POLICY ADVICE PAPER: REGULATIONS FOR LIGHT ELECTRIC VEHICLE (LEV)

REGIONAL FOCUS: LATIN AMERICAN CITIES

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PROJECT PARTNERS

ABOUT

This deliverable aims to provide policy advice from the SOLUTIONS+ consortium partners to the governments and policy makers on regards Light Electric Vehicles definition and classification as well as its national and local regulatory framework

TITLE

Policy Advice Paper: Regulations for Light Electric Vehicle (LEV)
Regional focus: Latin American Cities

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LAYOUT

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PICTURES

All the pictures are provided by the SOL+ partners

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List of Abbreviations

BRT	Bus Rapid Transit
COC	Certificate Of Conformity
DGT	General Transit Directorate
EMC	Electro-Magnetic Compatibility
EPAC	Electric Pedal-assisted Cycles
EV	Electric Vehicles
EVSE	Electric Vehicle Supply Equipment
GHG	Green House Gases
ICT	Information and Communication Technologies
INTI	National Institute of Industrial Technology
LCA	Environmental Configuration License
LCM	Model Configuration License
LDV	Light Duty Vehicles
LEFV	Light Electric Freight Vehicles
LEV	Light Electric Vehicles
LEZ	Low Emission Zones
MAAS	Mobility As A Service
MRV	Measurement, Reporting And Verification
PLEV	Personal Light Electric Vehicles
PMV	Personal Mobility Vehicles
PWD	People With Disabilities
PRM	Persons With Reduced Mobility
ROPS	Rollover Protective Structure
SUMP	Sustainable Urban Mobility Plan
TAD	Trámites A Distancia (Remote Procedures)
UNECE	United Nations Economic Commission For Europe
UMV	Urban Mobility Vehicles
VTV	Vehicle Technical Verification
WMI	World Manufacturer Identifier
ZEZ	Zero Emission Zones

EXECUTIVE SUMMARY

The emergence and take up of e-mobility and new mobility services and concepts, such as car-sharing and delivery platforms, have brought along new vehicle types and with that concepts such as micromobility and Light Electric Vehicles (LEV). In general terms, this type of vehicles can be defined as a vehicle type built for low speeds and short trips, thus, suitable for the transport of people and goods in urban areas, particularly for last mile connectivity and logistics, with a significant contribution to improving the safety, efficiency and inclusiveness of road space. Additionally, their smaller size in comparison to cars translates into less energy and resources used for their manufacturing and operation, resulting into reduced GHG emissions.

In recent years the LEV concept has been gaining increasing relevance in the English literature on Sustainable Mobility, with a strong focus on Europe, a market in which LEVs are present since 2011. Nevertheless, when it comes to the specific characteristics (maximum speed, power and mass or loading capacity) and subcategories enclosed in the LEVs umbrella, there is not a unanimous vision. Thus, this policy paper starts by proposing a definition of LEV, based on the literature founded mainly in English language, but also in Spanish given the Latin American focus of this document.

In order to maintain the wide variety of small and light vehicles that the LEVs umbrella comprises, for the purpose of this document we follow a broader approach by which Light Electric vehicles (LEVs) can be defined as those vehicles with a number of wheels >= 1 and <= 4, designed for personal mobility, transport of passengers or goods in an urban setting, propelled by electric motor(s) in pedal assistance mode or in exclusive mode. Their maximum continuous power is fifteen (15) kilowatts (kW) and the recommended maximum speed is 45 km/h.

The SOLUTIONSplus Project provided seed funding for the manufacturing and testing of different types of passenger and freight LEVs in Asia, Africa, Latin America and Europe. In Latin America, in particular, the Project funded 15 different types of vehicles manufactured by a total of 11 local SMEs. These vehicles were tested in 12 different use cases, mainly in logistics operations, but also in passenger transport. The results of the pilots carried out in 2 demonstration cities (Quito, Ecuador and Montevideo, Uruguay) and in 10 replication cities (Escobar and Buenos Aires in Argentina, Cuenca in Ecuador, Bogotá, Medellín, Barranquilla, Bucaramanga, Baranoa and Sabanalarga in Colombia) show high scale-up potential of this solutions in Latin America. However, one of the main barriers identified in most of the cases was the lack on national and local regulations to enable the widespread use of LEV in logistics and passenger transport.

Hence, this policy advice paper conducts a stocktake of international, national and local regulations norms and standards developed by international entities such as United Nations Agencies, the European Union or its member states, as well as by Latin American national and local governments. The goal of this comprehensive literature review is to enable the reader to understand the different approaches taken by countries and cities and choose the one more suited for their own context.

After introducing the topic and presenting the variety of LEVs that have been tested in the context of the SOLUTIONSplus project, the policy paper contrasts different sources with regards to the definition and categories of LEVs and micro vehicles, as well as other related terms such as EPACs and PLEVs. It continues with the norms and requirements for the homologation of LEV from a European perspective but presents case studies from Latin America. The paper finalises with the local regulations for the safe circulation of LEVs in cities, as well as recommendations of urban infrastructure to promote their use and untap their potential to contribute to sustainable urban mobility.

1 Introduction

2.1 Current trends in LEVs

Current trends in LEVs bring with it a series of challenges that exceed vehicles themselves but also include several topics related to the use of public areas, new technological trends and information and communication technologies (ICT), smart cities, and renewable energy. The interaction between these factors makes up a particular situation that must be addressed by national and local governments. New technologies and modes of passenger and freight transport require a major update in the national and local regulations. The new regulations should be an important part of the transition towards new modes of mobility, sustainable urban planning and foster the coexistence of different transport modes in the public space, prioritizing active mobility, i.e., walking and cycling, and other sustainable transport modes, such as public transport and shared mobility. Thus, regulations for light electric vehicles should pave the way for a new urban configuration, and foresee or regulate, within the possibilities, the current and future behavior of the different actors.

1.1.1 Advanced vehicles

Urban transport is being transformed by new and innovative multimodal and multifunctional vehicles, with the introduction of drones, robots and other technologies. In this context, micromobility, micro-vehicles, connected, autonomous and electrified vehicles are becoming increasingly important.

On the one hand, passenger transport has in recent years integrated new modes based on new technologies, new types of vehicles and multimodal transport, using different types of vehicles, from single-wheeled vehicles to e-buses or electric trains, passing through vehicles with new morphologies and structures. This includes micromobility, one of the concepts discussed in detail in section 3, which can be generally defined as personal transportation using light devices and vehicles whose power and speed are limited, including the use of human-powered vehicles such as bicycles, skateboards, etc. These types of vehicles are currently used in urban areas at an increasing rate.

With regard to freight transport, the shift to new modes and types of vehicles in urban areas is a clear trend that is increasingly being adopted by large logistics companies such as DHL, Fedex and others. In this sense, new light electric vehicles such as e-cargo bikes, electric tricycles and other LEVs with new morphologies are a reality that is on the rise.

Examples of the latest trends in vehicle development are presented below. Some of them are still at the conceptual phase and other might still seem very futuristic for the Latin American context. Nevertheless, it is important to have the full picture of the current developments, so that decision makers are able to elaborate regulations and policies that not only integrate the existing vehicles, but also consider the new developments. These will be contrasted by the passenger and freight LEVs manufactured and tested in real operations in the context of the SOLUTIONSplus project in Asia, Africa, Latin America and Europe (See Section 1.2.1).

Figure 1. Electric vehicles for urban logistics dpd, Germany. Source: RytleMovR, 2018

Multimodal and multifunctional vehicles: As mentioned above, multimodal and multifunctional vehicles tend to break into the market more and more, and disruptive vehicles are observed that work in combination with various modes of transport, both for people and goods.

Figure 2. Concept presented at IAA 2018 and Mondial de l'Automobile. Source: Renault EZ-Pro (2018)

Drones and robots: Drones and robots are part of the disruptive vehicles that are appearing, which are part of the new transport and mobility ecosystem in urban areas and cities.

Figure 3. Autonomous vehicle, United Kingdom. Source: Nuro R2 2020

Figure 4. Autonomous vehicle, San Francisco & Tallin. Source: Starship 2015

Connected, autonomous, and electrified vehicles: this type of vehicle is also growing since its technology is more and more accessible for manufacturers and users. Electric, autonomous and cloud-connected vehicles will be one of the key pieces in the development of new modes of transport for people and goods.

Figure 5. Volkswagen sedric concept of autonomous vehicle. Source: Volkswagen

1.1.2 Rethinking urban areas

Rethinking urban areas is a need that is increasingly imposed by new challenges related to improving the livability, coexistence and health of cities, as well as the needs related to new economic challenges, such as those related to urban logistics and new modes of passenger transport. In this sense, the current mobility trends presented in the previous section require changes in the way cities are planned and designed. One example is the creation of multimodal and integrated hubs and micro-hubs to enhance last mile connectivity and logistics, taking advantage of the emergence of new vehicle types and mobility services, such as LEVs and sharing systems. Similarly, there is a need to develop new types of infrastructure for LEVs, such as Zero Emission Zones (ZEZs), Low Emission Zones (LEZs), dedicated lanes for LEVs, bike lanes, etc. Other related concepts include superblocks and tactical urbanism, which aim to make cities more enjoyable for people by reclaiming public space from cars.

These new approaches to urban planning and design are enhanced by the emergence of new technologies, such as mobile applications that combine geolocation with the concept of Mobility as a Service (MaaS), smart cities and big data. All these components, presented in further detail below, bring with them the imperative need to establish new regulations for access and use of public space and its relationship with light electric vehicles.

Multimodal and integrated hubs and micro-hubs

Multimodal and integrated hubs or mobility stations are places that connect different transport modes and mobility services, such as parking, sharing and charging, and are often supported by a MaaS app. They are usually located in densely populated areas and / or in the surroundings of public transport stations with the aim of enhancing last mile connectivity and promoting intermodal trips. In certain cases, these hubs also include logistics services.

Micro-hubs or cross-docking platforms, on the other hand, are small transshipment points located in urban centralities or strategic areas for the last-mile distribution of goods. This type of hubs are often located in underutilized areas such as parking lots or empty garages, where small, medium and large trucks leave the goods that are later distributed by LEVs in the surrounding areas during the day. It is worth noting that these spaces can be occupied by one individual company, but the trend towards collaborative cross-docking platforms is gaining traction as it would a have significant on the efficiency and costs of LML.

As an example of spaces reconverted for various uses, we have the Saba parking in Barcelona. In recent years, the dissuasive policies to reduce the use of private vehicles in the city have led to the repurposing of 39 parking buildings spread throughout the city. For this reason, the spaces have been adapted for public and private bicycle parking, car wash businesses, EV charging and are expected to include micro-hubs for last-mile urban logistics. Most of these spaces are underground but perfectly located in busy residential, retail and business areas.

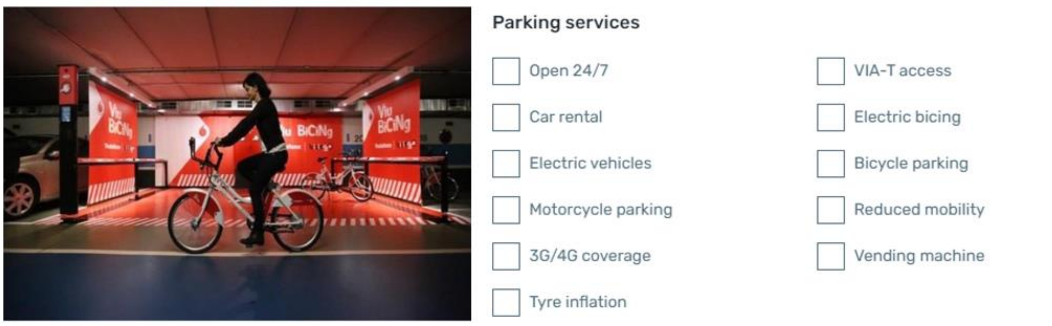

Figure 6. Underground Parking, Barcelona, Spain. Source: Saba

Another interesting example is the micro-hubs established in Buenos Aires. In 2020, the Municipality of Buenos Aires (GCBA) introduced in the Code for Transit and Building of the City of Buenos Aires, the definitions of cross-docking and urban logistics micro-hubs enabling commercial garages, parking lots and places authorized by the local authority as places where load breaking, loading and unloading and temporary storage of goods for their final distribution or for their direct distribution to other establishments could be carried out.

This change in the regulation enabled Express Logística, one of the largest beverage distribution companies in Argentina, to establish micro hubs in private garages in the central neighborhoods of Recoleta and Palermo, from where the goods are distributed using the locally manufactured L6-category LEVs, Sero Electric.

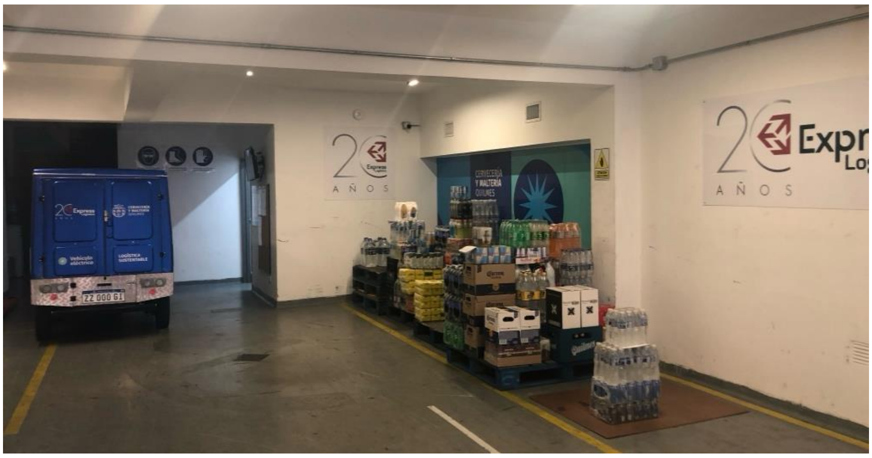

Figure 7. Micro Hub Express Logística, Buenos Aires, Argentina. Source: SOLUTIONSplus Repository

Urban infrastructure to promote the use of LEVs

Besides the Zero and low emission zones (ZEZ / LEZ), traffic calming measures, Zones 30, bicycle lanes and slow streets are the type of road infrastructure needed for the for adequate use of light electric vehicles. The space distribution of streets designed for the use of personal cars and medium delivery trucks are things that must be progressively modified, incorporating adequate infrastructure for new technologies. Similarly, a robust and sufficient charging network for LEVs is a must. Regarding this a concept that has been gaining importance specially when it comes to LEVs is battery swapping, a system by which users are able to quickly exchange the discharged battery pack by a fully charged one in what are called battery swapping stations.

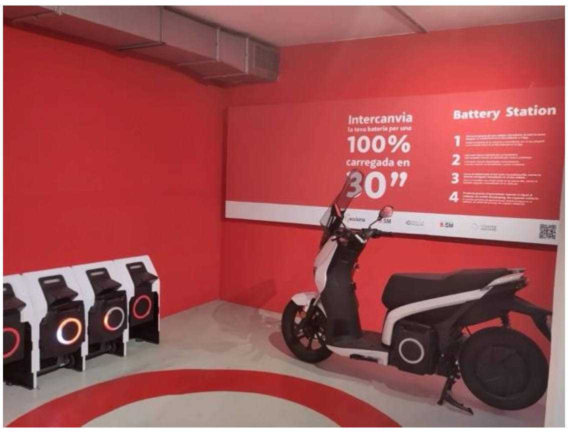

Figure 8. Battery swapping station. Barcelona,Spain. Source: POLIS

Figure 9. Low Emission Zone Guadalajara. Credits: Fernanda Hernández

Superblocks and other new urban concepts

New urban concepts such as superblocks are part of new urban arrangements and interventions that local governments can carry out to achieve the objectives set in terms of improving the health of the inhabitants and peaceful coexistence in public spaces. Superblocks, leveling of streets and sidewalks, speed limitation, street refinement and other interventions and changes in urban infrastructure are part of the new trends that favor the conditions of circulation and use of public space. Barcelona's Superblocks (Superilles in Catalan) have become a global benchmark for urban design due to two key principles: prioritizing people over cars with a focus on accessibility and adhering to community participation. These Superblocks are 400m x 400m units, i.e., larger than a typical city block but smaller than a neighborhood. This urban design aims to reclaim space for the community, enhance biodiversity, promote sustainable mobility, and foster social cohesion.

The city introduced the Superilles as part of its 2013-2018 Urban Mobility Plan, targeting the conversion of 120 intersections. This initiative aimed to reduce vehicular pollution and encourage sustainable transportation. Consequently, the city council plans to transform one in three streets in the L'Eixample district, an area originally designed by Ildefons Cerdà. Starting in 2022, urban designers plan to remodel 21 streets by 2030, moving from east to west. The 2024 Urban Mobility Plan further supports this vision, aiming to create 503 Superblocks citywide in the future.

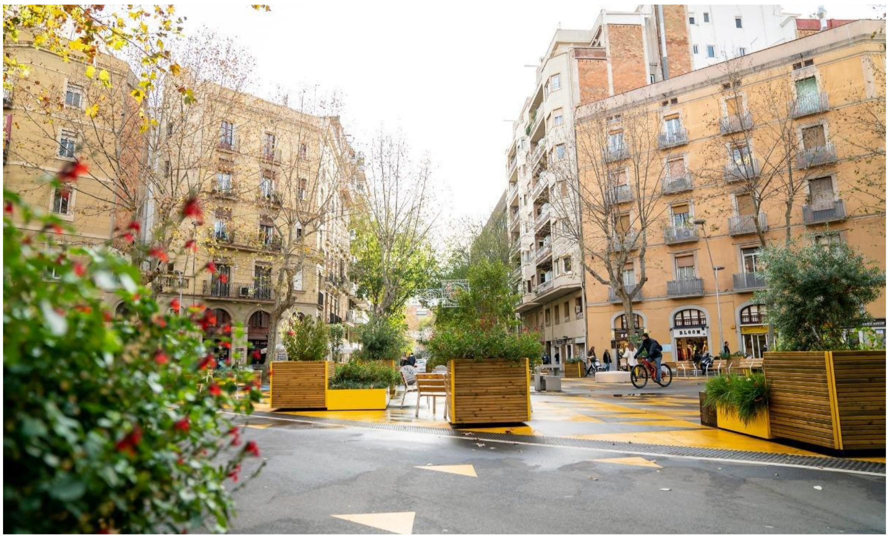

Figure 10. Tactical re-urbanisation Barcelona, Spain. Source: Ajuntament Barcelona

The Superblock concept has repeatedly surfaced in Barcelona's city planning, but it was not actualized as an urban design initiative until recently. Notably, architects Josep Lluís Sert and Le Corbusier included 400x400 meter modules in Barcelona's 1932 Plan Macià. In 1958, architect Oriol Bohigas proposed combining nine blocks in L'Eixample to modernize mobility. Later, under the Ecosystemic Urbanism model, the Barcelona Agency of Urban Ecology pushed forward the creation of Superblocks.

