

Baseline Study on the private sector related to micromobility, electric transport and last-mile logistics in Peru

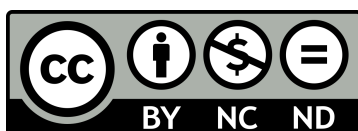
Execution: Lima Cómo Vamos



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April 2023

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The project Study Sustainable Mobility in Peru is supported by the Dutch Ministry of Foreign Affairs of The Netherlands under Dutch development foreign policy, financed by the Private sector development program of the Netherlands Enterprise Agency (RVO.nl)

Acknowledgment

We would like to express our special thanks to the following organizations and people consulted as part of the information gathering process through interviews and meetings, listed below in alphabetical order: AEDIVE PERU, Alfonso Córdova Rau, Autoridad de Transporte Urbano para Lima y Callao - ATU, Bike House Perú, BYCS, CAF - Development Bank of Latin America, Cargo Bike Perú, CIDATT, Emove, Fundación TRANSITEMOS, German cooperation for international development, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GreenLine, Grupo Crosland, Helliot Lévano Vásquez, Jaime Polo Fernández, Javier Chacón Marcés, Jorge Ignacio Asmat, Kallpa Móvil, Mario Chong, Max Elías Figueroa Huamán, Michelle Rodríguez Serra, Ministerio de Vivienda, Construcción y Saneamiento, Ministerio del Ambiente, Modasa - Motores Diesel Andinos SA, Municipalidad Metropolitana de Lima, Ransa Comercial S.A.C., Run City, Scooterland, Transportes Platinum SAC and World Bank.

Executive summary

1. Introduction

This study is part of the project Study Sustainable Mobility in Peru, developed by Lima Cómo Vamos, with the support and financing of the Embassy of the Kingdom of the Netherlands for Peru in Lima (EKN) and the Netherlands Enterprise Agency (RVO). The project aims to exploit the potential of Peru's private sector in terms of solutions and services related to micromobility, electric transport, and last-mile logistics while identifying opportunities for collaboration in the industry between Peru and the Netherlands. This study explores the private sector related to urban mobility and serves as a starting point for future more exhaustive studies. Its content will also help in drafting a road map.

2. Methodology

As a theoretical framework, this study combines the green growth, circular economy, and degrowth approaches according to local needs to achieve sustainable mobility in Peru. The private sector that provides goods and services related to micromobility, electric transport, and last-mile logistics must adapt to these approaches. Opportunities to achieve sustainable mobility in Peru must prioritize the following:

- Human-powered and partly motorized means of transport
- Transport public, cooperative or collective ownership
- Vehicle-sharing, vehicle-pooling and public transit systems
- Local production of transport goods, services, and technologies
- Transport technologies that require less use of raw materials and fossil fuels
- The redesign of cities in line with sustainable urban transport

The study focuses on three fields of sustainable urban mobility defined in line with the theoretical approach and according to local needs in Peruvian cities:

- *Micromobility*. Human-powered or partly motorized low-speed (up to 25 km/h) small devices such as conventional bicycles, cargo bikes, electric bicycles, electric kick scooters, electric unicycles, electric two-wheeled self-balancing vehicles, and electric roller skates
- *Electric transport*. Transport vehicles that make use of one or more electric motors and receive electricity from a sole source or in combination with another energy source (hybrids), whether the electrical energy comes from a rechargeable energy storage system (such as a battery) or directly from the grid (for instance through an overhead wire)
- *Last-mile logistics*. The distribution of goods to micro-retailers and home delivery by light, relatively small, and environmentally and human-friendly vehicles

This study combined the following strategies to collect data: a review of various sources; twenty-three interviews with experts and representatives of private and public, national and foreign, and multilateral organizations; an online workshop with seven private organizations

related to micromobility; and a mission to the Netherlands which allowed meeting Dutch sustainable mobility actors.

3. Context

During the COVID-19 pandemic, cycle and PMD sales rose initially but then fell. The overdemand turned into an oversupply. The pandemic also negatively affected the micromobility vehicle-sharing systems. The rise of micromobility has also benefited the consulting and construction sectors since local governments demand services to develop policies, regulations, and infrastructure. However, working with the public sector has become so unattractive that some practitioners and companies prefer to offer their services to private or foreign organizations. Other sectors with the potential to provide services to grow micromobility are insurance, manufacturing, and maintenance. The micromobility market is sensitive to the regulatory framework and its enforcement. It is necessary to implement mechanisms that ensure the quality of products and reduce the illegal and informal markets.

The Peruvian State is developing the regulatory framework for the massive introduction of EVs and charging infrastructure. Although electric transport is a broad field, the visions and actions of some public and private organizations tend toward light vehicles and individual use and property. Studies' recommendations do not consider vehicle-sharing schemes. During the last years, sales on BEV have not substantially increased. It is necessary to set clear goals related to the minimum number of BEVs required to enter the country so the local market could benefit from an economy of scale. But it is also essential to estimate the maximum desired vehicle fleet in cities and prioritize investments in shared use of cars and public transit systems to avoid the adverse effects of car dependency. The Peruvian market is also composed of locally manufactured vehicles. The use of electric buses for public transit is in its infancy. In 2020, the first battery-electric bus partially manufactured in the country was launched.

Some recent studies focus on last-mile logistics within Lima and Callao, but very few on the distribution to micro-retail stores and home delivery. There is a lack of proper local regulation, which contrasts with the fast development of private initiatives to address consumers' demands. The COVID-19 pandemic has significantly increased home deliveries, and several companies have benefited from the increase in online shopping. Micro-retailing generates problems and challenges in managing the last leg of freight distribution in Peruvian cities. These problems result in low competitiveness, and the increased costs associated with failures in the logistics system impact the final costs of goods and services. Developing proper infrastructures such as micro-warehouses, dark stores, collection points, and loading and unloading zones is necessary.

4. Regulatory framework

Since 2019, the Peruvian National Government has produced laws and regulations, while municipalities have established ordinances in cities related to micromobility. Both have addressed cycles and PMDs as two different groups. Municipalities began to regulate the use of PMDs in line with three simultaneous processes: the arrival of electric kick scooter

rental companies to Lima, the emergence of micromobility stores, and the increase of micromobility users. Three municipalities within the province of Lima led the development of ordinances. Several companies have faced regulatory gaps, unclear regulation, and different local regulatory frameworks within the same territory.

The Peruvian National Government is preparing the regulatory framework for developing electric transport. Studies carried out by the Peruvian State focus mainly on public transport. Nonetheless, recently approved national regulations on charging infrastructure focus primarily on light vehicles and, to a lesser extent, on public transit, while vehicle-sharing systems are absent. In Lima and Callao, some technical standards to introduce hybrid electric buses in public transit corridors in future tender processes are under development.

Local government regulations are vital to securing the distribution of goods to micro-retailers and homes. The juxtaposition of local regulations harms the private sector's development. Logistics operators that carry out their activities in more than one district of the same province must deal with different rules. Last-mile logistics rules are dispersed in multiple sub-metropolitan municipal regulatory frameworks that employ different typologies and criteria. As a result, some experts and studies recommend unifying and simplifying the regulatory framework. In addition to local juxtaposed regulations, there are regulatory gaps and a lack of a national policy on last-mile logistics.

5. Actor analysis

The study classifies the most relevant actors in groups. About micromobility, the main actors are the National Government, local governments, manufacturing and selling businesses, repair and maintenance services, vehicle-sharing and vehicle rentals companies, consulting firms, and cooperation agencies and multilateral organizations. Concerning electric transport, critical actors are the National Government, vehicle importers, sales stores and manufacturers, vehicle rental companies, associations, consulting firms, charging infrastructure technology providers and institutional customers, and cooperation agencies and multilateral organizations. Finally, the most relevant actors in last-mile logistics are the National Government, local governments, logistics operators, vehicle rental companies, vehicle sale businesses, consulting firms, higher education institutions, and cooperation agencies and multilateral organizations.

