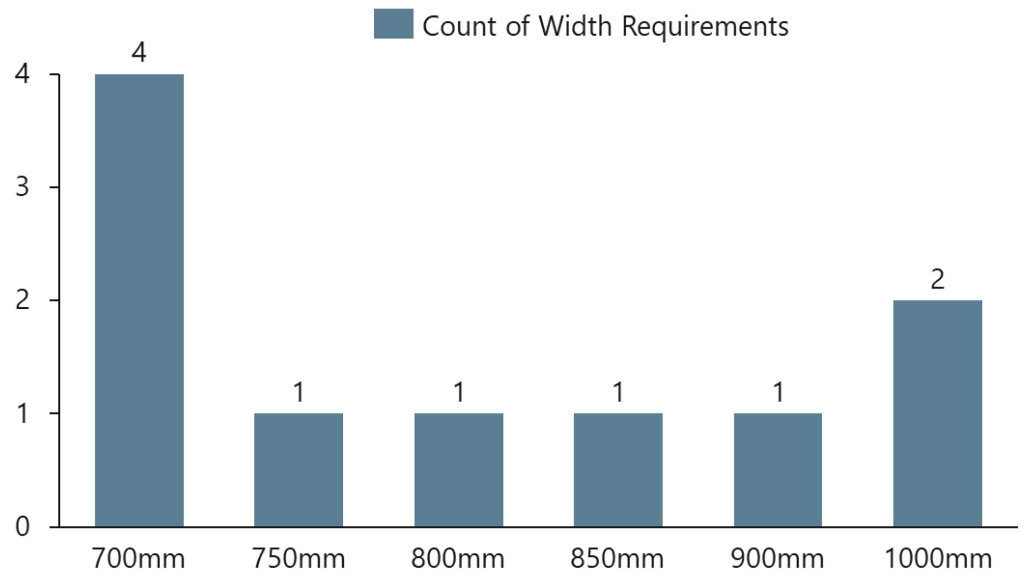

Figure 28: Detailed view of width requirements

Length and height requirements are depicted in Figure 29. Norway's maximum length requirement is 1.2m whereas France and Luxembourg allow 1.35m and 1.5m respectively. Spain allows lengths of up to 2m for personal transport and transport of goods and other services. Germany also imposes a 2m length limit. Denmark allows lengths of 2m for electric scooters and 1.2m for self-balancing vehicles and electric skateboards. Belgium allows a maximum height of 2.5m for a loaded PLEV whereas the UK trial guidance for shared e-scooters restricts this value to 1.5m for shared e-scooters (currently allowed only through a national shared e-scooter trial). Spain defines a maximum height of 1.4m for personal transport and 1.8m for vehicles used for transport of goods or other services. Germany defines a maximum height of 1.4m.

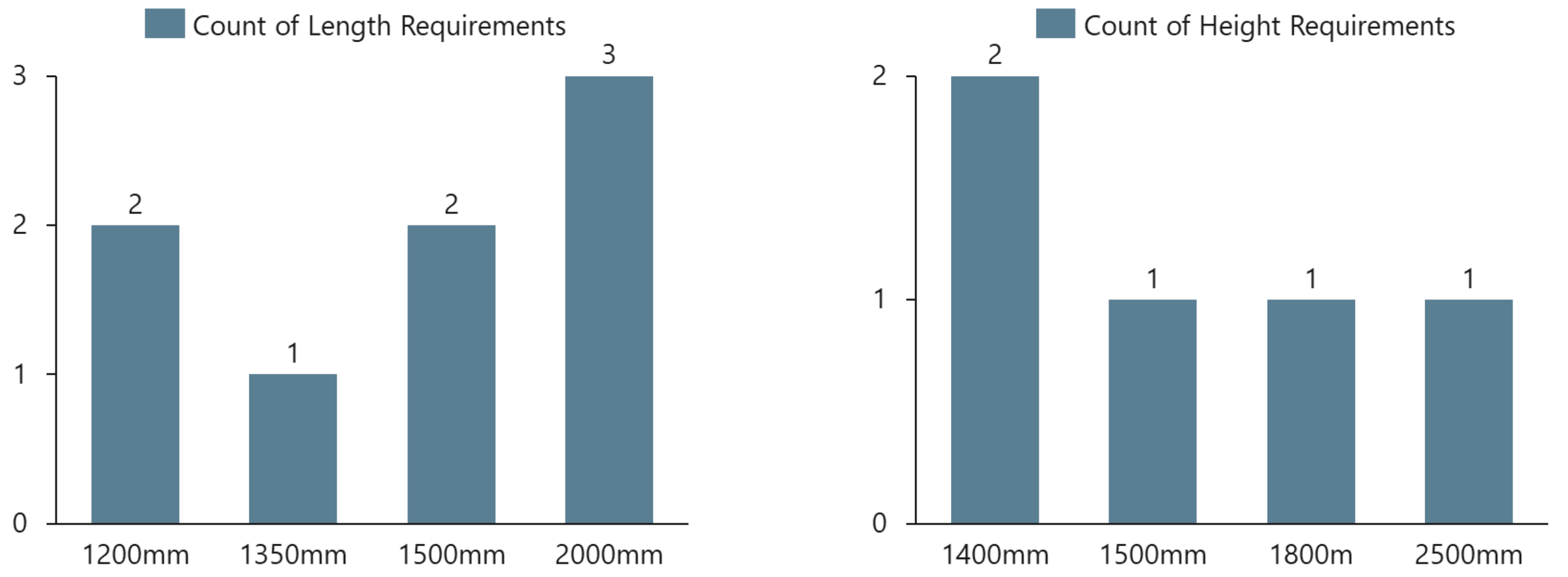

Figure 29: Detailed view of length and height requirements

Figure 30 contains a histogram of allowed masses (without rider) – aka device mass. The most commonly occurring value is 55kg which is prescribed by Germany for Elektrokleinstfahrzeuge and in the UK trial guidance for shared e-scooters. Denmark limits this value to 25kg (self-balancing vehicles and electric skateboards), Spain uses a limit of 50kg for personal mobility devices used for personal transport (not for the transport of goods or other services). A limit of 400kg is applied to vehicles used for transport of goods and services, however this value is not shown on the graph. Switzerland and Norway permit maximum masses of 65kg and 70kg.

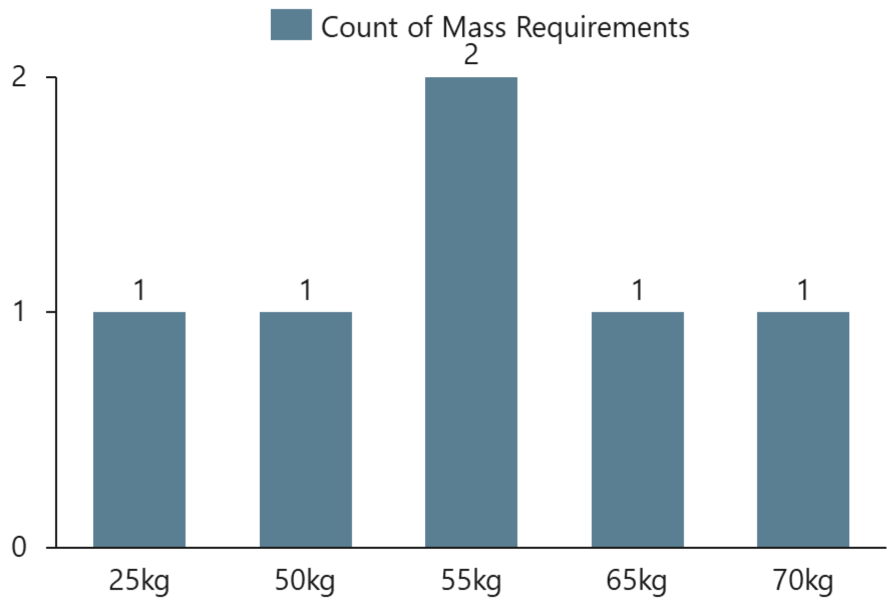

Figure 30: Detailed view of mass requirements

6.3. Control

Table 42: Overview of identified control characteristics (mandatory, M / optional, O / not specified, -) (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Steering	1	0	1							X														X																								
Braking	15	0	2	X			X			X			X			X			X			X		X	X			X			X			X			X		X	X			X			X		
Reverse Gear	1	0	1																																		X		X									
Audible Warning / Sound Signalling	13	1	2	X			X							X		X			X			X		X	X			X			X			X			X		X	X			X			X		

Table 42 shows the identified control characteristics for countries with known legislation and the UK's trial guidance for shared e-scooters. Germany (DE) requires a handlebar or support rod of at least 500 mm for self-balancing machines with a seat and at least 700 mm for motor vehicles without a seat. Czech Republic (CZ) describes a handlebar which has covered free ends with no sharp edges. Spain mandates a reversing assistant on vehicles transporting goods or other services along with a certification process.

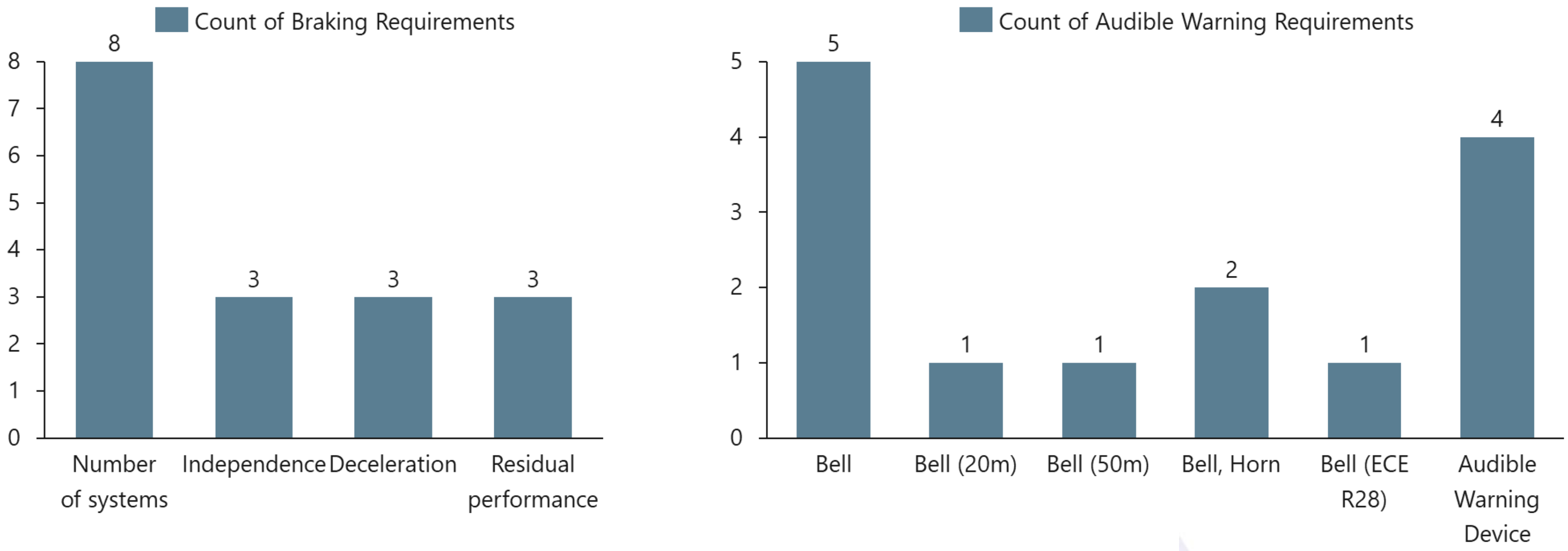

Figure 31: Detailed view of braking requirements

Braking and audible warning requirements are detailed in Figure 31. The number of braking systems is typically described as “two” or “front/rear”, as is the case in Spain, Czech Republic, Germany, Italy, Spain, Switzerland and in the UK trial guidance for shared e-scooters. France’s requirement on the number of systems varies by single-track or multi-track system and whether or not these systems are self-balancing. Germany, Spain and the UK trial guidance for shared e-scooters require these to be independent and achieve a declaration of 3.5 m/s^2. Germany and Spain require residual performance of 44% in the event of a failure of one braking system whereas Switzerland requires functionality “all the time”.

Regarding audible warnings, Austria, Denmark, Italy, Luxembourg and Switzerland simply require a bell, whereas Belgium and France require a minimum distance of audibility of 20m and 50m respectively. Germany requires a bell in compliance with ECE R28 and Norway and the UK trial guidance for shared e-scooters stipulate either a bell or a horn. Finland, Lithuania and Sweden describe an audible warning device where Spain leverages the requirements in section 16.2 of EN 17128.

A recently completed Member State survey by the European Commission makes reference to these points in Section 7.2.9.

6.4. Exterior Accessories

Table 43 Overview of identified accessories (mandatory, M / optional, O / not specified, -) (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Wheels	1	0	2																X																				X											X
Structural Integrity	0	0	1																																				X											
Stand	2	0	0																																		X									X		
Footrest	0	0	1																																				X											
Folding	0	1	1																																			X	X											
Exterior Projections	0	0	1																																				X											
Hot Surfaces	0	0	1																																				X											

Table 43 shows the identified accessories for countries with known legislation. Spain requires personal mobility vehicles to be equipped with wheels with a minimum diameter, including the tyre, of 203.2 mm (8"), and composed of a material that allows grip on the ground. According to the trial guidance for shared e-scooters in the UK, tyres may be of either pneumatic or non-pneumatic. France simply states that such vehicles must have tyres. Spain describes tests for structural integrity and EN 17128 requirements are applied to exterior projections, hot surfaces and footrests. The UK trial guidance for shared e-scooters requires e-scooters to have a stand in order to support them when left unattended whereas a kickstand, central stand or other stabilisation system is to be used while parked in Spain.

6.5. Lighting

Table 44: Overview of identified lighting characteristics (mandatory, M / optional, O / not specified, -) (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Lighting	2	0	0																			X																					X					
Indicators	2	1	1																				X		X												X		X									
Front light	15	0	2	X			X			X			X			X			X			X		X	X			X			X			X			X		X	X			X			X		
Rear light	14	1	2	X			X			X			X				X		X			X		X	X			X			X			X			X		X	X			X			X		
Braking light	1	1	0																																		X							X				
Stop lamp	0	0	0																																													
Front reflector	9	6	0	X			X			X			X				X		X			X				X			X			X			X		X			X				X		X		
Rear reflector	12	1	4			X	X					X	X			X			X			X		X	X			X				X		X			X		X	X			X			X		
Side reflector	8	5	2			X	X						X				X		X			X		X		X		X			X				X		X			X				X			X	

Table 44 shows the identified lighting characteristics for countries with known legislation. Germany (DE) requirements refer to §67 of the StVZO. Switzerland (CH) requires lights to be seen at least at 100 m at night. Spain (ES) requires indicators to be placed on the vehicle at a height of at least 150mm and emitted light colour must comply with ECE R 50 or ISO 6742-1. The minimum geometric visibility angle is 25° with respect to the horizontal plane. Germany also has this geometric visibility requirement for indicators installed at certain heights. Front and rear lights are discussed below.

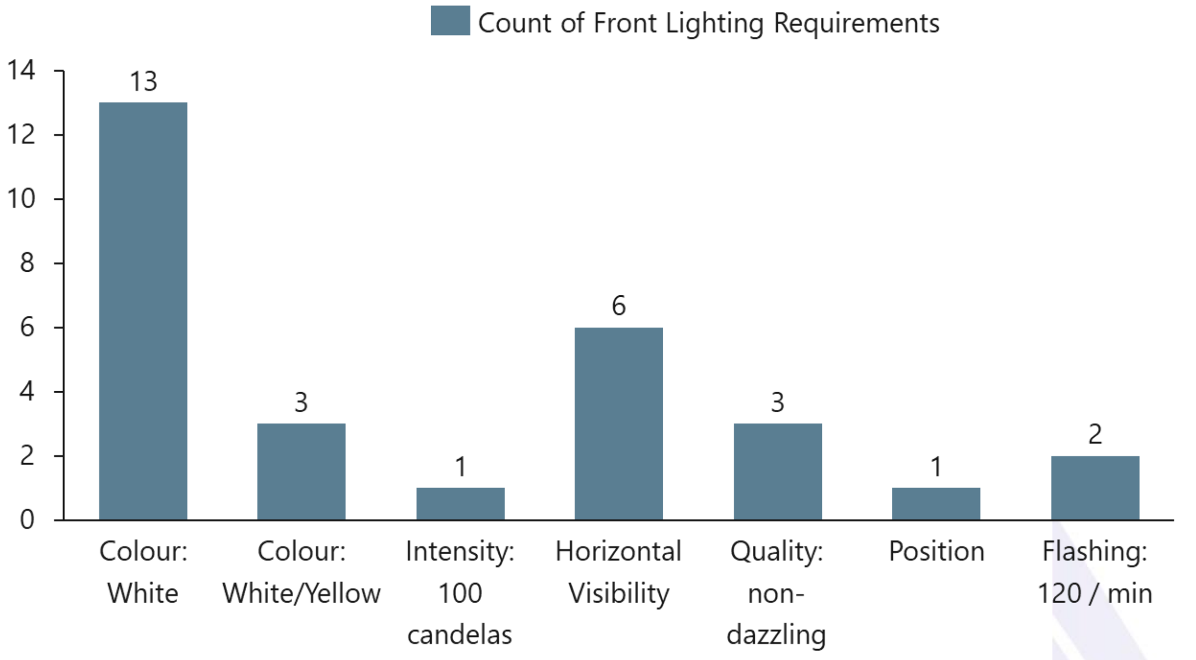

Figure 32: Detailed view of front lighting requirements

Figure 32 breaks down the various requirements of the front lighting. The colour is generally required to be white, however Belgium, France and Italy allow yellow lighting. Austria requires a light intensity of at least 100 candelas. The UK trial guidance for shared e-scooters requires that lights be visible from a reasonable distance, whereas this distance is defined as 150m in France, 200m in Belgium and 300m in Sweden, Denmark and Norway. The Czech Republic, Norway and UK trial guidance for shared e-scooters state that lights should not dazzle oncoming road users. Luxembourg specifies a height of at least 400mm from the ground at which the lights must be clearly visible. Denmark and Norway also lights to flash at 120 flashes/min.

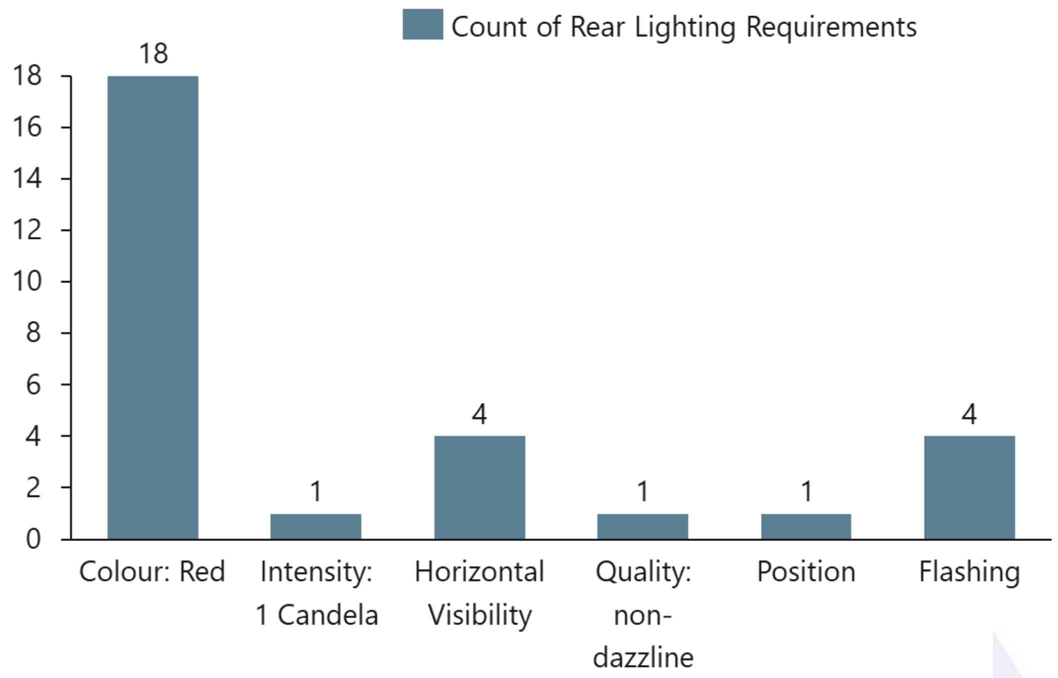

Figure 33: Detailed view of rear lighting requirements

The rear lights are examined in Figure 33. The colour can only be red. Austria requires an intensity of 1 candela. Horizontal visibility is set to 150m in Belgium and France, and 300m in Denmark and Sweden. The UK trial guidance for shared e-scooters and Luxembourg have similar non-dazzling and position requirements respectively as described above for the front lighting. The Czech Republic and Austria allow flashing red lights at the rear. Denmark and Sweden allow this flashing to occur at 120 and 200 flashes/min respectively. Luxembourg describes only a non-flashing light at the rear.