Barcelona's first Superblock was introduced in 1993 near the Basilica de Santa Maria del Mar in El Born. In 2005, plans for two more Superblocks in Gràcia were developed. Pilot projects initiated in 2014 led to a 10% increase in pedestrian trips, totaling 201,843 trips annually, and a 30% rise in cyclist trips. Since 2016, Barcelona has focused on implementing six fully functional Superblocks. The 'open project' involves a diverse range of stakeholders, including residents, the city council, private companies, district organizations, NGOs, universities, and expert institutions

Figure 11. Public space in a Superblock, Barcelona, Spain. Source: Ajuntament de Barcelona

The Superblocks initiative is closely aligned with redefining mobility in Barcelona. The 2024 Urban Mobility Plan aims to significantly alter mobility patterns, targeting a reduction in private vehicle journeys from 26.04% to 18.48%. Additionally, the plan aspires for 81.54% of all journeys to be made on foot, by bicycle, or via public transport by 2024. The council has outlined 300 specific measures to achieve these goals, including the addition of 32 km of pedestrian-only streets, a 40% expansion of the bike network, and the implementation of 30 km/h speed limits on roads with three or more lanes.

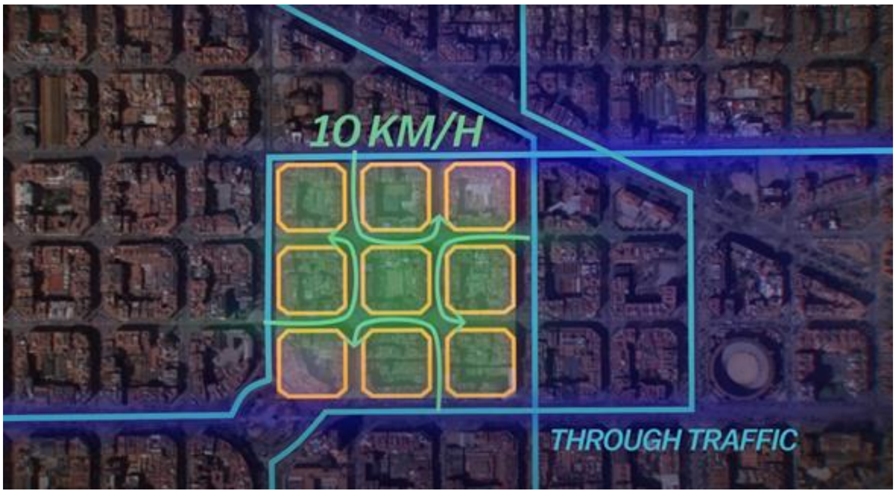

Figure 12. Traffic through a superblock explained. Source: Video [Superblocks:]() How Barcelona is taking city streets back from cars

Concepts such as superblocks, tactical urbanism, traffic calming measures and Zero and Low emissions Zones have been increasingly implemented in Latin American cities aiming at promoting sustainable urban mobility. Figures 13 to 16 show the interventions made in Rionegro, Colombia and Reynosa, Mexico, as well as the pedestrianisation processes in the city centers of Quito, Ecuador and Santiago, Chile.

Figure 13. Tactical Urbanism in Rionegro. Colombia. Source: BID

Figure 14. Tactical urbanism in Reynosa, México. Source: ONU Habitat

Figure 15. Pedestrian area Historic Center of Quito, Ecuador. Source: SOLUTIONSplus Repository

Figure 16. Pedestrianisation Paseo Bandera in Santiago, Chile. Source: La Tercera

Smart cities and big data: Smart cities and the use of big data is one of the most important tools to favor some of the trends in last-mile logistics and passenger transport through LEVs. Smart cities and big data are a tool that allows LEVs to be recharged at optimized times, as well as the use of relevant information in relation to the flow of people and goods. In the same way, big data can contribute to the multimodal use of the various modes of transport of people and can have a significant impact on the use of robots for the distribution of goods.

Smart mobility and Mobility as a Service (MaaS): Urban mobility as a service and not the vehicle as an object of personal property, is one of the challenges that is established within urban planning. In this sense, smart mobility that uses big data, geolocation and smart algorithms is one of the pillars for the new urban planning of passenger transport in smart cities.

1.2 The SOLUTIONSplus project

The SOLUTIONSplus project aims to enable a transformative shift towards sustainable urban mobility through innovative and integrated electric mobility solutions, which are implemented as pilots in 10 cities globally. It was funded by the European Union's Horizon 2020 research and innovation program and ran from January 2020 to June 2024. The project encompassed city-wide demonstrations to test different types of innovative and integrated e-mobility solutions, complemented by a comprehensive toolbox, capacity building, business model development and policy, scale-up and replication activities. In addition, the project provided technical and financial support to the local actors, relying on the knowledge and expertise of a consortium of 46 partners that bring together some of the main research and industry players in electric mobility. The project was implemented in 10 demonstration cities, i.e.: Kigali (Rwanda), Dar Es Salaam (Tanzania), Hanoi (Vietnam), Pasig (Philippines), Kathmandu (Nepal), Najing (China), Quito (Ecuador), Montevideo (Uruguay), Hamburg (Germany) and Madrid (Spain), and in more than 15 replication cities around the globe.

In Latin America, the SOLUTIONSplus carried out demonstration activities in Ecuador and Uruguay and replication in Colombia and Argentina focusing on the five main action lines depicted in Figure 17.

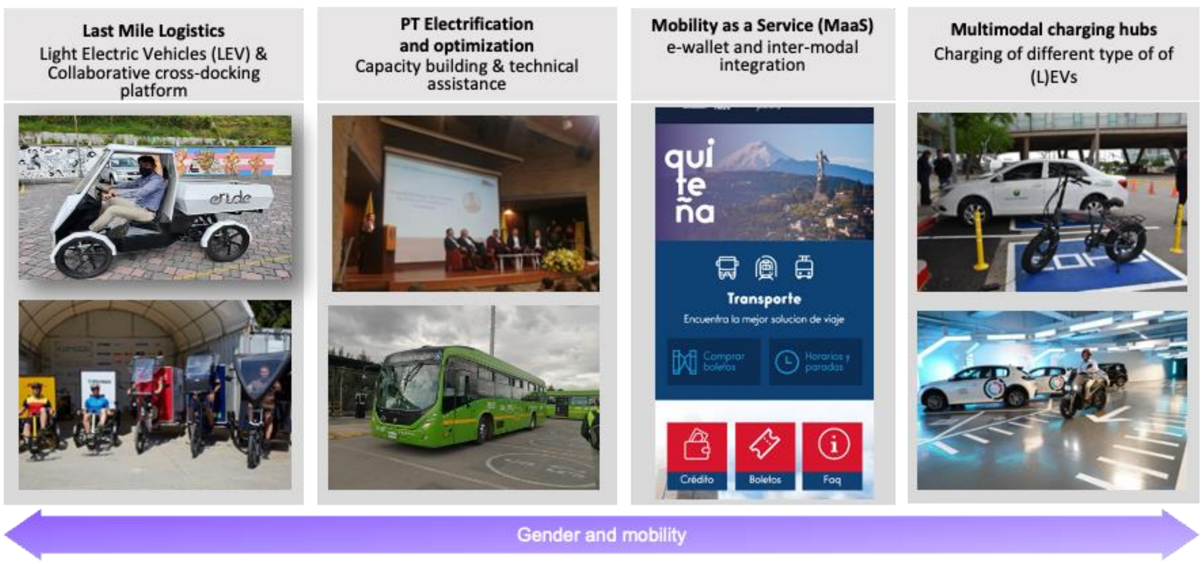

Figure 17. SOLUTIONSplus action lines in Latin America

In this context, SOLUTIONSplus provided seed funding for the manufacturing of 15 different types of LEVs (Figure 18) by a total of 11 local SMEs. These vehicles were tested in 12 different use cases, mainly in logistics operations, but also in passenger transport. The results of the pilots carried out in 2 demonstration cities (Quito, Ecuador and Montevideo, Uruguay) and in 10 replication cities (Escobar and Buenos Aires in Argentina, Cuenca in Ecuador, Bogotá, Medellín, Barranquilla, Bucaramanga, Baranoa and Sabanalarga in Colombia) show high scale-up potential of this solutions in Latin America. However, one of the main barriers identified in most of the cases was the lack on national and local regulations to enable the widespread use of LEV in logistics and passenger transport.

Figure 18. LEVs funded by SOLUTIONSplus in Latin America

1.2.1 SOLUTIONSplus LEV use cases worldwide

Beyond the LEVs funded by SOLUTIONSplus in Latin America, the project supported the local design and manufacturing of LEV for passengers and cargo in Asia, Africa and Europe. This section summarizes the types of LEVs and the variety of use cases in which they were tested.

Table 1 shows the LEV pilots and use cases for passenger transport, while Table 2 presents all the urban logistics LEVs introduced in the SOLUTIONSplus demo and replication cases. These cases are key examples and do not represent the total number of vehicles piloted in the project's context.

Table 1. SOLUTIONSplus use cases for passenger LEVs

Use case	Description
Last-mile connectivity with LRT Hanoi, Vietnam  *Figure 19. Urban Living Lab Hanoi, Source: SOLUTIONSplus*	**Type of vehicle:** e-mopeds **Vehicle brand:** Vinfast Ludo **Origin:** Vietnam **Pilot:** Hanoi LL aims to enhance last-mile connectivity with the shared electric 2-wheelers for the city's public transportation system, particularly buses, BRT and upcoming metro rail and key destinations, through the deployment of electric vehicles and smart services, such as vehicle booking app. The project seeks to increase public transport ridership and efficiency while reducing greenhouse gas emissions and improving air quality. The initial phase involves testing of 50 shared e-mopeds connecting BRT stops with commercial centers. This phase will be followed by expansion to other areas, linking metro terminals with residential zones. **Main results:** Helmets and insurance were provided for drivers' safety. In six months of pilot operation 497 people registered and 1573 trips made. The test period resulted the suggestion to the need of robust e-moped for sharing system than the normal private e-mopeds.
Inclusive bike sharing system Bogota, Colombia  *Figure 20. Test of handcycles in Bogota. Source: SOLUTIONSplus*	**Type of vehicle:** Electric handcycles **Vehicle brand:** Tembici **Origin:** Colombia **Pilot:** Electric engines were incorporated into mechanical handcycles that are already part of Bogotá's Shared Bicycle System to improve mobility access for People With Disabilities (PWD). A total of five handcycle were modified and two models of e-handcycles developed based on the feedback from wheelchair users. **Main results:** The main innovation is the effort in offering new alternatives and more sustainable transportation options for People with Disabilities. Moreover, users ranked the e-handcycles with a 4/5 of level of comfort, 4/5 level of confidence.

Use case	Description
Last-mile connectivity in peripheral areas Hamburg, Germany  *Figure 21. Urban Living Lab Hamburg. Source: SOLUTIONSplus*	**Type of vehicle:** e-scooters **Vehicle brand:** TIER **Pilot:** Provision and integration e-kick-scooters in outskirt areas as first/last-mile solution to expand public transport service. Four physical parking zones were established at HOCHBAHN metro stations in 2 demonstration areas. **Main results:** 400 e-scooters were actively in use, reaching 160.000 trips in 15 months (10.600 rides/per month), with a highest demand in the afternoon/evening and an average trip distance of 1,7 km. Ca. one fourth of all trips were part of intermodal travel chains and replaced car trips, contributing to GHG mitigation. Positive feedback from users was received, with comfort, fun and flexibility as the main reasons for using e-scooter. Main users were mainly under 35 years old, tend to be male (almost three-quarters) and employed. While the deployed vehicles are no solutions for all use cases or user groups (e.g. excluding young or handicapped people, not suitable for care trips or groceries), they targeted user groups with high car use and daily mileage.
Last-mile connectivity Kigali, Rwanda  *Figure 22. Urban Living Lab Kigali. Source: SOLUTIONSplus*	**Type of vehicle:** Electric moto-taxis **Vehicle brand:** Ampersand **Origin:** Rwanda **Pilot:** Last-mile connectivity by promoting electric two-wheelers providing feeder services to the public transport system, including the provision of 24 electric motorcycle-taxis, the assistance for the launch of Guraride's bikeshare system, and the installation of 80 bike racks for private e-bike use. **Main results:** Considered a gender-inclusive component that included a female drivers' training for 35 women recruited, with an unprecedented success rate of 68% at the driving exam. 24 e-moto-taxi were handed over to these women.

Table 2. SOLUTIONSplus use cases for logistics LEVs

Use case	Description
Recycling associations Quito, Ecuador  *Figure 23. Pilot in Quito. Source: SOLUTIONSplus*	**Type of vehicle:** rear load e-tricycle **Vehicle brand:** Bixicargo **Origin:** Ecuador **Pilot:** Two electric cargo-bikes were handed over to two inclusive recycling associations for transporting material to be recycle from the collection points to the recycling collection centres, during 2 months of operation. Both associations managed their own logistical operations in the historic centre, defining their own routes and schedules. **Main results:** The use of e-cargo bikes allowed increase the number of packages delivered in a 100% while improving the monthly income in 25% and reducing the working hours in a 56%.
Courier services Quito, Ecuador  *Figure 24. Pilot in Quito. Source: SOLUTIONSplus*	**Type of vehicle:** front load e-tricycle **Vehicle brand:** Bixicargo **Origin:** Ecuador **Pilot:** By using e-cargo bikes, drivers from the parcel delivery companies delivered light parcels from a cross-docking platform to clients and establishments located in the historic centre of Quito. Two delivery companies participated in the pilot that lasted 2 months. **Main results:** The use of e-cargo bikes allowed to increase the number of packages delivered from 8 to 35, improving the efficiency of the logistic operation.
National Postal Services Buenos Aires, Argentina  *Figure 25. Pilot of Correo Argentino, Source: SOLUTIONSplus*	**Type of vehicle:** Electric mini vans **Vehicle brand:** L Vouture - Sero Electric **Origin:** Argentina **Pilot:** Two electric mini vans were manufactured for the delivery of packages from Correo Argentino. **Main results:** The e-minivans were two months in operation, delivering 6,6 packages per hour in an average travel distance of 6,5 km per hour. The load capacity increased compared to the previous vehicles used, improving the logistics operation while reducing emissions.

Use case	Description
Food distribution from local markets Quito, Ecuador  *Figure 26. Pilot in Quito. Source: SOLUTIONSplus*	**Type of vehicle:** e-cargo bikes **Vehicle brand:** Bixicargo **Origin:** Ecuador **Pilot:** Two logistic operators tested 5 e-cargo bikes to delivered food products during 2 months. Two scheme of operation were implemented. The first scheme operated from markets and supply shops to restaurants and coffee shops located in the Historic Centre of Quito. The second scheme operated from a distribution centre of a specific restaurant to their establishments located in the Historic Centre of Quito. The use of e-cargo bikes allowed increasing the packages and volume transported in 100% while reducing the working hours in 50%. **Main results:** The use of e-cargo bikes allowed increasing the packages and volume transported in 100% while reducing the working hours in 50%.
Large scale food distribution Bogotá, Medellín and Barranquilla, Colombia  *Figure 27. Pilot of e-tricycle. Source: SOLUTIONSplus*	**Type of vehicle:** E-cargo vans & e-cargo bikes **Vehicle brand:** Ecotriciclos – Lola te mueve **Origin:** Colombia **Pilot:** In the five Colombian cities, e-vans, e-3 wheelers and e- cargo bikes delivered packaged food products from the distribution centre of Grupo Nutresa, a multinational food distribution company, to a set of fixed customers. **Main results:** There was an overall positive balance in all the operational models being the number of deliveries per hour the indicator that benefited the most with the use of the electric vehicles, achieving an average increase of 70% in all operations.
Delivery platform Montevideo, Uruguay  *Figure 28. Pilot of Wheele e-bike. Source: SOLUTIONSplus*	**Type of vehicle:** Long John & front load e-tricycle **Vehicle brand:** CargoBikeUY & Wheele **Origin:** Uruguay **Pilot:** Two e-cargo bikes, one of each manufacturer, were introduced in the operations of PedidosYA, the Latin American subsidiary of Delivery Hero. The operations were held for two weeks. **Main results:** 156 trips were made, 90 packages delivered with a total weight of 135 kg, and 187 km travelled. As a result, 86 kg CO2e were avoided. PedidosYA is working enabling the delivery of larger goods for which the e-cargo bikes would be ideal.

Use case	Description
Agroecological gardens Escobar, Argentina  *Figure 29. Pilot of electric pick-ups. Source: SOLUTIONSplus*	**Type of vehicle:** Electric mini pick-up **Vehicle brand:** Coradir SRL **Origin**: Argentina **Pilot:** Two electric pick-ups were used for harvesting and transporting food in the municipal Agroecological Gardens, with the aim of improving the delivery frequency of agricultural products to the community. **Main results:** Each vehicle allowed a 500kg load with an autonomy of 100km. During the pilot of 2 months, the introduction of the e-vans allowed the Municipal programme to increase its operations by 47%. Moreover, the pilot has the potential for replication and scaling-up in other municipal programs.
Distribution of medicines Cuenca, Ecuador  *Figure 30. Farmasol pilot. Source: SOLUTIONSplus*	**Type of vehicle:** Rear load e-tricycle **Vehicle brand:** Ecotriciclos **Origin:** Colombia **Pilot:** Two electric tricycles were tested in the delivery of medicines and first-hand supplies from the Farmasol distribution center to their pharmacies in Cuenca and in Azogues (Ecuador), replacing its heavy diesel truck. The e-tricycles had a load capacity of 300kg. **Main results:** The pilot considered the inclusion of two female drivers, adding a gender-inclusive component. Overall, the e-tricycles had a positive reception, improving the efficiency in delivery and trip times, a positive drivers' safety perception, while reducing emissions and noise.
Urban deliveries and distribution of medical supplies Dar es Salaam, Tanzania  *Figure 31. Pilot in Tanzania. Source: SOLUTIONSplus*	**Type of vehicle:** Pedal-assist electric bicycle **Vehicle brand**: AfricroozE **Place of manufacture:** Tanzania/India **Pilot:** 16 pedal-assisted electric vehicles have been used daily by the FASTA Cycling Cooperative to transport urban deliveries & medical supplies. The e-bicycles are designed for the African market and have a load capacity of 100kg. **Main results:** The pilot introduced pedal-assist electric bicycles in Dar es Salaam, where there was no such vehicle before the pilot. The vehicles have positive reception and attract interest from researchers, assemblers and delivery platforms, in particular as an alternative to mopeds and motorcycles to explore.