6. Initiatives

The study identified key initiatives that have taken place over the last five years (2017-2022) in the three fields of study. These initiatives involve local private organizations, multilateral organizations, foreign cooperation agencies for development, and the Peruvian Government. Although the study found several initiatives in urban mobility, twenty of them were considered most relevant for the three fields of study according to the theoretical approach.

7. Economic findings

The findings show the need to allocate more budget to cover the micromobility infrastructure gap in Peruvian urban settlements. There is a considerable difference between the local governments' budgets and the costs of developing cycling infrastructure in Peruvian cities. One way to deal with this shortage of financial resources for the development of micromobility is to receive financial contributions from foreign organizations. Although the development of cycle tracks and parking is essential when fostering traveling on cycles and PMDs, the success of micromobility depends on redesigning the entire urban road networks of each city and the investment in the transport system. The main risk of not investing in the required micromobility infrastructure is the reduction of micromobility travels. Cities would lose micromobility benefits, such as improvements in health, air quality, road safety, and household expenses.

Developing electric transport requires significant investments in charging infrastructure and electric vehicles. Although not explicitly focused on cities, some studies provide relevant data about the investments necessary to develop the electric charging infrastructure network. These studies also identify several benefits of investing in electrifying the transport sector. Benefits include savings in operating and maintenance costs, improved health, increased productivity, and reduced accidents. Not investing in the transition towards electric transport could bring several negative consequences to Peruvian society, such as a greater vulnerability to fossil fuel scarcity and increasing GHG emissions.

The most comprehensive study in last-mile logistics with infrastructure cost estimations for Lima and Callao comes from 2016. It seems that the COVID-19 pandemic changed the dynamics of urban logistics due to physical distancing, electronic commerce, and home delivery growth, which could have affected the findings and proposals of the 2016 study. Although financial information related to building intermodal logistics platforms exists, no investment estimations regarding infrastructure for distribution to micro-retailers and home delivery were found, such as costs of micro-hubs, micro-warehouses, dark stores, pickup points, and on-street loading and unloading zones. The Peruvian State must rapidly invest in enhancing last-mile logistics infrastructure. Otherwise, cities will be more affected by congestion, pollution, and road accidents in the coming years.

8. Sustainable mobility in the Netherlands

Today, Dutch cities lead urban cycling in European countries and are a model for other countries. In line with the growth of cycle journeys, the cycling industry also flourished in Dutch cities. Several companies produce and sell a variety of cycles and provide services and products related to planning, design, and management. Other organizations focus on defending and promoting the cycling culture locally and abroad. Unlike bikes, the Dutch Government does not foster PMD use, particularly electric kick scooters.

Although other European countries have a more developed automotive industry, the Netherlands stands out due to its research on electric and hybrid vehicles, particularly driving systems, batteries, lightweight materials, and automated transport systems. The

expansion of electric transport in the Netherlands seems to come from EV rental companies rather than individual purchases. Dutch companies provide a variety of goods and services, including EV-sharing systems, electric charging infrastructure, data management, and certification of electric charging solutions.

The Netherlands has a recognized experience in urban logistics, for instance, in setting requirements such as emission standards and maximum freight vehicle dimensions to operate in certain areas. An entire ecosystem of Dutch organizations has emerged, covering various key aspects of last-mile logistics, such as software services and data management, provision of small electric commercial vehicles, and freight vehicle eco-driving training. In recent years, the interest in cargo bikes has come back due to new electric storage technologies and global concerns about GHG emissions related to transportation. Some companies offer innovative and large loadspace cargo bikes.

9. Bilateral collaboration opportunities

Potential areas for private sector development and bilateral collaboration for the development of sustainable urban mobility in Peru are classified according to each field of study.

Opportunities in micromobility are cycle design and manufacturing, cycle facility and policy planning and design, cycle and PMD flow management and monitoring, micromobility infrastructure development, regulatory framework development, vehicle-sharing systems development, micromobility vehicle parking systems, micromobility and public transit integration, promotion of micromobility, association of service and goods providers, and research on micromobility. Opportunities in electric transport are vehicle-sharing systems development, public transit systems development, data management for decision making, electric charging infrastructure development, electric transport actors coalition, manufacturing, regulatory and policy framework development, and subsidies and loans. Opportunities in last-mile logistics are logistics infrastructure development, regulatory and policy framework development, urban logistics in cargo bikes and PMDs, last-mile logistics management, driving training, and teaching and research centers cooperation. The road map will explore these opportunities in more detail.

Table of contents

Acknowledgment	1
Executive summary	2
Table of contents	7
List of tables and figures	8
Glossary of acronyms and initialisms	9
1. Introduction	11
2. Methodology	12
2.1. Theoretical framework	12
2.2. Fields of study	15
2.3. Data collection	16
3. Context	17
3.1. Micromobility	17
3.2. Electric transport	18
3.3. Last-mile logistics	21
4. Regulatory framework	22
4.1. Micromobility	22
4.2. Electric transport	24
4.3. Last-mile logistics	26
5. Actor analysis	27
5.1. Micromobility	28
5.2. Electric transport	29
5.3. Last-mile logistics	30
6. Initiatives	31
7. Economic findings	34
7.1. Micromobility	34
7.2. Electric transport	36
7.3. Last-mile logistics	37
8. Sustainable mobility in the Netherlands	38
8.1. Micromobility	38
8.2. Electric transport	38
8.3. Last-mile logistics	39
9. Bilateral collaboration opportunities	40
9.1. Micromobility	40
9.2. Electric transport	42
9.3. Last-mile logistics	44
10. Conclusions	45
Appendix	47
Consulted people and organizations	47
Reference list	48

List of tables and figures

Tables

Table 1. Fields of study	16
Table 2. Micromobility actors	28
Table 3. Electric transport actors	29
Table 4. Last-mile logistics actors	30
Table 5. Initiatives	31
Table 6. Opportunities in micromobility	40
Table 7. Opportunities in electric transport	42
Table 8. Opportunities in last-mile logistics	44

Figures

Figure 1. Electric and hybrid light and heavy vehicle sales	20
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Glossary of acronyms and initialisms

AAP:	Asociación Automotriz del Perú (Automotive Association of Peru)
AEDIVE PERU:	Asociación de Emprendedores para el Desarrollo e Impulso de los Vehículos Eléctricos en el Perú (Association of Entrepreneurs for the Development and Promotion of Electric Vehicles in Peru)
AFD:	Agence Française de Développement (French Development Agency)
ATU:	Autoridad de Transporte Urbano para Lima y Callao (Urban Transport Authority for Lima and Callao)
BEV:	Battery electric vehicle
CAF:	CAF - Development Bank of Latin America
COVID-19:	Coronavirus disease 2019
EKN:	Embassy of the Kingdom of the Netherlands for Peru in Lima
EV:	Electric vehicle
GHG:	Greenhouse gas
GIZ:	German cooperation for international development, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HEV:	Hybrid electric vehicle
IADB:	Inter-American Development Bank
ICEV:	Internal combustion engine vehicle
IPCC:	Intergovernmental Panel on Climate Change
ITDP:	Institute for Transportation and Development Policy
KfW:	KfW – Bank aus Verantwortung (State Development Bank of the Federal Republic of Germany)
MEF:	Ministerio de Economía y Finanzas (Ministry of Economy and Finance)
MINAM:	Ministerio del Ambiente (Ministry of the Environment)
MINEM:	Ministerio de Energía y Minas (Ministry of Energy and Mines)
MML:	Municipalidad Metropolitana de Lima (Municipality of Lima)
MTC:	Ministerio de Transportes y Comunicaciones (Ministry of Transport and Communications)
MVCS:	Ministerio de Vivienda, Construcción y Saneamiento (Ministry of Housing, Construction and Sanitation)
NDC:	Nationally Determined Contribution
OECD:	Organisation for Economic Co-operation and Development
Osinerghmin:	Organismo Supervisor de la Inversión en Energía y Minería (Supervisory Agency for Investment in Energy and Mining)

PHEV:	Plug-in hybrid electric vehicle
PMD:	Personal mobility device
PNTU:	Política Nacional de Transporte Urbano (National Urban Transport Policy)
PRODUCE:	Ministerio de la Producción (Ministry of Production)
PROMOVILIDAD:	Programa Nacional de Transporte Urbano Sostenible (National Sustainable Urban Transport Program)
REEV:	Range extended electric vehicle
RVO:	Netherlands Enterprise Agency
SDG:	Sustainable Development Goals
WB:	World Bank
WHO:	World Health Organization

1. Introduction

Repeatedly, the inhabitants of Lima have identified public transit as one of the most critical problems that affect their quality of life¹. Likewise, the PNTU² identifies various problems related to mobility in cities, such as the poor state of the infrastructure, excessive travel times, insecurity, and low quality of service. Thus, the problems of mobility and urban transport have been discussed and studied by various specialists and public and private organizations, national and foreign, for the last ten years³. The approach that has been gaining relevance to problematize and seek solutions in the sector has been sustainable mobility, paying particular attention to non-motorized mobility and public transport.