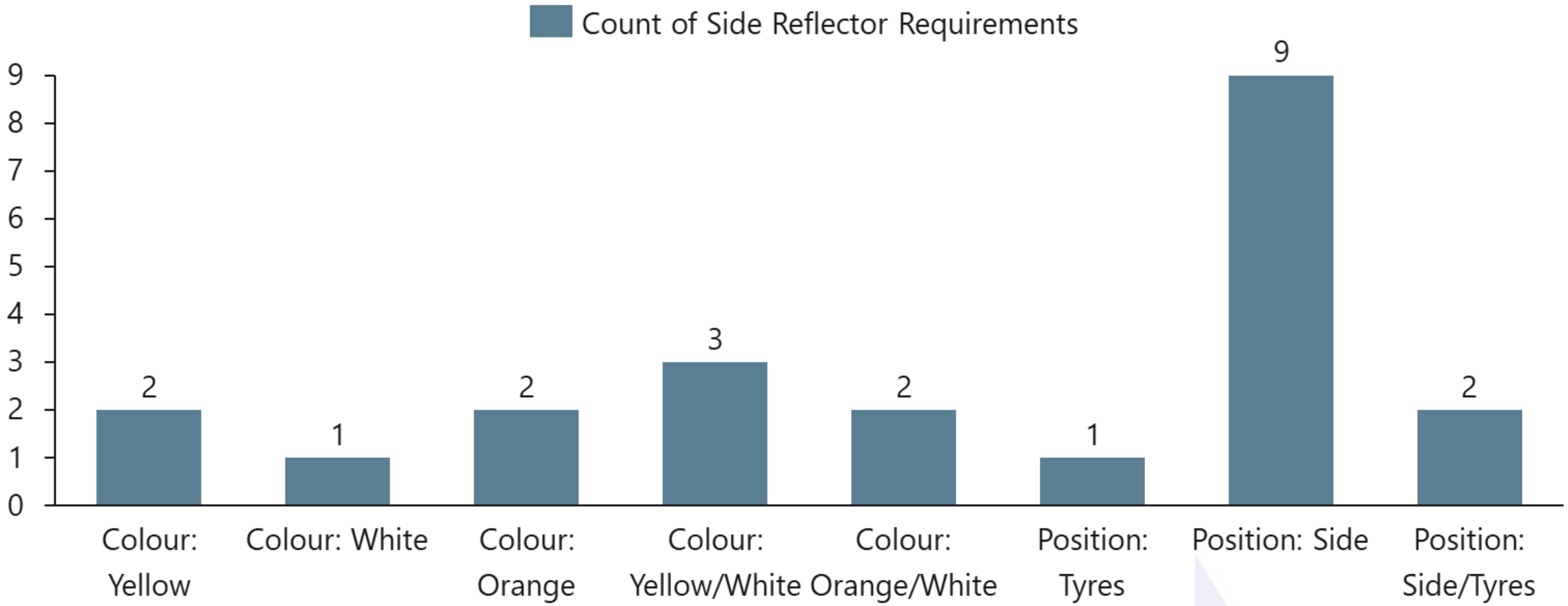

Figure 34: Detailed view of side reflector requirements

Figure 34 details the requirements for side reflectors. Germany and Austria state that these must be yellow, whilst Belgium stipulates white. France and Lithuania opt for orange. Germany, Spain and Denmark provide the option of yellow or white whereas PLEVs in Finland and Sweden may be equipped with orange or white side markers. Germany states that these should be attached to tyres, whilst Austria and Belgium declare this as an option.

A recently completed Member State survey by the European Commission makes reference to these points in Section 7.2.9

6.6. Miscellaneous Items

Items that could not easily be categorised under the above sections are included in Table 45.

Table 45: Overview of identified items (miscellaneous) (mandatory, M / optional, O / not specified, -) (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Speed regulator	1	0	0																						X																							
Indirect Vision	1	0	0																																		X											
Stability test	0	0	1																																													X
Test Requirements	0	0	2																					X															X									
Safety Requirements (Misc)	0	0	1																					X																								

Italy requires PLEVs to have a speed regulation configurable to a minimum of 6km/h and maximum of 20 km/h. Spain requires vehicles for the transport of goods or services to include a mirror on the right and left and sides of the vehicle for indirect vision. The UK has a stability test requirement (The British Government, 2024). Germany and Spain have specific requirements for the testing facilities. Germany makes references to UNECE R10 on electromagnetic compatibility and DIN EN 15194:2018-11 regarding bicycles partially driven by an electric motor.

7. Assessment of national road traffic rules for personal mobility devices

7.1. Review of road circulation and user requirements

Road circulation and user requirements are for the most part a national competency, and different member states apply a range of different rules to the manner in which PMDs and other light vehicles may be ridden. These national user requirements will interact with European PMD technical regulations in determining ultimately what, where and how an individual is allowed to ride.

Table 46 provides an overview of the user and road circulation requirements applied to PMDs in a variety of EU and EEA member states.

Table 46: Overview of identified road traffic rules relating to PMD (mandatory, M / optional, O / not specified, -) (LEVA, 2023)

	Total			AT			BE			CZ			DK			FI			FR			DE			IT			LT			LU			NO			ES			SE			CH			UK		
	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-	M	O	-
Parking	0	0	6			X															X			X			X									X			X									
Usage (specific)	0	0	3						X															X															X									
Usage (general)	1	0	13	X					X			X			X			X			X			X			X			X			X						X			X			X			X
License Req.	0	0	1	X																																							X			X		
Commercialisation	0	0	1																					X																								
Helmet	7	5	0	X				X		X			X							X			X		X			X				X					X			X								
Product Info	2	0	1																																		X		X							X		
Product ID	1	0	1																																				X							X		

Parking requirements are described by regulation in Austria, France, Italy, Norway and Spain. Austria states that devices must be parked in such a way that they cannot fall over or obstruct traffic. Furthermore, they may only be parked if the footway (sidewalk) is more than 2.5m wide. Although France's regulation states that PLEVs may be parked on footways, local councils may decide against this. In Italy, it is prohibited to park on the footway, except in areas identified by the municipalities. In Norway, devices are allowed to park on the pedestrian and cycle path, footway or pedestrianised street as long as the PLEV is not an obstacle or inconvenience. Although Spain allows such devices to be parked in motorcycle and bicycle parking lots, parking on footways is prohibited (with an exception for special pedestrian protection zones).

Usage of cycling infrastructure varies by country and device type. In the Czech Republic and Switzerland, e-scooters are obliged to use cycling lanes if available, whereas personal transporters may use the cycling lane. In Finland, segway riders may use footways at a walking pace. In France, Italy and Sweden, riders must use cycling infrastructure if available. If not, roads with a speed limit of 50 km/h may be used, and pedestrian areas (up to 6 km/h in France). Similarly in Germany, cycling infrastructure must be used if available. If there are no physically separated cycle tracks or cycle lanes, PLEVs can also be used on the road and, outside built-up areas, on the hard shoulder. Conversely, in Lithuania, devices can only use cycling infrastructure and footpaths.

Licencing requirements are provided by Austria, Switzerland and by the trial guidance for shared e-scooters in the UK. In Austria, children younger than 12 may drive electric scooters if a cycle license has been acquired, if not under supervision by a person of at least 16 years of age. In Switzerland, Cantonal approval is required for children aged between 14 and 16 years. In the UK, category Q entitlement on driving license is required.

Helmets need to be worn by children younger than 12 years in Austria. In Italy, the Czech Republic, Lithuania and Spain, this applies to children under 18 years. In Sweden, this applies to children under the age of 15. In Belgium, France, Germany, Luxembourg and the UK, a helmet is recommended. Denmark requires use of a helmet compliant with Regulation 2016/425. A recently completed Member State survey by the European Commission is covered in Section 7.2.7.

Product information and markings must meet requirements in Section 26 of Spain's National type-approval. The UK's trial guidance for shared e-scooters requires a conspicuous tamper-resistant and weather-proof label displaying manufacturer name, model ID, unique ID as well as maximum payload, speed and continuous rated power.

Given the broad definition of PMD employed for this study, there is potential that some machines, which might ultimately be regulated under a new EU PMD technical regulation, may be regulated from a user perspective under existing national moped regulations. Table 47 provides an overview of the regulations applied to mopeds in EU and EEA member states. Of particular note is the French, light cyclomobile category, which was introduced in 2022 as an entry level light electric vehicle category. This category is unusual in that it does not require riders to wear a helmet, although they are recommended. Many member states have a sub 25km/h light moped category, which, unlike the French example, largely predate the introduction of Regulation (EU) No 168/2013. While these sub 25km/h categories often have slightly different user requirements to their sub 45km/h heavy moped equivalents, the differences have decreased significantly in recent years as member states have tightened the requirements for licensing, insurance, helmet use and age limits. All moped types are required to comply with the technical requirements of Regulation (EU) No 168/2013, although in some cases, e.g. Poland, this is not explicit in their national legislation. In those member states that have introduced special regulations for PMDs, a distinction has been drawn between standing e-scooters and self-balancing machines, which are both explicitly excluded from Regulation (EU) No 168/2013, and seated e-scooters which theoretically fall within the scope of the regulation, although many are sold without type approval and consequently used illegally.

Table 47: National road traffic rules applied to mopeds in various EU and EEA member states

Country	Category	Maximum speed	Maximum motor power	Unladen mass	Minimum rider age	License required	Helmet	Insurance	Number plate
France	Light cyclomobile	25km/h	350W	35kg	14	Required	Recommended	Required	Not required
Sweden	Class 1 Moped	45km/h	Reg 168 applies	Reg 168 applies	15	AM required	Required	Required	Required
Sweden	Class 2 moped	25km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	
Netherlands	Light moped	25km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required
Netherlands	Heavy moped	45km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required
Belgium	Class A moped	25km/h	Reg 168 applies	Reg 168 applies	16		Required	Required	Required
Belgium	Class B moped	45km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required
Germany	Light moped	25km/h	Reg 168 applies	Reg 168 applies	15	Test certificate required	Required	Required	Required
Germany	Heavy moped	45km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required
Spain	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	AM required	Required	Required	Required
Italy	Moped	45km/h	Reg 168 applies	Reg 168 applies	14	AM required	Required	Required	Required
Denmark	Small moped	30km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	Required
Denmark	Large moped	45km/h	Reg 168 applies	Reg 168 applies	18	Required	Required	Required	Required
Norway	Moped	45km/h	Reg 168 applies	Reg 168 applies	16	Required	Required	Required	Required
Poland	Moped	45km/h	No power limit specified for electric mopeds		14	AM required	Required	Required	Required
Austria	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	Required
Finland	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	AM required	Required	Required	Required
Luxembourg	Moped	45km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required
Portugal	Moped	45km/h	Reg 168 applies	Reg 168 applies	14	AM required	Required	Required	Required
Greece	Moped	50km/h	Reg 168 applies	Reg 168 applies	16	Required	Required	Required	Required

Country	Category	Maximum speed	Maximum motor power	Unladen mass	Minimum rider age	License required	Helmet	Insurance	Number plate
Romania	Moped	45km/h	Reg 168 applies	Reg 168 applies	16	Required	Required	Required	Required
Bulgaria	Moped	45km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required
Czech Republic	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	Required
Slovakia	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	Required
Slovenia	Moped	50km/h	Reg 168 applies	Reg 168 applies	15	AM Required	Required	Required	Required
Cyprus	Moped	45km/h	Reg 168 applies	Reg 168 applies	17	AM required	Required	Required	Required
Croatia	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	Required
Estonia	Moped	45km/h	Reg 168 applies	Reg 168 applies	14	AM required	Required	Required	Required
Latvia	Moped	45km/h	Reg 168 applies	Reg 168 applies	14	AM required	Required	Required	Required
Lithuania	Moped	45km/h	Reg 168 applies	Reg 168 applies	15	Required	Required	Required	Required
Malta	Moped	45km/h	Reg 168 applies	Reg 168 applies	18	AM required	Required	Required	Required
Hungary	Moped	40km/h	Reg 168 applies	Reg 168 applies	14	AM required	Required	Required	Required
Ireland	Moped	45km/h	Reg 168 applies	Reg 168 applies	16	AM required	Required	Required	Required

7.1.1. Review of Regulation (EU) 168/2013

Regulation (EU) No 168/2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles as described in Sections 2, 4, 6.2 and 7.1, entered into force in January of 2016.Following this, a number of delegated and implementing regulations have further detailed a number of topics relating to two- or three-wheel vehicles and quadricycles:

- Commission Delegated Regulation (EU) 3/2014 with regard to vehicle functional safety requirements,
- Commission Delegated Regulation (EU) No 44/2014 with regard to the vehicle construction and general requirements,
- Commission Delegated Regulation (EU) No 134/2014 with regard to environmental and propulsion unit performance requirements,
- Commission Implementing Regulation (EU) No 901/2014 with regard to the administrative requirements
- Regulation (EU) 2019/129 as regards the application of the Euro 5 step to the type-approval (amends Regulation (EU) No 168/2013)

Of these delegated and implementing regulations, some have further been amended:

- Commission Delegated Regulation (EU) 2016/1824 with regard to vehicle functional safety requirements, to vehicle construction and general requirements and to environmental and propulsion unit performance requirements (amends Delegated Regulation (EU) No 3/2014, Delegated Regulation (EU) No 44/2014 and Delegated Regulation (EU) No 134/2014 respectively)
- Commission Delegated Regulation (EU) 2018/295 as regards vehicle construction and general requirements, and as regards environmental and propulsion unit performance requirements (amends Delegated Regulation (EU) No 44/2014,and Delegated Regulation (EU) No 134/2014 respectively)
- Commission Delegated Regulation (EU) 2023/2724 as regards certain references to Regulations of the United Nations Economic Commission for Europe (UNECE) and the availability of certain pure gases (amends and corrects Delegated Regulation (EU) No 134/2014)
- Commission Implementing Regulation (EU) 2016/1825 with regard to the administrative requirements for the approval and market surveillance (amends Implementing Regulation (EU) No 901/2014)
- Commission Implementing Regulation (EU) 2020/239 with regard to the adaptation of the templates for type-approval procedures (amends Implementing Regulation (EU) No 901/2014)

Table 48: Overview of Regulation (EU) 168/2013 Delegated and Implementing Regulations

Requirement	(EU) 168/2013	(EU) 3/2014	(EU) 44/2014	(EU) 134/2014	(EU) 2016/1824	(EU) 2018/295	(EU) 2023/2724	(EU) 901/2014	(EU) 2016/1825	(EU) 2020/239	(EU) 2019/129
ENVIRONMENTAL AND PROPULSION PERFORMANCE	Annex II(A), Annex V(A)			X	X	X	X				
OBD SYSTEMS	Article 21										X
VEHICLE FUNCTIONAL SAFETY	Annex II(B)	X			X						
CONSTRUCTION AND GENERAL TYPE-APPROVAL	Annex II(C)		X		X	X					
ADMINISTRATIVE REQUIREMENTS	Articles							X	X	X	

These are shown along with the respective relevant sections of Regulation (EU) 168/2013 in Table 48. The delegated and implementing regulations outlined above were filtered for requirements relating to electric vehicles.

Table 49: Selected vehicle functional safety requirements pertaining to EVs from Annex II(B) of Regulation (EU) 168/2013

No	Article	Subject	Amended by
3	22	electrical safety	(EU) No 3/2014, amended by (EU) 2016/1824
8		installation of lighting and light signalling devices, including automatic switching-on of lighting	

Table 49 summarises identified requirements relating to vehicle functional safety relevant for electric vehicles. Electrical safety is captured in Annex IV of Commission Delegated Regulation (EU) No 3/2014 and describes requirements for the approval of a type of vehicle with regard to electrical safety, general requirements concerning the protection against electrical shock and electrical safety applying to high voltage buses under conditions where they are not connected to external high voltage power supplies, requirements concerning the rechargeable electric energy storage system (REESS) and in-use safety requirements. Requirements concerning the REESS pertain to protection in case of excessive current, prevention of accumulation of gas, protection against electrolyte spills, accidental or unintentional detachment. Commission Delegated Regulation (EU) 2016/1824 amends point 4.1.4, specifically stating that “for vehicles of category L1e with a mass in running order ≤ 35 kg vehicle movement by its own propulsion system shall be inhibited as long as the connector of the battery charger is physically connected to the external electric power supply”. In other words, vehicle movement should be impossible whilst charging.

Annex IX of Commission Delegated Regulation (EU) No 3/2014 relates to lighting and light signalling devices, including automotive switching of lighting and has multiple requirements relating to “electrical connections”. Commission Delegated Regulation (EU) 2016/1824 amends 1.12 to include “for vehicles with electric or other alternative propulsion unit systems and vehicles equipped with an automatic stop/start system of the propulsion unit, as being linked to the master control switch having been activated with the vehicle in normal operation mode”, where automatically switched-on headlamp or daytime running lamp activation is linked to the running of an engine.

Table 50: Selected vehicle construction and general TA requirements pertaining to EVs from Annex II(C) of Regulation (EU) 168/2013

<table>
<tr><th>No</th><th>Article</th><th>Subject</th><th>Amended by</th></tr>
<tr><td>1</td><td>20</td><td>Anti-tampering measures</td><td rowspan="2">(EU) No 44/2014, amended by (EU) 2016/1824 and (EU) 2018/295</td></tr>
<tr><td>3</td><td>33</td><td>Conformity of production measurements</td></tr>
</table>

Table 50 summarises identified requirements relating to vehicle construction and type-approval for electric vehicles. Point 2.6 of the “General Requirements” under Annex II of Commission Delegated Regulation (EU) No 44/2014 applying to L3e-A1 and A2 state that manufacturer shall declare that manufacturer-facilitated modifications of the propulsion battery configuration or electric power to the electric motor(s) will not increase the propulsion unit performance. Furthermore, data must be provided proving that modification or disconnection of an electronic device which limits the propulsion unit performance will not increase performance. Specialised tools and procedures must facilitate any removable calibration memory chips shall be potted, encased in a sealed container or protected by electronic algorithms shall not be changeable without the use of specialised tools. Commission Delegated Regulation (EU) 2016/1824 adds point 6 containing additional requirements for (sub)categories L1e, L2e, L3e-A1, L4e-A1 and L6e.

Conformity of production is covered by Annex IV of Commission Delegated Regulation (EU) No 44/2014, where a type VII test on electric energy consumption and electric range determination is defined.

Table 51: Selected environmental and performance requirements pertaining to EVs from Annex II(A) of Regulation (EU) 168/2013

No	Article	Subject	Amended by
1	23 & 24	Environmental test procedures related to exhaust emissions, evaporative emissions, greenhouse gas emissions, fuel consumption and reference fuels	(EU) No 134/2014, amended by (EU) 2018/295, amended and corrected by (EU) 2023/2724*

Table 51 lists environmental and performance requirements for electric vehicles, which is defined in Annex V(B) of Regulation (EU) 168/2013 for pure electric vehicles. This test type VII procedure (only energy consumption) is described in detail in Annex VII of Commission Delegated Regulation (EU) No 134/2014. Appendix 2 contains a method of measuring the electric energy consumption whereas Appendix 3 outlines a method for measuring electric energy consumption and driving range of vehicles powered by a hybrid electric powertrain. Appendix 3.3 stipulates a method of measuring the electric range of vehicles powered by an electric powertrain along with various hybrid variants. Commission Delegated Regulation (EU) 2016/1824 amends Appendix 3.3 mentioned in the previous sentence, with a test method to measure the electric range and a condition that category L1e vehicles designed to pedal shall be exempted from the electric range test.

Table 52: Selected administrative requirements pertaining to EVs from Regulation (EU) 168/2013

No	Article	Subject	Amended by
-	Art. 27(1), 27(2)(a)	Templates for the information document and for the information folder	(EU) No 901/2014, amended by (EU) 2016/1825 and (EU) 2020/239
-	Art. 38(1)	Templates for the certificates of conformity	
-	Art. 39(1), 39(2)	Models for the statutory plate and EU type-approval mark	
-	Art. 32(1)	Format of test reports	
-	Art. 50(2)	List of parts or equipment which may pose a serious risk	
-	Art. 51(2)	Template and numbering system for the certificate	

Table 52 presents an excerpt of the administrative requirements for electric vehicles. Appendix 24 of Annex I in (EU) 901/2014 lays out a template for the manufacturer's declaration for vehicles capable of converting their performance level from subcategory (L3e/L4e)-A2 to (L3e/L4e)-A3 and vice-versa:

- Energy efficiency
  - 8.7.6. Energy consumption (1): …Wh/km AND 8.7.7. Electric range (1): …km
- Annex IV Appendix I: Certificate of conformity accompanying each vehicles int eh series of the type which has been approved (L-Cat)
- Energy Efficiency AND Appendix II: Conformity issued in accordance with Directive 2002/24/EC
  - 4.0.3.3. Energy consumption: Wh/km (CV*: … Wh/km) AND 4.0.3.4. Electric range: km (CV*: … km)
- Annex VIII: Format of test reports and template for the format of test reports

- 2.2.1.8. Test type VII requirements
- 2.2.1.8.7 Fuel consumption (manufacturer’s declared values)
    - Measured electric energy consumption (Wh/km) AND Measured electric range (km)

Part B of Annex I adds data entries to the information document concerning conformity of production:

- 1.8.5. Maximum continuous-rated power electric motor (15/30(4) minutes power): … kW at … min-1
- 1.8.6. Maximum continuous-rated torque electric motor: … Nm at … min-1

An example of the manufacturer’s data plate is embedded in Annex V concerning the EU type-approval mark albeit for an electric motorcycle.

Commission Implementing Regulation (EU) 2016/1825 contains additions to the information document and certificate of conformity for electric energy consumption (Wh/km) AND declared electric range (km) within Appendix 3, 6, 7, 8 and 24 of Annex I and Appendix 2 of Annex IV. Annex I additions of Appendix 5a/9a (electric motor), 11a/b (brief descriptions of electrical components) are also detailed. Finally, the declared electric energy consumption (Wh/km) AND declared electric range (km) are added to the test type VII requirements of Annex VII.

7.2. Results of the Member State Survey

In addition to documentation reviewed on road circulation and user regulations summarised in section 7.1, results from a recently completed survey of the EU High Level Group on Road Safety were also analysed (The European Commission, 2023). The survey pertained to bicycles (EPACs) and PMDs and respondents included government representatives from Belgium, Netherlands, Estonia, Ireland, Sweden, Slovakia, Denmark, Luxembourg, Finland, Hungary, Bulgaria and Spain. Respondents could respond with “yes”, “no” or “NR/DK” (no response/don’t know). In multiple instances, a blank response was provided, as was consistently the case with Austria, Bulgaria, Cyprus, Czech Republic, France, Greece, Italy, Norway, Poland, Portugal, Slovenia, Switzerland and the UK. The survey was conducted before the new Irish regulation was published in the first half of 2024.

The categories used in the survey were developed by the Commission and responded to by representatives from the Member States. One of the categories used in the survey was ‘EPAC (<250W) >25kmh, however by definition an EPAC must be <250W and <25km/h. This discrepancy was acknowledged by the Commission and it is assumed that this category was intended to refer to Speed Pedelecs, i.e. Powered Cycles (L1e-A) and cycles designed to pedal in L1e-B.

7.2.1. Obligation to obtain license plates

Table 53 shows that license plates are generally not required for both EPACs and PMDs, with the exception of Belgium for EPACs with speed exceeding 25 km/h and Germany for PMD types e-scooter as well as “other”. Ireland also has license plate requirements for PMDs of type “other”.

Regarding e-scooters, Latvia indicated future intention of incorporating such a requirement, whereas Slovakia, Hungary and Spain provided no response (NR) or unsure (DK). Regarding “other” bicycles, only Sweden expressed doubt as to whether this requirement would be mandatory in future.