Use case	Description
Shared use cargo and passenger e-quadricycle Pasig, Philippines  *Figure 32. Pilot in Pasig. Source: SOLUTIONSplus*	**Type of vehicle:** E-quadricycles **Vehicle brand**: Tojo Motors **Place of manufacture:** Philippines **Pilot:** Three solutions were implemented, (1) e-quadricycles developed for the delivery of parcels and personnel transport, (2) charging solutions and (3) an IT booking application to manage the operations of these e-quadricycles and other e-mobility vehicles of the city government. **Main results:** The e-quadricycles improve the roadside environmental quality compared to the combustion all-purpose vehicle previously used by the city government, the drivers reported that there was a positive effect on the road safety

2 Barrier analysis, scope and target groups

2.1 Typical barriers for the adoption of LEV in cities

The barriers described in this chapter need to be addressed by targeted policies that will improve the environment for the safe and effective adoption of light electric vehicle technologies. Policies can have a significant impact on the cost of LEVs and can enable local manufacturing, import and use of LEVs. Therefore, policies and regulations both at the national and at the local level have an important impact in LEVs adoption. Table the barriers and the policies that can support the adoption of LEVs in cities. However, this policy advice paper will focus mainly on homologation, at the national level, as well as the local polices and regulations needed at their local level for their safe circulations in cities.

Table 3. Policies that can help address the uptake barriers for LEVs adoption.

Barrier category	Policy or action needed
Economic and financial barriers	• Appropriate business models (leasing, renting, car sharing, pay per use, annuities, etc.) • Appropriate financial products for e-mobility • Subsidies, incentives, and tax rebates on investment in LEVs. • Scrapping programs • Lack of green taxes related to vehicle useful life • More convenient parking to LEVs or reduced parking fees for LEVs • Reduced electricity rates for LEVs charging • Low lease/rental price for LEV car sharing system • Removal of fossil fuel subsidies
Technical barriers	• New normative requiring parking and charging facilities for LEVs in existing and new constructions • Technical requirements for home, workspace and public charging • Skill development programme for LEVs maintenance
Policy and regulatory barriers	• Harmonization of the whole electric vehicle normative structure • Facilitation of procedures in public offices

	• Public procurement policies that promote use of LEVs • Implementation of Vehicle Labelling Schemes • Circulation regulation that favors LEVs • Selection of appropriate technologies and standards for LEVs, charging connectors, batteries, etc. • Lack of specific standards for the marketing and treatment of batteries for electric vehicles • Power Electric Utility companies' customized regulation • Low Emission Zones, including LEV public charging facilities • Integration or consideration of LEV charging infrastructure in a Sustainable Urban Mobility Plan (SUMP) and land use plans
Governance barriers	• E-mobility strategies as part of national and local planning • Articulating mechanisms between public agencies that enable e-mobility • Capacity Building program for public policy design and e-mobility implementation
Operative barriers	• Charging infrastructure development • Legal mechanisms to enable residential and private charging • Awareness creation and training for transport operators and associations • Eco-driving programs with LEVs • Capacity building and equipment for maintenance and mechanics • MRV systems development and implementation for emission reduction accounting
Environmental barriers	• Regulation and technical requirements for second life of batteries • Regulation for battery disposal and or reuse • Standards to calculate contaminants emissions
Final user related barriers	• Demonstration actions and pilots • Advertising and information campaigns • Institutional capacity building • Awareness campaign of importance and benefits of new technologies and LEVs • Test- driving experiences for LEVs potential users
Infrastructure barriers	• Specific lanes for LEVs • Limited speed zones (<30km/h) • LEZ and ZEZ areas • Public charging points for LEVs • Information regarding expected demand, location of fleets, traffic for the location of charging points • Infrastructure and equipment for battery swapping

Ensuring a clear strategy, as well as coherence and alignment between different public authorities and parastatals is a crucial step to ensure a sound deployment approach:

- Public authorities should develop a long-term mobility vision and strategy with clear goals on future developments. Plans and strategies for the uptake of electromobility and the deployment of its recharging infrastructure should be part of this long-term mobility vision and should ideally include measurable targets to monitor progress and create a stable investment climate.
- Coherence between the long-term strategies for LEV adoption by different public authorities at different governance levels is essential. This is also the case between

different policy domains (energy, mobility, housing, urban planning, industry, R&D, etc.) to reinforce and leverage impact.

- Examples of cooperation for the deployment of LEV adoption include different levels of administration and governance as well as cooperation between public and private actors.

2.2 Scope of the policy paper

As it can be seen in section 2.1 the list barriers to introduce LEV in urban areas go from the lack of economic incentives and financial mechanisms to promote the local manufacture and import of LEVs to the lack of adequate urban infrastructure for their safe circulation in cities. This paper, however, will not cover all topics. It will focus on the two topics that have been identified as priorities in the exchanges with the local counterparts in Ecuador, Colombia, Argentina and Uruguay.

To do so this paper conducts a stocktake of international, national and local guidelines, regulations norms and standards developed by United Nations Agencies, the European Union or its member states, as well as by Latin American national and local governments. The goal of this comprehensive literature review is to enable the reader to understand the different approaches taken by countries and cities and choose the one more suited for their own context.

As the concept of LEV is rather new and its definition still contested, this policy paper starts by proposing a definition of LEV, based on the literature founded mainly in English language, but also in Spanish given the Latin American focus of this document.

2.3 Policy target group

This policy paper is intended for stakeholders at different levels of government, both local and national levels, who may have an impact or incidence in any of the regulations related to light electric vehicles.

Likewise, this publication is addressed to private sector actors, who have participation in the market of light electric vehicles, i.e., importers, local manufacturers, customs brokers and technicians, involved in administrative processes in different public offices.

Finally, this document is addressed to user organizations (typically NGOs or trade unions) that may have an interest in the light electric vehicles presented in the different chapters, either as users or as organizations, which could be involved in the urban mobility of goods or passengers.

2.3.1 Relevant stakeholders

Main public actors and stakeholders involved in the regulation processes for LEVs, as well as counterparts for needs, inputs and implementation of regulation, can be summarized as follows:

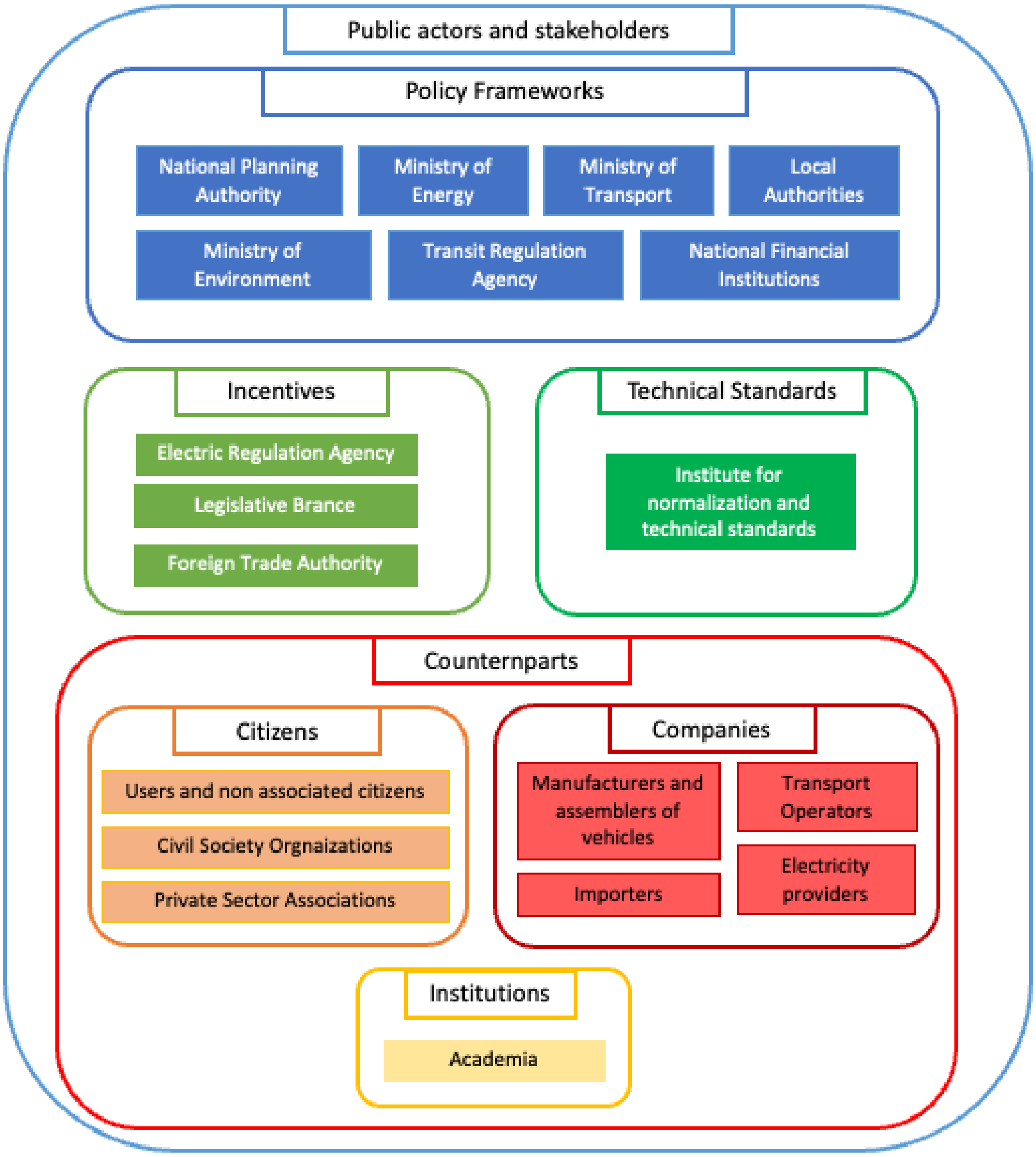

Figure 33. Stakeholders map

Their role can be summarized in the following Table 4.

Table 4. Role by type of stakeholder

Stakeholder	Role
National Financial Institutions	Sectorial policy related credit requirements; customized financial products for transport sectors that may include credit and grants or subsidies
Local Authorities	Transport planning, regulation for circulation and issuance of circulation permits; regulation for freight delivery; labelling requirements; charging stations
Transit Regulations Agency	Regulation: a. Values of useful life for public and commercial transport vehicles; b. Fleet renewal; c. Homologation requirements; d. Registration requirements
Ministry of Environment	Public policy to promote transition from fossil fuels to renewable sources; and national goals for CO2 emission reduction

Ministry of Transport	Public policy that seeks to improve transport services and mobility management at national and local level
Ministry of Energy	Public policy that seeks to improve energy consumptions habits, promote incorporating energy efficiency in sectors related to the provision and use of energy, including labelling.
National Planning Authority	National development goals and public policy guidelines
Foreign Trade Authority	Tariff incentives or exemption for LEVs
Legislative Branch	Tax exemption or incentives for LEVs
Electricity Regulation Agency	Preferential electric rates for EV charging
Institute for Normalization and Technical Standards	Regulation that ensures performance and safety
Users and non-associated citizens	Regulation that ensures performance and safety
Civil Society Organizations	Regulation that ensures performance and safety
Private Sector Associations	Promote regulations, incentive, and law creation in favour of specific interest
Manufacturers and assemblers	Private sector companies that may contribute to the transition to e-mobility through manufacturing of EVs and benefit from tax incentives
Importers	Private sector companies that may contribute to the transition to e-mobility through import and benefit of from tax and tariff incentives
Transport Operators	Private and public companies that may contribute to the transition to e-mobility through fleet conversion and benefit from electric fare and tax and incentives
Electric providers	Private and public companies that may contribute to the transition to e-mobility through charging facilities
Academia	Institutions that may contribute to the transition to e-mobility through knowledge creation, policy making demands and capacity building.

3 Definition, categorization & relevant standards for LEVs

3.1 Definition of Light Electric Vehicle (LEV)

The emergence and take up of e-mobility and new mobility services and concepts, such as car-sharing and delivery platforms, have brought along new vehicle types and with that the concept of Small and Light Electric Vehicles (LEV). In general terms, LEVs can be defined as a vehicle type built for low speeds and short trips, thus, suitable for the transport of people and goods in urban areas with a significant contribution to improving the safety, efficiency and inclusiveness of road space. Additionally, the smaller size of LEVs in comparison to cars translates into less energy and resources used for their manufacturing and operation, resulting into reduced GHG emissions (Brost et al., 2022; Ehrenberger et al., 2022; Ewert et al., 2020). In recent years the LEV concept has been gaining increasing relevance in the English literature on Sustainable Mobility, with a strong focus on Europe, a market in which LEVs are present since 2011. Nevertheless, when it comes to the specific characteristics (maximum speed, power and mass or loading capacity) and subcategories enclosed in the LEVs umbrella, there is not a unanimous vision.

In the Netherlands, for instance, according to the Institute for Road Safety Research (SWOV, 2021), LEVs are divided in two categories. The first one includes pedal-assisted and Personal Light Electric Vehicles (PLEVs) with maximum mass in running order of 55 kg. The second category consists of electrically powered vehicles with a maximum total mass in running order of 556 kg, including goods or passengers. In its factsheet on LEV, the SWOV (2021) states that all LEV should have a maximum construction speed of 25 km/h. Moreover, the Dutch LEFV-LOGIC project categorised Light Electric Freight Vehicles (LEFV) in electric cargo bikes, moped and small distribution vehicles with a maximum loading capacity of 350 kg, 599 kg and 750 kg, correspondingly (Balm et al., 2018; Moolenburgh et al., 2020). Meanwhile, in Germany the term LEVs covers from micro vehicles, including pedal-assisted and PLEVs, to 2-, 3- and 4-wheeled electric L-category vehicles following the EU regulation No 168/2013 (DLR & IMU Institut, 2019; Ehrenberger et al., 2022; Ewert et al., 2020). In accordance with this definition, LEV can have a maximum speed of 90 km/h, power of up to 15 kW and mass in running order of 600 kg, all these the characteristics of a L7e vehicle (DLR & IMU Institut, 2019).

It is worth noting that despite the traction that the LEV concept has gained in English literature, the term still has a very limited presence in Spanish literature, in which the most common terms used to describe these types of vehicles are micromobility and PLEVs. In Spain, for instance, the General Transit Directorate (DGT) issued in 2022 the Handbook of Characteristics of Personal Mobility Vehicles (PMV), which refers only to PLEVs (excluding Electric Pedal Assisted Cycles (EPACs)) and divides them in PMVs for personal transport and PMV for the transport of goods and other services (Manual de características de los vehículos de movilidad personal, 2022).

In Latin America, despite the fact that the non-motorized and ICE versions (and in recent years the electric versions too) of the vehicle types considered under the LEV umbrella, such as tricycles, motorized tricycles (tricimotos), motorcycles, etc., the so-called 2- and 3-weelers, are already embedded in the mobility system of cities in the region, at the moment the most prominent term to refer to new vehicle types is micromobility. However, it is important to mention that the electric versions of L-category vehicles have already been recognised in the national regulatory framework of many countries, such as Ecuador and Argentina, following the characteristics of the EU regulation No 168/2013 for 2- and 3-wheelers and quadricycles.

In order to maintain the wide variety of small and light vehicles that the LEVs umbrella comprises, for the purpose of this document we follow the broader approach of DLR & IMU Institut (2019), Ewer et al. (2020) and Ehrenberger et al. (2022) by which Light Electric vehicles (LEVs) can be defined as those vehicles with a number of wheels >= 1 and <= 4, designed for personal mobility, transport of passengers or goods in an urban setting, propelled by electric motor(s) in pedal assistance mode or in exclusive mode. Their maximum continuous power is fifteen (15) kilowatts (kW) and their recommended maximum speed is 45 km/h[1]. This is broad definition that by covering from electric micromobility to all vehicle types in the L-category, will allow us to showcase the variety of vehicles and vehicle categories that fall under the LEVs umbrella concept and compare the stand taken by different sources and regulations, so that policy makers can focus on and select the ones that are more relevant for their specific contexts. The different categories will be listed in the following section.

3.2 Categories of Light Electric Vehicles (LEVs)

Based on the existing literature, standards and regulations, the categorization of LEVs in this policy paper has been divided in two classes. The first class is related to micromobility vehicles, which have been classified by the International Transport Forum (OECD/ITF, 2020) and other sources in the sub-categories A, B, C and D. At the European level, there are two sub-categories and their corresponding standards that encompass micromobility, which include Personal Light Electric Vehicles (PLEVs) and Electric Pedal-assisted Cycles (EPACs), following the European Standards EN 17128: 2020 – Light motorized vehicles for the transportation of persons and goods and related facilities and not subject to type-approval for on-road use – Personal light electric vehicles (PLEV) – Requirements and test methods, and the EN 15194: 2018 – Cycles – Electrically power assisted cycles – EPAC Bicycles. These standards have been adopted in the national regulations of several European countries, such as Spain.

The second category draws on the L-category that exists under the Classification and Definition of Vehicles of the United Nations Economic Commission for Europe (UNECE) since 1998 and the Regulation (EU) No. 168/2013 of the European Parliament of 15 January 2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles. Despite being European, these regulations have been the basis for vehicle homologation standards, norms and procedures worldwide.