In the global context, the "Sixth Assessment Report, Climate Change 2022: Mitigation of Climate Change"⁴ highlights transportation's significant impact on the environment. In line with the above, it highlights the importance of cities investing in non-motorized mobility and public transport to reduce GHG emissions. The report pays attention to the relevance of electrification and the supply chain. In recent years, the development of policies aimed at favoring urban trips on non-motorized means of transport and the transition of the transport sector towards technologies less dependent on fossil fuels have gained relevance⁵. Three fields that have attained particular interest are micromobility, electric transport, and last-mile logistics.

Micromobility, meaning the use of cycles (such as bicycles, electric bicycles, and cargo bikes) and PMDs (such as electric kick scooters and electric unicycles), has been growing interest in Peru⁶. Cycle and PMD shops have experienced a rapid increase in sales during the first year of the COVID-19 pandemic, while cities have had to respond to fast growth in trips on these means of transport⁷ by developing a micromobility-oriented infrastructure⁸. Currently, the Peruvian State is developing the legal framework to implement policies in favor of EVs. Although it is still a nascent sector, the public and private sectors have developed various proposals and projects. Lastly, last-mile logistics have substantially changed due to the COVID-19 pandemic, with the significant increase in electronic commerce and home deliveries.

¹ Public transit is, almost every year, considered the second most critical problem in the city. Lima Cómo Vamos publishes yearly a citizen-based survey to track Lima's quality of life evolution. The following link shares all the reports published since 2010:

<http://www.limacomovamos.org/informesurbanos/>.

² Gobierno del Perú, 2019.

³ Examples, in order of release date, are the following: Fundación TRANSITEMOS et al., 2013; Dextre and Avellaneda, 2014; Gobierno del Perú, 2019; and Lima Cómo Vamos, 2021.

⁴ Intergovernmental Panel on Climate Change, 2022 - Final Draft version, subject to revisions.

⁵ Organizations such as the European Union, WB, IADB and GIZ implement programs and projects that promote these transport options.

⁶ This study uses the terms "cycle" and "PMD" (personal mobility device) since the Peruvian regulatory framework uses similar terms in Spanish: "ciclo" and "VMP" (Vehículo de Movilidad Personal).

⁷ Some studies show an increase in bicycle and electric kick scooter journeys. For instance, two studies carried out by CPI for MML and a survey carried out by Lima Cómo Vamos and Despierta Lima (2020).

⁸ PROMOVILIDAD, a Peruvian National Government program, has supported several local governments in developing cycle tracks during the COVID-19 pandemic.

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The project responds to the priorities of the annual plan of the EKN. It also contributes to achieving the SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) and SDG 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) of the United Nations. The following are some goals pursued by the Netherlands regarding climate and transport: traffic and transport in the Netherlands will not emit harmful exhaust gases and CO₂ in 2050, traffic and transportation will be cleaner and smarter, transport accessibility for all will be improved, traffic flow in cities will be improved, and areas and towns will be well connected. Therefore, the project has the potential to identify direct opportunities to align the Dutch goals and priorities with the development of Peru in terms of sustainable mobility.

This study comprises the following chapters: Chapter 2 presents the study methodology. Chapter 3 analyzes the local context of the three fields of study. Chapter 4 organizes the regulatory framework. Chapter 5 identifies, classifies, and describes the most important actors. Chapter 6 lists outstanding initiatives implemented by private and public, national and foreign, and multilateral organizations. Chapter 7 presents some economic findings related to transport infrastructure. Chapter 8 presents the context of urban mobility in the Netherlands. Chapter 9 identifies bilateral cooperation opportunities. Finally, Chapter 10 shows the conclusions.

2. Methodology

This chapter has three parts: the theoretical framework of the sustainable mobility approach adopted for the project, the definition of the three fields of study, and the data collection method.

2.1. Theoretical framework

Sustainable mobility (often referred to as sustainable transport) is a widely used approach to mitigate the effects of climate change, reduce road accidents, improve urban accessibility, and enhance public health. Various actors adopt this concept, such as governments, intergovernmental organizations, multilateral banks, development cooperation agencies, NGOs, and companies. For instance, the United Nations Secretary General's High-Level

Advisory Group on Sustainable Transport defines the approach as follows: "the provision of services and infrastructure for the mobility of people and goods—advancing economic and social development to benefit today's and future generations—in a manner that is safe, affordable, accessible, efficient, and resilient, while minimizing carbon and other emissions and environmental impacts"⁹. Another example is the WB approach: "Transport is fundamental to supporting economic growth, creating jobs and connecting people to essential services such as healthcare or education (...) Expanding sustainable transport options, especially in low-income or vulnerable communities, is a powerful way for countries to bolster human development and social inclusion"¹⁰. According to these views, sustainable mobility is related to development and economic growth.

Green growth and circular economy are two approaches gaining attention worldwide. According to the OECD, "Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies"¹¹. The European Parliament defines circular economy as follows: "The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended"¹². Some authors recommend adopting an "in-spiral economy" approach instead of talking about a circular economy¹³. In recent years, a new paradigm that critiques the direct relationship between development and economic growth, on the one hand, and wellbeing, on the other, has gained ground in the academic world and discussions around the climate and energy crises. This paradigm called "degrowth" is a sort of umbrella concept. The IPCC mentions the recent degrowth literature since authors address the questionable relationship between prosperity and economic growth, the "just transition", and the ecological boundaries of the planet¹⁴. According to Schneider et al., "Sustainable degrowth may be defined as an equitable downscaling of production and consumption that increases human wellbeing and enhances ecological conditions at the local and global level, in the short and long term. The adjective sustainable does not mean that degrowth should be sustained indefinitely (which would be absurd) but rather that the process of transition/transformation and the end-state should be sustainable in the sense of being environmentally and socially beneficial. The paradigmatic proposition of degrowth is therefore that human progress without economic growth is possible"¹⁵.

At first sight, green growth, circular economy, and degrowth seem incompatible. Nevertheless, countries such as Peru need to combine the findings and proposals of these three approaches to achieve a better quality of life. According to a green growth approach, sectors such as health, agriculture, education, and transportation require the development of

⁹ United Nations, 2016: p. 7.

¹⁰ World Bank, 29 March 2022.

¹¹ Organisation for Economic Co-operation and Development, n.d.

¹² European Parliament, 26 April 2022.

¹³ According to the second law of thermodynamics, the "use of energy is inexorably linked with its degradation" (Valero and Valero, 2019: p. 5). Valero and Valero add the following: "Because absolute circularity does not exist, the economic practice should recognize the spiral nature of recycling processes" (2019: p. 12).

¹⁴ Intergovernmental Panel on Climate Change, 2022 - Final Draft version, subject to revisions: p. 1-41.

¹⁵ Schneider et al., 2010: p. 512.

industries that respond to local needs, particularly those of the most vulnerable groups. At the same time, some human and environmentally damaging production and consumption patterns (such as a growing car dependency when it comes to mobility patterns) should turn into more sustainable practices. A degrowth approach can enlighten this change process toward societies away from an endless economic growth logic that threatens humanity and the planet. In other words, combining green growth in some fields with degrowth in others is necessary. A circular economy approach (or maybe an in-spiral economy approach) should frame this process.