Table 53: Overview of responses pertaining to license plate obligations

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	0	9	0	-	-	-
Other	0	5	0	2	3	0
Regular bikes	0	12	0	-	-	-
E-scooter	-	-	-	1	9	0
FUTURE						
EPAC (<250W) >25km/h	1	0	0	-	-	-
EPAC (<250W) ≤25km/h	0	9	0	-	-	-
E-scooter	-	-	-	1	5	3
Other	1	3	1	0	3	0
Regular bikes	0	12	0	-	-	-

In terms of the future outlook for bicycles, Ireland indicated that EPACs (<250W, >25km/h) and “other” were planned to be classified as per EU Type Approval categories as of Q1 2024. This will mean that they will be required to have a vehicle registration plate, motor tax and an AM Driving Licence. Furthermore, EPAC (<250W, >25km/h) that are pedal assisted will not require insurance. “Other” PMDs that do not require pedalling will also require insurance under the EU Motor Insurance Directive. Future plans concerning PMDs were highlighted by Latvia, which indicated that amendments to the law are being made for mandatory registration of e-scooters (and thus getting a licence plate).

7.2.2. Voluntary registration

Table 54 provides an overview of the voluntary registration schemes identified. The Netherlands and Spain allow this for EPAC (<250W) >25km/h. The Netherlands, Hungary and Spain allow this for regular bikes. Belgium has a voluntary scheme in place for the two aforementioned bicycle categories as well as “other”, in which a sticker (unique identifier or QR code) is used. Latvia is the single country to have indicated that e-scooters are permissible under such a scheme.

Table 54: Overview of voluntary registration characteristics

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	0	2	0	-	-	-
EPAC (<250W) ≤25km/h	3	6	0	-	-	-
E-scooter	-	-	-	1	8	0
Other	1	4	0	0	3	0
Regular bikes	4	8	0	-	-	-

The Netherlands and Hungary highlighted the practicality of such a system when dealing with stolen bicycles.

7.2.3. National Registry

Table 55 contained figures pertaining to national registry requirements. Belgium indicated the presence of such for EPAC (<250W, >25 km/h). Latvia and Ireland confirmed the presence of a national registry for e-Scooters and “other” respectively.

Table 55: Overview of National Registry Requirements

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	0	9	0	-	-	-
Other	0	5	0	1	4	0
Regular bikes	0	12	0	-	-	-
e-Scooter	-	-	-	1	9	0

Belgium indicated the use of a registry whereby the bicycle number plate is stored. Latvia has an electronic system operated by the Road Traffic Safety Directorate with information about vehicle and its owner. In Ireland, e-scooters and “other” PMDs are currently required to be registered and have a registration plate at present. Newly published legislation in Q1 2024 was planning to remove the need for registration plates for e-scooters within certain specifications only.

7.2.4. Insurance

Table 56 tallies counts of the various insurance requirements. Whereas Denmark and Finland stipulate an obligation to take out insurance for “other” bicycles (applicable to the vehicle), Germany has this requirement for PMDs of type e-scooter and “other” (applicable to the vehicle). Additionally, Sweden obliges riders to be insured when using e-scooters and Ireland for PMDs of type “other”, applicable to the driver and the vehicle in both cases.

Voluntary insurance schemes were also indicated in a range of countries for both bicycle and PMD categories. Schemes are generally offered by insurance companies and differ in terms of asset versus liability insurance.

Regarding bicycles, Slovakia, Hungary and Bulgaria use voluntary schemes for regular bicycles, whereas Netherlands, Estonia, Denmark, Finland and Spain do so for EPAC (<250W) ≤25km/h. Belgium was the only country to indicate the use of such a scheme for all categories of bicycle. Finland and Belgium have schemes for bicycles of category “other”.

Regarding PMDs, Latvia, Sweden, Estonia, Hungary and Spain indicated the existence of such a scheme for e-Scooters, whilst Belgium, Estonia, Finland did so for type “other”. The maximum amount of the civil liability insurance was not provided, except for “other” bicycle categories (€18.1 mil).

Table 56: Overview of insurance requirements

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	0	2	0	-	-	-
EPAC (<250W) ≤25km/h	0	9	0	-	-	-
Other	2	3	0	2	3	0
Regular Bikes	0	12	0	-	-	-
e-Scooter	-	-	-	2	8	0
FUTURE						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	1	7	1	-	-	-
e-Scooter	-	-	-	3	3	2
Other	1	1	1	2	1	0
Regular bikes	1	9	2	-	-	-

Looking forwards, Spain intends to make insurance mandatory regarding usage of regular bikes and EPAC (<250W) ≤25km/h and Ireland for EPAC (<250W) >25 km/h and “other”. Sweden expressed doubt for bicycle categories regular bikes, EPAC (<250W) ≤25km/h and “other” whilst Slovakia did so only regarding regular bikes. Slovakia and Hungary expressed a similar notion for e-scooters.

7.2.5. Licence and Training Requirements

Table 57 contains an overview of various license and training requirements. Estonia requires a licence or training for regular bikes and EPACs (<250W) ≤25km/h. Belgium has this requirement for EPACs (<250W) >25km/h as does Denmark for “other” bicycles. Estonia has mandatory licence and training for PMDs of type e-scooter and “other”. Ireland requires this for “other” PMDs only.

Voluntary training courses are available in a number of countries, which are typically done in schools. Regarding bicycles, Hungary and Bulgaria provide these for regular bicycles. The Netherlands, Estonia and Spain do so for EPAC (<250W) ≤25km/h. Again, Belgium is the only country to have indicated providing these for all categories of bicycles.

In terms of PMDs, Sweden, Estonia, Hungary and Spain offer courses for e-scooters. Belgium does this for category “other”.

Table 57: Overview of license and training requirements

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	1	8	0	-	-	-
Other	1	4	0	-	-	-
Regular bikes	1	11	0	-	-	-
e-Scooter	-	-	-	1	9	0
Other	-	-	-	2	3	0
FUTURE						
EPAC (<250W) >25km/h	1	0	0	-	-	-
EPAC (<250W) ≤25km/h	0	8	0	-	-	-
e-Scooter	-	-	-	2	4	3
Other	1	3	0	0	3	0
Regular bikes	0	11	0	-	-	-

In future, Ireland is considering mandatory licence and/or training for EPACs (<250W) >25km/h and “other” bicycles. Latvia and Hungary are considering future introduction of licence / training for e-scooters. Sweden, Slovakia and Spain expressed doubt on this matter. Voluntary training course are available in a number of countries.

7.2.6. Minimum driving age

Table 58 presents an overview of the minimum driving age across vehicle categories. Estonia and Luxembourg have a minimum age of 10 for regular bikes and EPACs (<250W) ≤25km/h. Belgium and Denmark require a minimum age of 16 and 15 years for and EPACs (<250W) >25km/h and “other” bikes respectively. Ireland reported they were considering, at the time of the survey, introducing a minimum age of 16 years for EPACs (<250W) >25km/h and “other” bicycles, whereas Sweden expressed doubt.

Regarding the present use of PMDs, Germany (14), Belgium (16) and Estonia (10) have minimum ages for e-scooters and “other” PMDs. Ireland also requires a riders of “other” PMDs to be at least 16. Slovakia and Denmark require a minimum of 15 years whereas Luxembourg allows riders as young as 10 for e-scooters. Latvia’s limit is currently 14 years. Looking ahead, Ireland and Hungary are planning to introduce minimum age requirements for e-scooters whereas Sweden and Spain expressed neither the affirmative nor the negative.

Table 58: Overview of minimum driving age requirements

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	2	7	0	-	-	-
Other	1	4	0	-	-	-
Regular bikes	2	10	0	-	-	-
E-scooter	-	-	-	7	5	0
Other	-	-	-	4	1	0
FUTURE						
EPAC (<250W) >25km/h	1	0	0	-	-	-
EPAC (<250W) ≤25km/h	0	7	0	-	-	-
e-Scooter	-	-	-	2	0	2
Other	1	2	1	0	1	0
Regular bikes	0	10	0	-	-	-

7.2.7. Helmet Requirements

Table 59 presents an overview of the helmet requirements. Estonia requires helmets for regular bikes and EPAC (250W) ≤25km/h. Belgium does so for EPAC (250W) >25km/h whereas this is applicable regarding “other” bicycles in Denmark. Looking forward, Sweden and Slovakia are unsure about whether such measures will be introduced for regular bikes. Sweden also expressed doubt for EPAC (250W) ≤25km/h and “other” bicycles.

Regarding PMDs, the use of a helmet is mandatory in Sweden, Estonia and Denmark. This is the case for “other” PMDs in Estonia and Ireland. In future, Latvia, Hungary and Spain are considering the introduction of such a measure, whereas Slovakia has not confirmed their stance.

Table 59: Overview of helmet requirements

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	1	8	0	-	-	-
Other	1	4	0	-	-	-
Regular bikes	1	11	0	-	-	-
e-Scooter	-	-	-	3	8	0
Other	-	-	-	2	3	0
FUTURE						
EPAC (<250W) >25km/h	1	0	0	-	-	-
EPAC (<250W) ≤25km/h	1	6	1	-	-	-
e-Scooter	-	-	-	3	3	1
Other	1	2	1	0	3	0
Regular bikes	1	8	2	-	-	-

7.2.8. Reflective Clothing

Table 60 quantifies requirements pertain to reflective clothing. Bulgaria has such a requirement for regular bikes, whilst Spain additionally applies this requirement to EPAC (<250W) ≤25km/h. Denmark requires reflective clothing for users of “other” bicycles.

Looking ahead, Hungary intends to apply this to riders of regular bikes, whereas Sweden and Slovakia have provided no definitive response. Sweden express similar uncertainty for EPAC (<250W) ≤25km/h and “other” bicycles. Ireland confirmed the affirmative for both EPAC (<250W) >25km/h and “other” bicycles.

In terms of PMDs, Ireland and Spain currently require reflective clothing for users of other PMDs and e-Scooters. Slovakia and Hungary expressed uncertainty regarding the application to riders of e-Scooter.

Table 60: Overview of reflective clothing requirements

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	0	2	0	-	-	-
EPAC (<250W) ≤25km/h	1	8	0	-	-	-
Other	1	4	0	1	4	0
Regular bikes	2	10	0	-	-	-
e-Scooter	-	-	-	1	9	0
FUTURE						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	0	8	1	-	-	-
e-Scooter	-	-	-	0	7	2
Other	1	2	1	0	4	0
Regular bikes	1	8	2	-	-	-

7.2.9. Technical Characteristics

Member states were asked specifically if particular technical characteristics of PMDs have been defined in regulation in their respective countries. These results are shown in Table 61.

The technical characteristics are described in detail in section 6.3 for acoustic warning devices and braking. Countries with audible warning requirements include Germany, Belgium, Sweden, Slovakia, Luxembourg, Finland and Spain. It is acknowledged that there is some level of disconnect between the national requirements identified by the survey and the actual requirements reviewed at the time of writing section 6. For example, Austria, Italy, Switzerland and France did not provide a response in the survey, but a national technical requirement could be identified. Denmark explicitly stated in the survey that acoustic warning devices had not been regulated in their respective countries, however national technical requirements are known to industry.

Countries which indicated braking requirements in the survey include Germany, Belgium, Slovakia, Luxembourg, Finland and Spain. Latvia and Sweden indicated doubt in this regard.

The technical characteristics are described in detail in section 6.1 for maximum speed and section 6.5 for lighting. Countries in the survey indicating a presence of such a requirement include Germany, Belgium, Latvia, Sweden, Estonia, Slovakia, Denmark, Luxembourg, Finland and Spain. National technical requirements were however analysed for Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Latvia, Luxembourg, Norway, Spain, Sweden, Switzerland and the UK.

Table 61: Overview of technical characteristics of personal mobility devices and regulation status

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
Acoustic warning device	-	-	-	7	5	0
Braking systems or deceleration requirements	-	-	-	6	4	2
Single or double braking	-	-	-	4	6	2
Lighting (Ilumination)	-	-	-	10	2	0
Maximum speeds	-	-	-	10	2	0
Power	-	-	-	8	4	0
Self-balancing devices (unicycle, hoverboard, segway,...)	-	-	-	7	4	1

7.2.10. Usage dependant regulation

Applicable regulations were deemed to be independent of the end use (personal use, sharing, parcel delivery etc) of the bicycle categories. In terms of PMDs (e-scooters), Ireland, Slovakia and Spain indicated a variation.

Table 62: Overview of dependency of applicable regulations on use

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) >25km/h	0	2	0	-	-	-
EPAC (<250W) ≤25km/h	0	9	0	-	-	-
Other	0	5	0	0	5	0
Regular bikes	0	12	0	-	-	-
e-Scooter	-	-	-	3	7	0

Variations in the bicycle category are instead evident when viewed in terms of infrastructure usage, as shown in Table 63. In terms of EPAC (<250W) >25km/h, Ireland has stated that EPAC (<250W) >25km/h and “Other” are planned to be treated like motorbikes from Q1 2024. Belgium indicate minor differences in road usage requirements when compared to regular bicycles. The Netherlands confirmed that EPAC (<250W) ≤25km/h must use the bicycle lane if there is one. If there is no bicycle lane, the EPAC must use the lane for motorcars (as far to the right as is possible).

Bulgaria indicated that regular bicycles are allowed on pavements.

Belgium restricts all bicycle categories to cycle paths. Denmark restricts regular bikes, EPAC (<250W) ≤25km/h and “other” to cycle paths. Hungary restricts regular bikes to cycles path.

Belgium, Slovakia, Hungary, Bulgaria and Spain allow regular bikes on all other roads. In Belgium and Spain this is also the case for EPAC (<250W) ≤25km/h. Only in Belgium is this so for EPAC (<250W) >25km/h and "other".

Table 63: Overview of restrictions dependent on infrastructure usage (bicycles)

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
RULES OF THE ROAD						
EPAC (<250W) >25km/h	2	0	0	-	-	-
EPAC (<250W) ≤25km/h	1	8	0	-	-	-
ALLOWED ON PAVEMENT						
EPAC (<250W) >25km/h	0	2	0	-	-	-
EPAC (<250W) ≤25km/h	0	9	0	-	-	-
Other	0	5	0	-	-	-
Regular bikes	1	11	0	-	-	-
RESTRICTED TO CYCLE PATHS						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	2	7	0	-	-	-
Other	2	3	0	-	-	-
Regular bikes	3	9	0	-	-	-
ALLOWED ON OTHER ROADS						
EPAC (<250W) >25km/h	1	1	0	-	-	-
EPAC (<250W) ≤25km/h	2	7	0	-	-	-
Other	1	4	0	-	-	-
Regular bikes	5	7	0	-	-	-

Certain restrictions do however apply. In the Netherlands, bicycles and EPACs are not allowed on motorways. In Estonia, a number of conditions apply depending on the type of road and role of the rider. In Ireland, bicycles/EPACs are not allowed on motorways. Sweden has specific age restrictions. Denmark states that if a cycle path is available it must be used, otherwise road suage is permitted.

In Finland, bicycles and EPACs are not allowed on sidewalks. Children younger than 12 years are allowed to ride a bicycle on the footway (sidewalk). Bicycles and EPACs are not allowed on motorways or expressways.

In Hungary, the cyclist has to travel on the cycle path, cycle lane, or on the bus traffic lane. If there is no such infrastructure, cyclist can use roads. If the road and traffic conditions allow it - on the road outside of built up areas, on the road marked as the main road, cyclists must drive to the right edge of the roadway. On a road in a built up area where the roadway is unsuitable for bicycle traffic, bicycles may use the pavement without interfering with pedestrian traffic and at a maximum speed of 10 km/h.

In Bulgaria, bicyclists under the age of 12 are not allowed to drive on paved roads. They are only allowed to drive on footways (sidewalks) and in parks.

Finally, in Spain bike riding on motorways is forbidden. Use is permitted on dual carriageways for over 14 years old if riding on the hard shoulder, unless there is a specific sign that prohibits it. On urban roads municipalities may decide.

Further variations can be identified for PMDs (Table 64). Germany, Latvia, Sweden, Estonia, Slovakia, Denmark, Luxembourg allow e-scooters on interurban roads. Germany, Belgium, Estonia and Finland permit “other” PMDs to do the same. With respect to use on pedestrian pavements, e-scooters are permitted in Latvia, Estonia and Slovakia[6]. Latvia, Estonia and Slovakia allow e-scooters to be usage in pedestrian pavements, the latter two of which also define a speed limit. Estonia also permits “other” PMDs on pedestrian pavements subject to a speed limit. Regarding the use on interurban roads and pedestrian pavements, Hungary responded with “NR/DK” (doubt). Latvia, Sweden, Denmark and Luxembourg all require e-scooters to use a bike lane, if available. Belgium and Finland apply this logic to “other” PMDs. Belgium applies this to e-scooters and “other”.

Table 64: Overview of restrictions dependent on infrastructure usage (PMD)

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
ALLOWED ON INTERURBAN ROADS						
e-Scooter	-	-	-	7	2	1
Other	-	-	-	4	1	0
ALLOWED ON PEDESTRIAN PAVEMENTS (SPEED LIMIT)						
e-Scooter	-	-	-	3 (2)	6	1
Other	-	-	-	1 (1)	4	0
MANDATORY USE OF BIKE LANES (IF AVAILABLE)						
e-Scooter	-	-	-	5	3	2
Other	-	-	-	3	2	0

[6] This is also the case for e-scooters in Bulgaria, Cyprus, Czech Rep, France, Greece, Italy, Norway, Poland, Portugal (not included in table figures)

7.2.11. Role of the Road Traffic Regulation for PMDs

Table 65: Overview of Road Traffic Regulation Characteristics

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
e-Scooter	-	-	-	8	2	0
Other	-	-	-	5	0	0

Germany, Latvia, Sweden, Estonia, Slovakia, Denmark, Luxembourg and Spain all apply a national regulation to e-scooters (Sweden and Spain also leverage a local regulation). Germany, Belgium, Estonia, Ireland and Finland utilise a national regulation for "other" PMDs. These are summarised in Table 65.

7.2.12. Requirements on parking in public spaces

Requirements on parking in public spaces are provided predominantly for bicycles.

In the Netherlands, the owner must park the bike such that no obstruction is caused. Also the owner cannot park the bike in areas where it is forbidden, which are indicated by road signs. In Hungary, a sign showing a depiction of a bicycle indicates where bicycles may be parked. Similarly in Sweden, parked bicycles shall not hinder traffic and e-scooters must be parked in a space designated for them or bicycles.

In Estonia, bicycles can be parked on the carriageway near to its edge or shoulder in such a way that at least a strip of 0.7 metres would be available for the movement of pedestrians. On a carriageway in a built-up area bicycles may stand two abreast. Bicycle must be no further than 0.2 metres from the edge of the carriageway. A cycle may also be stopped and parked on a pavement, leaving at least a 1.5-metre gap for pedestrians.

Parking requirements in Ireland are determined by Local Authorities/Councils. In Denmark and Bulgaria, there are no restrictions, however in the former, the bicycle/EPAC must be locked. This is also the case in Spain, however bike parking usually is forbidden on pavements or in areas where they obstruct pedestrian movement.

7.2.13. Role of the Shared Service

The Shared Service is observed to have a varying level of agency in various countries, shown in Table 66. In terms of bicycles, the Estonian Shared Service has specific rules on minimum age (16), whereas Belgium, Ireland and Denmark expressed doubt. Denmark was the sole country to indicate the existence of specific driving restrictions in this context, whereas Belgium and Ireland again expressed doubt.

In terms of specific requirements for parking in public spaces for bicycles, the Estonian, Danish and Hungarian Share Services have specific rules. Ireland expressed doubt regarding the role of the Shared Services on topics such as technical characteristics and mandatory helmet use pertaining to bicycles.

Regarding PMDs, the Danish Shared Service has specific rules regarding mandatory helmet use and minimum age (15), whereas their Belgium and Luxembourgian counterparts expressed doubt. The Shared Services in Latvia (14) and Estonia (16) also have specific rules regarding minimum age. The minimum ages provided align with the responses in Section 7.2.6 for Latvia and Denmark, however not for Estonia.

Specific rules of the Shared Services are apply to circularity restrictions in Latvia, Sweden and Ireland, whereas Belgium, Slovakia, Denmark, Luxembourg and Hungary indicated doubt.

Table 66: Overview of the Specific Rules of the Share Service

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
Technical characteristics	0	9	1	-	-	-
Mandatory helmet use	0	9	1	1	9	2
Minimum age	1	6	3	3	7	2
Driving restrictions	1	7	2	-	-	-
Specific requirements for the parking in public spaces	3	5	2	-	-	-
Circulation restrictions	-	-	-	3	4	5

7.2.14. Role of requirements and approval processes for bicycles

Requirements and corresponding approval processes are summarised in Table 67. Denmark has a set of requirements and an approval process for EPACs (<250W) ≤25km/h. Sweden expressed doubt on this aspect. Belgium and Ireland have requirements and an approval process for EPACs (<250W) >25km/h which have been adopted in line with Regulation (EU) 168/2013 homologation. Ireland and Denmark provide such measures for “other” bicycles. Denmark has a set of requirements and an approval process for regular bikes. Sweden and Bulgaria expressed doubt regarding this.

Table 67: Overview of requirements and approval processes for bicycles

	Bicycles			PMD		
	Yes	No	NR/DK	Yes	No	NR/DK
NOW						
EPAC (<250W) ≤25km/h	1	7	1	-	-	-
EPAC (<250W)>25km/h	2	0	0	-	-	-
Other	2	2	1	-	-	-
Regular bikes	1	9	2	-	-	-

8. Discussion

There are a multitude of different types of PMD on the market and in use on the road. Their presence in the form of EPACs, e-scooters and e-carrier cycles has become ubiquitous in most cities, while diverse new concepts are launched regularly. For some, such as seated e-scooters, there is already a clear if uncomfortable regulatory home within Regulation (EU) No 168/2013. But others, in particular standing e-scooters and self-balancing machines find themselves in regulatory limbo – specifically excluded from Regulation (EU) No 168/2013, but without a European level alternative. National technical regulations, most notably eKFV in Germany, but now including the Dutch Framework for PLEV and the Spanish Manual of Characteristics of Personal Mobility Vehicles, are beginning to fill this void, but with a very real risk of divergence between the requirements of different member states.