Micromobility vehicles

As mentioned, one of the ways that have been used to classify micromobility vehicles is in the sub-categories A, B, C (and eventually D), which include human-powered, pedal-assisted and fully electric vehicles, such as bicycles, e-bikes, self-balancing vehicles, different types of e-scooters and e-mopeds with a wide variety of shapes, some of which can be much heavier and faster than a bicycle. These vehicles are commonly composed by 1, 2 or 3 wheels (although in some particular cases could have

[1] The maximum speed of the category L7e is 90 km/h. However, as we are talking about vehicles for the transport of passengers and goods in an urban setting, the maximum speed has been defined as 45 km/h. 45 km/h is the maximum speed defined by the ITF (2020) for micromobility vehicles.

more than 3 wheels), typically used for personal mobility, but in some cases also for light freight or passenger transport. They are not defined by the riding position, which can be seated or standing, and may be powered by muscular energy, electric motor or a combination of these. However, given the focus of these policy paper on electric vehicles, human-powered and combustion engine micro-vehicles will only be mentioned as a reference.

According to the International Transport Forum (OECD/ITF, 2020), micromobility vehicles can be classified according to their maximum speed and mass. Types A and B vehicles include human-powered vehicles such as bicycles and pedal-assisted bikes, as well as other vehicles with a speed of up to 25 km/h[2]. Meanwhile, micromobility vehicles Type C and D present a top speed higher than 25 km/h and lower than 45 km/h. In terms of weight, Types A and C are vehicles lighter than 35 kg, while Types B and D. These two characteristics, mass and speed, are key when it comes to designing regulations for the different types of vehicles. Up to 25 km/h, e-bikes are generally considered and regulated as bicycles, which allows them to share cycle lanes with other types of bicycles in most local regulations. Moreover, beyond the threshold kerb weight of 35 kg regulators could impose more safety requirements due to its influence on kinetic energy and braking systems. The weight of the vehicle can also be taken as a proxy for the vehicle capacity to transport passengers and goods.

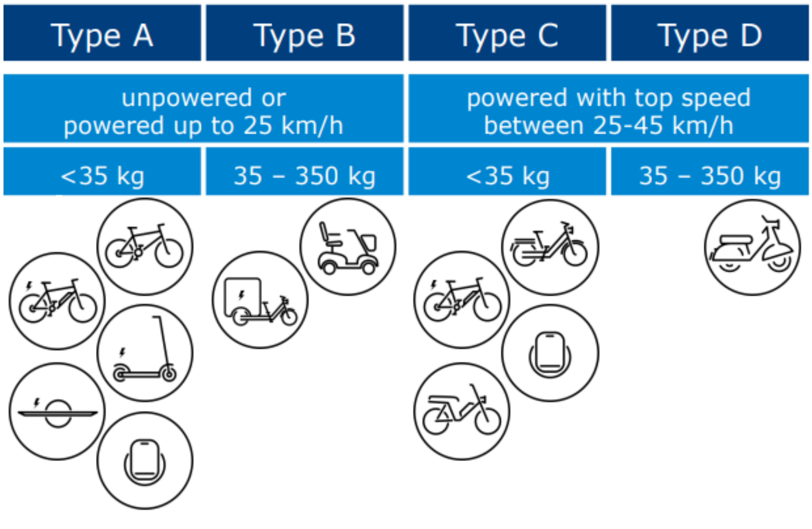

Figure 34. A micro-vehicles classification proposal according to OECD/ITF (2020)

On the other hand, SAE International, the global standards development and professional association, in its taxonomy and classification of powered micromobility vehicles – SAE J3194, defines this type of vehicles as “a wheeled vehicle that must be fully or partially powered, have a curb weight <= 500 lb (227 kg) and a top speed <= 30 mph (48km/h), primarily designed for human transport and to be used in used on paved roadways and paths” (SAE International, 2019, p. 1). SAE’s classification includes only 6 types of vehicles (powered bicycle, standing/ seated scooter, non-/self-balancing board and skated).

[2] Given that the focus of this document focuses of electric vehicles, human powered vehicles and combustion engine vehicles from this classification will not be included.

As it was mentioned before, in Europe there is not unanimity in the definition of neither micromobility, nor LEV. However, there are specific standards for PLEVs and EPACs, which combined could encompass the micromobility category. Here we present a summary of those European Standards.

Electrically power assisted cycles (EPAC)

Another important reference which presents a classification of micro-vehicles related to electric bicycles is the European standard EN 15194 “Cycles – Electrically power assisted cycles – EPAC Bicycles”. This standard specifies general requirements and test procedures for power assisted bicycles of a type which have a maximum continuous rated power of 0.25 kW, of which the output is progressively reduced and finally cut off as the EPAC reaches a speed of 25 km/h, or sooner, if the cyclist stops pedaling.

This European Standard specifies requirements and test methods for engine power management systems, electrical circuits including the charging system for the design and assembly of electrically power assisted bicycles and sub-assemblies for systems having a rated voltage up to and including 48 V D.C. or integrated battery charger with a nominal 230 V A.C. input.

This European Standard specifies safety and safety related performance requirements for the design, assembly, and testing of EPAC bicycles and subassemblies intended for use on public roads and lays down guidelines for instructions on the use and care of such bicycles.

This European Standard applies to EPAC bicycles that have a maximum saddle height of 635 mm or more and that are intended for use on public roads. According to EN 17860, it applies to terms and definitions related to safety and performance requirements for the design, assembly, and testing of carrier cycles.

Personal Light Electric Vehicles (PLEV)

Personal Light Electric Vehicles (PLEVs) are LEVs that fall neither under the L-category defined in Regulation (EU) 168 / 2013, that will be defined in detail in the next section, nor are classified as bicycles or EPACs (ACEM, 2021). In order to regulate them, in 2020 a new European Standard was created, the *EN 17128: Light motorized vehicles for the transportation of persons and goods and related facilities and not subject to type-approval for on-road use - Personal light electric vehicles (PLEV)*. As it can be seen in the title of the standard, the term PLEV refers not only to passenger vehicles, but also to logistics ones.

It is worth noting that the term Personal Mobility Device (PMD) is sometimes used interchangeably with PLEVs. However, according to ACEM - The Motorcycle Industry in Europe, PMDs cover a wider range of vehicles that includes EPACs and L1 vehicles (ACEM, 2021). Figure 35 shows the overlaps that exist between the different terms and regulations, especially for passenger vehicles.

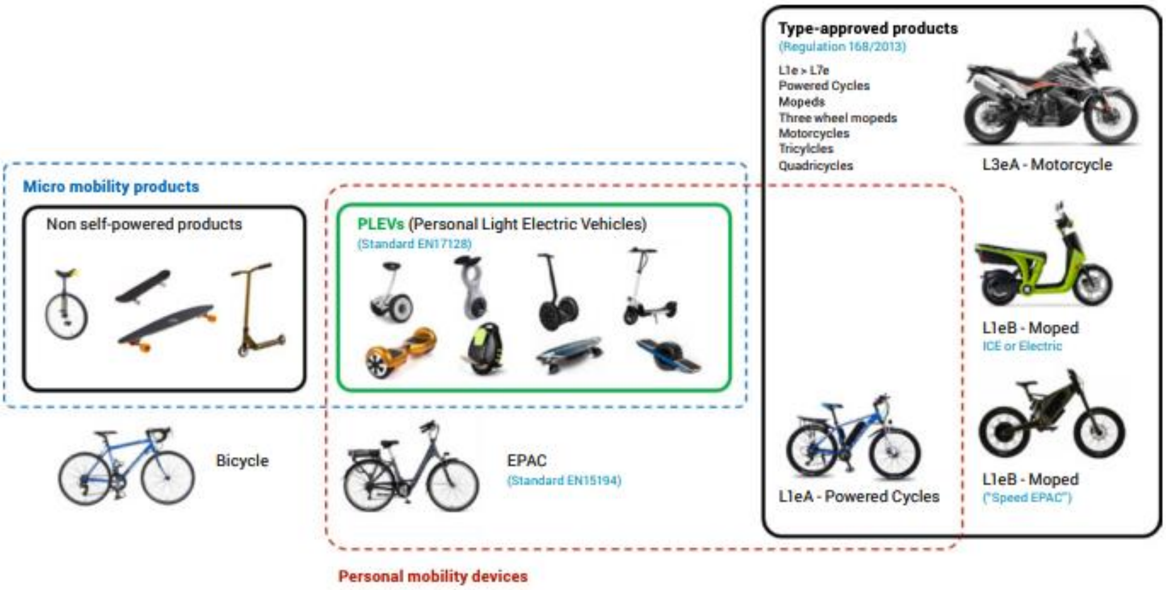

Figure 35. Overview of micromobility vehicles and terms. Source: ADEM (2021)

Following the discussions around PLEVs and how to regulate them, several European countries have issued their own national regulations no enable their safe circulation on urban roads.

In 2022 the General Directorate of Transit (DGT) of Spain approved the Manual of technical characteristics for the Personal Light Electric Vehicles, mostly based on the European Standard EN 17128 (DGT, 2022), which defines Personal Light Electric Vehicle (PLEV) as a vehicle with one or more wheels equipped with a single seat and propelled exclusively by electric motors that can provide the vehicle with a maximum design speed between 6 and 25 km/h. They can only be equipped with a seat or saddle if they are equipped with a self-balancing system. Within this category of vehicle there are two sub-categories well differentiated, one is the vehicle destined to personal transport and the other focused on transport for goods or other services. Moreover, it establishes that in order to be able to circulate, PLEVs require a circulation certificate that guarantees compliance with the technical requirements set by national and international regulations included in their characteristics manual, as well as their identification. A detailed description of this case can be found in Section 4.3.4.1.

Germany, on the other hand, understanding the potential of PLEVs to be used for last-mile connectivity and thus enhance intermodality in cities issued the Personal Light Electric Vehicle Regulation in 2019 aiming to "allow for new forms of modern, environmentally friendly and clean mobility in cities, while at the same time ensuring safety on roads" (BMDV, 2023, p. 1). This regulation specifically sets the requirements for the circulation on public roads of PLEVs with a handlebar or stanchion. At the same time new provisions related to PLEVs were introduced in the German Road Traffic Regulations. The characteristics of the PLEVs allowed in public roads are the following (BMDV, 2023, p. 4):

- Handlebars or stanchions
- Maximum design speed between 6 and 20 km/h

- Power limitation to 500 W (1,400 W for self-balancing vehicles)
- Minimum road safety standards, i.e., braking and lighting systems, dynamics of vehicle movements and electrical safety
- Have a general or individual type approval and a valid insurance sticker
- Users must be at least 14 years old. Riding on pedestrian infrastructure is prohibited and riders must use cycle lanes where available, otherwise use vehicle lanes. Wearing a helmet is recommended but not compulsory.

This definition rules out some types of PLEV (see table below), such as self-balancing vehicles, e-skateboards or electric skates. Speed pedelecs (45 km/h top speed) are classified as L1B, similar to mopeds, including the need for a driver's licence, compulsory insurance, wearing a helmet, and are banned from pedestrian and cycle infrastructure.

In order to summarize the different terms and sources addressed in this section, Table 5 presents an overview of all electric micro-vehicles covered by each one of them.

Table 5. Definitions of electric micro-vehicles identified in the literature review

N° of wheels	Electric micro-vehicle	Definition	OECD/ ITF (2020)	SAE (2019)	DLR & IMU (2019)	SWOV (2021)	EN 15194 - EPACs	EN 17128 - PLEVs
1	**Electric unicycle**  Source: Airwheel	Self-balancing electric personal transporter with a single wheel. The rider controls the speed by leaning forwards or backwards, and steers by twisting the unit using their feet. Some dual-wheel models exist, but the principle remains that of a single axle device, used with feet in the direction of travel and placed either side of the wheel(s).	X		X			X
1	**Onewheel**  Source: Boardsport M.Pesce	Self-balancing electric personal transporter, on which the user stands and places feet perpendicular to the direction of travel, on front and back platforms.	X		X			X
2	**Hoverboard / Self-balancing board**  Source: Soarboards.com	Self-balancing micro-vehicle consisting of two motorised wheels connected to a pair of articulated pads on which the rider places their feet. The rider controls the speed by leaning forwards or backwards, and direction of travel by twisting the pads.	X	X	X			X

N° of wheels	Electric micro-vehicle	Definition	OECD/ ITF (2020)	SAE (2019)	DLR & IMU (2019)	SWOV (2021)	EN 15194 - EPACs	EN 17128 - PLEVs
4	**Electric skateboard**  Source: E-Boarder	Skateboard with electric battery, motor, and wireless remote controller.	X	X				
2	**E-scooter / electric kick-scooter / e-standing scooter**  Source: Voi E. Brwon	A stand-up scooter that can be propelled by the electric motor itself, irrespective of the user kicking.	X	X	X	X		X
2	**Seated e-scooter**  Source: Veo Cosmo	An electric scooter with seat is basically an e-scooter installed with a seat for additional functionality.	X	X				
2	**Segway**  Source: Segway, D. McKelvey	A motorized personal vehicle consisting of two wheels mounted side by side beneath a platform that the rider stands on while holding on to handlebars, controlled by the way the rider distributes their weight.			X	X		X

N° of wheels	Electric micro-vehicle	Definition	OECD/ ITF (2020)	SAE (2019)	DLR & IMU (2019)	SWOV (2021)	EN 15194 - EPACs	EN 17128 - PLEVs
2	**Powered skates**  Source: Autoevolution	Skates with electric battery and motor, controlled by the user leaning forward or backward or using a remote controller.	X	X				
3	**Mobility scooter**  Source: Pixabay	Electrically powered vehicle specifically designed for people with restricted mobility, typically those who are elderly or disabled. The term scooter is used in reference to the flat vehicle frame and the foot platform.	X					
3	**e-trikke**  Source: R. Wijnant	The e-trikke is a chainless, pedalless, personal vehicle with a three-wheel frame, in which the rider stands on two foot platforms above the two rear wheels and steers the vehicle with handlebars attached to the lone front wheel.			X	X		X
2	**Speed-pedelec/fast e-bike**  Source: Gracebikes	A type of pedal-assisted bicycle where the electric power cuts off when the vehicle reaches approximately 45 km/h (exact limit depends on local regulations).	X	X	X			

N° of wheels	Electric micro-vehicle	Definition	OECD/ ITF (2020)	SAE (2019)	DLR & IMU (2019)	SWOV (2021)	EN 15194 - EPACs	EN 17128 - PLEVs
2	**Pedelec**  Source: Tier bikesharing	A type of pedal-assisted bicycle where the electric power cuts off when the vehicle reaches approximatively 25 km/h (exact limit depends on local regulations).	X	X	X	X	X	
2	**Electric Pedal Assisted Bicycle (EPAC)**  Source: City Bank, P. Wasneski	A type of e-bike which only provides assistance when the user is pedalling. It includes models of various power output levels, such as pedelecs and speedpedelecs.					X	
2	**E-bike**  Source: Cyclotricity Wikimedia	A type of bicycle with a supportive power unit, providing pedal assistance or fully throttle-controlled propelling force.		X			X	

N° of wheels	Electric micro-vehicle	Definition	OECD/ ITF (2020)	SAE (2019)	DLR & IMU (2019)	SWOV (2021)	EN 15194 - EPACs	EN 17128 - PLEVs
2-3	**E-moped**  Source: Wikimedia	Electric moped, with two to three wheels and a seat, sometimes equipped with pedals. Maximum vehicle speed depends on national regulations but is typically limited to 45 km/h. Number plates are imposed in some countries and on some classes of mopeds.	**X**		**X**			
3	**e-Pedicab / e-bicitaxi**  Source: e-bike cab, Facempls	A pedal-assisted tricycle, available for hire, with an attached seat for one or two passengers.				**X**		
2-3	**E-cargo bike**  Source: Wikimedia	A pedal-assisted bicycle (e.g.: long john) or tricycle (front or rear load) for the transport of goods.			**X**	**X**		

Source: OECD/ITF (2020); SAE International (2019); DLR & IMU Institut (2019); SWOV (2021)

L-category vehicles

The L-category vehicles, on the other hand, are a well-established and known vehicle category, not only in Europe, but worldwide. However, several countries are still lagging behind in the integration of the electric version of their ICE peers.

The European Regulation 168/2013 refers to the approval and market surveillance of two- or three-wheel vehicles and quadricycles (European Commission, 2013). L-category vehicles comprise powered two-, three- and four-wheel vehicles, including powered cycles, two- and three-wheel mopeds, two- and three-wheel motorcycles, light and heavy on-road quadricycles, and light and heavy quadri-mobiles. For all these vehicles (L1e to L7e), general dimensions must comply:

- **Height** ≤ 2 500 mm
- **Length** ≤ 4 000 mm (or ≤ 3 000 mm for a L6e-B vehicle, or ≤ 3 700 mm for a L7e-C vehicle)
- **Width** ≤ 2 000 mm (or ≤ 1 000 mm for a L1e vehicle, or ≤ 1 500 mm for a L6e-B or a L7e-C vehicle)

Table 6. presents a summary of the L1e two wheeled vehicles, listed in the European Regulation 168/2013.

Table 6. Categories and sub-categories of two wheeled L1e-classified vehicles.

Category/ sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles	Indicative image
L1e	Light two-wheeled vehicle	• two wheels and powered by a propulsion system • maximum design vehicle speed ≤ 45 km/h • maximum continuous rated or net power ≤ 4 kW • maximum mass= technically permissible mass declared by the manufacturer	
L1e-A	Powered cycle	• cycles designed to pedal equipped with an auxiliary pedaling assistance propulsion system • output of auxiliary propulsion is cut off at a vehicle speed ≤ 25 km/h • maximum continuous rated or net power ≤ 1 kW • a powered three- or four-wheel cycle complying with supplemental specific sub-classification criteria here enumerated is classified as being technically equivalent to a two-wheel L1e-A vehicle.	
L1e-B	Two-wheel moped	• any other vehicle of the L1e category that cannot be classified as a L1e-A vehicle.	

Source: Adapted from EU R.168/2013, only for electric vehicles

L1e category (Light two-wheel powered vehicle) has a maximum vehicle speed of 45 km/h, maximum power 4 kW, maximum width ≤ 1 000 mm, and includes pedal assisted bikes. Additionally, the output power of the auxiliary propulsion system is cut off at a vehicle speed ≤ 25 km/h and also three and four wheeled vehicles can be categorized as L1e-A if the described requirements are completed.

Table 7 presents the categories and sub categories of three-wheeled electric mopeds as classified in the Regulation 168/2013. All the technical aspects referred to the conventional vehicles and internal combustion engines were not included in the table and description.