Based on a sustainable mobility approach, a frequent recommendation by several organizations and studies is to invest in active mobility and public transit. Target 11.2 from the United Nations General Assembly's SDG 11 indicates expanding public transport in cities¹⁶. One of the GIZ 10 principles for sustainable urban transport is encouraging walking and cycling. The IPCC points out something similar: "Strategies for established cities to achieve large GHG emissions savings include (...) supporting non-motorised (e.g., walking, bicycling) and public transport"¹⁷. Following degrowth criteria, Cattaneo et al. evaluate different urban mobility options, including non-motorized transportation and public transit¹⁸. They explain that private motorized vehicles are undesirable due to their social and environmental impacts, a persistent statement in sustainable mobility literature. But the authors add the following: although public transport is a desirable option, it "depends on long-term investment in costly infrastructure [and] cannot contribute sufficiently to the rapid change of mobility patterns that climate change and pandemic emergencies indicate is required"¹⁹. Thus, "attention must be given primarily to active and hybrid options, and those that operate on a sharing/pooling basis"²⁰. Finally, the authors argue for collective property and sharing instead of a corporate and individual property²¹.

Sustainable transport development is only possible when cities change into more sustainable urban patterns. For instance, promoting walking and cycling is a lost cause in low urban concentration territories. Therefore, city design and urban transport policies should work together. But change is required not only in the urban design field since urban planning and management changes are also necessary. Savini critiques the current planning practices and suggests ways to adapt cities to degrowth goals²². The author proposes autonomy, meaning the "community's capacity to independently provide biophysical, material, and social resources for its survival and prosperity"²³. Within the transport industry, autonomy could mean progressively reducing dependence on foreign transport technologies and products while developing a local transport industry able to respond to local needs.

In conclusion, to achieve sustainable mobility in Peru, it is necessary to combine the green growth, circular economy, and degrowth approaches according to local needs. The private sector, a key piece for success, should frame within the sustainable mobility approach in line

¹⁶ United Nations. (n.d.).

¹⁷ Intergovernmental Panel on Climate Change, 2022 - Final Draft version, subject to revisions: p. SPM-39.

¹⁸ Cattaneo et al., 2022.

¹⁹ Cattaneo et al., 2022: p. 24.

²⁰ Cattaneo et al., 2022: p. 22.

²¹ Cattaneo et al., 2022: p. 5.

²² Savini, 2021.

²³ Savini, 2021: p. 1085.

with the presented theory. As a result, this study uses criteria based on the proposed approaches to identify opportunities for bilateral collaboration on sustainable mobility development:

- C1. Human-powered²⁴ and partly motorized means of transport²⁵ are, in general, more desirable for urban journeys than motorized vehicles²⁶.
- C2. Transport public, cooperative or collective ownership is a preferable option to a private for-profit or single-person ownership.
- C3. Vehicle-sharing, vehicle-pooling and public transit systems are more sustainable options than personal motorized vehicle use.
- C4. As far as possible, local production must replace imported transport goods, services and technologies in the long term.
- C5. Urban transport must stop using polluting technologies to start using technologies that require less use of raw materials and fossil fuels.
- C6. The redesign of cities should go hand in hand with the shift toward sustainable urban transport.

2.2. Fields of study

Micromobility is a growing sector with no consensus over its definition. The ITDP addresses micromobility as follows: "Micromobility, though not yet universally defined, has been used to refer to a number of different modes. In this report, we use the term 'electric micromobility' to refer to electric-powered modes of transport that are low-speed (comparable to a bicycle), small, lightweight, and typically used for short distance trips. These include primarily electric bicycles and standing e-scooters, but also other small electric devices, and can be shared or personally owned"²⁷. Although micromobility is commonly associated with electrical-powered devices, it is not strictly limited to theme. In a broader sense, micromobility includes all those human-powered or partly motorized low-speed small devices, such as conventional bicycles, cargo bikes, electric bicycles, electric kick scooters, electric unicycles, electric two-wheeled self-balancing vehicles, and electric roller skates.

Electric transport is commonly associated with BEVs and HEVs, mainly light vehicles, such as electric cars. For instance, the German Federal Ministry for Digital and Transport says that "The term electric mobility (also known as eMobility) stands for forms of movement using electric motors. Cars, buses, commercial vehicles, trains, bicycles and motorcycles, ships and smaller aircraft – all can be powered by electric energy. An electrically powered vehicle within the meaning of the Electric Mobility Act is an all-battery electric vehicle, an externally chargeable hybrid electric vehicle or a fuel cell powered vehicle"²⁸. The field of electric transport is much broader than BEVs or HEVs and includes all those vehicles that operate partially or entirely based on electricity. In other words, electric transport is not only about vehicles achieving a certain degree of autonomy through energy storage devices,

²⁴ Cattaneo et al. (2022: p. 4) call them "active modes", such as walking and cycling.

²⁵ Cattaneo et al. (2022: p. 5) call them "hybrid means", which are similar to active but partly motorized, such as electric kick scooters and electric bikes.

²⁶ Such as cars and motorbikes.

²⁷ Institute for Transportation and Development Policy, 2019: p. 5.

²⁸ Federal Ministry for Digital and Transport, 21 August 2019.

such as batteries, but also about vehicles receiving electricity directly from the grid through overhead wires, such as trams and trolleybuses. The Dutch experience fits within this broader definition since the Netherlands is a worldwide model in electric transport due to its vast electric rail network and its efforts in electrifying several automotive sectors such as cars, public transit, and freight transport.

Last-mile logistics is the last leg of the supply chain. As part of city freight distribution, logistics operators provide goods to micro-retailers and homes. Conventional freight transport vehicles, such as trucks, can negatively impact dense parts of urban settlements causing road accidents, pollution, and damage to public spaces. Due to the increase in electronic commerce and home delivery, and the impact of freight transport GHG emissions on Climate Change, last-mile logistics has emerged as a field of interest. In the Netherlands, the use of cargo bikes and small EVs for good distribution is an increasing practice with the support of the Dutch Government. A survey conducted by CityChangerCargoBike²⁹, supported by the European Union's Horizon 2020 program, shows that the cargo bike industry is a growing sector. From a sustainable mobility point of view, urban logistics vehicles for distribution to micro-retail stores and home delivery should be light, relatively small, and human and environmentally friendly.

Table 1 defines the three fields of study.

Table 1. Fields of study

Field	Definition
Micromobility	Human-powered or partly motorized low-speed (up to 25 km/h) small devices such as conventional bicycles, cargo bikes, electric bicycles, electric kick scooters, electric unicycles, electric two-wheeled self-balancing vehicles, and electric roller skates
Electric transport	Transport vehicles that make use of one or more electric motors and receive electricity from a sole source or in combination with another energy source (hybrids), whether the electrical energy comes from a rechargeable energy storage system (such as a battery) or directly from the grid (for instance through an overhead wire)
Last-mile logistics	The distribution of goods to micro-retailers and home delivery by light, relatively small, and environmentally and human-friendly vehicles

Source: own elaboration based on the theoretical framework and approach.

2.3. Data collection

This study combined three strategies to collect information. The first consisted of reviewing various sources (such as laws, regulations, ordinances, studies, plans, manuals, guides, and news). The second was interviews and an online workshop. The interviews were requested with experts and representatives of private and public, national and foreign, and multilateral organizations. In addition, various private organizations (businesses) related to micromobility were asked to participate in a workshop. Most people and organizations agreed to the requests. The list of people and organizations consulted is shown in the appendix. Seven

²⁹ CityChangerCargoBike, 20 September 2021.

organizations participated in the online workshop, and twenty-three people (experts and representatives of various organizations) agreed to be interviewed. Finally, the third was a mission with the Colombian delegation to the Netherlands within the framework of the Intertraffic event held in Amsterdam between March 29 and April 1, 2022, which allowed meeting Dutch sustainable mobility actors. The information gathered through these three strategies has been systematized for this study.

3. Context

This chapter analyzes the local context of urban mobility, emphasizing the business environment of the three fields of study.