While EPACs have a well-developed set of regulations which for the most part function effectively, there is still a considerable prevalence of machines which fulfil neither the requirements of the EPAC regulations or Regulation (EU) No 168/2013 because of their top speed or ability to be controlled by a throttle alone. This highlights the limitations of even the best technical regulations – they require enforcement at a very practical level on the street. For most police forces, a lack of clarity on the rules applicable to personal mobility devices may make enforcement difficult, and compliance with the nuances of technical regulations for small light machines may take a low priority. For product safety agencies, the task of intercepting non-compliant machines before they reach the end user is significant and made more difficult by the prevalence of online rather than physical retailers who are often based outside the EU and thus beyond the reach of enforcement. This illustrates the risk that even the best set of technical regulations may struggle to have a significant impact on the quality and safety of the machines actually used on the road.

Although we have seen an improvement in the coverage of collisions involving EPACs and e-scooters in some member states, there is still a lack of good collision data for most PMDs. This is in part driven by a lack of accepted definitions for many PMD types, but primarily is driven by under-reporting by users and a long lag in changing the basic processes that are used by police forces to record collisions.

The data on failures of the type which could effectively be addressed through technical regulations is extremely limited. While there is anecdotal evidence of problems with the structural integrity of e-scooters, including those which comply with the requirements of EN17128, there is nothing that could be regarded as systematic evidence of poor PMD design leading to collisions and injury. The same is true for variations in the manufacturing of other PMD types e.g. hoverboards, which anecdotally exhibit significant variations of components between ostensibly identical machines, but with little evidence that this is leading to significant harm. The exception here being the growing problem of fires resulting from poor quality, non-approved PMD batteries. Here there are clear opportunities for improvement in standards, most urgently perhaps bringing the battery requirements of EN17128 into line with those in EN15194, which requires compliance with EN 50604-1:2016+A1:2021.

8.1. Priorities for regulation

8.1.1. Road safety

The primary purpose of regulation is to protect the public from harm. A secondary purpose of regulation may be to promote things which may be of benefit to society, including trade and industry, and increasingly, environmental protection. Road safety is a composite of many factors including technical regulations applied to the vehicles or machines themselves, road circulation regulations applied to the users of those vehicles or machines, societal behaviours including the education and attitudes of all road users, traffic volumes and make-up, infrastructure design and maintenance, and environmental conditions. This project has considered only the changes that could be made to the technical regulations governing the design of PMDs, but any such change must be considered in the broader context of all the factors that affect road safety, trade and industry and environmental protection.

In Section 5 we reviewed the data and research available on PMD collisions. While many PMD groups, e.g. EPACs, are now quite mature, the recording and reporting of collisions involving PMDs is still much less comprehensive than collisions involving traditional motor vehicles. Consequently it is very difficult to discern significant trends that may be affecting PMD safety. Clearly there has been a growth in recent years in the number of people being injured or killed in collisions involving PMDs, however this growth accompanies a growth in the use of PMDs. For more novel PMD groups such as e-scooters there is little or no historic data on injury numbers, either because historic use was minimal or because no recording system existed for this type of machine. We must therefore be careful not to be misled into believing that a sudden increase in reported casualties represents a fundamental change in the risk profile of specific machine types. Instead what we are perhaps seeing is an increasing number of incidents as the rate of PMD use increases, combined with an increasing rate of reporting as the scope of statistical analyses are increased to include these novel types. What the data does not show with any clarity is where opportunities may lie for intervention through technical regulation to change the upward trajectory in casualty numbers, i.e. there is no “smoking gun” of obvious structural failures that could easily be mitigated through better construction standards. The data does show that a significant majority of PMD collisions do not involve a third party, i.e. the causes of the collision are isolated to the machine, its user and the environment in which it is operating. Data also show that user factors, especially impairment due to alcohol are responsible for many of these incidents. There is also evidence to suggest that collisions are more common while riders are learning how to ride. We should note that most jurisdictions have no mandatory training requirements for PMD users (as discussed in Section 7), who as a consequence must learn through a process of trial and error. This lack of mandatory training means that in many cases new riders are learning how to control their machine at the same time as they are learning the rules and etiquette of the road. Clearly there is a significant opportunity to improve here, but one that is outside the scope of this project and largely beyond the control of the European Commission.

What then could be done, from a technical perspective, to improve the safety of PMDs? Here the question splits into two parts – 1) what could we do to prevent dangerous behaviours e.g. speeding, or riding while inebriated, and 2) what could be done to improve the controllability and stability of PMDs. In the former category, possible technical interventions could include mandatory speed limiters which remove the opportunity for riders to ride in a manner that increases the risk to themselves and others, and mandatory alcolocks to prevent operation while intoxicated, although this would be without precedent in vehicle regulations despite the frequency with which alcohol is a factor in vehicle collisions.

In the latter category, requirements could be considered to improve the design of PMDs in order to make them less sensitive to the skill of the rider. Some groups of PMD are inherently configured in a manner that makes them less stable or controllable than others – e-unicycles for example are inherently unstable in the lateral and longitudinal planes and could not be made more stable through regulation without fundamentally changing the configuration of the machine, i.e. adding more wheels. Likewise standing e-scooters leave the motion of the rider decoupled from the motion of the machine, and thus prone to instability, in a manner than can really only be compensated for by mandating that the rider sits on a seat.

However, there are basic principles which could be applied to all PMD types which would help to make them less prone to collision and would to some extent mitigate the consequences of collisions when they do occur:

- Mandating that PMDs be fitted with speed limitation devices, already mentioned as a method for combating rider misuse, would also help to reduce the energy of any collision, would ensure that machines could be designed with a specific performance envelope in mind, would ensure that appropriate user requirements could be put in place for that known performance envelope and would reduce the risk of encountering dynamic instability when riding on rough surfaces or when encountering obstacles.
- A maximum laden mass limit would reduce the energy and force of any collision and would reduce the demands placed on the braking and steering systems.
- Mandating that every wheel be fitted with a brake would ensure that all available grip could be used to slow the machine and would improve stability under harsh braking. This would also ensure a level of redundancy in the braking system so that a single point of failure would be less likely to leave the machine without any braking.
- Mandating a minimum level of controllability, and stability when encountering obstacles. This is the basis of the German eKFV system and the Spanish micromobility approval scheme which closely mimics it. Functional tests of this nature may be more effective in ensuring that PMDs are safe to use in real world environments than requirements for the properties or dimensions of specific components. Here functions such as the ability to modulate brake forces to prevent wheel locking or to control acceleration without wheel spin can be mandated.
- While not strictly a road safety issue, battery safety is also a topic of considerable concern, affecting both the post-collision behaviour of battery machines, and perhaps more importantly, their safety while charging – often inside people's homes.

Section 9.3 provides a more detailed list of parameters and performance criteria which we recommend be included in a approval scheme for PMDs.

8.1.2. Supporting commerce

A lack of harmonised regulations means that businesses that trade in more than one EU member state may incur additional costs, which in turn will either be passed on to their customers, or mean that goods or services are not available in all member states. The additional costs arise through:

- Approval processes including test, inspection and certification costs, and the additional cost to the company of preparing any documentation, producing and delivering test prototypes, attending tests or inspections, corresponding with the relevant authorities, etc.

- Engineering costs incurred when different versions of a product have to be designed to comply with different market requirements. These costs may have an associated opportunity cost since the engineering team may not be able to move on to working on a new product which might generate new market potential.
- Administrative costs associated with maintaining multiple sets of approval records, certificates of conformity, etc. and the need to engage with multiple national authorities.
- Inventory costs of storing and shipping multiple versions of the same product and the components that go into them. This may also give rise to a requirement to hold and distribute multiple variants of replacement parts.
- Labelling and packaging costs to comply with different market requirements.

The magnitude of these costs is dependent to some extent on the degree of difference in the technical requirements of different member states. Where national technical regulations set different but not contradictory requirements, it may be possible to produce a common product which meets the requirements of all markets, e.g. where one member state has a wheelbase limit of 1200mm and another 1100mm, then a machine with an 1100mm wheelbase would be accepted in both markets. However, while this may eliminate the need to engineer different products for different markets, and hold stocks of those different products, it does not eliminate the approval or administrative costs of dealing with multiple authorities. Where demand is high then these additional costs may simply be viewed as additional economic activities – money spent either paying regulatory fees or for additional warehousing or engineering time doesn't disappear, it simply recirculates within the economy. But where demand is lower, these additional costs may represent the difference between profit or loss for the company, which may mean that some products or markets are not viable – thus eliminating the economic activity that would otherwise have been produced. These effects may be stronger for smaller companies, who may be made entirely unviable by the additional costs associated with disharmonised national regulations.

An example of the disruption that this lack of harmonisation can create is the difference in e-scooter regulations between Germany, the Netherlands, Spain and Ireland. Ireland legalised the use of e-scooters on public roads on the 20th of May 2024 with technical requirements which include a maximum unladen mass of 25kg, while Spain specifies a maximum of 50kg and German and Dutch regulations specify a maximum unladen mass of 55kg. Thus, based exclusively on the advertised unladen masses of the machines we reviewed in our survey, 39 machines would be legal to use in Spain, Germany and the Netherlands but would not be legal to use in Ireland, and three more would be legal to use in Germany and the Netherlands but not Spain or Ireland. Meanwhile both Spain and the Netherlands specify a maximum speed of 25km/h while Ireland and Germany specify a maximum speed of 20km/h. While it is very difficult to significantly reduce the mass of an e-scooter, it is much easier to limit its maximum speed through software settings in the motor controller. We found, for example, that Segway Ninebot sell a German version of the F2 Pro E with a maximum speed of 20km/h, which is available in Spain with a maximum speed of 25km/h. The same machine is available in the Netherlands and Ireland, with a maximum speed of 25km/h, but at the time of writing, according to Segway Ninebot's own website, is not legal to use on the road in either country.

The variation in user regulations between member states may also have a negative economic and social impact. For example, where neighbouring member states apply different user restrictions, e.g. minimum age, some users may be prevented from using a PMD for a journey that crosses the border because they meet the requirements on one side but not the other. The uncertainty regarding user regulations in other member states may have a greater chilling effect on PMD use than actual restrictions themselves – because it may be hard to know definitively what is allowed in another member state, users may take a precautionary approach rather than risk prosecution or loss of their machine, even when they would be compliant with the regulation in force.

8.1.3. Supporting the green economy and mode shift

In principle, micromobility, being a form of transport which uses light vehicles with zero tailpipe emissions, should be less polluting than other transport modes. However, the evidence for the environmental impact of micromobility is mixed, and poor levels of durability, short lifespans and inadequate recyclability of some types of PMD can significantly increase their carbon footprint to levels which may be comparable to internal combustion engine vehicles. We must therefore consider the ways in which regulation can be used to ensure that the environmental benefits of PMD use are maximised while not hampering their adoption where their use is beneficial. Here the use of consumer labelling to show the energy efficiency and embodied carbon content of PMDs would allow the market to drive desirable environmental behaviours by allowing consumers to make informed choices between comparable products. Such a scheme would add an additional barrier to the release of new designs and thus consideration should be given to the production volumes, manufacturer sizes or PMD types for which such a scheme should be mandated.

When considering mode shift, regulation must be conscious of the factors that may support the adoption of smaller, lower emission machines. For example, prohibiting the carriage of passengers by PMDs will exclude their use by anybody who needs to transport a child or person who is unable to safely use their own PMD, thus forcing these potential PMD users to choose larger and potentially more polluting transport modes. The same is true of maximum permitted mass limits for PMDs, which must be set sufficiently high to permit the largest adults to choose a PMD over another mode.

8.2. Approval mechanisms

8.2.1. Self-certification vs. third-party testing

The type-approval system for vehicles uses three main methods to test the conformity of a design with regulations:

A. Tests by manufacturer: The manufacturer itself performs the test, either (a) physical or (b) virtual, and produces the test report. This is usually referred to in the industry as “In-house testing”.

B. Physical test by a technical service: The technical service, designated by the member state in charge of the Type Approval, shall perform the test and issue the test report. Manufacturers can themselves apply to become accredited as technical services and perform these tests.

C. Testing carried out by the manufacturer under the supervision of a technical service. This is usually referred to in the industry as “Witnessed testing”.

Each method has its own advantages and disadvantages. In-house testing is reliant on the competence and honesty of the manufacturer to conduct the required tests to the required standards. The automotive industry is typically quite stable in its organisational composition, with very few new mass-market manufacturers entering the market in the last few decades. The organisational culture of these manufacturers therefore tends to be long-lived and each manufacturer has a significant level of organisational memory, built up through procedures and policies, which allow them to competently test their own products. By contrast many manufacturers in some sectors of the PMD industry are very new to manufacturing machines for use on the road having either started as new companies, or having moved into the sector from the consumer electronics industry. These companies may be much less able to competently undertake their own product testing.

Testing by a technical service ensures that tests are conducted using a known methodology by an organisation which in theory should be competent to conduct the test. In the automotive industry the system of technical services is mature and largely highly experienced in serving its industry. It may be possible to extend the scope of the capabilities of some technical services to incorporate the tests required by PMDs. However, the process of introducing these additional capabilities may be costly and may not be uniformly distributed in all member states. Using existing technical services may also create delays in the process of approving PMDs due to limitations in the capacity of those technical services to process new applications. Feedback from manufacturers of *cycles designed to pedal in* L1e-B suggests that this lack of facilities and capacity in technical services is a significant barrier to the approval of their products.

Witnessed testing perhaps offers the best of both worlds in that testing is conducted under supervision of a technical service, and is thus more likely to be conducted in a competent and honest fashion, but is not reliant on the facilities of the technical service to conduct the test. This does of course create a barrier for PMD manufacturers, who would be required to provide their own test facilities – either of their own or of a third party test house.

Both testing by a technical service and witnessed testing have the additional constraint that they must be conducted by technical services within the EU, or at least using EU licensed facilities. This is likely to create an additional barrier to manufacturers based outside the EU.

8.2.2. CE Marking

CE marking is the approval system for manufactured goods in the EU. For the majority of manufactured goods, in-house testing is the primary means of ensuring compliance, although third-party testing by EU recognised notified bodies is also common for some products, in particular those with safety related systems. Technical requirements are set either by European regulations, or by standards, which are called up by European regulations.

Manufacturers who make products available on the European market are required to ensure that those products are compliant with relevant EU rules and that they issue an EU declaration of conformity to that effect.

Importers who make products available on the EU market are required to:

- ensure goods conform with relevant technical requirements
- label products with both their own address and the address of the manufacturer
- ensure the correct conformity assessment procedures have been carried out and are marked accordingly
- ensure the manufacturer has drawn up the correct technical documentation and labelled the product correctly
- retain copies of certificates of conformity for 10 years after placing goods on the market.

In principle then, given an appropriate standard with which to comply, CE marking would seem to offer many benefits as an approval mechanism for PMDs. However, compliance with the Machinery Regulation does not confer any right for a particular machine to be used on the road, nor is the Machinery Regulation intended to ensure road safety. The approach taken for EPACs was to regulate their technical characteristics at a European level via a standard, EN15194, which was harmonised under the Machinery Directive, with member states then individually introducing very similar, but not formally harmonised, user regulations permitting their use on the road and cycle infrastructure. Given their similarity to conventional bicycles, which have been in use for many years, and already had mature user regulations in place, this was a relatively straightforward process. Given the novelty of other PMD types, member states have not yet settled on a consistent set of user regulations. Thus the task of enabling the uniform use of PMDs across the EU is much more complicated than was the case for EPACs.

An additional barrier to this approach is the availability of appropriate harmonised standards for all PMD types, which fully addresses road safety requirements. For EPACs, EN15194 has been harmonised and appears to be functioning adequately in ensuring the safety of EPACs, although appears to be ineffective in preventing tampering. For e-scooters and hoverboards EN17128 exists but has not been harmonised, due, it appears, to concerns over the extent to which it ensures safety. Evidence provided to TRL in a separate project indicated that the structural integrity requirements of the standard are insufficient and are not preventing dangerous failures of critical structural components – particularly the steering columns of e-scooters. Concerns have also been expressed regarding the suitability of the battery safety requirements in the standard. For carrier cycles the EN17860 series of standards are currently in development, but not yet harmonised.

9. Recommendations

We propose four potential regulatory options for PMDs:

- Option 1 – Do nothing
- Option 2 – Increase the scope of Regulation (EU) No 168/2013 to include some or all PMD types
- Option 3 – Develop a series of bespoke approval systems for different types of PMDs
- Option 4 – Develop a universal approval system for all types of PMDs.

In the following section we provide the rationale for each of these options and discuss their relative merits. We

9.1. Assessment of options

In this section we have provided some commentary on the merits of the regulatory options we have proposed. One of the central imperatives for the creation of European regulations that apply to all member states is that they support trade and the free movement of goods within the Union and reduce the regulatory burden imposed on industry by the need to comply with twenty-seven separate sets of regulations.

Our assessment is largely based on the effect these proposals might have on the following groups:

- Manufacturers
- Importers
- Distributors
- Short term rental operators
- Users
- Society
- National regulators and law enforcement
- Local authorities

But we have also considered other issues that might impact the feasibility of these options and the consequences which they might have for other stakeholders.

9.1.1. Option 1: Do nothing

Under this option, no regulatory action is taken at a European level, member states are free to introduce whatever technical regulations they see fit for vehicles outside the scope of Regulation (EU) No 168/2013. The scope and content of Regulation (EU) No 168/2013 remains unchanged.

For manufacturers, distributors and importers there is a risk that member states may choose to develop their own technical regulations which may lead to divergence between the requirements of different member states and thus require different products for each member state. This is already apparent in the regulations of those member states which have created their own national technical regulations. As noted above, this runs the risk that the opportunity cost of introducing new products or starting new PMD companies may be too great and thus economic activity may be reduced.

For users and society more broadly, especially those in member states with no technical regulations for PMDs, there is a risk that dangerous products may be made available on the market and used on the roads, with an attendant risk to public safety. Law enforcement and product safety agencies may remain without an adequate set of requirements against which to assess PMDs, and will thus be prevented from taking enforcement action against potentially dangerous products. In the long run this may lead to member states that are currently without technical regulations either developing their own, with the attendant issues noted above, or banning some types of PMD altogether. This type of action is already apparent in the bans being imposed on the carriage of some PMDs on public transport due to the risk, perceived or real, of poor quality batteries from non-approved sources.

9.1.2. Option 2: Increasing the scope of Regulation (EU) No 168/2013

Under this option, the scope of Regulation (EU) No 168/2013 is expanded to include vehicles without seats and self-balancing vehicles. It is proposed that these vehicles would be incorporated into new sub-categories in L1e.

It is expected that this option would place a significant extra burden on technical services, which in many member states already struggle to meet demand from existing automotive and motorcycle manufacturers, which would create a bottleneck in the issuing of new approvals for all users of the service. Feedback from organisations representing manufacturers', distributors and importers of PMDs is mixed on this proposal, with some favouring an approach which introduces new limits on the peak power and assistance factor of pedal assisted PMDs and creates new sub-categories within the L-category for heavy carrier cycles (greater than 250kg maximum permitted mass) and e-bikes with speeds greater than 25km/h, while others are strongly opposed to the extension of type-approval to PMDs and believe that all PMDs should be excluded from the scope of Regulation (EU) No 168/2013 and provided with a bespoke approval system of their own. Those organisations favouring a greater use of the L-category for the approval of PMDs seem primarily to be motivated by protecting the EPAC industry from the encroachment of other types of non-pedal assisted PMD which they feel may ultimately lead to a loss of access to cycle infrastructure and perhaps ultimately a greater level of regulation for users, which they feel would impact their market more severely than the additional burden of type approval for some of their products.

Some convertible machines which can be used either seated or standing have already received European type approval in the L-category. This approval, or rather the performance of the machine which necessitates it, effectively obliges member states to treat these machines as mopeds, with the attendant user requirements for registration, insurance, license, helmet etc. Clearly the manufacturers of these products feel that having unrestricted access to the whole European market at the expense of greater regulatory burden for themselves and their users is a price worth paying, but it remains to be seen whether the market will embrace machines of this type. Certainly it seems unlikely that the short term hire industry will have a great appetite for machines that place such a significant regulatory burden on themselves and their users.

9.1.3. Option 3: Develop bespoke approval schemes for different types of PMDs

Under this option, separate European level approval schemes would be created for specific categories of PMD. This would be separate from the existing type-approval system under Regulation (EU) No 168/2013 and Regulation (EU) No 2023/1213 (the Machinery

Regulation). The scope of these schemes would be broadly defined and, taken as a whole, would cover all of the most common types of PMD in use today:

- Carrier cycles (cargo and passenger carrying) with maximum permitted masses less than 250kg
- Standing machines (non-self-balancing)
- Self-balancing machines
- Single-wheel machines
- Other types, as required

This option would permit different limits to be created for different PMD types, e.g. carrier cycles could have a higher mass limit than standing machines, standing machines could have a higher speed limit than self-balancing machines etc. This system would also allow for different approval mechanisms and systems of conformity assessment for different types e.g. single-wheel machines might be subject to third-party testing, while self-balancing machines could be tested by their manufacturer. Such a system of systems does however introduce significant additional regulatory complexity, with attendant administrative burden for the Commission, and the possibility that some types may still not have a regulatory home. There is also a risk that regulations for some types may be seen as more favourable than others.

9.1.4. Option 4: Develop a universal approval scheme for PMDs

Under this option, a universal European approval scheme for all types of PMD would be created. Like Option 3, this would be separate from the existing type-approval system and Regulation (EU) No 2023/1213 (the Machinery Regulation). The creation of this scheme would create a hard dividing line between PMDs and L-category vehicles based on mass and speed. The scheme would otherwise be technology agnostic and would not seek to apply different requirements to machines based on their configuration, drive system or number of wheels. A challenge here is that there is little, if any, evidence that a hard dividing line exists in the level of risk posed by vehicles as their maximum mass or speed increases, i.e. there is no specific speed or mass at which a machine switches from being “safe” to being “dangerous”. However the underlying principle is correct, of course, that risk increases with increasing speed and mass, on the basis of greater kinetic energy at higher speeds and masses. From a pragmatic perspective, we propose that a maximum permitted mass of 250kg and a maximum speed of 25km/h may be sensible cut-offs. Any machine which was either faster or heavier than these limits would, if eligible, be required to undergo type-approval under Regulation (EU) No 168/2013 or any appropriate alternative.

We do not propose any power limit for this new PMD category. Instead, we propose a maximum acceleration limit under all load conditions of $2m/s^2$, which is in-line with EN17128. If both speed and acceleration are regulated, then motor power is not relevant to the performance of the machine in any meaningful way.