Table 7. Categories and sub-categories of two wheeled L2e-classified vehicles.

Category or sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles	Indicative image
L2e	Three-wheel moped	• three wheels and powered by a propulsion system • maximum design vehicle speed ≤ 45 km/h and • maximum continuous rated or net power ≤ 4 000 W • mass in running order ≤ 270 kg • maximum of two seating positions, including the seating position for the driver	
L2e-P	Three-wheel moped for passenger transport	• L2e vehicle other than those complying with the specific classification criteria for a L2e-U vehicle.	
L2e-U	Three-wheel moped for utility purposes	Exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets the following criteria: • length loading bed X width loading bed > 0,3 X Length vehicle X maximum Width vehicle or • an equivalent loading bed area as defined above in order to install machines and/or equipment • designed with a loading bed area which is clearly separated by a rigid partition from the area reserved for the vehicle occupants • the loading bed area shall be able to carry a minimum volume represented by a 600 mm cube.	

Source: Adapted from EU R.168/2013, only for electric vehicles

It should be noted that this type of three-wheeled vehicles (L2e) is powered by a maximum continuous rated power not higher than 4 kW, their maximum design vehicle speed is not higher than 45 km/h, their mass in running order less or equal to 270 kg and is equipped with a maximum of two seating positions, including the seating position for the driver

Table 8 presents the categories and sub categories of two-wheeled electric motorcycles as classified in the Regulation 168/2013. All the technical aspects referred to the conventional vehicles and internal combustion engines were not included in the table nor in the description.

Table 8. Categories and sub-categories of two wheeled L3e-classified vehicles.

Category/sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles.	Indicative image
L3e	Two-wheel motorcycle	• two wheels and powered by propulsion system • maximum mass= technically permissible mass declared by the manufacturer • two-wheel vehicle that cannot be classified as category L1e	
L3e-A1	Low-performance motorcycle	• maximum continuous rated or net power ≤ 11 kW and • power/weight ratio ≤ 0,1 kW/kg	
L3e-A2	Medium-performance motorcycle	• maximum continuous rated or net power ≤ 35 kW • power/weight ratio ≤ 0,2 kW/kg • not derived from a vehicle equipped with an engine of more than double its power • L3e vehicle that cannot be classified under supplemental sub-classification of a L3e-A1 vehicle	
L3e-A3	High-performance motorcycle	• any other L3e vehicle that cannot be classified according to the classification criteria of a L3e-A1 or L3e-A2 vehicle.	
L3e-AxE	Enduro motorcycles	• seat height ≥ 900 mm • ground clearance ≥ 310 mm • overall gear ratio in highest gear (primary gear ratio × secondary gear ratio in the highest speed × final drive ratio) ≥ 6,0 • mass in running order plus the mass of the propulsion battery in case of electric or hybrid electric propulsion ≤ 140 kg • no seating position for a passenger	
L3e-AxT	Trial motorcycles	• seat height ≤ 700 mm • ground clearance ≥ 280 mm • fuel tank capacity ≤ 4 litres • overall gear ratio in highest gear (primary gear ratio × secondary gear ratio in the highest speed × final drive ratio) ≥ 7,5 • mass in running order ≤ 100 kg • no seating position for a passenger	

Source: Adapted from EU R.168/2013, only for electric vehicles

The common points for these vehicles are to have two wheels, a maximum mass equal to the technically permissible mass declared by the manufacturer and to not be able to be classified as category L1e.

Table 9 presents the category L4e, which is composed by a motorcycle with a side-car accessory. All the technical aspects referred to the conventional vehicles and internal combustion engines were not included in the table nor in the description.

Table 9. Motorcycle category with side-car.

Category/sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles	Indicative image
L4e	Two-wheel motorcycle with side-car	• base powered vehicle complying with the classification and subclassification criteria for a L3e vehicle • base powered vehicle equipped with one side-car • with a maximum of four seating positions including the driver on the motorcycle with side car • a maximum of two seating positions for passengers in the side car • maximum mass= technically permissible mass declared by the manufacturer	

Source: Adapted from EU R.168/2013, only for electric vehicles

L4e (Two-wheeled motorcycle with a side-car) is a three-wheeled vehicle equipped with one side-car on its left or its right hand, which has a maximum of four seating positions including the driver and it has a maximum of two seating positions for passengers in the side-car.

Table 10 presents powered three-wheelers classified as L5e, which contains several types of tricycles intended for different types of uses, for utility purposes and passenger transport. All the technical aspects referred to the conventional vehicles and internal combustion engines were not included in the table nor in the description.

Table 10. Categories and sub-categories of powered tricycles and quadricycles

Category/sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles	Indicative image
L5e	Powered tricycle	• three wheels and powered by a propulsion system • mass in running order ≤ 1 000 kg • three-wheel vehicle that cannot be classified as a L2e vehicle	
L5e-A	Tricycle	• L5e vehicle other than those complying with the specific classification criteria for a L5e-B vehicle • with a maximum of five seating positions, including the seating position of the driver	
L5e-B	Commercial tricycle	• designed as a utility vehicle and characterized by an enclosed driving and passenger compartment accessible by maximum three sides • equipped with a maximum of two seating positions, including the seating position for the driver • exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets the following criteria: 1.length loading bed X width loading bed > 0,3 X Length vehicle X Width vehicle or 2.an equivalent loading bed area as defined above designed to install machines and/or equipment and 3.designed with a loading bed area which is clearly separated by a rigid partition from the area reserved for the vehicle occupants and 4.the loading bed area shall be able to carry a minimum volume represented by a 600 mm cube.	

Source: Adapted from EU R.168/2013, only for electric vehicles

The common characteristics in this type of vehicles are to have three wheels and powered by a propulsion system, mass in running order not higher than 1000 kg as well as to be three-wheelers that cannot be classified as L2e vehicles.

Table 11 presents L6e vehicles, which have four wheels, different power specifications and are intended for the use of passenger and goods transport. The technical aspects referred to the conventional vehicles and internal combustion engines were not included in the table nor in the description.

Table 11. Categories and sub-categories of powered tricycles and quadricycle

Category/sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles	Indicative image
L6e	Light quadricycle	• four wheels and powered by a propulsion system • maximum design vehicle speed ≤ 45 km/h • mass in running order ≤ 425 kg • equipped with a maximum of two seating positions, including the seating position for the driver	
L6e-A	Light on-road quad	• L6e vehicle not complying with the specific classification criteria for a L6e-B vehicle • maximum continuous rated or net power ≤ 4 000 W.	
L6e-B	Light quadri-mobile	• enclosed driving and passenger compartment accessible by maximum three sides • maximum continuous rated or net power ≤ 6 000 W and	
L6e-BP	Light quadri-mobile for passenger transport	• L6e-B vehicle designed for passenger transport • L6e-B vehicle other than those complying with the specific classification criterion for a L6e-BU vehicle.	
L6e-BU	Light quadri-mobile for utility purposes	Vehicles exclusively designed for the carriage of goods with an open or enclosed, uniform and horizontal loading bed that meets the following criteria: (a) length loading bed X width loading bed > 0,3 X Length vehicle X Width vehicle or (b) an equivalent loading bed area as defined above in order to install machines and/or equipment and (c) designed with a loading bed area which is clearly separated by a rigid partition from the area reserved for the vehicle occupants and (d) the loading bed area shall be able to carry a minimum volume represented by a 600 mm cube.	

Source: Adapted from EU R.168/2013, only for electric vehicles

It should be noted that L6e-B category is also divided in two sub-sub categories: L6e-BP, for passenger services and L6e-BU, for utility purposes. Other characteristics of L6e vehicles are: four wheels and powered by an electric propulsion system, maximum design vehicle speed not higher than 45 km/h, mass in running order less or equal than 425 kg and equipped with a maximum of two seating positions, including the seating position for the driver. Can be appreciated that the mass of the vehicles and the top speed is a requirement, and the power of these vehicles cannot be higher than 6 kW.

Table 12 presents L7e vehicles, which have four wheels, different power specifications and are intended for the use of passenger and goods transport. The technical aspects referred to the conventional vehicles and internal combustion engines were not included in the table nor in the description of these vehicles.

Table 12. Categories and sub-categories of powered tricycles and quadricycles

Category/sub-category	Category name	Vehicle category/subcategory characteristics, adapted for electric vehicles	Indicative image
L7e	Heavy quadricycle	• four wheels and powered by a propulsion system • L7e vehicle that cannot be classified as a L6e vehicle • mass in running order: 1. ≤ 450 kg for transport of passengers; 2. ≤ 600 kg for transport of goods.	
L7e-A	Heavy on-road quad	• L7e vehicle not complying with the specific classification criteria for a L7e-B or a L7e-C vehicle • vehicle designed for the transport of passengers only • maximum continuous rated or net power ≤ 15 kW	
L7e-A1	A1 heavy on-road quad	• maximum two straddle seating positions, including the seating position for the rider • handlebar to steer	
L7e-A2	A2 heavy on-road quad	• L7e-A vehicle not complying with the specific classification criteria for a L7e-A1 vehicle • maximum two non-straddle seating positions, including the seating position for the driver	
L7e-B	Heavy all terrain quad	• L7e vehicle not complying with the specific classification criteria for a L7e-C vehicle • ground clearance ≥180 mm	
L7e-B1	All terrain quad	• maximum two straddle seating positions, including the seating position for the rider • equipped with a handlebar to steer • maximum design vehicle speed ≤ 90 km/h • wheelbase to ground clearance ratio ≤ 6.	
L7e-B2	Side-by-side buggy	• L7e-B vehicle other than a L7e-B1 vehicle • maximum three non-straddle seats of which two positioned side-by-side, including the seating position for the driver • maximum continuous rated or net power ≤ 15 kW • wheelbase to ground clearance ratio ≤ 8	
L7e-C	Heavy quadri-mobile	• L7e vehicle not complying with the specific classification criteria for a L7e-B vehicle • maximum continuous rated or net power ≤ 15 kW and • maximum design vehicle speed ≤ 90 km/h • enclosed driving and passenger compartment accessible via maximum three sides	
L7e-CP	Heavy quadri-mobile for passenger transport	• L7e-C vehicle not complying with the specific classification criteria for a L7e-CU vehicle • maximum four non-straddle seats, including the seating position for the driver.	

L7e-CU	Heavy quadri-mobile for utility purposes	• exclusively designed for the carriage of goods with an open or enclosed, uniform and horizontal loading bed that meets the following criteria: (a) length loading bed X width loading bed > 0,3 X Length vehicle X Width vehicle or (b) an equivalent loading bed area as defined above designed to install machines and/or equipment or (c) designed with a loading bed area which is clearly separated by a rigid partition from the area reserved for the vehicle occupants and (d) the loading bed area shall be able to carry a minimum volume represented by a 600 mm cube • maximum two non-straddle seats, including the seating position for the driver.	

Source: Adapted from EU R.168/2013, only for electric vehicles

In particular, it can be observed that L7e-A category has two sub-sub categories with differences in the maximum straddle seating positions and the seating position for the rider and driver as well as the handlebar to steer. L7e-B is divided in two: All terrain quad (L7e-B1) and Side-by-side buggy (L7e-B2). Finally, L7e-C has two differentiations: Heavy quadri-mobile for passenger transport (L7e-CP) and Heavy quadri-mobile for utility purposes (L7e-CU).

Summarizing L1e to L7e vehicles, it is possible to note that L1e category refer to two-wheeled vehicles except the L1e-A that can be three or four wheelers, L2e and L4e are moped and motorcycles with three wheels (L4e equipped with a side-car), and L3e vehicles consist in several types and sizes of motorcycles. On the other hand, categories L5e, L6e and L7e are composed by tricycles and quadricycles. L5e category (Powered tricycle) has three wheels and a mass in running order equal or less than 1000 kg. Additionally, L6e (Light quadricycle) is a four wheeled vehicle with a maximum design vehicle not exceeding 45 km/h, mass in running order less than 425 kg, and equipped with a maximum of two seating positions, including the seating position for the driver. Finally, L7e (Heavy quadricycle) is a four wheeled vehicle with a mass in running order that not exceeds the 450 kg for transport of passengers and not exceeding 600 kg for transport of goods.

3.3 International regulations and standards for LEV

3.3.1 The UN standards for LEV

In order to reduce international trade barriers and to promote the global trade of vehicles and their components, efforts are being made to have harmonized vehicle regulations worldwide. The major forum for this role is the World Forum for Harmonization of Vehicle Regulations (Working Party 29) under the United Nations Economic Commission for Europe (UNECE). Currently, some of the EU Regulations are technically equivalent to UN Regulations or only refer to the requirements of the corresponding UN Regulation.

UN Regulations referred particularly to L-classified vehicles are shown in Table 13 where the number of Regulation, the Title, which describes the content of each regulation and the covered category of electric vehicles are presented. The table was performed with a color code in which yellow refers to lighting and reflective elements, blue refers to noise, orange refers to brakes, green refers to electric powertrain and grey refers to safety belts and protections. These regulations might also apply to L-category ICE vehicles unless stated otherwise.

Table 13. UN Regulations which apply to L-category electric vehicles

No.	Title	L_1	L_2	L_3	L_4	L_5	L_6	L_7
3	Uniform provisions concerning the approval of retro-reflecting devices for power-driven vehicles and their trailers	x	x	x	x	x	x	x
7	Uniform provisions concerning the approval of front and rear position lamps, stop-lamps and end-outline marker lamps for motor vehicles (except motor cycles) and their trailers	x	x	x	x	x	x	x
9	Uniform provisions concerning the approval of category L_2, L_4 and L_5 vehicles with regard to noise		x		x	x		
16	Uniform provisions concerning the approval of:		x		x	x	x	x
	I. Safety-belts, restraint systems, child restraint systems and ISOFIX child restraint systems for occupants of power-driven vehicles							
	II. Vehicles equipped with safety-belts, safety-belt reminder, restraint systems, child restraint systems, ISOFIX child restraint systems and i-Size child restraint systems							
22	Uniform provisions concerning the approval of protective helmets and their visors for drivers and passengers of motor cycles and mopeds							
25	Uniform provisions concerning the approval of head restraints (headrests), whether or not incorporated in vehicle seats		x		x	x	x	x
28	Uniform provisions concerning the approval of audible warning devices and of motor vehicles with regard to their audible signals			x	x	x		
39	Uniform provisions concerning the approval of vehicles with regard to the speedometer equipment including its installation	x	x	x	x	x	x	x
57	Uniform provisions concerning the approval of headlamps for motor cycles and vehicles treated as such			x	x	x	x	x
75	Uniform provisions concerning the approval of pneumatic tyres for motor cycles and mopeds	x	x	x	x	x		
78	Uniform provisions concerning the approval of vehicles of category L_1, L_2, L_3, L_4 and L_5 with regard to braking	x	x	x	x	x		
81	Uniform provisions concerning the approval of rear-view mirrors of two-wheeled power-driven vehicles with or without side car, with regard to the mounting of rear-view mirrors on handlebars	x	x	x	x	x	x	x
87	Uniform provisions concerning the approval of daytime running lamps for power-driven vehicles	x	x	x	x	x	x	x
136	Uniform provisions concerning the approval of vehicles of category L with regard to specific requirements for the electric power train	x	x	x	x	x	x	x

Source: Adapted from EU R.168/2013

It should be noted that the application of Regulation number 22 depends not on vehicle type, but it depends on the local regulation applicable in each city or area.

Additional standards and regulations which refer to electric and functional safety of electric vehicles in general, and in some cases, apply to at least one type of LEVs are presented in Table 14.

Table 14. Additional standards and regulations for safety of light electric vehicles

Regulation / Norm / Standard	Description / Objective / Purpose
UN Regulation No. 136 – Electric vehicles of category L (EV-L) (2023)	Uniform provisions concerning the approval of L-category vehicles with regard to specific requirements for the electric power train. The aim of this UN Regulation is the description of technical requirements for the Rechargeable Electrical Energy Storage System (REESS) and the vehicle to ensure the electrical safety. The Regulation is divided in two parts, one focuses on the approval of the REESS as a component and the other part focuses on the vehicle approval.
UN G.T.R. Nº20 - Global Technical Regulation on the Electric Vehicle Safety (EVS) (2018)	This regulation specifies safety-related performance of electrically propelled road vehicles and their rechargeable electric energy storage systems. The purpose of this regulation is to avoid human harm that may occur from the electric power train. This regulation applies to vehicles of Category 1 and Category 2 with a maximum design speed exceeding 25 km/h, equipped with electric power train containing high voltage bus, excluding vehicles permanently connected to the grid. The regulation includes the following two sets of requirements that may be selected by Contracting Parties according to the category and gross vehicle mass (GVM) of the vehicles: (a) For all vehicles of Category 1-1 and vehicles of Categories 1-2 and 2 with GVM of 4,536 kg or less; (b) For vehicles of Category 1-2 and Category 2 with GVM exceeding 3,500 kg. Contracting Parties may exclude the following vehicles from the application of this regulation: (a) vehicles with four or more wheels whose unladen mass is not more than 350 kg, not including the mass of traction batteries, whose maximum design speed is not more than 45 km/h, and whose engine cylinder capacity and maximum continuous rated power in the case of hybrid electric vehicles do not exceed 50 cm3 for spark (positive) ignition engines and 4 kW for electric motors respectively; or whose maximum continuous rated power in the case of battery electric vehicles does not exceed 4 kW; and (b) vehicles with four or more wheels, other than that classified under (a) above, whose unladen mass is not more than 450 kg (or 650 kg for vehicles intended for carrying goods), not including the mass of traction batteries and whose maximum continuous rated power does not exceed 15 kW.
EN 15194: Electrically power assisted cycles - EPAC Bicycles (2023)	The European Standard EN 15194 applies to EPAC bicycles for private and commercial use with exception of EPAC intended for hire from unattended station. This Standard is intended to cover all common significant hazards, hazardous situations and events of electrically power assisted bicycles, when used as intended and under condition of misuse that are reasonably foreseeable by the manufacturer. It specifies requirements and test methods for engine power management systems, electrical circuits including the charging system for the design and assembly of electrically power assisted bicycles and sub-assemblies for systems having a rated voltage up to and including 48 V d.c. or integrated battery charger with a nominal 230 V a.c. input, and a maximum saddle height of 635 mm or more. Specifies safety and safety related performance requirements for the design, assembly, and testing of EPAC bicycles and subassemblies intended for use on public roads, and lays down guidelines for instructions on the use and care of such bicycles.
EN 17128: Light motorized vehicles for the transportation of persons and goods and related facilities and not subject to type-	This regulation applies to personal light electric vehicles totally or partially electrically powered from self-contained power sources with or without self-balancing system, with exception of vehicles intended for hire from unattended station. Also applies to personal light electric vehicles with or without self-balancing system totally or partially electrically powered from self-contained power sources having battery voltages up to 100 VDC, with or without an integrated battery charger with up to a 240 VAC input. This document specifies safety requirements, test methods,

approval for on-road use - Personal light electric vehicles (PLEV) (2020)	marking and information relating to personal light electric vehicles to reduce the risk of injuries to both third parties and the user during intended use, i.e. when used as intended and under conditions of misuse that are reasonably foreseeable by the manufacturer.
ISO 13063: Electrically propelled mopeds and motorcycles — Safety specifications (2022)	ISO 13063:2012 specifies requirements for functional safety means, protection against electric shock and the on-board rechargeable energy storage systems intended for the propulsion of any kind of electrically propelled mopeds and motorcycles when used in normal conditions. It is applicable only if maximum working voltage of the on-board electrical circuit does not exceed 1000 V a.c. or 1500 V d.c. It does not provide comprehensive safety information for manufacturing, maintenance and repair personnel.