3.1. Micromobility

With the arrival of PMDs (mainly electric kick scooters) to Peruvian cities, 2019 was a crucial year for the development of micromobility in Peru. The National Government and municipalities started to produce a more precise and complete regulatory framework related to cycles and PMDs based on laws, regulations, manuals, and ordinances. In the private sector, several ventures took place in Lima: three electric kick scooter rental startups with foreign private capital (Movo, Grin, and Lime) started to operate in some areas of Lima, and a bicycle-sharing system (CityBike Lima), in Miraflores, a high-income district. It is essential to note that these systems were preceded by the public bicycle program San Borja en Bici, launched in 2012 and managed by the Municipalidad de San Borja (Municipality of San Borja), which involved private economic participation based on financing infrastructure by advertising³⁰.

While the COVID-19 pandemic played a central role in the rise of sales and use of cycles and PMDs, it also negatively affected the vehicle-sharing businesses and micromobility shops. In the year before the pandemic, shared systems generated a lot of interest from the community. Still, the actions adopted by the Peruvian State during the outbreak, which included mandatory social isolation, damaged the business schemes of the electric kick scooter rentals ventures. Initially, the startups tried to reformulate their business strategies, but soon everything ended with the departure of the three companies from the country. Of the four systems that began operations in 2019, only CityBike Lima survived. According to some workshop participants and interviewees, the second half of 2021 meant a setback for micromobility shops' sales. The initial enthusiasm of micromobility shops and new users during the first months of the pandemic flooded the local market with micromobility devices. The overdemand suddenly turned into an oversupply of imported vehicles. Additional external factors hit the local industry: the global energy crisis and the mobility restrictions in several countries affected by the pandemic involved increasing the prices of certain raw materials and freight rates.

³⁰ Westreicher, 13 November 2012.

The rise of micromobility has also benefited the consulting and construction sectors since local governments demand services related to the design, planning, management, and development of policies, regulations, and infrastructure. Establishing the framework of policies and regulations (such as programs, laws, and ordinances) and implementing the infrastructure (such as bike paths and bicycle parking) requires the participation of professionals and companies that provide advice and services to the Peruvian National Government, its agencies and municipalities. However, according to the professionals consulted, some problems constrain the potential of consulting services: low-quality and scarce public data (such as indicators and studies), poor professional skills and knowledge of public servants who are in charge of projects and coordination with the private sector, local governments with a limited scope of actions since several local projects depend on funding and approval from the Peruvian National Government, and few local practitioners with extensive experience. Working with the public sector has become so unattractive that some practitioners and companies in the consulting industry prefer to offer their services to private or foreign organizations (such as private companies, cooperation agencies, and multilateral banks).

Other sectors with the potential to grow are insurance, manufacturing, and maintenance. While other countries' local markets offer insurance products to micromobility users (such as accident and vehicle insurance), Peruvian companies would not be keen on providing these products due to high road accidents and robbery rates. The local cycle manufacturing industry is relatively small. Some small businesses manufacture cycles for the local market, such as JANKO - Ecobicicletas, which offers bicycles with bamboo frames, and Cargo Bike Perú, which manufactures bicycles and cargo bikes on demand. Other businesses produce for foreign markets, such as Marino Bike, which makes custom bicycle frames. Larger national private companies, such as Modasa - Motores Diesel Andinos SA, which owns the brand ZAFIRO, are part of the market. ATU designed an affordable bicycle prototype to be produced with local manufacturers, but the project halted during the COVID-19 pandemic³¹. A growing local market creates several opportunities: the more significant the growth of the cycle market, the greater the potential to flourish cycle maintenance and repair shops.

Finally, the micromobility market is sensitive to the regulatory framework and its enforcement. Consulted businesses pointed out that sellers who offer low-quality products harm businesses that comply with regulations, such as cycle and PMD shops that import vehicles designed to comply with the maximum speed allowed and safe accessories. In this sense, it is necessary to implement mechanisms that ensure the quality of products and reduce the illegal and informal markets.

3.2. Electric transport

Currently, the Peruvian State is developing the regulatory framework for the massive introduction of EVs and charging infrastructure. The private sector is accompanying this process through two automotive industry associations that, in recent years, have drawn up

³¹ León, 24 June 2020.

plans for developing electric transport in Peru. On the one hand, AAP published a national electric transport plan in 2021. On the other hand, AEDIVE PERU published a national charging infrastructure plan in 2022. Although electric transport is a broad field (which includes electric buses and trains), the visions and actions of some public and private organizations tend toward light vehicles and individual use and property. While the planning proposals from the private sector consider public transit, the proposed incentives and investments for EVs and HEVs acquisition and use prioritize personal use. If the Peruvian State does not design any national policy and specific plans to regulate the ownership and use of private cars and promote vehicle-sharing programs and public transit systems, problems related to EVs will replace current issues related to ICEVs. Even though EVs reduce GHG emissions related to car usage, they do not solve issues such as the high occupation of public space, the high rate of road accidents, and the negative impact on ecosystems related to car manufacture³². It is essential to point out that the study's recommendations prepared for AAP do not consider vehicle-sharing schemes, a void also found in the priorities identified in a study published by Osinergmin³³.

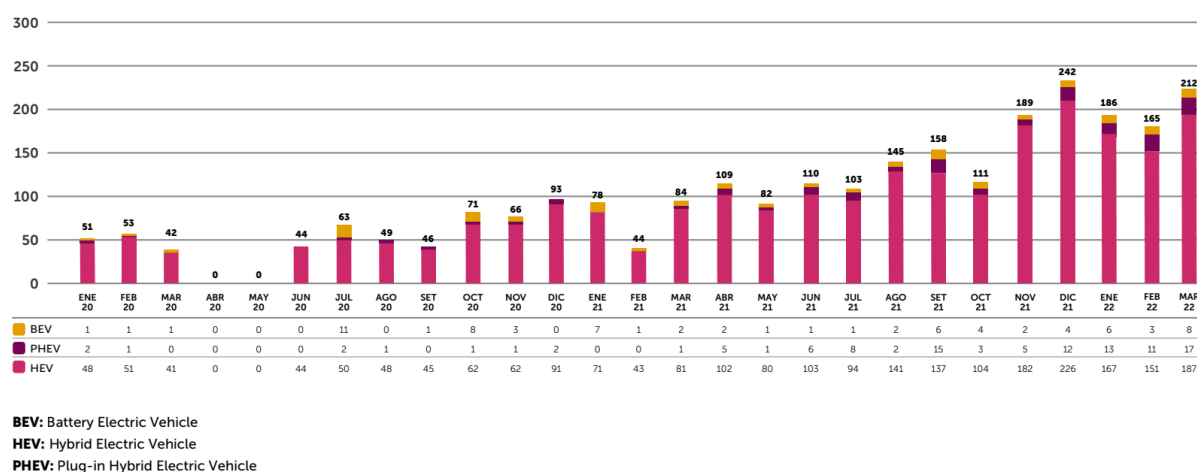
Figure 1 shows an increase in light and heavy EV and HEV sales between February 2020 and March 2022. A comparison of March of each year indicates that sales are slightly more than doubled compared to the previous year (42 in 2020, 84 in 2021, and 212 in 2022). However, the data also shows that the monthly sales of the last two years have not led to a substantial change in the specific category of BEV. Consulted people linked to the industry mentioned the existence of various local initiatives to import EVs. They also noted that the Peruvian State should set clear goals related to the minimum number of BEVs required to enter the country so that the field of electric transport can benefit from an economy of scale and, in that sense, accelerate the transition from ICEVs to BEVs. To reduce the problems related to car usage, it is also essential to estimate the maximum desired vehicle fleet in cities and prioritize investments in shared use of cars (such as car rental schemes and car-sharing programs) and public transit systems. The advantage of sharing vehicles is that they reduce the number of units produced and private purchases by individuals. In addition, they also optimize the use of cars and public spaces. Toyota's recent initiative, KINTO SHARE Perú, is an example of a car-sharing strategy.

³² In this regard, Valero et al. (2018) analyze the various materials required to manufacture battery-powered electric vehicles.

³³ Schmerler et al., 2019.