Harmonised technical regulations would mean that manufacturers could produce a single product which could be sold across the whole EU, with no need to change designs to comply with different regulations in each member state. Harmonised regulations would also eliminate the need to demonstrate compliance in each member state separately, thus saving the cost of any testing, verification or assessment processes that might be required.

These effects would apply equally to manufacturers based in the EU, and those seeking to import their products into the EU from outside.

The effects for distributors and importers are similar to those for manufacturers – no need to stock different products and their associated support and spares inventory for different member states. A single route for compliance would eliminate the need to gain approval in multiple member states.

These effects would make it easier for EU based distributors to operate across the whole EU, but would also make it easier to import products into the EU from outside.

Like manufacturers and distributors, short term rental operators might benefit from harmonised regulations in that they would be able to operate a common fleet across the whole EU with attendant economies of scale and reduced overheads due to the complexities of operating different fleets in different member states. However, this would be contingent on local authorities not imposing additional requirements through their licensing and contractual arrangements.

Currently many member states do not have national technical regulations for PMDs. The creation of a single set of harmonised European technical regulations would ensure a baseline level of product safety, with attendant benefits for users of the devices themselves, and other road users, who would be less likely to suffer collisions and injury, and society in general, which would not have to bear the cost and inconvenience associated with those collisions. The costs saved by industry, illustrated above, may be passed on to customers.

National authorities would be absolved of the burden of creating their own regulatory framework for personal mobility devices.

Law enforcement would be provided with metrics against which machines either stopped on the road or inspected at a border or point of entry could be assessed.

Currently most parts of the world do not have well developed technical regulations for personal mobility devices, it is thus possible that other jurisdictions would adopt European regulations, potentially bringing global benefits.

9.2. Regulation of EPACs

In our 2021 report[7] we made it clear that the European regulatory regime for EPACs should not be changed, since it was functioning effectively in terms of supporting the European trade in EPACs and ensuring the safety of users and the general public. While there has been some discussion regarding the implications of the introduction of the Machinery Regulation, in place of the Machinery Directive, the status of EPACs has effectively remained unchanged. While some in the industry regard this current arrangement as unsatisfactory, since the Machinery Regulation confers no right for compliant vehicles to be used on the road or cycle infrastructure, and the regulation has no requirements that are specific to road safety, the disruption of introducing a new regulatory regime for EPACs may not outweigh the benefits of harmonising their requirements with other PMD types.

We retain the view that there is no compelling reason to change the regulatory arrangements for EPACs at this time. However, if a universal approval scheme for PMDs were to be created (Option 4), then there may be some advantage to incorporating EPACs into that scheme, provided that the new approval mechanism was no more onerous than the existing arrangements and that inclusion in the new scheme provided a recognisable benefit in ensuring road safety and access to the road and cycle infrastructure for EPACs.

There is a precedent in both the European Driving License Directive (2006-126-EC) and the European Insurance Directive (2021-2118) to treat machines which can be propelled partly

[7] Study on market development and related road safety risks for L-category vehicles and new personal mobility devices - Publications Office of the EU (europa.eu)

or entirely by human power differently to those which are propelled exclusively by mechanical means.

Some stakeholders proposed that carrier cycles with a maximum mass of 250kg should be treated differently to lighter machines. We agree with this view on the basis that heavier machines pose a greater risk to the safety of the public than lighter ones and consequently require both greater care in their design and manufacture, and a greater level of oversight. Such machines could be incorporated into existing L-categories and subject to type approval, or could be approved under a bespoke approval system, although such a system would likely include many of the features of the existing type-approval route. A common argument against inclusion in the L-category is that inclusion within this technical regulation creates an automatic expectation that these machines will be treated as “vehicles” for the purposes of user regulation, as is the case with *Cycles designed to pedal in L1e-B.* Of particular significance is the effect this has on the ability for the users of these machines to access dedicated cycle infrastructure, which when prohibited may compromise the viability of cargo and passenger services intended to replace those which would otherwise be provided using larger taxis or vans. We must however be careful to ensure that the desire to minimise the regulation imposed on carrier cycles, in order to promote their use, does not create a loophole permitting inappropriately large and heavy machines which compromises the safety of the public, including those using cycle infrastructure. The technical regulation of carrier cycles should be decoupled from user regulations so that an effective scheme of technical regulations can be created. Member States should then be encouraged to take a deliberate approach to the creation of appropriate user regulations for heavy carrier cycles, which should include decisions about licensing, insurance and permitted routes. This will allow member states to make strategic decisions based on their own circumstances and priorities as part of a holistic transport policy.

9.3. Conformity assessment

Options 2, 3 and 4 foresee that some new technical requirements will be applied to PMDs. Table 68 provides an overview of the machine parameters that could be regulated in a European PMD approval scheme, whether part of a revised Regulation (EU) No 168/2013 (Option 2), or as part of a new approval system (Option 3 and 4), and the methods by which conformity with requirements could be assessed. This list should not be considered exhaustive.

Table 68: Potential scope and conformity procedures for technical requirements

System	Requirements	Conformity[8] procedure	Rationale
Maximum permitted mass	Maximum 250 kg	Declaration by manufacturer	Controlling the risk associated with heavier machines
Payload	Minimum and maximum declared	Declaration by manufacturer	Ensuring payload is considered when machines are designed

[8] Where the manufacturer is not based in the EU this function may be undertaken by the importer or distributor

System	Requirements	Conformity[8] procedure	Rationale
Structural integrity	Aligned to EN 15194 where relevant	Testing conducted by manufacturer or third party	Ensuring machines do not fail prematurely or in a dangerous manner In our view the structural integrity requirements of EN 17128 are insufficient to ensure safety
Battery safety	Aligned to EN 50604	Testing conducted by third party	Reducing the risk of fire, both in use and while charging
Stability and controllability	Aligned to eKFV	Testing conducted by manufacturer or third party	Reducing the risk of collisions due to loss of control/instability
Speed regulation	Maximum 25 km/h	Testing conducted by manufacturer or third party	Controlling the risk associated with faster machines
Maximum acceleration	Maximum $2 m/s^2$ demonstrated at minimum declared payload	Testing conducted by manufacturer or third party	Ensuring controllability
Braking	Minimum deceleration $3.5 m/s^2$ At least two completely independent systems capable of bringing the machine to a stop from maximum speed	Testing conducted by manufacturer or third party	Ensuring that machines can be stopped effectively. Ensuring redundancy so that a single failure does not become safety critical
Lighting	Aligned to EN 17128	Testing conducted by manufacturer	Ensuring visibility of the PMD to other road users
Audible warning devices	Aligned to EN 17128	Testing conducted by manufacturer	Ensuring that vulnerable road users can be alerted to the presence of a PMD
Anti-tampering	Aligned to EN 15194	Testing conducted by manufacturer or third party	Ensuring that users cannot modify machines in a manner that invalidates the assumptions made in

System	Requirements	Conformity[8] procedure	Rationale
			technical and user regulations
Electromagnetic compatibility	Aligned to EN 15194	Testing conducted by manufacturer or third party	Ensuring that electrical interference does not impair the controllability of the machine
Moisture ingress	Aligned to EN 15194	Testing conducted by manufacturer or third party	Ensuring that moisture does not impair the controllability of the machine or cause dangerous electrical faults

For many of the requirements specified here we have suggested that either manufacturers could self-certify or that third party testing may be required. An approach that relies heavily on testing by the manufacturer with very little external oversight at the point of approval is predicated on the notions that the risks posed by PMDs primarily arise from the manner in which they are used rather than their technical characteristics, and that their manufacturers can be relied on to engineer their products in a competent and responsible manner. While the first assumption is supported by the evidence provided in Chapter 5, the second assumption may be questionable, particularly for companies with no previous background in the design and manufacture of vehicles, and those whose business models may be based on the reselling of commodity electronics who may lack both the inclination and capacity to verify the safety and performance of their own products. Germany, Spain and the Netherlands have all introduced approval schemes for PMDs which rely on third party testing by an approved agency to ensure that compliance claims are truly valid. This approach is rather more analogous to traditional vehicle type-approval, with its associated additional costs and disruption to the product lifecycle, but with the benefit of providing the support and oversight that some manufacturers require. A resolution to this dichotomy may be to introduce a graduated approval scheme for manufacturers, in which the default is that most systems are subjected to third party testing, but manufacturers are offered the opportunity to register themselves as approved testing organisations, with an appropriate system of qualification and oversight. Such a system would obviously have some administrative burden for both the companies involved and the European or national authorities responsible for administering it, but would perhaps provide the appropriate balance of technical assurance and flexibility that the industry in Europe needs to thrive while assuring the safety of the public.

A system based on testing conducted by the manufacturer would be heavily reliant on market surveillance to ensure conformity of design and production. This will place an additional burden on national authorities who will be required to administer this system. However, in the absence of a formal registration scheme in which vehicles can only enter service having individually received approval from a licensing agency who are able to verify that a machine has at least been issued with a certificate of conformity against a verified set of requirements, some level of market surveillance will always be necessary to ensure the compliance of products available on the market.

Regardless of the conformity procedures used, the simple existence of a European technical regulation for PMDs is likely to have a positive effect on both commerce and safety. A regulation which is harmonised across the EU will specify a minimum level of performance for machines in all member states, providing an immediate benefit to those member states which currently lack relevant national regulations. Harmonisation will allow manufacturers to produce a single “European” product, which will automatically be compliant in all 27 member states, thus reducing the burden of producing, distributing and having approved different national specifications of the same machine. The availability of compliant products is likely to have a positive evolutionary effect on the market by reducing the attraction of non-compliant alternatives. To be fully effective in achieving the goal of eliminating unsafe products however is likely to require some significant investment in the creation of national approval agencies who are able to issue European PMD approvals and enforcement to intercept non-compliant machines. This investment is likely to be offset for some member states who may choose to defer approvals to one of their neighbours, which an EU level scheme would facilitate and support. This is likely to be wholly appropriate for member states who have no national PMD manufacturers and are thus unlikely to have any demand for the issuing of approvals. Member states with significant levels of national PMD production will have the option of offering European approvals and thus supporting exports to other member states.

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Appendix A. PMD Inventory (August 2024)

All data is taken from publicly advertised sources, which are available in the “Weblink” column. Some machines may be available with different specifications in different jurisdictions.

Standing e-scooters

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Razor	Party Pop	Razor Party Pop Electric Scooter | Halfords UK	80	6	11	N/A	59 x 31 x 80	50	4	54	USA
Razor	Tekno	Razor Tekno Electric Scooter | Halfords UK	80	6	11	N/A	59 x 31 x 80	50	4	54	USA
Globber	E-Motion 11	Globber E-Motion 11 Electric Scooter - Blue | Halfords UK	150	8	15	N/A	75 x 31 x 88	70	7	77	
Zinc	Folding Electric Flex	Zinc Folding Electric Flex Scooter – ZINC - UK's No 1 Scooter Brand (zincsports.com)	200	13	24	91 x 43 x 30	93 x 43 x 109	80	9	89	
Zinc	Folding Electric Eco Scooter	Zinc Folding Electric Eco Scooter – ZINC - UK's No 1 Scooter Brand (zincsports.com)	200	13	25	102 x 43 x 34	93 x 43 x 102	80	9	89	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Razor	Power Core s85	Razor Power Core S85 Electric Scooter Blue | Halfords UK	350	9	16	N/A	85 x 40 x 89	54	10	64	USA
Citybug	Eco	CITYBUG ECO | CITYBUG	250	11	18	98 x 47 x 50	98 x 47 x 106	100	10	110	
Zinc	Eco Plus	Zinc Eco Plus Electric Scooter – ZINC - UK's No 1 Scooter Brand (zincsports.com)	250	14	25	114 x 43 x 41	98 x 43 x 111	100	11	111	
Citybug	Luxe	CITYBUG LUXE | CITYBUG	250	20	25	95 x 47 x 50	95 x 47 x 108	100	11	111	
Aovopro	ES80/M 365	New 2023 AOVOPRO Electric Scooter ES80 M365 Pro Long Range High Speed Foldable Electric Scooter Trottinette électrique – AOVO PRO Electric Scooter Official Store	350	29	25	107 x 43 x 53	107 x 43 x 110	120	12	132	
iScooter	i9	i9 Foldable Electric Scooter With Seat | iScooter (iscooterglobal.co.uk)	350	30	25	108 x 43 x 50	108 x 43 x 112	100	12	112	
Flow	Camden Air	Flow Camden Air Electric Scooter – Electroheads	350	20	25	108 x 44 x 50	108 x 44 x 110	120	12	132	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Unagi	Model One E500	Unagi Model One E500 Electric Scooter – Electroheads	500	25	40	96 x 42 x 38	96 x 42 x 110	125	12	137	
Xiaomi	Mi Electric Scooter 3	Mi Electric Scooter 3 - Xiaomi UK	300	30	25	108 x 43 x 49	108 x 43 x 114	100	13	113	China
Xiaomi	Electric Scooter 3 Lite	Xiaomi Electric Scooter 3 Lite - Xiaomi UK	300	20	25	110 x 43 x 48	111 x 43 x 114	100	13	113	China
E-Twow	GT Sport	E-Twow Booster GT Sport Black | Electric Scooters | London | PET (personalelectrictransport.co.uk)	700	40	43	106 x 33 x 15		110	13	123	
E-Twow	S2 Eco	E-TWOW S2 ECO | In stock and Fast worldwide shipping | Voltride.com	500	25	25	97 x 15 x 33	102 x 38 x 116	100	13	113	
E-Twow	S2 Booster Plus	E-TWOW S2 Booster Plus | In stock and fast worldwide shipping | Voltride	700	30	25	97 x 15 x 33	102 x 38 x 116	100	13	113	
isinwheel	S9Pro 350W	S9Pro Foldable Electric Scooter 30km | isinwheel	350	29	30	109 x 43 x 48	109 x 43 x 114	120	14	134	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Indi	EX-2	Indi EX-2 Electric Scooter - Black | Halfords UK	350	29	25	107 x 43 x 49	107 x 43 x 115	100	14	114	
Indi	EX-1	Indi EX-1 Electric Scooter - Silver | Halfords UK	250	20	25	104 x 43 x 47	104 x 43 x 113	100	14	114	
Swifty Scooters	Air-E	Swifty Scooters Air-E Electric Scooter – Electroheads	250	35	25		135 x 60 x 100	150	14	164	
Swifty Scooters	One-E	Swifty Scooters One-E Electric Scooter – Electroheads	250	35	25	107 x 16 x 66	137 x 56 x 101	150	14	164	
Zinc	Formula E GZ3 Series	Zinc Formula E GZ3 Series Folding Electric Scooter 500W – ZINC - UK's No 1 Scooter Brand (zincsports.com)	500	30	25	113 x 44 x 53	112 x 44 x 120	100	15	115	
Razor	C25	C25 Electric Adult Scooter | Razor | UK & IE	250	25	25	114 x 44 x 50	114 x 44 x 112	100	15	115	USA
Navee	N20	Navee N20 Folding Electric Scooter 10" 380W Black | PcComponentes.com	250	20	25	114 x 50 x 48	114 x 50 x 118	100	15	115	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
8TEV	B10 Roam	Buy the 8TEV B10 Roam Electric Scooter from electroheads.com – Electroheads	500	42	35			100	15	115	
E-Dash	Limited Edition 1	E-Dash Limited Edition 1 (Detachable Battery) Electric Scooter – Electroheads	350	45	32	108 x 42 x 46	108 x 42 x 119	125	15	140	
Razor	C35	Razor C35 Electric Scooter – Electroheads	350	29	29		114 x 44 x 112	100	15	115	
Pure Electric	Air³	Pure Air³ Electric Scooter | Pure Electric	550	30	25	113 x 55 x 46	113 x 55 x 115	120	16	136	
Pure Electric	Advance Flex	Pure Advance Flex Electric Scooter | Pure Electric	710	40	25	62 x 30 x 57	104 x 60 x 108	120	16	136	
Pure Electric	Advance	Pure Advance Electric Scooter | Pure Electric	710	40	25	104 x 15 x 54	104 x 60 x 108	120	16	136	
Pure Electric	Advance +	Pure Advance+ Electric Scooter | Pure Electric	710	50	25	104 x 15 x 54	104 x 60 x 108	120	16	136	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
iScooter	i9Max	i9Max Electric Scooter with Smart App control | iScooter (iscooterglobal.co.uk)	500	40	30	116 x 55 x 53	115 x 55 x 117	120	16	136	
iScooter	iX6	iX6 Off Road Electric Scooter 1000W With Seat | iScooter (iscooterglobal.co.uk)	1000	45	45	122 x 22 x 57	122 x 63 x 125	150	16	166	
isinwheel	S9Max 500W	S9Max Foldable Electric Scooter For Commuting | isinwheel	500	35	35	113 x 43 x 54	113 x 43 x 120	120	16	136	
The Urban	xR1	THE-URBAN xR1 | TU97001-B	300	25	25	107 x 47 x 48	107 x 47 x 120	120	16	136	Germany
Mtricscoto	S10BK-7.5Ah	Megawheels S10BK Electric Scooter-7.5Ah – Mtricscoto	250	22	25	105 x 43 x 55	105 x 44 x 115	75	16	91	
Xiaomi	Electric Scooter 4 Lite	Xiaomi Model 4 Lite Electric Scooter | Halfords UK	300	20	25	111 x 44 x 50	111 x 44 x 115	100	16	116	China
Navee	V40	NAVEE V40 electric scooter 20 km/h Black 7.8 Ah | Electric scooters on offer on Unieuro	300	40	32	114 x 48 x 49	114 x 48 x 119	120	16	136	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Navee	V40 Pro	NAVEE V40 Pro Monopattino Elettrico con il manubrio da chiuso ruotabile, Autonomia 40KM Motore Max 600W Gomma 10 e Frecce Direzionali | Monopattini elettrici in offerta su Unieuro	300	40	32	114 x 16 x 51	114 x 49 x 117	120	16	136	China
Apollo	Air Pro V2	The Apollo Air Pro V2 Electric Scooter - PET London (personalelectrictransport.co.uk)	500	31	31			100	16	116	
8TEV	B12 Proxi	Buy the 8TEV B12 Proxi Electric Scooter from electroheads.com – Electroheads	500	22	35			120	16	136	
Navee	N40	Navee N40 Electric Scooter – Electroheads	350	40	30	114 x 50 x 48	114 x 50 x 118	100	16	116	
Velocifero	Mad Air	Buy the Velocifero Mad Air Electric Scooter | Electroheads.com	350	29	25	111 x 50 x 49	111 x 50 x 116	100	16	116	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Velocifero	Eco Mad	Buy the Velocifero Eco Mad Electric Scooter | Electroheads.com	350	29	25	116 x 48 x 49	116 x 48 x 116	120	16	136	
Velocifero	Eco Mad Pro	Buy the Velocifero Eco Mad Pro Electric Scooter | Electroheads.com	350	40	25	116 x 48 x 52	116 x 48 x 117	120	16	136	
Pure Electric	Air³ Pro	Pure Air³ Pro Electric Scooter | Pure Electric	710	40	25	113 x 55 x 46	113 x 55 x 115	120	17	137	
Pure Electric	Air³ Pro+	Pure Air³ Pro+ Electric Scooter | Pure Electric	710	50	25	113 x 55 x 46	113 x 55 x 115	120	17	137	
The Urban	xT1	THE-URBAN xT1 | TU96001-B	300	25	25	113 x 47 x 48	113 x 47 x 123	120	17	137	Germany
The Urban	xH1	THE-URBAN xH1 | TU92004-B	350	30	25	105 x 19 x 38	115 x 15 x 102	100	17	117	Germany
Xiaomi	Electric Scooter 4 Pro	Xiaomi Electric Scooter 4 Pro - Xiaomi UK	350	35	25	120 x 48 x 51	120 x 48 x 124	120	17	137	China
Carrera	impel is-1 2.0	Carrera impel is-1 2.0 Electric Scooter | Halfords UK	350	29	25	110 x 47 x 48	110 x 47 x 120	120	17	137	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Navee	V25i Pro	NAVEE V25i Pro Electric Scooter with Rotatable Closed Handlebar, Autonomy 25KM Max Motor 600W Rubber 10 and Directional Arrows | Electric scooters on offer on Unieuro	300	25	30	118 x 16 x 51	114 x 57 x 117	100	17	117	China
Navee	V50	Trottinette électrique NAVEE V50 Noir | Boulanger	350	50	32	115 x 16 x 52	114 x 48 x 117	120	17	137	China
GPad	Svan Max	GPad Svan Max | Beatiful electric scooter | In stock | Voltride.com	350	40	25	100 x 44 x 47	100 x 44 x 119	100	17	117	
8TEV	B12 Classic	Buy the 8TEV B12 Classic Electric Scooter from electroheads.com – Electroheads	500	31	35			120	17	137	
Emove	Touring	EMove Touring Eectric Scooter – Electroheads	500	51	40	109 x 20 x 30	99 x 56 x 119	140	17	157	
Inmotion	Air Pro	Inmotion Air Pro - The Best Of Electric Mobility (inmotion-store.com)	400	48	35	113 x 44 x 52	113 x 44 x 120	120	18	138	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
GPad	Joyride Eco	GPad Joyride Eco | In stock and fast worldwide shipping | Voltride.com	350	30	25	107 x 19 x 40	115 x 55 x 126	120	18	138	
Inokim	Light Hero	INOKIM Light Hero | In stock and ready for shipping | Voltride.com	250	25	25	94 x 18 x 38	103 x 48 x 109	100	18	118	
Ducati	Pro-III	Buy the Ducati Pro-III electric scooter from electroheads.com – Electroheads	350	50	25			100	18	118	
Aovopro	ESMAX	AOVOPRO ESMAX 500W 14.5Ah Dual Suspension Dual Brake 10 inch Air Tyre Foldable Electric Scooter – AOVO PRO Electric Scooter Official Store	500	45	25	118 x 47 x 56	118 x 47 x 124	120	19	139	
Segway Ninebot	F2 Pro E	F2 Pro E - Segway-Ninebot	450	40	25	116 × 57 × 53	116 × 57 × 125	120	19	139	USA/China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
M Megawheels	A6	M MEGAWHEELS Electric Scooter Adult, 9" Tires, 25km/h Max Speed with 3 Speed Modes, Up to 20km Range, Double Braking System and App : Amazon.co.uk: Sports & Outdoors	250	18	25	111 x 44 x 50	111 x 44 x 116	100	19	119	
Evercross	EV10K	EVERCROSS EV10K PRO Electric Scooter, 10'' Honeycomb Tires & 500W Moto – eu.evercross.eu	500	40	30	110 x 51 x 54	110 x 51 x 118	150	19	169	
8TEV	C12 Roam 3-wheel	Buy the 8TEV C12 ROAM three-wheel e-scooter from electroheads.com – Electroheads	700	42	35			120	19	139	
Jeep	2XE	Buy the Jeep 2xe Camou electric scooter from electroheads.com – Electroheads	700	45	25	120 x 47 x 52	120 x 47 x 117		19		
Aprilia	E-SR2 EVO	Aprilia E-SR2 EVO Electric Scooter – Electroheads	500	50	25	122 x 46 x 55	122 x 46 x 119	100	19	119	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Speedway	Leger	Speedway Leger | In stock and fast EU shipping | Voltride.com	1360	50	25	104 x 20 x 33	110 x 53 x 72	120	20	140	
Speedway	Leger Eco	Speedway Leger Eco - Voltride	500	30	25	104 x 20 x 33	110 x 53 x 72	120	20	140	
Engwe	Y10	Engwe Y10 Electric Scooter - 350W E-scooter Up to 25 KM/H (engwe-bikes-eu.com)	350	65	32	118 x 51 x 54	118 x 51 x 120	120	20	140	
Nanrobot	C1	NANROBOT C1 | Ideal for Daily Commuting	500	40	40	120 x 57 x 54	120 x 57 x 114	118	21	139	China
Speedway	Leger Pro	Speedway Leger Pro | Small scooter for long range riding | Voltride	1360	75	25	104 x 20 x 33	110 x 53 x 71	120	21	141	
isinwheel	M2 800W	isinwheel® M2 Off Road Electric Scooter 800W | isinwheel	800	35	45	120 x 20 x 50	120 x 60 x 128	200	22	222	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Zinc	Velocity Plus 500W Folding Electric Scooter with 10inch Wheels	Zinc Velocity Plus 500w Folding Electric Scooter with 10inch Wheels – ZINC - UK's No 1 Scooter Brand (zincsports.com)	500	50	25	116 x 55 x 58	116 x 55 x 119	120	22	142	
Techtron	Ultra 5000	Pre-order the NEW Techtron Ultra 5000 electric scooter from electroheads.com – Electroheads	500	40	40			120	22	144	
Windgoo	M20	Windgoo M20 Electric Scooter – Electroheads	350		25	113 x 50 x 51	113 x 50 x 120	120	22	144	
Emove	Cruiser S	EMove Cruiser S Electric Scooter – Electroheads	1000	100	53	124 x 25 x 36	124 x 25 x 64	160	23	183	
Alba	S Pro	Alba E-Bikes S Pro Electric Scooter – Electroheads	350	62	25	122 x 61 x 63	122 x 61 x 113	120	23	143	
Razor	E300	Razor Power E300 Electric Scooter | Halfords UK	250	14	24	N/A	109 x 23 x 52	100	24	124	USA
Segway Ninebot	MAX G2 E	MAX G2 E - Segway-Ninebot	450	50	25	121 x 57 x 61	121 x 57 x 126	120	24	144	USA/China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Navee	S65	Navee S65 Electric Scooter - Personal Electric Transport	500	65	25	122 x 56 x 54	122 x 55 x 126	120	24	144	China
Navee	N65	-184€ sur Trottinette électrique NAVEE N65 25km/h 500W moteur pneus 10 pouces 48V12.5Ah Noir - Trottinette électrique - Achat & prix | fnac	500	64	25	121 x 21 x 46	119 x 51 x 122	120	24	144	China
InMotion	S1	Inmotion LeMotion S1 | Electric Scooter | PET | London (personalelectrictransport.co.uk)	800	90	30	131 x 52 x 56	150 x 28 x 65	115	24	139	China
iScooter	iX4	iX4 Off Road Electric Scooter For Adults With App Control | iScooter (iscooterglobal.co.uk)	800	45	45	120 x 22 x 50	120 x 65 x 128	150	25	175	
PET	Motorun	Motorun by PET Dual Motor Electric Scooter - PET London (personalelectrictransport.co.uk)	650	56	50	56 x 56 x 117	121 x 56 x 117	120	25	145	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Dualtron	Mini Dual Brake	Dualtron Mini Dual Brake - Voltride	600	50	25	111 x 21 x 41	112 x 60 x 117	100	25	125	
Vsett	9+ 2023 21Ah Dual Motor	VSETT 9+ Red Electric Scooter | Personal Electric Transport	2200	100	50	122 x 28 x 46	122 x 69 x 121	120	25	145	
Speedway	4	Speedway 4 | In stock and fast worldwide shipping | Voltride.com	600	60	25	124 x 25 x 40	121 x 58 x 118	120	25	145	
Buzze	F450	Buzze F450 Electric Scooter – Electroheads	450	60	34	119 x 51 x 50	119 x 51 x 124	120	25	145	
isinwheel	GT2 800W	GT2 Off Road Electric Scooter 800W | isinwheel	800	48	45	122 x 22 x 57	122 x 22 x 125	150	26	176	
isinwheel	R3 800W	R3 Off Road Electric Scooter 800W | isinwheel	800	40	45	129 x 67 x 55	129 x 67 x 118	200	26	226	
Apollo	City Pro V2	The New Apollo City Pro V2 eScooter - PET London (personalelectrictransport.co.uk)	1000	40	50			100	26	126	
Navee	S65C	Trottinette électrique NAVEE S65C Noir | Boulanger	450	64	32	123 x 53 x 57	123 x 59 x 129	120	27	147	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Ducati	Scrambler Cross-E	Buy the Ducati Scrambler Cross-E electric scooter from electroheads.com – Electroheads	500	35				120	27	147	
Weped	SMAX TEN	SMAX TEN - WEPED Mall (cyberfold.co.kr)		120					28		Korea
Velocifero	Mini MAD+	Buy the Velocifero Mini MAD+ Electric Scooter | Electroheads.com	500	40	25	124 x 50 x 51	124 x 50 x 122	100	28	128	
Razor	EcoSmart SUP	EcoSmart SUP Big Wheel Electric Scooter | Razor | UK & IE	350	25	25	146 x 53 x 50	146 x 53 x 115	100	29	129	USA
Weped	93 Ten	WEPED 93 TEN - WEPED Mall (cyberfold.co.kr)		120					30		Korea
Apollo	Ghost V2	Apollo Ghost V2 Electric Scooter | High Performance Ride | London (personalelectrictransport.co.uk)	2000	40	58			130	30	160	
Nanrobot	D4+3.0	NANROBOT D4+3.0 Electric Scooter	2000	64	64	128 x 63 x 63	125 x 63 x 132	150	32	182	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Dualtron	Compact	Dualtron Compact - | Small, yet powerful e-scooter | Voltride	3000	50	60			120	32	152	
Nami Electric	Klima ONE	NAMI Klima ONE Electric scooter | PET London (personalelectrictransport.co.uk)	1000	100	68		129 x 23 x 123	120	32	152	
Inokim	Ox Hero	Inokim Ox Hero | In stock and ready for shipping | Voltride.com	1000	40	25	122 x 59 x 54	122 x 59 x 130	120	32	152	
Speedway	5	Speedway 5 | In stock and fast worldwide shipping | Voltride.com	1000	75	25	123 x 26 x 34	124 x 61 x 92	120	33	153	
Dualtron	Spider II	Dualtron Spider II - Voltride	4000	80	25	114 x 61 x 50	114 x 61 x 124	120	34	154	
Swifty	Go GT500	Stand-On Moped Electric Scooter, Swifty GO GT500 | Swifty Scooters	500	40	38			120	34	154	
Nanrobot	D6+2.0	NANROBOT D6+2.0 Electric Scooter | Nanrobot	2000	103	64	132 x 73 x 55	132 x 73 x 133	150	35	185	China