4 Norms and requirements for the homologation of LEV

4.1 LEV homologation

The European regulation that applies to light electric vehicles homologation, in particular for L1e to L7e categories presented before, is the Regulation No. 168/2013 (R.168) of the European Parliament and of the Council on the approval and market surveillance of two- or three-wheel vehicles and quadricycles (European Commission, 2013). This is the regulation that has been adopted, either completely or is used as a reference for national regulations, by several countries in Latin America. Thus, it has been used as the main reference in this policy advice paper.

R.168 establishes the administrative and technical requirements for the homologation of all new vehicles, systems, components and separate technical units of the vehicles but it does not apply to the approval of individual vehicles. On the other hand, this Regulation does not apply to the approval of individual vehicles. However, Member States granting such individual approvals shall accept any type-approval of vehicles, systems, components and separate technical units granted under this Regulation instead of under the relevant national provisions.

Also, R.168 establishes the requirements for the market surveillance of vehicles, systems, components and separate technical units subject to approval. This Regulation also establishes the requirements for the market surveillance of parts and equipment for such vehicles.

The Regulation No. 168/2013 applies to all two- or three-wheeled vehicles and quadricycles as categorized before (L1e to L7e), that are intended to travel on public roads, including those designed and constructed in one or more stages, and to systems, components and separate technical units, as well as parts and equipment, designed and constructed for such vehicles.

Finally, it should be noted that this Regulation does not apply to the following vehicles:

1. vehicles with a maximum design speed not exceeding 6 km/h;
2. vehicles exclusively intended for use by the physically handicapped;
3. vehicles exclusively intended for pedestrian control;
4. competition vehicles;

5. vehicles designed and constructed for use by the armed services, civil defense, fire services, forces responsible for maintaining public order and emergency medical services;
6. agricultural or forestry vehicles;
7. vehicles primarily intended for off-road use and designed to travel on unpaved surfaces;
8. pedal cycles with pedal assistance which are equipped with an auxiliary electric motor having a maximum continuous rated power of less than or equal to 250 W, where the output of the motor is cut off when the cyclist stops pedaling and is otherwise progressively reduced and finally cut off before the vehicle speed reaches 25 km/h;
9. self-balancing vehicles (typically PMVs);
10. vehicles not equipped with at least one seating position (also typically PMVs);
11. vehicles equipped with any seating position of the driver or rider having a height less or equal than 540 mm in case of categories L1e, L3e and L4e or not higher than 400 mm in case of categories L2e, L5e, L6e and L7e.

Regarding the exclusions presented before, can be noted that it is not mandatory the homologation of self-balancing vehicles, vehicles not equipped with at least one seating position and pedal cycles (bicycles) assisted by an electric motor not higher than 250 W up to 25 km/h.

4.1.1 LEV homologation requirements

4.1.1.1 Introduction

An approval authority which grants an EU type-approval shall take the necessary measures to verify, if necessary, in cooperation with the approval authorities of the other Member States, that adequate arrangements have been made to ensure that the vehicles, systems, components or separate technical units in production will conform to the approved type. In order to verify that a vehicle, system, component or separate technical unit conforms to the approved type, the approval authority which has granted the EU type-approval may carry out any of the checks or tests required for EU type-approval, on samples taken at the premises of the manufacturer, including production facilities.

L-category vehicles and systems, components and separate technical units intended for such vehicles must comply with the requirements listed in Annexes II to VIII of Regulation 168/2013, applicable to the relevant vehicle categories and sub-categories. Those requirements cover a wide range of technical characteristics, starting in environment protection and performance of vehicles, following with a broad spectrum of functional safety (including electrical safety), finalizing with technical services, Vehicle construction, and general type-approval requirements.

4.1.1.2 Environmental and performance requirements

Regarding environmental protection and propulsion requirements, manufacturers shall ensure that vehicles are designed, constructed and assembled so as to minimize the impact on the environment. About these requirements, environmental test procedures related to exhaust emissions, evaporative emissions, greenhouse gas emissions, fuel consumption and reference fuels are defined for internal combustion engine powered vehicles. Also, test procedures related to sound, maximum design vehicle speed, maximum torque, maximum continuous engine power of propulsion are defined for the L-category vehicles.

As regards electric energy consumption and electric range, these values shall be either calculated based on the type-approval emission laboratory test results or measured, witnessed by the technical service and reported to the approval authority. The requirements for environmental efficiency and performance of the propulsion unit are established for these vehicles according to what is written in Regulation 134/2014*2023/2724 (European Commission, 2023).

4.1.1.3 Vehicle functional safety requirements

Regulation 168/2013 lays manufacturers obligations, who shall ensure that vehicles are designed, constructed, and assembled to minimize the risk of injury to the vehicle occupants and to other road users. The functional safety of the vehicle shall endure throughout the normal life of the vehicle if used under normal conditions and serviced in accordance with the manufacturer's recommendations. The manufacturer shall also confirm that the endurance of the systems, parts and equipment critical for functional safety is ensured through appropriate testing and use of good engineering practice.

Vehicle functional safety requirements include:

- audible warning devices
- braking, including anti-lock and combined brake systems
- electrical safety
- safety systems, parts and equipment
- front and rear protective structures
- front and rear protective structures
- glazing, windscreen wipers and washers, defrosting and demisting devices
- driver-operated controls including identification of controls, tell-tales and indicators
- installation of lighting and light signaling devices, including automatic switching-on of lighting
- rearward visibility
- rollover protective structure (ROPS)
- safety belt anchorages and safety belts
- seating position (saddles and seats)
- steer-ability, cornering properties and turn-ability
- installation of tires
- vehicle maximum speed limitation plate and location on vehicle
- vehicle occupant protection, including interior fittings, head restraint and vehicle doors
- maximum continuous rated or net power and/or vehicle speed limitation by design
- vehicle structure integrity

About advanced brake systems, L3e-A1 subcategory has to be equipped with either an anti-lock or a combined brake system or both types of advanced brake systems, at the choice of the vehicle manufacturer. Additionally, L3e-A2 and L3e-A3 motorcycles have to be equipped with an anti-lock brake system (some exceptions apply in case of Trial and Enduro sub-sub categories).

About safety cornering on hard-surfaced roads, L-category vehicles are to be constructed such that each of the wheels can rotate at different speeds at all times in order to allow safe cornering on hard-surfaced roads. If a vehicle is equipped with a lockable differential, it must be designed to be normally unlocked.

About lighting, vehicles must comply with some improvement of vehicle and rider visibility by automatic switching-on of lighting. Additionally, regarding electrical safety vehicles of L-category, with respect to the electric power train when equipped with one or more traction motor(s) operated by electric power, as well as their high voltage components and systems connected to the high voltage bus of the electric power train, shall be designed so as to avoid any risk to electrical safety.

Vehicles of category L, with respect to concerning vehicle occupant protection as well as their front and rear structures, shall be designed to avoid pointed or sharp parts or projections which are directed outwards, and which are likely to catch on or significantly increase the severity of injuries or chance of lacerations to vulnerable road users in case of a collision. Concerning the safety belts, vehicle categories L2e, L5e, L6e and L7e with a mass in running order > 270 kg shall be fitted with them. Vehicles of categories L7e-A2, L7e-B2 and L7e-C shall be fitted with three-point or harness-type safety belts on all seating positions. The other vehicle categories shall meet the relevant requirements of the UN Regulation 16 prescribed for N1 vehicle category.

Additional requirements for vehicle functional safety are established for these vehicles according to what is written in Regulation 3/2014*2016/1824 of the European Union.

4.1.1.4 Vehicle construction and general type-approval requirements

Vehicle construction and general homologation requirements are laid down in Regulation 168/2013 in several annexes and articles, meeting a diverse nature of topics which look for the approval of L-vehicles, beyond their motorization. As it follows, topics regulated in Regulation 168/2013 which refers to light electric vehicle construction and their homologation are listed below:

- anti-tampering measures
- arrangements for type-approval procedures
- conformity of production requirements
- coupling devices and attachments
- devices to prevent unauthorized use
- electromagnetic compatibility (EMC)
- external projections
- load platforms
- masses and dimensions
- on-board diagnostics
- passenger handholds and footrests
- registration plate space

- repair and maintenance information
- stands

As regards electromagnetic compatibility of light electric vehicles, these vehicles must control the following aspects:

- Radiated narrowband and broad band emissions when the vehicle is running
- Immunity against an electromagnetic field when the vehicle is running
- Vehicle coupled to the grid
  - Emission control of the harmonics generated
    - Emission control of voltage fluctuations and flickers
    - Emission control radio frequency alterations
    - Immunity control fast transient / burst electrical disturbances

Additional general requirements as well as requirements for vehicle construction are established for these vehicles according to what is laid down in Regulation 44/2014*2018/295 of the European Union.

4.1.1.5 Requirements of technical services

Operational obligations of technical services established that technical services shall carry out the categories of activities for which they have been designated on behalf of the designating approval authority and in accordance with the assessment and test procedures provided for in Regulation 168/2013. Technical services shall supervise or carry out the tests required for approval or inspections as set out in the Regulation. The technical services shall not conduct tests, assessments or inspections for which they have not been duly designated by their approval authority.

According to Regulation 168/2013, in order to ensure that technical services meet the same high level of performance standards in all Member States, the Commission shall be empowered to adopt delegated acts concerning the standards with which the technical services have to comply and the procedure for their assessment.

As for the assessment of the skills of technical services, the designating approval authority shall draw up an assessment report demonstrating that the candidate technical service has been assessed for its compliance with the requirements of this Regulation and the delegated acts adopted pursuant to R.168/2013.

Where a technical service finds that requirements laid down in the Regulation 168/2013 have not been met by a manufacturer, it shall report this to the designating approval authority with a view for the designating approval authority requiring the manufacturer to take appropriate corrective measures and subsequently not to issue a type-approval certificate unless the appropriate corrective measures have been taken to the satisfaction of the approval authority.

4.1.1.6 LEV administrative procedures homologation

The administrative requirements for the approval of vehicles in the European Union derive from the Delegated Act R (EU) 901/2014 * 2020/239. This document establishes the following three requirements that must be met by the applicant, in order to be granted homologation. These requirements are:

- The preparation of the technical documentation to be provided to the approval authority
- The preparation of the Certificate of Conformity (CoC) that will accompany each unit produced and the registered signatories
- Obtaining the WMI (World Manufacturer Identifier)
- Statements to be presented as part of the homologation package (endurance testing, durability, RMI, etc.)

For its part, the Homologation Authority of each Member State will grant the manufacturer's registration as well as make the appointment of a representative, in the case of manufacturers established outside of the EU.

4.2 Case Studies

4.2.1 The case of Argentina – Homologation of L6/L7 category

In 2019, the first locally manufactured light electric vehicle was homologated in Argentina by the Industry Secretariat, part of the Ministry of Production, accrediting compliance with safety requirements to circulate on public roads. The Model Configuration License (Licencia de Configuración de Modelo - LCM) is the document granted by this institution once the compliance with the active and passive safety requirements of a vehicle is verified by the National Institute of Industrial Technology (Instituto Nacional de Tecnología Industrial - INTI), the national agency competent in this matter.

Although the Sero Electric model (Figure 37) of the company L Voiture SA located in the outskirts of the city of Buenos Aires was already manufactured and commercialized since 2015, its utilization was limited to private spaces. This happened since its unrestricted use in public spaces was not allowed due to the absence, until 2019 of its LCM. Until a few years ago, LEVs practically did not exist in Argentina and other parts of the region. For this reason, until 2018, categories L6 and L7, in which the Sero Electric models are included, were not listed in the Transit Law either.

In October 2018, Decree 32/2018 was approved. This Decree is the most important update made to the 1994 Transit Law (Ley Nacional N° 24.449/1994) during the last years and is the result of the joint work between different agencies, among which the National Road Safety Agency and the National Commission of Transit and Road Safety of the National Ministry of Transport and the Secretariat of Industry of the National Ministry of Production stand out.

Decree 32/2018 defines, categorizes and regulates several LEVs, incorporating them into the Argentinian transport system. These vehicles include (Ministerio de Transporte, 2018):

- pedal-assisted bicycles
- L6 and L7 vehicles
- 2 and 3 wheeled motorcycles not exceeding 50 cc / 4Kw and 50 km/h
- Quadricycles not exceeding 15 Kw and 400kg for passenger transport and 550kg for cargo
- Tricycles not exceeding 50 cc / 4Kw and 50 km/h

Decree 32/2018 defines and categorizes the vehicle models authorized for public transit, as well as their characteristics, following the guidelines of European Standards (Regulation 168/2013). It also states that L6 and L7 vehicles can circulate on the roads following the requirements / criteria of the National Agency of Road Safety.

Currently, the process to obtain an LCM is initiated on an online platform (Trámites a Distancia - TAD) introduced some years ago by the national government to simplify administrative processes. For new vehicles to circulate on public roads, manufacturers and importers must obtain this License that guarantees compliance with the Transit Law. In Argentina, the Transit Law (Ley Nacional N° 24.449/1994), together with its regulatory norms and annexes, governs the circulation of vehicles for the transportation of passengers and cargo on public roads and determines the different vehicle categories. This set of regulations establish the responsibility of manufacturers/importers with respect to the safety of their vehicles (and spare parts) including the minimum requirements of active and passive safety, as well as further technical and environmental requirements. The Law requires manufacturers/importers to certify that each of their models commercialized for transit on public roads complies with the standards and therefore can be homologated.

The homologation process of a vehicle model is not simple and may represent a major challenge for local innovators and entrepreneurs. The approval of a model can involve between 15 and 20 different tests (depending on the category) with a set of specifications that must be fulfilled: braking systems, lighting systems, tires, mirrors, seats and headrests, seat belts, locks and side doors, inflammability of materials, among others. This is a process that can take several months, in which various tests (some of them destructive), computer modeling, software simulations and technical verification visits to authorized laboratories or production plants are carried out. Throughout the national territory, INTI is the leading organization that supports the development process with its technical capabilities and laboratories.

It is worth noting that the EU Regulation 168/2013 related to the homologation of L category vehicles, including L6 (light four-wheelers) and L7 (heavy four-wheelers) and specifying the obligations of manufacturers, technical, safety and environmental requirements; as well as the specific procedure for the homologation including testing and model certifications is one of the main inputs for the modifications carried out through Decree 32 in relation to category L. It is common practice for national technical bodies in Argentina, as well as in other Latin American countries, to take European standards as sufficient and adopt them as long as they are not controversial or counterproductive. In addition, EU regulations are written in Spanish, thus preventing linguistic obstacles and facilitating the comprehension of the norm.

Annex P of the regulatory Decree of the Transit Law details the requirements and procedure for the LCM issuance. The LCM application must be submitted through a previously registered representative (registered in RUMP) together with all safety tests corresponding to the vehicle category and conformity affidavits. Electric vehicles are exempt from presenting the vehicle emissions certificate, which is indeed a requirement for ICE and hybrid vehicles. Figure 36 shows a simplified version of the homologation process.

Moreover, to launch a new vehicle model on the market, in addition to the LCM, each company must apply for the Environmental Configuration License (Licencia de Configuración Ambiental - LCA), which is granted by the Ministry of the Environment and certifies compliance with gaseous, sound and electromagnetic emissions standards and consumption levels through various technical tests. This is a procedure that can also be carried out via TAD platform.

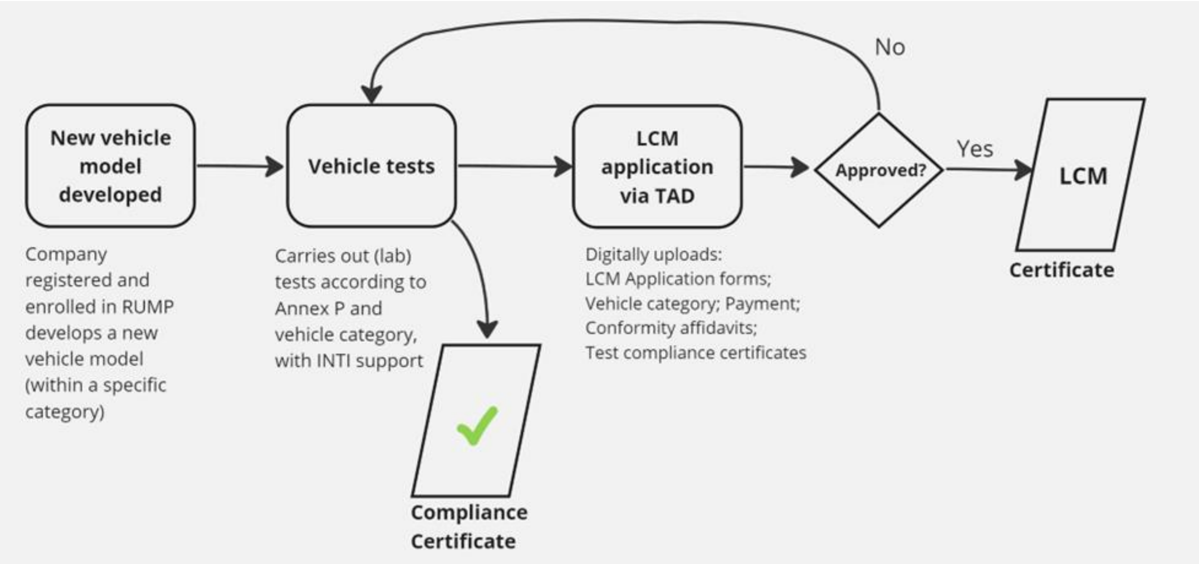

Figure 36. Homologation process in Argentina

Decree 32/2018 played an essential role by aligning the legislation with technological advances and productive developments in the field of transportation. L Voiture SA acknowledges having actively participated in the negotiations and advocacy efforts to incorporate the L6 and L7 categories to the modifications proposed in 2018. They also recognize that the outcome was only possible by aligning political support, a great commitment from technical agencies and the support of the productive sector through private companies as well as chambers and associations for the promotion of electric mobility. Since the approval of the Decree 32/2018, Argentinian manufacturers have invested in LEVs production lines. This is the case of L Voiture SA and Coradir SA that currently produce the Sero electric and Tita, the electric mini vans and pick-ups that were used in the SOLUTIONSplus replication cases in Escobar and Buenos Aires (see Table 2). The two companies have established production plants, on in the Metropolitan Area of Buenos Aires and the other one in San Luis, Mendoza.