Figure 1. Electric and hybrid light and heavy vehicle sales

VENTA DE VEHÍCULOS LIVIANOS Y PESADOS ELECTRICOS E HÍBRIDOS



Source: Asociación Automotriz del Perú, March 2022.

The Peruvian market is also composed of locally manufactured vehicles. There is a small national industry that manufactures buses. In 2020, the first battery-electric bus partially manufactured in the country was launched³⁴. This bus, called E-Titán, resulted from a joint effort between the Peruvian company Modasa - Motores Diesel Andinos SA and the French company Engie with an investment of USD 1.4 million. The vehicle is a 12 m long urban bus with the capacity to transport 85 people and a range of approximately 200 km. According to the information gathered in the interviews, this first design would open the door to developing a wide range of vehicles for passenger transport. In 2022, the Municipalidad de San Isidro (Municipality of San Isidro), in the city of Lima, launched a free battery-electric bus service called Expreso San Isidro³⁵ with three buses with front racks to carry bicycles. ATU is designing technical standards to introduce hybrid electric buses to the public transport system in Lima and Callao³⁶. Similarly, PROMOVILIDAD could help various provincial municipalities carry out similar processes with electric buses imported or partially produced in Peru.

As mentioned before, although electric transport is today associated with energy storage devices, such as batteries, it is not restricted to this technology. It also includes electric vehicles that obtain energy directly from the grid network during their operation (such as tramways, trolleybuses, and cable cars). Currently, only an urban electric train operates in the country: Línea 1 of Metro de Lima y Callao (Line 1 of Lima and Callao Metro). A second metro line and a branch of a third one are under construction in the same area. But the Peruvian State's approach to electric mass transit could be changing. The Peruvian National Government recently announced its intention to build monorails in several cities³⁷. Moreover,

³⁴ Modasa - Motores Diesel Andinos SA., n.d.

³⁵ Municipalidad de San Isidro, n.d.

³⁶ Andina, 26 May 2022.

³⁷ Economía LR., 10 January 2022.

in Lima, it was announced in 2022 the execution of three cable cars, one with private investment³⁸ and two with public investment³⁹.

3.3. Last-mile logistics

Several studies have been carried out on logistics in Peru during the last two decades, particularly in Lima and Callao. These studies address various issues: road freight transport services, freight vehicles flow, freight volume, rail freight transport, freight routes, logistics corridors, storage and distribution centers, truck centers, loading and unloading zones, and Intelligent Transportation Systems (ITS). Some interviewees consider a study published in 2016 the most complete⁴⁰. It identifies the most important previous studies that address the urban distribution of goods to some extent: eight addressing the national territory, and eight focused on Lima and Callao. Some recent studies focus on last-mile logistics within Lima and Callao⁴¹.

Of the three fields addressed by this study, last-mile logistics related to the delivery to micro-retail stores and homes is the one with less research and planning studies. An exception is the "Observatorio de Lima"⁴² (a local observatory from the Universidad del Pacífico) which has some studies and projects that address these topics. There is also a lack of proper local regulation, which contrasts with the fast development of private initiatives to address consumers' demands.

According to some people consulted and publications, the COVID-19 pandemic would have significantly increased home deliveries. A news published in February 2021 indicates that, according to Touch Task, the home delivery industry grew by 250% during the pandemic and that roughly 50,000 people delivered purchases either on motorcycles or bicycles⁴³. The number of app-based delivery workers would have reached about 10,000 by October 2020⁴⁴. Home delivery growth is related to electronic commerce growth. The 2021 annual report of the Cámara Peruana de Comercio Electrónico (Peruvian Chamber of Electronic Commerce) shows how electronic commerce during 2020, despite an initial drop in the weeks following the start of the social isolation due to the pandemic, exceeded pre-pandemic growth expectations⁴⁵. Several companies have benefited from the increase in online shopping. For example, Rappi, the company that entered the local market in 2018, grew in services and users during the pandemic⁴⁶. It is not a Peruvian phenomenon but a global one. And

³⁸ Andina, 19 January 2022.

³⁹ Redacción EC, 9 March 2022.

⁴⁰ Táryet and Teirlog Ingeniería, 2016.

⁴¹ Some examples are the following: Winkenbach et al., 2018; Regal et al., 2019; and Huivin et al., 2020.

⁴² Observatorio de Lima is an online observatory. For more detailed information, see its website: <https://www.observatoriodelima.org/>.

⁴³ Lozano, 9 February 2021.

⁴⁴ Redacción RPP, 19 October 2020.

⁴⁵ Cámara Peruana de Comercio Electrónico, 2021.

⁴⁶ In addition to Cámara Peruana de Comercio Electrónico (2021), the following sources can be reviewed: Redacción RPP, 25 September 2020; and Maza, 16 March 2021.

although it generates various opportunities in the private sector, as will be seen later, it is also related to multiple city problems.

Last-mile logistics is a reasonably complex field with peculiar characteristics in Peruvian cities. Unlike other cities, where large stores (such as supermarkets and shopping malls) are the primary consumer attraction centers, micro-retail is the predominant way of consumption in Peruvian cities such as Lima. Micro-retailing generates problems and challenges in managing the last leg of freight distribution. According to consulted experts and organizations, as well as the review of the existing literature, the following are recurrent problems: increases in logistical costs related to failed deliveries, heterogeneous regulations within a city that make it difficult for logistics operators to comply with rules, road congestion due to the use of lorries that make multiple deliveries, occupation of scarce public spaces by large freight vehicles, absence of well-designed loading and unloading zones, informality of various logistics operators that affects the performance of those that comply with established standards, use of informal warehouses in the absence of adequate infrastructure, recurrent violations of logistics regulations that impact the economy of businesses, and inappropriate behaviors of freight vehicle drivers. The problems mentioned above result in low competitiveness, and the increased costs associated with failures in the logistics system impact the final costs of goods and services.

Even though the problems, there are several opportunities to develop the private sector of last-mile logistics. Urban logistics operators can acquire new vehicles with cleaner technologies and smaller dimensions that are safer for pedestrians and non-motorized vehicle users. It is necessary to develop proper infrastructures such as micro-warehouses, dark stores, collection points, and loading and unloading zones. Logistics operators can introduce new software and technologies to manage their fleet. There is also room for collaboration between the academic sector and municipalities to improve the conditions of urban logistics in local settings⁴⁷.

4. Regulatory framework

This chapter analyzes critical issues of the regulatory framework and lists the primary laws, policies, regulations, and Peruvian State specialized documents of each of the three fields of study.

4.1. Micromobility

Since 2019, through MTC, the Peruvian National Government has produced laws and regulations, while municipalities have established ordinances in cities related to micromobility. Both have addressed cycles and PMDs as two different groups. To promote and regulate the use of cycles, the Peruvian National Government enacted Law No. 30936

⁴⁷ For instance, the Universidad del Pacífico (a Peruvian university) supported the Municipalidad de Miraflores (Municipality of Miraflores), resulting in an ordinance regulating loading and unloading goods in public spaces. See Municipalidad de Miraflores (17 October 2019).

in 2019 and its regulations in 2020. Through Supreme Decree No. 023-2021-MTC, MTC included a definition of PMDs to the "Reglamento Nacional de Vehículos" (National Vehicle Regulations) in 2019, later supplemented through Supreme Decree No. 023-2021-MTC in 2021, which incorporated PMDs into the "Reglamento Nacional de Tránsito" (National Traffic Regulations). In 2022, the Peruvian National Government approved the strategic actions of the NAMA Transporte Urbano Sostenible del Perú - NAMA TRANSPerú (Nationally Appropriate Mitigation Actions of Sustainable Urban Transport of Peru) developed by a multisectoral working group led by MTC. Ten strategic actions (from 14 to 23) have been designed to develop non-motorized transportation.