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Apollo	Phantom V3	Apollo Phantom V3 Electric Scooter | High Performance | London (personalelectrictransport.co.uk)	3200	72	65			120	35	155	
Apollo	Phantom Ludicrous 60V	Apollo Phantom Ludicrous 60V E-scooter - PET London (personalelectrictransport.co.uk)	4400	64	71			120	35	155	
Nami Electric	Klima Max	NAMI Klima MAX Electric scooter | PET London (personalelectrictransport.co.uk)	2000	135	70	129 × 23 × 55	129 × 23 × 123	120	36	156	China
Nami Electric	Klima Electric	NAMI Klima 25Ah Electric scooter | PET London (personalelectrictransport.co.uk)	2000	100	68	129 × 23 × 55	129 × 23 × 123	120	36	156	China
Hidoes	iE-ES30	iENYRID ES30 2400W Electric Scooter | Dual Motor Electric Scooter – Hidoes.eu	2400	76	60		133 x 23 x 130	130	36	166	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Vsett	10+ 2023 60V 28Ah	VSETT 10+ 60V 28Ah | 2023 Large Central Display | PET London (personalelectrictransport.co.uk)	2800	160	80	130 x 26 x 46	130 x 63 x 136	120	38	158	China
Dualtron	Victor Luxury Plus 2024	Dualtron Victor Luxury Plus 2024 (EY4, 35Ah) - PET London (personalelectrictransport.co.uk)	4300	80	85	117 x 61 x 56	117 x 61 x 131	120	38	158	
GPad	Storm	GPad Storm | In stock and fast worldwide shipping | Voltride.com	800	60	25	127 x 66 x 44	127 x 66 x 127	120	38	158	
Dualtron	City	Dualtron City - Voltride	1000	90	25	157 x 26 x 75	157 x 62 x 131	150	41	191	
Nanrobot	N6 72V	NANROBOT N6 (72V) Electric Scooter	3000	130	80	135 x 67 x 51	135 x 67 x 135	150	42	192	China
Weped	Fold 3	FOLD3 - WEPED Mall (cyberfold.co.kr)	3600	100	95	99 x 25 x 46	124 x 25 x 118		42		Korea
Inokim	OxO	Inokim OxO | Hardcore electric scooter | In Stock | Voltride.com	2000	70	25	122 x 59 x 54	122 x 59 x 130	120	42	162	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Velocifero	One-X	Buy the Velocifero One-X Electric Scooter (Single Motor) | Electroheads.com	250	50	25	138 x 63 x 60	138 x 63 x 128	120	43	163	
Dualtron	III	DUALTRON III | In stock and fast worldwide shipping | Voltride.com	1000	120	25	114 x 28 x 53	114 x 61 x 120	120	44	164	
Nami Electric	Blast Max (40Ah)	NAMI Burn-e 2 MAX 40Ah Escooter | PET London (personalelectrictransport.co.uk)	3000	145	85	133.5 × 29 × 55	134 × 29 × 125	120	45	165	China
Weped	FF2S	WEPED SFF2 E-SCOOTER - WEPED Mall (cyberfold.co.kr)	1200	110	120	98 x 22 x 47	123 x 22 x 118		46		Korea
Nami Electric	Burn-e 2 Max (30Ah)	NAMI Burn-e 2 30Ah 2000W Escooter | PET London (personalelectrictransport.co.uk)	2000	113	72	136 x 62 x 64	135 x 62 x 145	120	47	167	China
Dualtron	Achilleus	Dualtron Achilleus - Voltride	1000	100	25	111 x 28 x 56	111 x 61 x 125	120	47	167	
Dualtron	Thunder III	Dualtron Thunder III - Voltride	11000	170	25	121 x 38 x 58	121 x 61 x 127	120	47	167	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Dualtron	Ultra 2	Dualtron Ultra 2 | Premium Electric Scooter | Fast and Reliable | In Stock (voltride.com)	1000	120	25	121 x 32 x 53	121 x 60 x 122	120	49	169	
Nami Electric	Burn-e 2 Max (40Ah)	NAMI Burn-e 2 MAX 40Ah Escooter | PET London (personalelectrictransport.co.uk)	3000	185	97	136 x 62 x 64	135 x 62 x 145	120	50	170	China
Segway Ninebot	GT2P	GT2P - Segway-Ninebot	3000	90	70	148.5 x 65.6 x 86.0	148.5 x 65.6 x 130.8	150	52.6	202.6	USA/China
Nanrobot	LS7+ 72V	NANROBOT LS7+ (72V) | The Fastest Scooter	6000	130	120	143 x 70 x 57	143 x 70 x 136	150	53	203	China
Segway Ninebot	GT2P	Ninebot Segway GT2P Escooter | PET London (personalelectrictransport.co.uk)	>2000 W	50	70	149 x 66 x 86	149 x 66 x 131	150	53	203	USA/China
Inmotion	RS 72V	INMOTION RS 72V Electric Scooter - RAPTOR - PET London (personalelectrictransport.co.uk)	4000	160	110	143 x 71 x 60	143 x 71 x 134	150	56	206	China
GPad	F3 Max	GPad F3 Max DT - Voltride	1000	100	25	139 x 28 x 64	135 x 64 x 111	140	59	199	

Standing e-scooters			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	**Model**	**Weblink**									
Dualtron	Storm	Dualtron Storm LTD - Voltride	1000	220	25	121 x 32 x 61	121 x 60 x 130	120	60	180	
Weped	Sonic X	WEPED SONIC X E-SCOOTER - WEPED Mall (cyberfold.co.kr)	4000	100	140	115 x 31 x 70	143 x 31 x 129		80		Korea
Weped	Sonic Dual	WEPED SONIC DUAL E-Scooter - WEPED Mall (cyberfold.co.kr)	8000	200	170	200 x 32 x 99	200 x 32 x 144		150		Korea
Weped	Sonic S Dual	WEPED SONIC S DUAL E-SCOOTER - WEPED Mall (cyberfold.co.kr)	8000	280	170	200 x 32 x 99	200 x 32 x 144		170		Korea
Weped	Fold Mini 10	FOLD MINI 10 - WEPED Mall (cyberfold.co.kr)		100	75	88 x 24 x 45	111 x 24 x 116				Korea
Riley	RS2	Riley RS2 Electric Scooter – Electroheads	350	45	25	113 x 17 x 49	113 x 17 x 118	120			
Number of machines		Median	**500**	**42**	**25**			**120**	**20**	**139**	
141		Minimum	**80**	**6**	**11**			**50**	**4**	**54**	
		Maximum	**11000**	**280**	**170**			**200**	**170**	**226**	

E-mopeds

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Razor	E300S Electric Scooter With Seat	E300S Electric Scooter with Seat | Razor | UK & IE	250		24		104 x 43 x 106	100	28	128	USA
Razor	Pocket Mod	Pocket Mod - Razor - United Kingdom and Ireland			24		127 x 46 x 76	77	27	104	USA
Razor	PowerRider 360	PowerRider 360 - Razor			13		95 x 60 x 62	120	12		USA
T-sport	X1 Super High 35 Miles Range Fastest Electric Scooter	X1 SUPER HIGH 35 MILES RANGE FASTEST ELECTRIC SCOOTER – T-Sport Power (tsportpower.com)	600		40	114 x 24 x 48	114 x 61 x 111	120	25	145	
T-sport	Vhem6-largebasket	ELECTRIC SCOOTER WITH CARGO BAG, SUSPENSION & KEY MAX RANGE 15 MILES 12 INCH TYRES : Amazon.co.uk: Sports & Outdoors	350	25			126 x 45 x 115	120	20	140	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
T-sport	Powerful Electric Scooter With Suspension and Seat	Powerful Electric Scooter with Suspension and Seat – T-Sport Power (tsportpower.com)	800								
Ealirie	Yd-m4-3	Electric Scooter 10Ah 500W Powerful Motor, 30-40KM Range, 25KM/H Folding E Scooter 10" Tire for Adults Teens, Load 130KG Triple Shock Absorbers : Amazon.co.uk: Sports & Outdoors	500	40	25			130	28	158	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
MelkTemn	MelkTemn	Electric Scooter 10" for Adults, Powerful Motor 500W, 40-50KM Range, Max Speed 25KM/H, Folding Scooter, 3 Speed Modes with LCD Screen for Adults : Amazon.co.uk: Sports & Outdoors	500		25			120	15	135	
Engwe	S6	ENGWE S6 Electric Scooter with seat 10 Inch Tires 45Km/h | United Kingdom (geekbuying.com)	500	60	25			120	32	152	China
iScooter	iX5 Off Road Electric Scooter	iX5 Foldable Off Road Electric Scooter 45 Km/h | iScooter (iscooterglobal.co.uk)	800	45	45	118 x 20 x 50	118 x 60 x 123	150	27	177	
Doohan	iTank	Doohan iTank - Electric Scooter 2024	1500	140	50				99		China

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
MotoTec	Vulcan	Amazon.com : MotoTec Vulcan 48v 1600w Electric Scooter Black : Sports & Outdoors	1600				132 x 64 x 117	141	65	206	USA
MotoTec	Fatboy	Amazon.com: MotoTec Fatboy 48V 500W Electric Scooter : Sports & Outdoors	500				130 x 28 x 122		46		USA
Hidoes	iEnyrid M4 Pro S+ Max	iENYRID M4 Pro S+ Max 800W Electric Scooter, 48V 20Ah Battery, 45km/h – Hidoes.eu	800	75	45		120 x 25 x 50	150	30	180	
Hidoes	iEnyrid M4	iENYRID M4 600W Electric Scooter | Commuting Electric Scooter for Adults – Hidoes.eu	600	30	45		118 x 26 x 49	150	23	173	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Hidoes	iEnyrid M8	iENYRID M8 500W Electric Scooter for Commuting, Folding Electric Scoot – Hidoes.eu	500	35	36			120			
Hidoes	iEnyrid ES20	iENYRID ES20 2400W Electric Scooter, Dual Motor Electric Scooter, 48V – Hidoes.eu	2400	60	55			150	51	201	
Tyokum		Amazon.com : TYOKUM Electric Scooter Adults With Seat - 800W Adults Electric Scooter Up to 28MPH & 34Miles Range Fast Electric Scooter,48V 18Ah Electric Scooter for Adults Commuter Foldable Escooter with 10''Tires : Sports & Outdoors	800	56	45		118 x 60 x 117	150	28	178	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Yikebike	Model C	YikeBike model C specifications and materials	200	20	23	67 x 21 x 58	104 x 64 x 83	100	11	111	New Zealand
Yikebike	Model V	YikeBike model V specifications and materials	200	20	23	67 x 19 x 55	105 x 64 x 83	100	14	114	New Zealand
Smacircle	S1	Micro Mobility Electric Bike-Transport Vehicle Smacircle S1	250		20	29 x 53 x 20	95 x 86 x 47	100			
Emoko	HT-HVD3	Amazon.com : EMOKO Electric Scooter - 800W Power, 35 Miles Range, 28MPH Speed, Foldable, Dual Braking System, Adjustable Handlebar Height, Seat, Cruise Control : Sports & Outdoors	800	65	40	117 x 47 x 53	117 x 47 x 120	150	25	175	China
Enviro rides	Electric Carry Commuter Scooter	Electric 500W Carry Commuter Scooter | Folding Seat Adult eScooter – EnviroRides	500	40	24			100	16	116	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Enviro rides	EVR Pro Off Road Electric Scooter	EVR Pro Off Road Adult Electric Scooter With Seat | 3200W, 55mph, GPS – EnviroRides	3200	56	89			200	42	242	
Zipper		Zipper Electric Scooter 800W With Suspension (scootercity.co.uk)	800	33	25			120	40	160	
Zipper	Off Road Electric Scooter	1000W Zipper Off Road Electric Scooter (scootercity.co.uk)	1000	30	25				46		
Zipper	M6	Zipper M6 350W Electric Scooter (nitrotek.co.uk)	350	25					17		
Windgoo	B9	Windgoo B9 Electric Scooter With Seat – Electroheads	350		25	120 x 54 x 99	120 x 54 x 99	120	24	144	China
Windgoo	B3	Windgoo B3 Seated Electric Scooter – Electroheads	350		25	105 x 20 x 64	105 x 48 x 99	120	20	140	China

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
EMove	Roadrunner V2	EMove Roadrunner V2 Seated Electric Scooter – Electroheads	850	161	56			150	25	175	
EMove	RoadRunner Pro Seated Electric Scooter	EMove RoadRunner Pro Seated Electric Scooter | Beyond PEV		80	80		144 x 78 x 110	150	52	202	
Kugoo	M4 Pro+	Kugoo M4 Pro+ Electric Scooter With Foldable Seat 21Ah 500W (britishhoverboard.co.uk)	500	80	45	114 x 39 x 60	119 x 112 x 60	150	23	173	China
HVD-3	Electric Scooter (WX4)	HVD-3 E Scooter (WX4) - Electric Scooter with Seat & LED Light - Wheelie World	800	65	45	117 x 47 x 53	117 x 47 x 120	150	25	175	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
E5	Adult All Terrain Suspension Off Road Electric Scooter	E5 Adult All terrain Suspension Off Road Electric Scooter with Free Shipping and Customer Support - Wheelie World	600			121 (length) x 54 (height)	122 (length) x 54 (height)	140			
Velcifero	MAD 2000W	Velocifero MAD 2000w Electric Scooter | Beyond PEV	2000	40	50	135 x 32 x 57	135 x 59 x 108	140	48	188	
Velcifero	MAD 1000W	Velocifero MAD 1000W E-scooter - Velocifero MAD | Electric Scooter | Online Store (velociferostore.com)	1000	35	25	133 x 35 x 57	133 x 35 x 110	140	48	188	
Velcifero	MAD 1600W	Velocifero MAD 1600W Electric scooter - Velocifero MAD | Electric Scooter | Online Store (velociferostore.com)	1600	35	30	133 x 35 x 57	133 x 35 x 110	140	48	188	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Velciferо	MAD 500W	Velocifero MAD 500W | EEC-approved | E-scooter - Velocifero MAD | Electric Scooter | Online Store (velociferostore.com)	500	25	20	133 x 35 x 57	133 x 35 x 110	140	48	188	
Velcifero	MAD 810W	Velocifero MAD 810W 48V Brushless - Velocifero MAD | Electric Scooter | Online Store (velociferostore.com)	810	32	35	133 x 35 x 57	133 x 35 x 110	140	48	188	
Engwe	S6	Engwe S6: Folable Seated E-scooter Reaching 25KM/H (engwe-bikes-eu.com)	500	60	25	116 x 25 x 53	116 x 25 x 106	120	32	152	
Engwe	Y600	Engwe Y600 Electric Scooter: Seated E-scooter Up to 45KM/H (engwe-bikes-eu.com)	600	70	45	118 x 28 x 47	118 x 28 x 123	120	31	151	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Eneway	The Revoluzzer45	The Revoluzzer45 3.5 - 1200W - E-Scooter 45km/h - 48V 12AH BleiGel | The Revolutionary by Eneway (eneway24.de)	1200	60	45	131 x 63 x 59	145 x 63 x 115		56		Germany
Eneway	The Revoluzzer45 Plus	The Revoluzzer45 3.5 "plus" - 1200W - E-Scooter 45km/h - 48V 18AH BleiGel | The Revolutionary by Eneway (eneway24.de)	1200	60	45	131 x 63 x 59	145 x 63 x 115		57		Germany
Eneway	The Revoluzzer45 Pro	The Revoluzzer45 3.5 "pro" - 1600W - E-Scooter 45km/h - 48V 18AH BleiGel | The Revolutionary by Eneway (eneway24.de)	1600	60	45	131 x 63 x 59	145 x 63 x 115		57		Germany