Figure 37. Sero electric (left) and TITA (right) LEVs

For vehicle manufacturers in Argentina, it is essential to ensure that their prototypes and developments can be framed in any of the vehicle categories provided by the Transit Law. This is the only way to consider medium- and long-term development and scales that would enable sustainable business models. If a product is not developed within any of the specific categories, it will be impossible to obtain an LCM and an authorization to circulate on public roads. Although categories L6 and L7 still have certain restrictions for circulation, model approval alone opens a door to increase the commercialization spectrum: government fleets, company fleets and, ultimately, private users.

Based on the homologation performed by the Industry Secretariat with support of the INTI, electric L-category vehicles may circulate in urban areas, including streets and avenues, but are not authorized to circulate on roads, highways and freeways. For example, the regulation establishes a maximum speed of 50km/h for L6 vehicles. Due to this maximum speed limitation, seat belts are the only mandatory safety equipment. Therefore, safety parameters are not equivalent to those of light duty vehicles (LDV), since L6 vehicles are not required to have Airbags, ABS or ESP (stability control). For the time being, electric vehicles do not require to pass the Vehicle Technical Verification (VTV), an annual procedure that all ICE vehicles must undergo. Although a VTV concept is being developed for electric vehicles in the future, the current verification process is not adapted to the specifications of an electric vehicle. Another aspect that requires further development, and a specific procedure (including final disposal), is testing and homologation of batteries for electric vehicles. This important issue is not yet consolidated and must be addressed to accompany an increased number of LEV models.

Like an M or N category automobile, L6 and L7 vehicles must be properly registered and have an identifying license plate. Drivers must have a valid driver's license. Electric vehicles must be insured, something that for the time being does not present major difficulties. Insurance companies are already developing insurance policies that in some cases are even cheaper than those for LDV vehicles.

Table 15. List of regulations that address L-category vehicles in Argentina

NAME	BRIEF DESCRIPTION
National Transit Law N° 24.449/1994	Together with its regulatory norms and annexes, this national law governs the circulation of vehicles for passenger and cargo transportation on public roads. It also determines the different vehicle categories.
Decree 32/2018 (Ministry of Transport)	It is the most recent and important update made to the Transit Law to align the legislation with technological and productive developments in transportation. Decree 32 incorporates the new categories L6 / L7, based on EU Regulation 168/2013.
Annex A of Decree 32/2018	Defines and categorizes the vehicle models authorized for public transit, based on the IRAM-AITA 10.275 standard.
Annex P of Decree 32/2018	Establishes the requirements and procedure for the LCM issuance.

4 Local regulations and policies for LEV

As it was mentioned in the introduction, technology is transforming the way in which mobility happens in cities. The combination of digitalisation, electrification and the shift to Mobility as a Service (MaaS) is driving a wave of transport innovation, that goes from the expansion of LEV and shared mobility to connected autonomous vehicles. These new vehicle types and mobility concepts could contribute significantly to sustainable mobility in cities. However, for this to happen, the regulatory framework at the local level needs to be sufficiently fast and flexible to guide their development in the right direction and the infrastructure needs to be adapted to provide safe conditions for the safe circulation of LEV. In the introduction we mentioned a series of international examples of these changes at the urban level and the extensive list of SOLUTIONS use cases for LEV showcasing how these could contribute to a more sustainable, inclusive and efficient transport of people and goods, particularly in the last mile in cities around the world.

This section refers to the set of regulations and policies that should be defined at the local level (municipalities, cities, metropolitan areas, etc.) for the safe circulation of LEV and the requirements that both vehicles and users must comply to be able to circulate in urban areas. It will address topics such as the safety requirements of users, the types of roads on which LEV are authorized to circulate and designated parking areas for this type of vehicles. Other aspects covered in this section refer to the registration and payment of vehicle licenses, driving licenses and authorization to carry passengers or deliver goods.

4.3 Local regulations and policies for LEVs

4.3.1 Regulatory changes due to the introduction of LEVs.

The fast introduction of new vehicle types in cities around the globe, including in Latin America, has shown the need to regulate them not only nationally, but also at the local level, to guarantee the safety of all road users. In particular, the use of micromobility and personal mobility vehicles is being regulated. The fast technological advances in the mobility field require the decision makers to be dynamic and show the following characteristics (Department for Transport, 2020):

Agility: the pace of technological changes means that the regulatory framework should be able to respond quickly. It is necessary to enable the wider roll out of transport innovations pilots which demonstrates clear social, environmental and safety benefits.

Local consent and leadership: what can be suitable for one region, city or environment will not be for another. Where local leaders are keen to lead the way in transport innovation, the regulatory system should support them to do so.

Innovation: the right regulatory framework can unlock innovation, rather than block its development, in a way that manages any potential negative or unintended consequences.

Based on evidence: the regulatory framework supports innovation where the evidence shows net benefits for society, the environment and the economy, in line with the urban planning.

Multi-modality: regulation should facilitate to develop multimodal transport systems.

Several regulations around the world have been developed over the centuries, reflecting evolutions in technology and society. Now, as the pace of change accelerates and the lines between different modes and business models, new products and ideas are challenging these existing regulatory structures and their scope. The review of the current legislation at city or national level may conclude that substantive legislative reform is required following the criteria presented before.

The introduction of light electric vehicles in the markets represents a disruptive milestone in the transport sector which has forced national and local governments to approve new regulation (laws, decrees, ordinances, etc.), to keep pace with technological changes. At city level, new circulation criteria have been adopted such as top speeds, distances between vehicles, parking for bikes and e-bikes, drivers and pedestrian safety, licences and other related measures.

4.3.2 The importance of local regulations for LEV

Through homologation, national governments are responsible for deciding the vehicle types and requirements that these need to fulfill to be able to enter the country and circulate on public roads. Meanwhile, at the local level the types of roads and safety conditions for a harmonious circulation of LEVs in cities are defined.

Given the significant number of new vehicle types, with or without electric motors, and features, that coexist today in cities, it is necessary to have regulations that help order their circulation to protect the most vulnerable users of the road and prevent accidents. Thus, for example, bicycles, e-scooters and other micro-vehicles that do not exceed 25 km/h are usually allowed to circulate on bike lanes, but not on sidewalks or high-speed roads.

Another relevant aspect of local regulations for LEVs, is the safety of LEVs users, as LEVs are vehicles with a high level of exposure. In this sense, by not having certain safety elements such as airbags, ABS and others, LEV users have a higher risk of injury in the case of a road accident (Boniface et al., 2011). Thus, they can be considered among vulnerable road users. In this context, establishing regulations related to, for example, the use of helmets, reflective elements on vehicles and riders, minimum age limits for driving, and other aspects relevant to personal safety is crucial.

It is worth noting that the national regulations for LEV, such as homologation, have several points of contact with local regulations. Table 16 presents the overlapping areas between national and local regulations.

Table 16. Scope and characteristics of homologation regulation, Urban Vehicle Regulations and the common "grey area".

Urban Vehicle Regulations	Common points ("Grey area")	Homologation Regulation
○ **City level regulation** ○ **Max. speed** ○ **Use of helmet** ○ **Use of reflective clothing** ○ **Use of reflective devices** ○ **Circulation areas (road, bike lanes, etc.)** ○ **Parking areas** ○ **Vehicle patent** ○ **Driving license** ○ **Goods transport and delivery services** ○ **Public transport services** ○ **Vehicle definitions** ○ **Vehicle classification and categories** ○ **Vehicle functional safety (safety belts, horn, lighting, mirrors, brakes, etc.)**	○ Vehicle definitions ○ Vehicle classification and categories ○ Vehicle functional safety (safety belts, horn, lighting, mirrors, brakes, etc.)	○ National level regulation ○ Vehicle definitions ○ Vehicle classification and categories ○ Vehicle electric safety ○ Vehicle functional safety (safety belts, horn, lighting, mirrors, brakes, etc.) ○ Environmental performance requirements ○ Vehicle construction ○ After-sales service ○ Type-approval procedures

The regulation overlapping often brings about some relevant complications, since there are inconsistencies or contradictions between the different types of regulations, which is problematic for those operators that introduce and use this type of vehicles in urban areas. In this sense, it is necessary to harmonize the different regulations.

4.3.3 Local regulations and policies for LEV

Local regulations for LEVs are expected to regulate or include the following aspects:

- Definition of (new) vehicle types
- Circulation and parking rules
- Requirements
- Uses for LEVs
- Use of public spaces

Moreover, the existence of new vehicle types on the road also requires an adjustment in urban planning and infrastructure, so that LEVs could properly serve the purpose of contributing to sustainable mobility in cities, mainly in the first and last mile connectivity and logistics.

4.3.3.1 LEVs Definition

As it was mentioned in Section 3, defining and categorizing LEVs is the first step to regulate them. What has been observed so far is that in Latin American cities, regulations tend to focus on PLEVs, leaving out the wide variety of vehicles covered by the LEVs spectrum. Thus, this policy advice paper advocates for the inclusion of micro-vehicles, including the categories C/D, that include larger bicycle models for the transport of people and goods. Moreover, cities should also include larger LEV, i.e., L-category vehicles, in their regulations to norm their circulation in the city, depending on their speed, size and loading capacity. The complete definition of LEV and all the vehicle categories covered by the LEV umbrella is detailed in Section 3.

4.3.3.2 Circulation and parking rules

In some of the existing local regulations in Latin America, micro vehicles such as e-bikes and e-scooters are allowed to ride on bike lanes at a maximum speed of 25 km/h. In practice, however, due to the lack of regulations and proper infrastructure for (other) LEVs, many of them also circulate on bike lanes despite their higher speed. Without the proper rules can often put other vulnerable users at risk in bike lanes that are already at their capacity or just too narrow for larger vehicle types.

In this context, this policy advice paper suggests the following rules for LEVs:

- Micromobility vehicles as defined in Section 3 can ride on bike lanes, as long as their speed is limited to 25 km/h
- L-category vehicles, on the other hand, are only allowed on mixed traffic, on roads with a maximum speed of 50 km/h
- All LEVs are allowed on all streets / lanes with a speed limit of 30 km/h
- LEV users cannot ride on sidewalks. If needed, e.g., to access a parking area on a sidewalk, they will have to walk next to the LEV.

With regards to parking, just like bicycles, LEVs should be parked in the public spaces designated and signaled for that. This means of course that municipalities should create enough secure spaces for LEVs users to park, without generating chaos on the roads and sidewalks, as it has been observed in many cities worldwide.

4.3.3.3 Requirements for LEV users

The requirements depend on the type of LEV, however, the main ones are:

- For micromobility vehicles, similar to bicycles, LEVs should count at least with a bell, lights and reflective elements.

- LEV users should be at least 15 years old.
- The use of helmets is recommended, but not mandatory. Except in specific cases, such underaged users, circulation in mixed traffic and the use of LEVs for goods deliveries.
- The use of headphones while riding a LEV is forbidden.
- LEV users cannot ride under the influence of alcohol or drugs levels above the threshold defined by the traffic law of each country
- A driving license could be required for L-category vehicles, depending on the regulations of the country.

4.3.3.4 Commercial uses of LEVs

LEVs can be used commercially for:

- Passenger transport (e.g.: bicitaxi)
- Last mile logistics
- Shared mobility services
- Touristic activities

The LEVs used for commercial purposes might be subject to additional requirements, such as for example:

- The use of helmets
- Liability insurance
- Vehicle registration and control

4.3.3.5 Urban planning and infrastructure for LEVs

It is expected that in the near future an important share of car and bicycle drivers shift to LEVs, which could imply some mismatches between the new ways of mobility and the existing infrastructure (Zagorskas & Burinskienė, 2019). In this context, the space now used by cars can be reorganized to serve public transport and PMVs along with bicycles. On the other hand, sidewalks and bike lanes may be more crowded, but will not create major problems, due to the tiny space used by PMVs compared to a car.

Moreover, the need to plan for designated parking and charging spaces, as well as connecting them to the public transport system in order to promote intermodality, has brought about concept such as multimodal hubs and mobility stations.

4.3.3.5.1 Road infrastructure

Understanding the needs for change that new mobility vehicles and services pose to urban infrastructure, NACTO, one of the international institutions leading the conversation on the design of bike and pedestrian friendly streets, developed 7 working papers to update its Urban Bikeway Design Guide. One of them is titled “Designing for Small Things with Wheels”, in which it acknowledges the required shifts in infrastructure needed to safely integrate micromobility vehicles in the road space (Benton et al., 2023). Figure 38 shows the proposed infrastructure.

Other sources speak of "slow" or "light" lanes to allow these new vehicles to circulate safely. According to Klein (2019), based on the standard US street design, a "slow" lane takes the travel lane next to the parking lane and reduces its width to 2,5m (vs. its current 3m – 4m). Thermoplastic markings signal the "slow lane" with a 25 km/h speed limit that prioritizes non-cars.

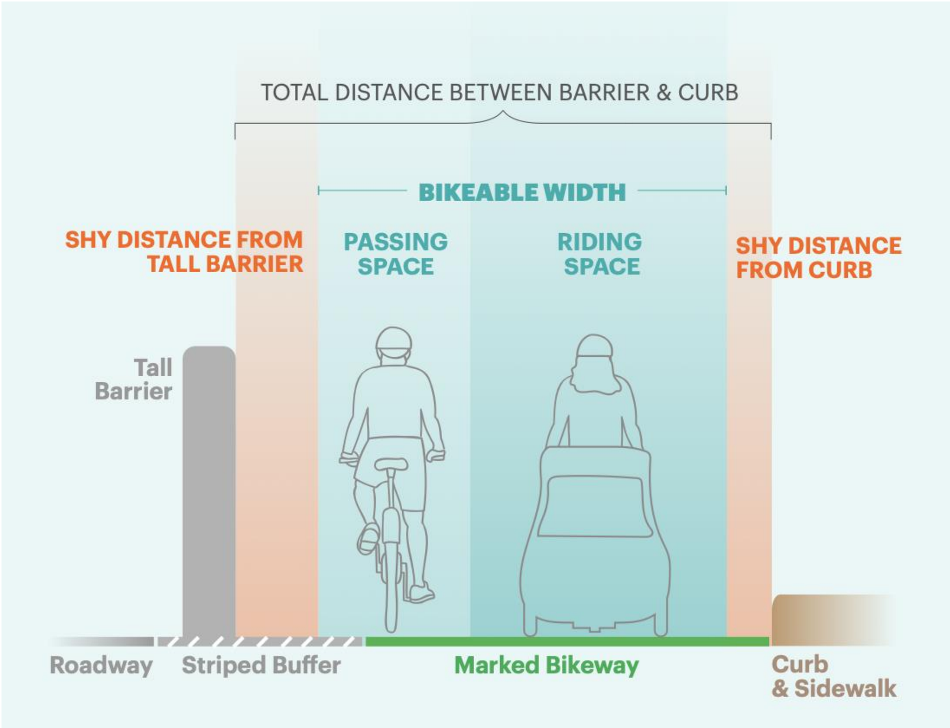

Figure 38. Example of how infrastructure for LEVs can be designed. Source: NACTO (2023)

In the case of Madrid, in its Sustainable Mobility Ordinance the city introduces the concept of multimodal lanes. These are lanes with speed limited to 30 km/h or less if specifically marked, specially conditioned for bicycles and other personal mobility vehicles (PMV), in which circulation is shared with other vehicles. Users of bicycles and PMVs have preference over motor vehicles (Ayuntamiento de Madrid, 2024).

Figure 39. Multimodal lanes in Madrid. Source: enbicipormadrid

4.3.3.5.2 Multimodal hubs / mobility stations

Mobility Stations are being implemented in many cities around the world with 3 main objectives:

1) to order the use of public space by LEVs,
2) provide charging infrastructure for their efficient use, and
3) to promote intermodality between public transport and micromobility services.

Regarding the occupation and use of public space for the integration of LEVs into the city's transportation system and the construction of multimodal hubs / mobility stations for LEVs, at least the following aspects are suggested to be taken into account in relation to the location, design and construction in order to get a suitable use of public areas (UTE/UDELAR, 2021):

- **Location:** A multi-operability LEVs charging network, should be located in strategic points of the city, considering people flow and movements, population density, urban logistics and other relevant factors. It should also take into account the main circuits that the LEVs will run, both those for passenger and freight transport. The station should be located in a public area.
- **Charging & Parking:** at least for some types of LEVs intended for urban logistics or passenger transport, parking and charging (or battery swapping as well) should be combined in order to optimize the waiting time.
- **Usability:** The length of the cables to be used must be considered in such a way that there are no inconveniences for the circulation of users or safety risks. Safety railings must not be an obstacle for pedestrians and cyclists. All ergonomic aspects of the elements must be considered. It is also suggested to add to the local infrastructure other features or services, such as, for example, a water dispenser for hand washing, or drinking water supply.
- **Activity during recharging:** Associate the charging system to places where an activity can be developed, but take into account what happens if the charging ends before the activity and

the user does not return in time. Consider the possibility that by sending a message to the cell phone the user should come to disconnect his vehicle or another option.