Municipalities began to regulate the use of PMDs in line with three simultaneous processes: the arrival of electric kick scooter rental companies to Lima, the emergence of micromobility stores, and the increase of micromobility users. Three municipalities within the province of Lima led the development of ordinances, which are listed later below. According to the consulted people, the electric kick scooter rental companies that arrived faced regulatory gaps, unclear regulation, and different local regulatory frameworks within the same territory. Companies had to coordinate with different actors simultaneously: on the one hand, the Peruvian National Government, and on the other hand, several local authorities within the same province, each of them with different expectations and regulations. This tangle of rules and regulations, very restrictive in the beginning, hampered the expansion of these systems and discouraged PMD users.

Peruvian National Government regulatory framework:

- Decreto Supremo N° 012-2019-MTC Dispone la aprobación de la Política Nacional de Transporte Urbano⁴⁸ (Supreme Decree No. 012-2019-MTC Approval of the National Urban Transport Policy)
- Ley N° 30936 Ley que promueve y regula el uso de la bicicleta como medio de transporte sostenible⁴⁹ (Law No. 30936 Law that promotes and regulates the use of bicycles as a sustainable means of transport)
- Resolución Ministerial N° 308-2019 MTC/01.02 Incorpórense los numerales 88), 89) y 90) al Anexo II del Reglamento Nacional de Vehículos, aprobado por Decreto Supremo N° 058-2003-MTC⁵⁰ (Ministerial Resolution No. 308-2019 MTC/01.02 Modifications of the National Vehicle Regulations)
- Decreto Supremo N° 012-2020-MTC Aprobar el Reglamento de la Ley N° 30936, Ley que Promueve y Regula el Uso de la Bicicleta como Medio de Transporte Sostenible⁵¹ (Supreme Decree No. 012-2020-MTC Approve the Regulations of Law No. 30936)
- Decreto Supremo N° 023-2021-MTC Modifica el Reglamento Nacional de Tránsito aprobado por Decreto Supremo N° 033-2001-MTC y el Reglamento Nacional de Vehículos aprobado por Decreto Supremo N° 058-2003-MTC para establecer las reglas de circulación de los vehículos de movilidad personal y otras disposiciones⁵² (Supreme Decree No. 023-2021-MTC Amends the National Traffic Regulations and

⁴⁸ Ministerio de Transportes y Comunicaciones, 10 April 2019.

⁴⁹ Congreso de la República, 24 April 2019.

⁵⁰ Ministerio de Transportes y Comunicaciones, 29 April 2019.

⁵¹ Ministerio de Transportes y Comunicaciones, 4 June 2020.

⁵² Ministerio de Transportes y Comunicaciones, 3 July 2021.

the National Vehicle Regulations to establish the traffic rules for personal mobility vehicles and other provisions)

- Decreto Supremo N° 003-2022-MINAM Declaran de interés nacional la emergencia climática⁵³ (Supreme Decree No. 003-2022-MINAM The climate emergency is declared of national interest)
- Resolución Ministerial N° 123-2022-MTC/01.02 Aprobar la “Matriz de Actividades Estratégicas que permitan la mitigación de los Gases de Efecto Invernadero en el Sector Transporte Urbano”, elaborada por el “Grupo de Trabajo Multisectorial de la NAMA Transporte Urbano Sostenible del Perú - NAMA TRANSPerú”⁵⁴ (Ministerial Resolution No. 123-2022-MTC/01.02 Approve the "Matrix of Strategic Activities that allow the mitigation of Greenhouse Gases in the Urban Transport Sector", prepared by the "Multisectoral Working Group of the NAMA Sustainable Urban Transport of Peru - NAMA TRANSPerú")

Peruvian National Government documents related to micromobility:

- Manual para ciclistas del Perú: Reglas y recomendaciones para el uso de la bicicleta y otros ciclos⁵⁵ (Manual for cyclists of Peru: Rules and recommendations for the use of bicycles and other cycles)
- Guía de Implementación de Sistemas de Transporte Sostenible no Motorizado⁵⁶ (Guide for the Implementation of Non-Motorized Sustainable Transport Systems)

Local governments' regulatory frameworks examples in Lima:

- Miraflores District: Ordenanza N° 524/MM Aprueban Ordenanza que promueve la convivencia en espacios públicos en el distrito de Miraflores⁵⁷ (Ordinance No. 524/MM Promotes coexistence in public spaces in the district of Miraflores)
- San Borja District: Ordenanza N° 624-MSB Ordenanza que declara de interés la promoción de la movilidad intermodal y reglamenta el uso responsable de vehículos de movilidad individual en el distrito⁵⁸ (Ordinance No. 624-MSB Declares the promotion of intermodal mobility of interest and regulates the responsible use of individual mobility vehicles in the district)
- San Isidro District: Ordenanza N° 507-MSI Ordenanza que regula el uso y operación de los vehículos de movilidad personal en el distrito de San Isidro⁵⁹ (Ordinance No. 507-MSI Regulates the use and operation of personal mobility vehicles in the district of San Isidro)

4.2. Electric transport

⁵³ Ministerio del Ambiente, 25 January 2022.

⁵⁴ Ministerio de Transportes y Comunicaciones, 1 March 2022.

⁵⁵ Ministerio de Transportes y Comunicaciones, 2020a.

⁵⁶ Ministerio de Transportes y Comunicaciones, 2020b.

⁵⁷ Municipalidad de Miraflores, 17 October 2019.

⁵⁸ Municipalidad de San Borja, 24 April 2019.

⁵⁹ Municipalidad de San Isidro, 6 October 2019.

The Peruvian National Government is preparing the regulatory framework for developing electric transport⁶⁰. MINEM, the ministry responsible for the regulation, focuses on EVs, BEVs, PHEVs and REEVs. So, vehicles that operate receiving energy directly from the grid without storing it, such as trolleybuses and trains, are not prioritized⁶¹. Studies carried out by the Peruvian State, in particular those framed within the NAMA de Transporte Terrestre Eléctrico (Nationally Appropriate Mitigation Actions of Electric Land Transport), focus mainly on public transport⁶². Nonetheless, recently approved national regulations by MINEM related to charging infrastructure focus primarily on light vehicles and, to a lesser extent, on public transit, while vehicle-sharing systems are absent. A MINAM Supreme Decree declaring the climate emergency of national interest urges various ministries and State agencies to deploy several actions on that subject. Accordingly, MTC must propose measures to promote electric, hybrid, and hydrogen-powered vehicles.

MTC plays a central role in electrifying public transit systems. In this regard, the NAMA TRANSPerú, mentioned before, defines four strategic actions directly related to electric public transit in Lima and Callao (strategic actions 1, 2 and 3 about the electric train system, and strategic action 40 about the bus system). Strategic action 42 is related to the charging infrastructure regulation. Strategic action 43 concerns the inclusion of EVs into the "Reglamento Nacional de Vehículos" (National Vehicle Regulations). Finally, strategic action 44 aims to facilitate the use of EVs in the road network. In line with this NAMA, ATU is developing technical standards to introduce hybrid electric buses in public transit corridors in future tender processes in Lima and Callao. Vehicle-sharing systems are also missing in the MTC regulatory framework.

Peruvian National Government regulatory framework:

- Decreto Ley N° 25844 Ley de Concesiones Eléctricas⁶³ (Decree Law No. 25844 Electricity Concessions Law)
- Ley N° 27345 Ley de Promoción del Uso Eficiente de la Energía⁶⁴ (Law No. 27345 Law for the Promotion of the Efficient Use of Energy)
- Decreto Supremo N° 053-2007-EM Aprueban Reglamento de la Ley de Promoción del Uso Eficiente de la Energía⁶⁵ (Supreme Decree No. 053-2007-EM Regulations of the Law for the Promotion of the Efficient Use of Energy)
- Decreto Supremo N° 064-2010-EM Aprueban la Política Energética Nacional del Perú 2010-2040⁶⁶ (Supreme Decree No. 064-2010-EM Approves the National Energy Policy of Peru 2010-2040)
- Decreto Supremo N° 022-2020-EM Decreto Supremo que aprueba disposiciones sobre la infraestructura de carga y abastecimiento de energía eléctrica para la

⁶⁰ EY (2021: p.) presents a more detailed regulatory framework with a timeline of actions taken from 2018 to 2020 to develop electric transport in Peru.