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Eneway	COCO II Plus	ENEWAY COCO II plus 2000W 60V Fatwheel LowRider Scooter with Road Approval 45 km/h BLACK | The Revolutionary by Eneway (eneway24.de)	2000	50	45		176 x 38 x 75		70		Germany
Eneway	COCO II Wave-S	ENEWAY COCO Wave-S 1000W 48V Fatwheel LowRider Scooter with Road Approval 45 km/h BLACK | The Revolutionary by Eneway (eneway24.de)	1000	38	42		139 x 63 x 98	120	37	157	Germany

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
FORÇA	CAPTAIN PRO	FORÇA CAPTAIN PRO Electric Scooter up to 50 km/h Top Speed in Black - 12AH Lead-Gel Battery | The Revolutionary by Eneway (eneway24.de)	2000	25	50		128 x 61 x 111		37		
Cruzaa	K1 Hammer	k1-hammer (outdoordreams.eu)	250	45	25	124 x 54 x 27	120 x 62 x 99	120	19	139	
Kugoo	KuKirin M4	KuKirin (Kugoo) M4 Electric Scooter (locoscooters.ie)	500	45	45			120	23	143	
Kugoo	KuKirin M5	KuKirin (Kugoo) M5 Pro Electric Scooter (20Ah) (locoscooters.ie)	1000	700	52			120	36	156	
Kugoo	KuKirin G2 Pro	KuKirin G2 Pro Electric Scooter | With Removable Seat (kugoo.eu)	600	55	45	119 x 62 x 56	119 x 62 x 132	120	27	147	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
Kugoo	KuKirin C1 Pro	KuKirin C1 pro Long Range Electric Scooter | Up to 100km Range (kugoo.eu)	500	100	45	140 x 30 x 65	140 x 61 x 110	120	34	154	
Fiido	Q1S	Fiido Seated Electric Scooter - VORO MOTORS	350	29	25	114 x 30 x 71	119 x 64 x 109	127	20	147	
Bogist	M5 Max	BOGIST M5 Max Electric Scooter with Seat, 14-inch Tire, 1000W Motor, 48V 13Ah Battery, With EEC certification - GEEKMAXI.COM	1000	40	40			120	36	156	
Fiido		Fiido Seated Electric Scooter - VORO MOTORS		29	24	114 x 30 x 70	119 x 62 x 109	127	20	147	
EMOVE	RoadRunner V2	EMOVE RoadRunner V2 Seated Electric Scooter - VORO MOTORS	1680	85	55		127 x 64 x 67	150	25	175	
EMOVE	RoadRunner Pro	EMOVE RoadRunner Pro Seated Electric Scooter - Voromotors	2000	80	80		144 x 78 x 110	150	52	202	

E-mopeds			Power (W)	Max Range (km)	Max Speed (km/h)	Folded Dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink									
EMOVE	RoadRunner SE	EMOVE RoadRunner SE Ultra Light-Weight Seated Electric Scooter Bike - VORO MOTORS		32	32			109	14	123	
Okai	EA10	OKAI EA10 Electric Scooter with Seat, Up to 25 Miles Range & 15.5MPH – Happy Trail (happytrayl.myshopify.com)	750	40	25		114 x 53 x 104				
Number of machines 59		Median Minimum Maximum	775 200 3200	45 20 700	40 13 89			120 77 200	29 11 99	156.5 104 242	

EPACs

EPACs												
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Carrera	Vengeance E Mens Electric Mountain Bike	Carrera Vengeance E Mens Electric Mountain Bike Shimano 2.1 - L Frame | Halfords UK		64	25			120	23	143	
Carrera	Impel im-3.1	Carrera impel im-3.1 Electric Hybrid Bike - M, L Frames | Halfords UK	250	121	25			120	20	140	
Carrera	Actuate 2 Lowstep	Carrera Actuate 2 Lowstep Electric Hybrid Bike - M, L Frames | Halfords UK		80	25			120	19	139	
Carrera	Crossfire E Mens	Carrera Crossfire E Mens Electric Hybrid Bike 2.0 - S, M, L Frames | Halfords UK			25			120	23	143	

EPACs			Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink									
Carrera	Subway E Mens	Carrera Subway E Mens Electric Hybrid Bike 2.0 - S, M, L Frames | Halfords UK							18		
Lapierre	Overvolt 5.5	Lapierre Overvolt 5.5 Mix Frame Hardtail Electric Mountain Bike - S Frame | Halfords UK		134	25			120			
Lapierre	e-Explorer 8.7 Low 2024	e-Explorer 8.7 Low | 2023 | Lapierre Bikes			25				27		
Lapierre	Overvolt HT 7.6 High 2024	Overvolt HT 7.6 High | 2024 | Lapierre Bikes			25				24		
Lapierre	Overvolt HT 8.7 High 2025	Overvolt HT 8.7 High | 2024 | Lapierre Bikes			25						
Lapierre	Overvolt TR 4.6 2024	Overvolt TR 4.6 | 2024 | Lapierre Bikes			25						

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Lapierre	E-Explore 4.4	Lapierre E-Explore 4.4 Low Step Electric Hybrid Bike - S Frame | Halfords UK		105	25			120			
EBCO	Adventure 3R	EBCO Adventure 3 Roadster Mens Electric Hybrid Bike - S, M, L Frames | Halfords UK		74	25			120	22	142	UK
EBCO	Adventure 3T	Adventure 3T - EBCO (ebco-ebikes.co.uk)									
EBCO	Adventure 5R	Adventure 5R - EBCO (ebco-ebikes.co.uk)									
EBCO	Adventure 5T	Adventure 5T - EBCO (ebco-ebikes.co.uk)							27		
EBCO	Street 2	Shop eBikes - EBCO (ebco-ebikes.co.uk)									

EPACs											
Make	**Model**	**Weblink**	**Power (W)**	**Max Range (km)**	**Max Speed (km/h)**	**Folded dimensions (L x W x H cm)**	**Unfolded Dimensions (L x W x H cm)**	**Max Payload (kg)**	**Empty Mass (kg)**	**Max Gross Mass (kg)**	**Manufacturing Location**
Superior	SBC 400i L	Superior SBC 400i L Electric Hybrid Bike - Brown - M Frame | Halfords UK		145	25			120	25	145	
Superior	eWAY 6.7	Superior - eWAY 6.7 (superiorbikes.com)		150	25						
Superior	SSC 160 L	Superior - SSC 160 L (superiorbikes.com)		185	25						
Vitus	Mach E Urban	Mach E Urban eBike Alivio – Vitus Bikes		97					17		
Super 73	The Iconic Urban Cruiser	SUPER73-S2 | The Iconic Urban Cruiser	250	121			175 x 64 x 107	147	33	180	
Pendleton	Somerby	Pendleton Somerby Electric Bike - Midnight Blue - S, M Frames | Halfords UK	250		25			120	22	142	

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Raleigh	Felix + Low Step	Raleigh Felix+ Low Step Electric Hybrid Bike - 46cm Frame | Halfords UK		82	25			120	25	145	
Raleigh	Felix + Crossbar	Felix Plus Electric Bike | Raleigh UK		113					26		
Raleigh	Array	Array Crossbar Electric Bike | Free Delivery & 0% Finance | Raleigh		97					23		
Raleigh	Stow E-way Folding Electric Bike	Stow-E-Way Folding Ebike | Free Delivery | Raleigh UK		48				110	20	130	
Raleigh	Motus Tour	Motus Tour | Hub Gear | Raleigh UK		129				120	28	148	
Raleigh	Motus Grand Tour - Derailleur Gear	Motus Grand Tour 2021 | Raleigh Uk		161				120			

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Apollo	Metis Womens	Apollo Metis Womens Electric Hybrid Bike 2021 - Small | Halfords UK			25			120	22	142	
Apollo	Phaze	Apollo Phaze Mens Electric Mountain Bike - M Frame | Halfords UK						120	19	139	
Assist	Step-Thru	Assist Step-Thru Hybrid Electric Bike 2021 | Halfords UK		32	25			120	23	143	
Assist	Crossbar	Electric Bikes | E-Bikes | Halfords UK			25			120	22	142	
Rockmachine	Storm INT e70-29	Rockmachine Storm INT e70-29 Mens Electric Mountain Bike - M, L Frames | Halfords UK		97	25			120	23	143	
Rockmachine	Vyory e70	Rock Machine - Vyöry e70 (rockmachinebikes.com)	250								

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
GreenEdge	CS2	Buy a Greenedge CS2 Electric Mountain Bike from E-Bikes Direct	250	56	25				19		
Dallingridge Diablo Integrated Hardtail Electric Mountain Bike	26" Wheel - Gloss Black/Red	Buy a Dallingridge Diablo Integrated Hardtail Electric Mountain Bike from E-Bikes Direct	250	40	25						
Basis Beacon	E-MTB Electric Mountain Bike	Buy a Basis Beacon Electric Mountain Bike from e-BikesDirect	250	97	25				23		
Ampere	Explorer Electric Mountain Bike, 16Ah-Toxic Yellow	Buy a Ampere Explorer Electric Mountain Bike - Toxic Yellow from E-Bikes Direct	250	121	25				20		

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Ampere	X-Trail Hardtail Electric Mountain Bike, 27.5" Wheel - Green	Buy an Ampere X-Trail Hardtail Electric Mountain Bike Green from E-Bikes Direct	250	129	25				23		
Ampere	X-Trail Hardtail Electric Mountain Bike, 29" Wheel - Matt Black	Buy an Ampere X-Trail Hardtail Electric Mountain Bike from E-Bikes Direct	250	129	25				23		
Haibike	Alltrack Y outh e-MTB Hardtail - Olive/Red	Buy a Haibike Alltrack Youth e-MTB Hardtail - Olive/Red from E-Bikes Direct	250					80			

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Haibike	Trekking 5 HIGH All-Rounder Electric Bike 2023, 27.5" Wheel, Yamaha PW-S2 - Metallic Red	Buy a Haibike Trekking 5 HIGH Electric Mountain Bike 2023 from E-Bikes Direct	250	209	25						
Haibike	AllTrack 6 Hardtail Electric Mountain Bike 720Wh, 29in - Gloss Papaya/Titan	Buy a Haibike AllTrack 6 eMTB 29in Papaya/Titan from E-Bikes Direct	250		25			120			
Claud Butler	Wrath 1.0 Electric Mountain Bike - Grey	Buy a Claud Butler Wrath 1.0 E-MTB from E-Bikes Direct	250	45	25						

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Merida	eOne-Forty 500 e-MTB 29" Wheel, 11 Speed - Teal/Black	Buy a Merida eOne-Forty 500 e-MTB Teal Black from E-Bikes Direct Outlet									
Eskuta	SX-250 Series 4 Classic Electric Bike	Eskuta Electric Bike SX-250 Series 4 | Best EAPC Electric Bike	250	80	25				53		
Eskuta	SX-250 Series 4 Tourer Electric Bike	Eskuta Electric Bike SX-250 Series 4 Tourer | Electric Touring Bike		80	25				53		
Eskuta	SX-250 Series 4 Voyager Electric Bike	SX-250 Series 4 Voyager Electric Bike (eskuta.com)	250	80	25				53		
Eskuta	SX-250 Series 4 Explorer Electric Bike	Eskuta Electric Bike SX-250 Series 4 Explorer | Ebike Explorer	250	80	25				53		

EPACs Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Ekobike	Model 15	Model 15 | Electric Bike | E Rider Bikes (ekobikes.co.uk)	250	45	25			130	40		
Engwe	Engine Pro 2.0	Engwe Engine Pro 2.0 All-terrain Adventure Folding E-bike (engwe-bikes-eu.com)		110	25		170 x 55 x 130	150	32	182	
Engwe	L20	Engwe L20: Step-Thru Fat Tire Ebike for Long Ranges (engwe-bikes-eu.com)	250	140	25			120	34	154	
Engwe	Engine X	Engwe Engine X | 250W Foldable E Fat Bike for All Terrain (engwe-bikes-eu.com)	250	120	25		170 x 55 x 130	150	32	182	

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Engwe	E26	Engwe E26: 250W All Terrain Fat E Bike for Commuting (engwe-bikes-eu.com)	250	140	25			150	35	185	
Engwe	P275 ST	Engwe P275 ST - Step Through Urban E Bike | Range NO.1 (engwe-bikes-eu.com)	250	260	25			100	26	126	
Engwe	P275 Pro	Engwe P275 Pro: Urban E Bike for Long Ranges & Commuting (engwe-bikes-eu.com)	250	260	25			100	25	125	
Engwe	T14	Engwe T14 - Affordable Foldable Mini E-bike for Commuting (engwe-bikes-eu.com)	250	42	25		124 x 47 x 98	100	23	123	

EPACs			Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink									
Engwe	P20	Engwe P20 - Foldable Urban E-bike for Easy Commuting (engwe-bikes-eu.com)	250	100	25		158 x 42 x 120	120	19	139	
Engwe	P26	Engwe P26: 250W Urban E-bike for Commuting | 100KM Range (engwe-bikes-eu.com)	250	100	25			100	58	158	
Volta	GTS One	Volta GTS One | Voltes - Electric Mobility	250	50	25		165 x 68 x 110		35		
Volta	FX Ranger	Volta FX Ranger Black | Voltes - Electric Mobility	250	80	25		165 x 67 x 105		30		
Volta	City X	Volta City X Black | Voltes - Electric Mobility	250	80	25				30		
Knaap	AMS	Knaap AMS Black Edition | Voltes - Electric Mobility	250	140	25		148 x 25 x 88		28		
Knaap	RTD	Knaap RTD | Voltes - Electric Mobility	250	140	25		148 x 25 x 88		37		

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Knaap	LON	Knaap LON Black | Voltes - Electric Mobility	250	120	25				38		
Knaap	BCN	Knaap BCN Black | Voltes - Electric Mobility	250	120	25				38		
Phatfour	FLS+	Phatfour FLS+ Black | Voltes - Electric Mobility	250	65	25		160 x 70 x 125		25		
Phatfour	FLX	Phatfour FLX Black | Voltes - Electric Mobility	250	184	25				36		
Phatfour	FLX+	Phatfour FLX+ Mouse Grey | Voltes - Electric Mobility	250	184	25				36		
Super73	ZG	Super73 ZG White | Voltes - Electric Mobility	250	40	25		162 x 32 x 87		25		
Super73	Z Miami	Super73 Z Miami Panthro Blue | Voltes - Electric Mobility	250	80	25		163 x 64 x 99		27		
Super73	ZX Storm	Super73 ZX Storm Grey | Voltes - Electric Mobility	250	60	25		183 x 32 x 87		28		

EPACs Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Super73	S2	Super73 S2 Obsidian | Voltes - Electric Mobility	250	120	25		183 x 32 x 97		33		
Super73	RX Mojave	Super73 RX Mojave Obsidian | Voltes - Electric Mobility	250	120	25		183 x 32 x 97		38		
Brekr	Model F250	Brekr Model F250 Jet Black Matte | Voltes - Electric Mobility	250	75	25		175 x 74 x 109		32		
Bird	Grafity	Bird Bike Grafity Gray | Voltes - Electric Mobility	250	70	25		183 x 68 x 103		23		
Watt	Valencia	Watt Valencia Pearl White | Voltes - Electric Mobility	250	70	25		180 x 25 x 100		20		
Watt	Dublin	Watt Dublin | Voltes - Electric Mobility	250	70	25		180 x 25 x 100		20		
Watt	Brooklyn	Watt Brooklyn | Voltes - Electric Mobility	250	70	25		180 x 25 x 100		18		

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Watt	California	Watt California Pearl White | Voltes - Electric Mobility	250	70	25		180 x 25 x 100		20		
Watt	Boston	Watt Boston Male Black | Voltes - Electric Mobility	250	70	25		180 x 25 x 100		18		
Tenways	CGO600	Tenways CGO600 Pro Midnight Black | Voltes - Electric Mobility	250	100	25				16		
Tenways	CGO800S	Tenways CGO800S Midnight Black | Voltes - Electric Mobility	250	100	25				19		
Tenways	CGO009	Tenways CGO009 Midnight Black | Voltes - Electric Mobility	250	85	25				23		
Tenways	AGO X	Tenways AGO X Midnight Black | Voltes - Electric Mobility	250	100	25				29		

EPACs											
Make	Model	Weblink	Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Tenways	AGO T	Tenways AGO T Midnight Black | Voltes - Electric Mobility	250	100	25				31		
Cowboy	Classic	Cowboy Classic Black | Voltes - Electric Mobility	250	80	25		181 x 54 x 95		19		
Cowboy	Cruiser	Cowboy Cruiser Black | Voltes - Electric Mobility	250	80	25		181 x 62 x 103		19		
Cowboy	Cruiser ST	Cowboy Cruiser ST Black | Voltes - Electric Mobility	250	80	25		179 x 57 x 104		19		
Cowboy	Cross	Cowboy Cross Lava | Voltes - Electric Mobility	250	120	25		189 x 66 x 108		28		
Cowboy	Cross ST	Cowboy Cross ST Lava | Voltes - Electric Mobility	250	120	25		186 x 66 x 108		27		
Number of machines		Median	250	97	25			120	25	143	
91		Minimum	250	32	25			80	16	123	
		Maximum	250	260	25			150	58	185	

Speed pedelecs (not type-approved)

Speed pedelecs (not type-approved)			Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink									
HPC	Revolution	Revolution | Hi Power Cycles (hpcbikes.com)	6000	159	88				37		
Stealth	B-52	Stealth B-52 | Stealth Electric Bikes	6200		80			120	51	171	
Engwe	EP-2 Pro	Engwe EP-2 Pro Fat Bike | Off Road Folding Electric Bike (engwe-bikes-eu.com)	750	120	25		170 x 55 x 130	150	30	180	
Engwe	X26	Engwe X26/X24/X20|Foldable Electric Bike for Long Distance (engwe-bikes-eu.com)	1200		50		196 x 72 x 115	150			
Engwe	M20	Engwe M20 | Electric Fat Bike with the Longest Range (engwe-bikes-eu.com)	750	75	25			120	76	196	

Speed pedelecs (not type-approved)			Power (W)	Max Range (km)	Max Speed (km/h)	Folded dimensions (L x W x H cm)	Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink									
Frey	AM1000	off road ebike 1500w electric bike best Full Suspension AM1000 V6 - FreyBike (frey-bike.com)	1000	100	59		Depends on frame size	120	33	153	
Frey	Ex Pro Dual Battery Mountain Bike	Best Electric Mountain BikeEX - FreyBike (frey-bike.com)	1000	160	61		Depends on frame size	120	31	151	
Number of machines		Median	1000	120	59			120	35	171	
		Minimum	750	75	25		0	120	30	151	
7		Maximum	6200	160	88		0	150	76	196	

Cycles designed to pedal in L1e-B (type-approved under Regulation (EU) No 168/2013)

Cycles designed to pedal in L1e-B			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Stromer	ST3	myStromer_BrandCatalogue_MY25_I_rz.indd (stromerbike.com)	820	150	45	Depends on frame size				Switzerland
Stromer	ST1	myStromer_BrandCatalogue_MY25_I_rz.indd (stromerbike.com)	670	120	45	Depends on frame size				Switzerland
Stromer	ST7	myStromer_BrandCatalogue_MY25_I_rz.indd (stromerbike.com)	940	260	45	Depends on frame size				Switzerland
Stromer	ST5	myStromer_BrandCatalogue_MY25_I_rz.indd (stromerbike.com)	850	180	45	Depends on frame size				Switzerland
Qwic	MA11 Speed	QWIC Performance MA11 Speed | Speed pedelec, the ultimate commuter		70	45	Depends on frame size		24.8		Netherlands
Qwic	MD11 Speed	QWIC Performance MD11 Speed - Speedbike with mid drive | QWIC		71	45	Depends on frame size		24.2		Netherlands
Qwic	RD11 Speed	QWIC Performance RD11 Speed - The best speedbike with up to 45 km/h		55	45	Depends on frame size		26.8		Netherlands
Klever	X Speed 45	X SPEED 45- Stylish E-bike Of Quality | Klever Mobility (klever-mobility.com)	800	135	45	Depends on frame size	120	28	148	Taiwan

Cycles designed to pedal in L1e-B			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Klever	N Pinion 45	N Pinion 45 - Klever mobility (klever-mobility.com)	600	220	45	Depends on frame size	150	27	177	Taiwan
Klever	Y Muse 45	Y Muse 45 - Klever mobility (klever-mobility.com)	600	220	45	Depends on frame size	120	28	148	Taiwan
Number of machines 10		Median	800	142.5	45		120	26.9	148	
		Minimum	600	55	45		120	24.2	148	
		Maximum	940	260	45		150	28	177	

E-carrier cycles

E-carrier cycles			Power (W)	Max Range (km)	Max Speed (km/h)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass(kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Urban Arrow	Shorty	Urban Arrow Shorty Electric Bike | Fully Charged UK					190	28	218	The Netherlands
Urban Arrow	Tender 1000	Urban Arrow Tender - Three Wheeled Commercial Electric Cargo Bike – Urban eBikes	250	32	25		300			The Netherlands
Gazellle	Makki Load	Gazelle Makki Load Electric Bike | Fully Charged UK								The Netherlands
Butchers & Bicycles	MK1-E Gen3	Butchers & Bicycles MK1-E Vario Electric Bike | Fully Charged UK	250	129			100	50	150	
Riese & Muller	Transporter 85	Riese & Müller Transporteur2 85 Electric Bike | Fully Charged UK								Germany
Riese & Muller	Packster 70	Packster (r-m.de)								Germany
Tern	Quick Haul	2023 Tern Quick Haul D8 Active Plus LR Electric Cargo Bike In Gloss Tabasco (theelectricbikeshop.co.uk)		105				23	150	China
Tern	GSD S10	GSD S10: Our Most Popular Electric Cargo Bike | Tern Bicycles		85	25			34	200	China
Tenways	Cargo One	Tenways Cargo One | Voltes - Electric Mobility	250	90	25	266 x 69 x 130		56		