- **Security and vandalism:** possible incidents of vandalism or theft should be taken into account. For this purpose, urban interventions should consider the implementation of some measures such as video surveillance cameras or guard service, or the location in fenced and/or guarded places as well.
- **Mobile App:** It is crucial to have an App that is well adapted to the infrastructure. It is a priority that it continues to add functions, such as visualizing the time remaining for the vehicle occupying a given Electric Vehicle Supply Equipment (EVSE), the availability of charging points, the station's maintenance status, etc. A technological system would be necessary to regulate the waiting time or to cut or interrupt the time of the previous user when he/she spends too much time plugged in without charging.
- **Maintenance:** Given the complexity of multi-operational charging stations (equipment that exceeds only one EVSE), maintenance requirements increase as there are many elements to maintain. Wood, roof boards and other materials may not be the best option when maintaining the structure.
- **CS Roofs:** It is necessary to verify the height and general dimensions, since their function is to protect against rain and wind. The height and surface coverage are crucial. The morphology of the roofs should be harmonious with the surroundings and aesthetically pleasing. Materials such as recycled tempered glass, polycarbonate, or other materials can be used. The location of benches and connectors should be under the protection of the roof. It also seems favourable for the electric car to be partially covered.
- **General appearance:** It is understood that the appearance of multi-operability charge spaces should be in accordance with the surroundings and should also represent the link with cleaner technologies.
- **Lighting:** Lighting is a factor that becomes important, given that much of the charge may occur at night.
- **Visual Communication:** Evidencing the renewable energy sources that contribute as a percentage of each vehicle's charge could be in real time. Evidencing that charging stations are inclusive spaces for EVs, LEVs, cyclists, general public, and non-exclusive users.
- **Solar panels:** There is the opportunity to place a photovoltaic panel to give the image of friendly and sustainable technologies and use them, for example, for the lighting of the station itself.
- **Scalable parametric design:** Scalable parametric design that allows linking the pieces together as they grow from minimum, through intermediate and finally large station. This system of modular parts or components would seem to facilitate production and maintenance, as well as adaptation to different contexts.
- **Regular controls:** no other than the regular infrastructure must be used to be the LEVs charged. A scheme of controls and penalties should be implemented for eventual deviations.

Figure 40 presents a couple proposals for a multi-operability EV charging station, designed in the context of the UTE/UDELAR Agreement which aimed to the design of charging infrastructure for different types of electric vehicles situated in Montevideo city.

Figure 40. A couple of possible design for a multimodal station. Source: UTE/UDELAR (2021)

Figure 41 shows Jelbi points and stations, which are multimodal hubs being deployed in the city of Berlin, Germany to promote the use of public transport, by connecting it efficiently to LEV services. This is complemented by a Mobility as a Service (MaaS) app, a platform in which all mobility services can be booked, paid and planned. The services included in these stations are: public transport, e-cargo-bike sharing, e-moped sharing, EV sharing and charging and taxis.

Figure 41. Jelbi Mobility points and stations from Jelbi

4.3.4 Case studies of local regulations for LEVs

In this section we present two examples of local regulations for LEVs. The first one is the case of Madrid and the second one the case of Montevideo, two cities where certain regulations have been implemented or are in the process of implementation. In the first case, the regulations refer specifically to PLEVs of PMV, and in the second case the Municipal Resolution covers the full spectrum of LEVs.

4.3.4.1 Case Study for PLEVs in Madrid, Spain

In the case of Madrid, Spain, the municipality follows the norms and regulations provided by the General Traffic Directorate (DGT), an autonomous agency of the Spanish Government responsible for the execution of road policy on state-owned roads in Spain. In 2016, the DGT emitted a Resolution 16/V-124, which aims to provide guidance for municipalities in the Spanish territory on how to regulate PMVs. In this Resolution, the DGT used the categories A, B, C0, C1 and C2 referred to in Section 3 and defined the main requirements for each one of them in terms of speed, weight, capacity, size, accessories, allowed uses, etc. (Instrucción 16/V-124 - Vehículos de Movilidad Personal (PMV), 2016).

Due to the approval of the European Standards for PLEVs in 2020, in 2022, the DGT, emitted a new resolution, which defines Personal Light Electric Vehicle (PLEV) as a vehicle with one or more wheels equipped with a single seat and propelled exclusively by electric motors that can provide the vehicle with a maximum design speed between 6 and 25 km/h. They can only be equipped with a seat or saddle if they are equipped with a self-balancing system.

Within this category of vehicle there are two sub-categories well differentiated, one is the vehicle destined to personal transport and the other focused on transport for goods or other services. Table 17 presents the main characteristics.

Table 17. Categories and characteristics of PLEVs

<table>
<tr><th>Characteristic</th><th>PLEVs for personal transport</th><th>PLEVs for transport of goods or other services</th></tr>
<tr><td>Maximum speed</td><td>From 6 to 25 km/h</td><td>From 6 to 25 km/h</td></tr>
<tr><td rowspan="2">Nominal power</td><td>Without self-balancing system: ≤ 1.000 W</td><td rowspan="2">≤ 1.500 W</td></tr>
<tr><td>With self-balancing system: ≤ 2.500 W</td></tr>
<tr><td>Mass in running order</td><td>< 50 kg</td><td>< 400 kg</td></tr>
<tr><td>Maximum length</td><td>2.000 mm</td><td>2.000 mm</td></tr>
<tr><td>Maximum height</td><td>1.400 mm</td><td>1.800 mm</td></tr>
<tr><td>Maximum width</td><td>750 mm</td><td>1.000 mm</td></tr>
</table>

Source: DGT (2022)

Moreover, it establishes that in order to be able to circulate, PLEVs require a circulation certificate that guarantees compliance with the technical requirements set by national and international regulations included in their characteristics manual, as well as their identification.

Likewise, it defines the technical requirements that PLEVs must meet for their circulation, their classification, the testing processes for their certification and the mechanisms that will be used for their identification.

In this context, the city of Madrid integrated the guidelines from the DGT in its Sustainable Mobility Ordinance (Ordenanza 10/2021, por la que se modifica la Ordenanza de Movilidad Sostenible de 5 de octubre de 2018, 2021) in the following manner.

4.3.4.1.1 Definition

Personal mobility vehicles are defined by the national General Vehicle Regulation which limits their maximum speed by construction to 25 km/h. The Sustainable Mobility Ordinance refers to them as PMVs or, interchangeably, as urban mobility vehicles (UMVs). Electric scooters are PMVs.

4.3.4.1.2 General conditions

It is important to note that in all cases:

You must ride with the necessary diligence and caution to avoid damage to yourself or others, avoiding endangering other people using the road.

The general traffic rules established in the Sustainable Mobility Ordinance as well as other regulations and legislation in force on traffic, circulation of motor vehicles and road safety must be respected at all times.

PMVs must carry approved bells, lights and reflective elements. Lights must be used as required by the General Traffic Regulations, and it is advisable to use them at all times.

Only persons over 15 years of age may ride PMV on public roads and spaces. Exceptionally, minors under that age may ride in PMV provided that they are over 10 years old, accompanied and under the responsibility of their parents or guardians in a PMV appropriate to their age, height and weight and protecting their head with an approved or certified helmet.

The use of the homologated or certified helmet is recommended in the circulation of PMV. The use of helmets is mandatory for:

- Drivers under 18 years of age;
- circulating on multimodal lanes (which have the speed limited to 30 km/h);
- and for carrying out an economic activity of transporting goods.

It is forbidden to circulate with headphones connected to sound devices, with the presence of drugs or with alcohol rates in the organism higher than those established in the general traffic regulations.

4.3.4.1.3 Places to circulate

All PMVs may circulate on:

- Ciclocalles;
- bicycle lanes;
- the reserved lane of sidewalk-bike lanes at speeds not exceeding 10 km / h, respecting the right of way for pedestrians at marked crossings and exercising extreme caution in the event of possible irruption of pedestrians;
- cycle paths at a speed of no more than 5 km/h on weekends and public holidays; on weekdays, they must travel at a maximum speed of 5 km/h during peak pedestrian traffic hours and up to 15 km/h at other times.
- cycle paths at speeds not exceeding 20 km/h;
- the roadway of single-platform streets with separators between pedestrians and vehicles at speeds of less than 20 km/h, and at speeds of less than 15 km/h when there are no separators;
- the roadway of streets integrated within 30 zones, respecting pedestrian priority;
- on streets where the maximum speed in all lanes is equal to or less than 30 km/h;
- in public parks, only on those routes allowed for bicycles, at a speed not exceeding 5 km/h if they are paths shared with pedestrians.

In no case may PMVs circulate on sidewalks or spaces reserved for pedestrians, or landscaped areas, or lanes with a maximum speed of 50 km / h, or bus lanes, or on the M-30 road and its accesses and unlit sections of the M30, or in tunnels of urban roads.

The following rules shall be observed in traffic (article 172.2 OMS): All users of a PMV shall circulate in the central part of the lane, upright and standing on the PMV, recommending the use of helmets, which shall be mandatory in multimodal lanes at 30 km/h, for persons under 18 years of age and for the exercise of economic activities; adapting their speed and trajectory to avoid risks.

When circulating on the reserved lane of bicycle sidewalks, bike paths and Zones 20, a distance of at least 1 meter must be kept from pedestrians, and pedestrians must dismount and walk next to the PMV if the occupation and pedestrian movements do not allow them to respect this safety distance.

4.3.4.1.4 Economic activities and leasing without fixed or shared basis

Circulation of PMVs in tourist activities in which the use of the PMV is leased:

PMVs used for conducting tours or tourist guides that include the leasing of the vehicle must have, in order to circulate, with:

(a) the mandatory use of an approved or certified helmet;

b) a compulsory civil liability insurance that covers possible damages that may be caused to third parties;

c) authorization for the circulation of more than 2 persons and a guide, being able to authorize groups of up to 8 persons and a guide;

PMV leasing (shared use):

Short-term, non-fixed-base leasing services of PMVs (known as 'shared-use' PMVs) are expressly regulated:

(a) the company owning the PMVs must have insurance covering civil liability for damages that may be caused to the user, to other persons and property, as well as to the municipal patrimony.

b) PMVs must be approved and comply with the requirements of the Sustainable Mobility Ordinance and the General Vehicle Regulations. They shall be subject to a schedule of controls and the necessary preventive and corrective maintenance. PMVs that are not in a safe circulating condition may not be placed in the public space or leased.

c) the PMVs must be identified and must externally display their owner and their destination for lease.

d) the special use of the local public domain that involves the parking of PMVs for lease without a fixed base on public roads and spaces is subject to municipal authorization, which requires civil liability insurance; the geolocation of the PMVs interoperable with municipal systems and the limitation of the number of vehicles or elements in use in the public space.

4.3.4.1.5 Parking:

The on-street parking conditions for PMVs are common with those established in the Mobility Ordinance for bicycles, pedal-assisted pedal bicycles and all other cycles.

They shall be parked in the spaces specifically reserved and marked for this purpose:

In the reserves located in parking band, being able to be chained to their anchoring and separation elements without damaging them.

In the stations and anchorages specifically reserved for this purpose on sidewalks and parking areas, which must be accessed by walking next to the PMV once they climb from the roadway to the sidewalk.

Exceptionally, when there is no specific reservation for these vehicles duly signposted and visible at less than 50 meters, they may park on the sidewalk of streets not declared pedestrian or of special protection for pedestrians, provided that at least 3 meters are kept free for pedestrians and at least 2 meters with respect to the tactile-visual pavements and bus stop routes, without invading the pedestrian area of bus stops or reservations for Persons with Reduced Mobility (PRM). In this case, they may be anchored to the urban furniture delimiting spaces without hindering their maintenance and never to signs.

Shared-use PMVs (short-term, driverless rental without a fixed base) and food and goods delivery vehicles may park in municipal reserves as long as they do not occupy more than 50% of the existing spaces in each specific reserve.

4.3.4.2 *The Case Study of LEVs in Montevideo, Uruguay*

4.3.4.2.1 Introduction

The Decree 37330 was approved by the Montevideo Departmental Broad in December 2019, regulating several topics related to the urban vehicle categories and requirements for users, vehicles, circulation, and road usage in the city of Montevideo.

Chapter 1 of the Decree establishes certain definitions, among which are the definition of skateboards without impulse, skateboards with impulse, bicycle, pedal-assisted bicycle, pedal tricycle, pedal-assisted tricycle and platform (Segway type). In addition, category "L" vehicles are listed (L1 to L7), establishing a definition within each category, including technical specifications such as maximum speed, cylinder capacity, number of wheels, etc. It should be noted that the established definitions partially coincide with what is established by the European Union Regulation 168/2013, but the coincidence is partial and not total.

The second chapter refers to the safety of the users of these vehicles. It establishes the mandatory use of helmets for all users of all defined vehicles, which must be in compliance with the standards in force and the respective regulations. In the case of category L1, L2, L3, L4, L5, L6 and L7 vehicles, they must wear a buckled safety helmet, with the exception of those users who circulate in a closed cabin or closed passenger transport bodywork. The users of the vehicles included in this article shall wear high visibility clothing, except for those users who circulate in vehicles with closed cabs or bodywork for closed passenger transport.

Finally, third and fourth chapter refers to vehicle safety and circulation provisions respectively, and the last five chapters refer to speed limits, parking, vehicle registration, driver´s licence, prohibitions and sanctions, as described below.

4.3.4.2.2 Regulatory provisions

Security provisions

All vehicles included in the decree must have: a front and rear braking system, rear-view mirrors, bell or horn and a lighting system consisting of a white light headlight and a reflector of the same colour located jointly with it in the front part and a red-light headlight and a reflector of the same colour, placed in the rear part, both visible at a prudent distance in normal atmospheric conditions. In the case of skateboards with and without impulse, bicycles and pedal-assisted bicycles, tricycles and pedal-assisted tricycles, as well as platforms (Segway type), in addition to the equipment mentioned in the preceding paragraph, they must have at least two retro-reflective devices on each of their wheels to enable their lateral reflection and a band of retro-reflective material on both fronts of each of the pedals. Likewise, for L2, L4, L5, L6 and L7 vehicles, it is established that they must be equipped with two or three-point seat belts and head restraints where applicable.

Roads and bike lanes

The fifth chapter refers to the regulations for the circulation of vehicles. It establishes that skateboards with and without impulse, bicycles and pedal-assisted bicycles, as well as platforms (segway type) must circulate on the street, with the exception of those roads where there is infrastructure dedicated to bicycles (bike paths, bicycle lanes, busbikes). In cases where there is infrastructure dedicated to bicycles, this type of vehicle must circulate on the same. The rest of the vehicles covered by this decree must in all cases, circulate on the street.

Speed regulation

The users of the vehicles defined in this decree shall be obliged to respect the different speed limits established for circulation on public roads. Without prejudice to the foregoing, in no case may they develop a maximum speed of:

a) Users of skateboards with and without momentum as well as platforms (segway type), up to 25 km/hour.
b) Users of category L6 vehicles, up to 45 Km/hour.
c) Users of category L1 and L2 vehicles, up to 50 Km/hour.

Parking regulations

Skateboards with and without impulse, bicycles and pedal-assisted bicycles, tricycles and pedal-assisted tricycles, as well as platforms (Segway type) will be prohibited to park in areas disqualified by the Municipality of Montevideo, for this type of vehicles. The rest of the vehicles may only park in authorized areas according to the characteristics of the vehicle and in accordance with the current regulations and its rules.

Vehicle registration

L1, L2, L3, L4, L5, L6 and L7 vehicles must be registered at the Municipality of Montevideo.

Regulations regarding driver's license

Drivers shall be required to obtain the driver's license in accordance with the following:

a) vehicles category L1 and L2 a), b) and c) with handlebars, driver's license category G1.
b) vehicles category L3, L4, L5 and L6 a) and L7 a), driver's license category G2 for vehicles up to 200cc or equivalent nominal power, and G3 for vehicles over 200cc or equivalent nominal power.
c) vehicles category L2 c) with steering wheel, L6 b) and L7 b) driver's license category A or higher.

Prohibitions

The vehicles included in the decree that are not registrable, may only be driven by persons 16 years of age or older. It is also forbidden to provide passenger transportation services in any of the vehicles defined in the decree, except for specific circuits determined by the Municipality of Montevideo.

Regulatory overlapping

Some of these classifications and criteria overlap with national regulations, since the establishment of vehicle classification and vehicle safety conditions are the responsibility of national governments. In this sense, it is necessary to work to establish the corresponding harmonization between local regulations and national regulations. As an example, it should be noted that definitions in Decree 37330 partially matches with those established by the European Union Regulation 168/2013, but there are important mismatches that could be problematic in the near future and should harmonized.

5 Conclusions

Targeted policies and regulations to improve the environment for the safe and effective adoption of light electric vehicle technologies are fundamental both at the national and local level in Latin America. A sound regulatory framework can have a significant impact on the cost of LEVs, enable local manufacturing, import and use of LEVs. In this context, this policy advice paper focused on the international standards and guidelines, such as the Regulation No. 168/2013 (R.168) of the European Parliament and of the Council, "on the approval and market surveillance of two- or three-wheel vehicles and quadricycles", which could serve (has already served) as a relevant reference for the homologation of LEVs in Latin American countries. Homologation is the first step towards formalizing a transport mode that not only is already embedded in the mobility system of many cities in the region, but also towards acknowledging the potential of LEVs to contribute to a sustainable, inclusive and integrated mobility in cities.

At the local level, this policy advice paper has analysed the different aspects that would need to be regulated by municipalities to ensure that LEVs circulate safely in urban areas, without compromising the safety of their users and the one of other vulnerable road users, such as cyclists and pedestrians. Nevertheless, it is worth noting that the change of paradigm ingrained in the promotion of LEV from a sustainable urban mobility perspective, requires not only a change in the regulations, but also in the distribution of road space and the generation of the proper infrastructure to address the needs of these new vehicle types and mobility concepts. Initiatives such as the multimodal lanes adopted by the City of Madrid, the Jelbi Mobility Stations in Berlin and the slow lanes that are gaining traction in the literature should integrated widely in the mobility and urban planning.

Thus, this paper focuses on the main regulations that need to be adopted at the national and local level to promote the use of LEVs in cities. These, however, need to be accompanied by a series of policies, measures and incentives to really untap the full potential of LEVs.

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