E-carrier cycles			Power (W)	Max Range (km)	Max Speed (km/h)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass(kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Cangoo	Keewee	Cangoo Keewee Black | Voltes - Electric Mobility	250	80	25	230 x 80 x 125		90		
Cangoo	Easy E	Cangoo Easy-E Mat Grey | Voltes - Electric Mobility	250	90	25			75		
Cangoo	Noon	Cangoo Noon | Voltes - Electric Mobility	250	80	25	230 x 92 x 125	120			
Cangoo	Buckle	Cangoo Buckle | Voltes - Electric Mobility	250	80	25	230 x 92 x 125	120	75	195	
Cangoo	Buzz	Cangoo Buzz | Voltes - Electric Mobility	250	80	25	267 x 56 x 114				
Estarli	eCargo Longtail	Estarli eCargo Longtail Electric Bike (Cargo Version) – Electroheads	250	120	25	183 x 118	210	28	238	
AM Cargo	Kindergarten	AM Cargo Kindergarten Open Electric Trike (6 Children) – Electroheads	250		25	214 x 88 x 126	150	47	197	
AM Cargo	Workman 2	AM Cargo Workman 2 Electric Trike – Electroheads	250		25	214 x 88 x 126	150	47	197	
AM Cargo	Ultimate Curve	AM Cargo Ultimate Curve Electric Trike – Electroheads	250	60	25	218 x 84 x 122	150	47	197	
AM Cargo	Ultimate Harmony	AM Cargo Ultimate Harmony Electric Trike – Electroheads	250	60		222 x 118 x 82	150	47	197	
Riese & Muller	Load 75 HS	Load 75 – Exceptional freedom | Riese & Müller (r-m.de)			45			38.2	200	

E-carrier cycles			Power (W)	Max Range (km)	Max Speed (km/h)	Unfolded Dimensions (L x W x H cm)	Max Payload (kg)	Empty Mass(kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Number of machines		Median values	250	80	25		150	47	197	
		Minimum values	250	32	25		100	23	150	
20		Maximum values	250	129	45		300	90	238	

Self-balancing personal transporters

Make	Model	Weblink	Power (W)	Range (km)	Max Speed (km/h)	Dimensions	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Eswing	XMSJ	ESWING Original Factory Segways Adult 19 Inch Hover Board Two Wheels Self Balancing Electric Scooter - AliExpress 1420	3200	20	20	82 x 49 x 56		54		China
Sunnytimes	STS-04	Smart Self-Balancing Electric Personal Transporter Scooter For Sale In Stock - AliExpress	2400	60	20			54		China
Daibot		Daibot Powerful Electric Scooter 2400W 60V 80KM Two Wheeled Self Balancing Scooters Off Road Hoverboard For Adults APP Bluetooth (aliexpress.us)	2400	80	20					China

Number of machines		Median	2400	60	20			54		
		Minimum	2400	20	20			54		
3		Maximum	3200	80	20			54		

Hoverboards

Hoverboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Hover 1	Rival	Buy Hover-1 Rival Pink Hoverboard with LED Wheels | Gifts for her | Argos		4.8	11	21x55x21	72	6.8	78.8	
Zinc	Megastar	Buy Zinc Megastar 240W Hoverboard - Chrome | Hoverboards | Argos	240	8	10	18x19x60	100	6.5	106.5	
Zimx	HB2	Buy ZIMX HB2 Hoverboard - Black | Currys		16	13	19x25x62		8		
SISIGAD	Hoverboard	SISIGAD Hoverboard Self Balancing Scooter 6.5" Two-Wheel Self Balancing Hoverboard with Bluetooth Speaker and LED Lights Electric Scooter for Adult Kids Gift : Amazon.co.uk: Sports & Outdoors	600	10	10		120	7.4	127.4	
Hoverboard	Monster Fire	Monster Fire Balancing Board HOVERBOARD® (hoverboards.co.uk)	700		12	65x27x27		11		
Hoverboard	6.5 Inch	Hoverboard 6.5 inch Black | Voltes - Electric Mobility	700	15	15	59 x 19 x 18		8		

Hoverboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Hoverboard	8 Inch	Hoverboard 8 inch Black | Voltes - Electric Mobility	700	15	15	59 x 23 x 21		9		
Hoverboard	Off Road	Off Road Hoverboard 8.5 inch Black | Voltes - Electric Mobility	700	15	15	71 x 21 x 23		10		
Speedio	Deluxe	Speedio DELUXE Hoverboard - Speedio.eu	700	20	15	58 x 19 x 18	120	11	131	
Speedio	Offroad	Speedio Offroad hoverboard - Speedio.eu	700		15	69 x 29 x 28	120	14	134	
Speedio	Sport	Speedio Sport Hoverboard - Speedio.eu	700		15	58 x 19 x 18	120	11	131	
Speedio	Track	Speedio TRACK Hoverboard - Speedio.eu	700	20	15	75 x 25 x 28	120	14	134	
Speedio	Max	Speedio MAX hoverboard - Speedio.eu	700		15	70 x 34 x 34	120	14	134	
Hover-1	Helix	Amazon.com: Hover-1 Helix Electric Self-Balancing Hoverboard with 7 mph Max Speed, Dual 200W Motors, 4 Mile Range, and 6.5" Wheels : Sports & Outdoors	400	8	11	64 x 24 x 23	73	7	80	

Hoverboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Hover-1	All-star	Amazon.com: Hover-1 All-Star 2.0 Hoverboard 7MPH Top Speed, 7MI Range, Dual 200W Motor, 5HR Recharge, 220lbs Max Weight, LED Wheels & Headlights : Sports & Outdoors	400	11	11	63 x 24 x 23	100	7	107	
Hover-1	Ultra	Amazon.com: Hover-1 Ultra Electric Hoverboard | 7MPH Top Speed, 12 Mile Range, 500W Motor, Long Lasting Li-Ion Battery, Rider Modes: Beginner to Expert, 4HR Full Charge : Sports & Outdoors	500	19	11	61 x 23 x 24	100	10	110	

Hoverboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Hover-1	Ranger	Amazon.com: Hover-1 Ranger + Electric Hoverboard, 9MPH Top Speed, 9 Mile Range, Long Lasting Li-Ion Battery, 4HR Full Charge, Built-In Bluetooth Speaker, Rider Modes: Beginner to Expert, Black : Sports & Outdoors		15	11			7		
Hover-1	Blast	Amazon.com: Hover-1 Blast Electric Self-Balancing Hoverboard with 6.5" Tires, Dual 160W Motors, 7 mph Max Speed, and 3 Miles Max Range : Sports & Outdoors	320	5	11	63 x 23 x 22		6		
Hover-1	Rocket	Amazon.com: Hover-1 Rocket 2.0 Hoverboard | 7MPH Top Speed, 3 Miles Range, 160lbs Max Weight, 320W Motor, LED Headlights & Footpads, Cert. & Tested, Green : Sports & Outdoors	360	5	11	63 x 23 x 22		7		

Hoverboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Jetson	Litho X	Amazon.com: Jetson Litho X Hoverboard, Active Balance Technology, 500-Watt Motor, Up To 10 mph, Range of Up to 10 Miles, 3 Speed Modes, Illuminated Rims, Light-Up Body, Ages 12+, Gray, JLITHX-GRY : Sports & Outdoors	400	10	10	62 x 18 x 19	100	6	106	
Razor	Hovertrax Prizma	Amazon.com: Razor Hovertrax Prizma Hoverboard with LED Lights, UL2272 Certified Self-Balancing Hoverboard Scooter, Prismatic Color, for Kids Age 8+ : Sports & Outdoors	300		15		103	9	112	
Gyroor	Warrior	Amazon.com: Gyroor Warrior 8.5 inch All Terrain Off Road Hoverboard with Bluetooth Speakers and LED Lights, UL2272 Certified Self Balancing Scooter : Sports & Outdoors	700	16	16	71 x 28 x 25	120	13	133	

Hoverboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Number of machines		Median	700	15	12.5		111.5	8.5	119.7	
22		Minimum	240	4.8	10		72	6	78.8	
		Maximum	700	20	16		120	14	134	

E-skateboards

E-skateboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Razor	RazorX Cruiser Electric Skateboard	RazorX Cruiser Electric Skateboard - Razor	125		16	75 x 27 x 14	100	5		
Blitzart	Hurricane	Amazon.com : Blitzart 38" Hurricane Electric Longboard Electronic Skateboard 18mph 350w brushless Motor (Hurricane Black) : Sports & Outdoors	350	16	29		113	6		
Caroma										
Evolve	Hadean Carbon All Terrain	Shop Hadean Carbon All Terrain at Evolve Skateboards UK - Official Store (rideevolve.co.uk)	3000 x2	40	42		120	13.5		
Evolve	Stoke	Shop Stoke Electric Skateboard at Evolve UK - Official Store – Evolve Skateboards UK (rideevolve.co.uk)	1500 x2	15	36		100	9.8		
Evolve	GTR Series 2 (Street)	Evolve GTR Series 2 Carbon Street | Voltes - Electric Mobility	3000	50	42	101 x 24 x 12		10		

E-skateboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Evolve	GTR Series 2 (All terrain)	Evolve GTR Series 2 Carbon All Terrain | Voltes - Electric Mobility	3000	30	36	101 x 24 x 12		11		
Evolve	Hadean Carbon (Street)	Evolve Hadean Carbon Street | Voltes - Electric Mobility	6000	65	50	205 x 24 x 12		12		
Koowheel	ESR 550 (Street)	Koowheel ESR 550 Street | Voltes - Electric Mobility	1100	20	40	90 x 28 x 13		8		
Summerboard	SBX	Summerboard SBX | Voltes - Electric Mobility	3000	20	40	82 x 24 x 12		9		
Evolve	Renegade	Renegade (evolveskateboards.de)	6000	50	42		120	16	136	
Evolve	Onirique	Onirique (evolveskateboards.de)	3000	25	36		100	9	109	
WowGo	2S MAX	Best Electric Skateboard Longboard 2S Max (wowgoboard.com)	1100	23	45					
WowGo	3E	Longboard Electric Skateboard For Sale (wowgoboard.com)	1300	21	45					
WowGo	Mini 2S	Cool Skateboards Electric Shortboard for Adults (wowgoboard.com)	1400	30	45					

E-skateboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
WowGo	AT2 Plus	All Terrain Electric Skateboard Longboard (wowgoboard.com)	4200	30	50			14		
WowGo	Mini 2	Mini Electric Skateboard Small Shortboard (wowgoboard.com)	1360	25	40			7		
WowGo	Pioneer X4	Motor Skateboard Longboard Electric Long Range (wowgoboard.com)	1400	33	45			8		
WowGo	Pioneer 4	Off Road Skateboard Electric Longboards for Sale (wowgoboard.com)	1360	35	45	98 x 29 x 15	150	8	158	
Lorentz	Major	Lorentz Major - All Terrain Electric Skateboard - LORENTZ BOARDS	11000	50	64	119 x 50 x 20	145	28	173	
Tynee	Mini 3	Tynee Mini 3 Electric Skateboard & Shortboard – TyneeBoard	1700	42	52	76 x 29 x 15	150			
Tynee	Mini 3 Pro	Tynee Mini 3 Pro Electric Skateboard - Best Torque Mini E Skateboard – TyneeBoard	5550	50	60	76 x 29 x 15	150	9	159	

E-skateboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Tynee	Stinger	Tynee® Stinger Long Range DKP Electric Skateboard & Shortboard – TyneeBoard	6000	53	55	86 x 34 x 18	150	12	162	
Tynee	Ultra X Pro	Tynee Ultra X Pro Electric Skateboard with 423Wh Molicel P42A Battery and 105 Boosted Soft Wheels – TyneeBoard	6000	52	60	98 x 34 x 16	150	10	160	
Tynee	Mini 3 SL	Tynee Mini 3 SL Hub Motor Electric Skateboard & Longboard- Tyneeboard.com – TyneeBoard	1100	32	48	76 x 29 x 15	150	10	160	
Tynee	Ultra	Tynee Ultra Hub Motor Electric Skateboard & Longboard- Tyneeboard.com – TyneeBoard	1100	40	45	97 x 30 x 14	150	24	174	
Tynee	Explorer	Tynee Explorer All Terrain Electric Skateboard – TyneeBoard	7000	84	50	120 x 32 x 16	150	14	164	
Meepo	V5	MEEPO V5 - best budget electric skateboard for	1000	32	45	97 x 28 x 14	150	9	159	

E-skateboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
		beginner (meepoboard.com)								
Meepo	Mini 5	MEEPO MINI 5 Electric Skateboard: Dish-Shaped Deck for Dynamic Control (meepoboard.com)	1000	32	45		150	8	158	
Meepo	Flow	MEEPO FLOW - Surfboard-Inspired Electric Carving Skateboard (meepoboard.com)	5038	38	52		150	11	161	
Meepo	City Rider 3	MEEPO City Rider 3 - Affordable All-Terrain Electric Skateboard (meepoboard.com)	7000	35	48		150	14	164	
Meepo	Q1	MEEPO Q1 BOARD (meepoboard.com)	200	9	19		65	5	70	
Meepo	Tundra	MEEPO TUNDRA - Off-Road Electric Skateboard (meepoboard.com)	7000	32	50	105 x 39 x 19	250	14	264	
Meepo	Voyager	MEEPO Voyager Electric Skateboard- Blazing Speeds & Street Board Supremacy (meepoboard.com)	5544	49	64		150	11	161	

E-skateboards			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (cm)	Max Payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing Location
Make	Model	Weblink								
Number of machines		Median	3000	32.5	45		150	10	160	
34		Minimum	125	9	16		65	5	70	
		Maximum	11000	84	64		250	28	264	

One-wheels

One-wheels			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Onewheel	Pint	Onewheel PINT - Free UK Delivery + Finance Options (rideandglide.co.uk)	750	8	26		100	11	111	
Onewheel	Pint X	Onewheel PINT X - In Stock Ready for Free Express UK Delivery (rideandglide.co.uk)	750	29	29		100	12	112	
Onewheel	GT	Onewheel GT - Free Express Delivery & Demos Available | Ride + Glide (rideandglide.co.uk)	750	52	32		125	16	141	
Onewheel	GT S-Series	Onewheel GT S-Series - Free Express Delivery & Demos Available (rideandglide.co.uk)		40	40		125	16	141	
Gosmilo	X1+	Gosmilo X1+ (smilomotors.com)	700	50	20	74 x 26 x 28	120	15	135	
Gosmilo	X3	Gosmilo X3 (smilomotors.com)	1000	40	26	74 x 26 x 28	120	15	135	
Gosmilo	X5	Gosmilo X5 (smilomotors.com)	1500	40	35	77 x 26 x 28	125	17	142	
McConks	T1 Magwheel	McConks T1 Magwheel one wheel electric skateboard - that foiling feel on land! - Foil Shop	700	25	20	80 x 30 x 30	100	15	115	

One-wheels			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
McConks	T3	McConks Skatewheel - T3 one wheel - surf all year round!	1500	35	35	79 x 31 x 34	125	17	142	
SoverSky	Elf-one wheel	soversky New self balancing one wheel electric scooter unicycle one wheel motorcycle one wheel skating shoes scooters - AliExpress 44	1000	60	30		120	14	134	
Number of machines		Median	750	40	29.5		120	15	135	
10		Minimum	700	8	20		100	11	111	
		Maximum	1500	60	40		125	17	142	

E-unicycles

E-unicycles			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
KINGSONG	S22 EAGLE PRO	Kingsong S20 (S22) Eagle Electric Unicycle | Free Delivery | Ride + Glide (rideandglide.co.uk)	3300	200	70	27x13x23	120	27		
KINGSONG	KS S18	Kingsong KS S18 Electric Unicycle | Free Delivery | Ride + Glide (rideandglide.co.uk)	2200	75	48		120	22		
Veteran	Sherman-S	Veteran Sherman-S Electric Unicycle - Personal Electric Transport	3000		100	57 x 21 x 71	120	44	164	
Veteran	Lynx	Veteran Lynx 151V Electric Unicycle - PET London (personalelectrictransport.co.uk)	8000		125	59 x 20 x 73	120	40	160	
Veteran	Patton	Veteran Patton 50S Electric Unicycle - Personal Electric Transport	3000		105	53 x 20 x 67	120	39	159	
Inmotion	V14	Inmotion V14 50S Adventure | Electric Unicycle EUC | PET London	9000	120	110		140	39	179	

E-unicycles			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
		(personalelectrictransport.co.uk)								
Inmotion	V13	Inmotion V13 Challenger Electric Unicycle - PET London (personalelectrictransport.co.uk)	10000	120	90		120	60	180	
Inmotion	V14 Adventure	Inmotion V14 Adventure | Electric Unicycle | PET | London (personalelectrictransport.co.uk)	9000	120	110		140	39	179	
Inmotion	V11Y	Inmotion V11Y 2023 | RAPTOR | Electric Unicycle | PET | London (personalelectrictransport.co.uk)	7000	120	60		120	30	150	
Inmotion	V12 HT	Inmotion V12 HT | Electric Unicycle | 100V EUC | PET | London (personalelectrictransport.co.uk)	2800	160	70		120	29	149	
Inmotion	V5F	Inmotion V5F | Electric Unicycle | Light Electric Vehicles | PE	550	40	25		120	12	132	

E-unicycles			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
		(personalelectrictransport.co.uk)								
KINGSONG	S19	Kingsong S19 Electric Unicycle - PET London (personalelectrictransport.co.uk)	6500	145	60		120	31	151	
KINGSONG	16S 2023	Kingsong 16S 2023 Electric Unicycle - Personal Electric Transport	1200	64	35		150	18	168	
KINGSONG	S16 Pro	New KingSong S16 PRO | Suspension EUC | PET London (personalelectrictransport.co.uk)	3000	129	60		120	33	153	
KINGSONG	16X 2023	New KingSong KS16X | Electric Unicycle | EUC | PET | London (personalelectrictransport.co.uk)	2200	150	50		120	24	144	
	S2000	Self- Hoverboard Electric Scooter 60V Electric Unicycle - AliExpress	2000	100	48		120			
		500w 60v Unicycle Electric Single Wheel Motorcycle Balacing Scooter | Fruugo UK	2200	120	50					

E-unicycles			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Ninebot-Segway	One S2	Ninebot One S2 - Segway-Ninebot	500	30	24	45 x 42 x 18	120	11		
Ninebot-Segway	Z10	Ninebot Z10 - Segway-Ninebot	1800	90	45	46 x 53 x 18	150	28	178	
KINGSONG	S9 'Basketball'	Kingsong S9 'Basketball' Electric Unicycle - Fast Delivery (e-rides.com)	500	11	10		60	10	70	
Begode	Mten4	Begode Mten4 (750wh, 84V) - Best Small Electric Unicycle - e-RIDES	1000	70	57		100	13	113	
Begode	EXN	Begode EXN Electric Unicycle - Fast Delivery (e-rides.com)	2800	145	69		130	33	163	
Begode	T4	Begode T4 Suspension Electric Unicycle - 1800WH - e-RIDES		64	56			31		
Begode	Extreme	Begode Extreme - Electric Unicycle (e-rides.com)		72	110		130			
ExtremeBull	Commander	ExtremeBull Commander Mini 134v - e-RIDES		80	80		120	45	165	

E-unicycles			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass (kg)	Max Gross Mass (kg)	Manufacturing location
Make	Model	Weblink								
Number of machines		Median values	2800	110	60		120	30.5	159.5	
25		Minimum values	500	11	10		60	10	70	
		Maximum values	10000	200	125		150	60	180	

E-skates

E-skates			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass(kg)	Max Gross Mass(kg)	Manufacturing location
Make	Model	Weblink								
Segway-Ninebot	Drift W1	Segway-Ninebot electric scooter; scooter; mobility scooters; electric scooters adult; adult scooter; mobility scooter accessories; electric scooters; stunt scooter; e scooter : Amazon.co.uk: Sports & Outdoors	.		12	12x16x29		8.1		
BROLEO	Double Wheel Electric Roller Skate	BROLEO Double Wheel Electric Roller Skate, Inline Electric Skates, Hub Motor Provides Flexibility, Aluminum Alloy for Outdoor Park (Plug : Amazon.co.uk: Sports & Outdoors	200	8	15		80	3.8		
Escend	Blades	ESCEND BLADES	800	16	25		100	3.75 x 2		
IRTrick	A1 Ultra	AIRTRICK ESKATES | A1 ULTRA	720	24	32		120			
IRTrick	A1 Pro	AIRTRICK ESKATES | A1 PRO	640	18	28		120			
RollWalk	eRW2	RollWalk Electric Rollerblades Shoes eRW2 – Rollwalk	300	18	17	29 x 13 x 9	100	2	102	
RollWalk	eRW3	Rollwalk Electric Shoes eRW3 | Electric Skates	600	19	32	29 x 13 x 9	100	2	102	

E-skates			Power (W)	Max Range (km)	Max Speed (km/h)	Dimensions (H x W x D cm)	Max payload (kg)	Empty Mass(kg)	Max Gross Mass(kg)	Manufacturing location
Make	Model	Weblink								
Wheelfeet	Eskates	Wheelfeet | Electric Shoes Roller Skates | Motorized Eskates | Roller – electric roller skates		15	25					
Atmos Gear	Eskates	Atmos Gear Electric Skates – electric roller skates		8	19		100			
Airtrick	Eskates	Airtrick Electric Skates | Motorized rollerblades – electric roller skates	640	18	28	31 x 67 x 13	120	2	122	
Gyroor	S300	Amazon.com: Gyroor Hoverboard Hovershoes-Gyroshoes S300 Electric Hover shoes Hoverboard with LED Lights,UL2272 Certificated Self Balancing Hovershoes for Kids and Adults : Sports & Outdoors	600	10	10	32 x 27 x 22		7		
Number of machines		Median values	620	17	25		100	2.9	102	
11		Minimum values	200	8	10		80	2	102	
		Maximum values	800	24	32		120	8.1	122	

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