⁶¹ Interviewees were more inclined to use new technologies, such as BEVs, than traditional technologies, such as vehicles using overhead wires.

⁶² Information about the NAMA de Transporte Terrestre Eléctrico and studies related to the electrification of public transit can be found in the following link:

<https://namasenergia.minem.gob.pe/es-pe/subpagina/namatransporte>.

⁶³ Gobierno del Perú, 19 November 1992.

⁶⁴ Congreso de la República, 8 September 2000.

⁶⁵ Organismo Supervisor de la Inversión en Energía y Minería, 23 October 2007.

⁶⁶ Organismo Supervisor de la Inversión en Energía y Minería, 24 November 2010.

movilidad eléctrica⁶⁷ (Supreme Decree No. 022-2020-EM Provisions on the infrastructure for charging and supplying electricity for electric transport)

- Resolución Ministerial N° 189-2021-MINEM/DM Proyecto de Decreto Supremo que aprueba el Reglamento para la Instalación y Operación de la Infraestructura de Carga de la Movilidad Eléctrica⁶⁸ (Ministerial Resolution No. 189-2021-MINEM/DM Draft Supreme Decree approving the Regulations for the Installation and Operation of Electric Transport Charging Infrastructure)
- Decreto Supremo N° 003-2022-MINAM Declaran de interés nacional la emergencia climática⁶⁹ (Supreme Decree No. 003-2022-MINAM The climate emergency is declared of national interest)
- Resolución Ministerial N° 123-2022-MTC/01.02 Aprobar la “Matriz de Actividades Estratégicas que permitan la mitigación de los Gases de Efecto Invernadero en el Sector Transporte Urbano”, elaborada por el “Grupo de Trabajo Multisectorial de la NAMA Transporte Urbano Sostenible del Perú - NAMA TRANSPerú”⁷⁰ (Ministerial Resolution No. 123-2022-MTC/01.02 Approve the "Matrix of Strategic Activities that allow the mitigation of Greenhouse Gases in the Urban Transport Sector", prepared by the "Multisectoral Working Group of the NAMA Sustainable Urban Transport of Peru - NAMA TRANSPerú")

Peruvian National Government documents related to electric transport:

- Electromovilidad. Conceptos, políticas y lecciones aprendidas para el Perú⁷¹ (Electric transport. Concepts, policies and lessons learned for Peru)

Regulatory framework example in Lima and Callao:

- Proyecto de Especificaciones Técnicas para la Estandarización de las características físicas y motrices del Bus Patrón Híbrido⁷² (Project of Technical Standards for the Standardization of the physical and motor characteristics of the Hybrid Standard Bus)

4.3. Last-mile logistics

Although MTC has responsibilities in logistics, through the General Directorate of Policies and Regulation in Multimodal Transport⁷³, the municipalities (both provincial and district) regulate the local distribution of goods⁷⁴. Local government regulations are vital to securing the distribution of goods to micro-retailers and homes. According to the consulted people and reviewed literature, the juxtaposition of local regulations harms the private sector's development. Logistics operators that carry out their activities in more than one district of the same province must deal with different rules regarding, for example, loading and unloading schedules. Last-mile logistics rules are dispersed in multiple sub-metropolitan municipal

⁶⁷ Ministerio de Energía y Minas, 21 August 2020.

⁶⁸ Ministerio de Energía y Minas, 26 June 2021.

⁶⁹ Ministerio del Ambiente, 25 January 2022.

⁷⁰ Ministerio de Transportes y Comunicaciones, 1 March 2022.

⁷¹ Schmerler, 2019.

⁷² Autoridad de Transporte Urbano para Lima y Callao, 26 May 2022.

⁷³ Ministerio de Transportes y Comunicaciones, 2 November 2020.

⁷⁴ Congreso de la República, 27 May 2003.

regulatory frameworks that employ different typologies and criteria. The ordinances of two adjacent municipalities of Lima are listed later below as an example. Although ATU primarily focuses on the transportation of people, in a complementary manner, it has some responsibilities in terms of freight transportation, such as providing recommendations regarding hours of operation and parking of freight vehicles⁷⁵. Still, its regulatory scope is limited since municipalities are responsible for regulations at the local level. As a result, some experts and studies recommend unifying and simplifying the regulatory framework⁷⁶.

State programs like PROMOVILIDAD can help local governments face the problems mentioned before by providing specialized advice and channeling support from foreign development agencies, as it occurs within the transport of people. However, this study did not identify any specific actions from PROMOVILIDAD related to last-mile logistics. Its focus has been mainly on urban cycling and public transport systems. The PNTU approved in 2019 addresses transport of people and freight transport, yet it prioritizes the former⁷⁷. So, in addition to local juxtaposed regulations, there are regulatory gaps and a lack of a national policy on last-mile logistics.

Local governments' regulatory frameworks examples in Lima:

- La Victoria District: Ordenanza Municipal N° 289-2018/MLV Ordenanza que Regula el Horario de Abastecimiento, carga y descarga de mercadería en establecimientos comerciales, centros de abastos, así como de materiales de construcción, accesorios, acabados y/o similares en obras civiles en el distrito de La Victoria⁷⁸ (Municipal Ordinance No. 289-2018/MLV Ordinance that Regulates the Supply Schedule, loading and unloading of merchandise in commercial establishments, and supply centers in La Victoria District)
- Miraflores District: Ordenanza N° 548/MM Aprueban Ordenanza que regula el uso del espacio público para la carga y descarga de mercancía en el distrito⁷⁹ (Ordinance No. 548/MM Ordinance that regulates the use of public space for loading and unloading freight in the district)

5. Actor analysis

This chapter analyzes the most essential mapped actors for developing urban mobility, emphasizing the private sector. Tables 2, 3 and 4 classify the actors in groups and describe their roles, needs, and interests according to each field of study.

⁷⁵ Ministerio de Transportes y Comunicaciones, 11 February 2019.

⁷⁶ For instance, Táryet and Teirlog Ingeniería (2016).

⁷⁷ Ministerio de Transportes y Comunicaciones, 10 April 2019.

⁷⁸ Municipalidad de La Victoria, 31 October 2018.

⁷⁹ Municipalidad de Miraflores, 24 July 2020.

5.1. Micromobility

Table 2. Micromobility actors

Sector	Type	Description
State	National government	MTC is responsible for setting the requirements and characteristics of cycles and PMDs entering and operating in the territory. It also defines the nationwide rules that regulate the use of these vehicles in the road system ⁸⁰ . The PNTU, a policy run by MTC, includes bicycles within its guidelines but without clear objectives. This policy does not address PMDs. MVCS, based on its "Política Nacional de Vivienda y Urbanismo" (National Housing and Urban Policy) and "Ley de desarrollo urbano sostenible" (Sustainable urban development law), could foster micromobility through urban mobility planning and mobility infrastructure. PRODUCE could support the growth of local cycling manufacturing. Finally, MINAM is vital for framing micromobility within the national environmental goals, the intergovernmental agreements related to climate change, and the NDCs related to mitigation.
State	Local governments	The provincial and district municipalities, some of them with the support of PROMOVILIDAD, international cooperation agencies and multilateral banks (such as the GIZ, KfW and WB), are developing projects focused on bicycles and complementary infrastructure (such as cycle parking). The actions are mainly concentrated on bicycles and, to a lesser extent, in other cycles (such as cargo bikes) and PMDs.
Private	Manufacturing and selling businesses	These businesses manufacture cycles, represent foreign micromobility brands, and import and sell micromobility products. Some businesses are dedicated exclusively to micromobility, such as Bike House Perú. They are usually small businesses. Large companies, typically chain stores, include micromobility products within extensive catalogs of products, such as Saga Falabella. Some are dedicated mainly or exclusively to the sale of bicycles, such as Anza Bicycles, while others are primarily or solely devoted to selling PMDs, such as Scooterland. Some small businesses manufacture custom cycles, such as Cargo Bike Perú.
Private	Repair and maintenance services	Some companies either dedicated specifically to the maintenance and repair of micromobility vehicles, usually small businesses, or offer this service in addition to the sale of products, such as Emove.
Private	Vehicle-sharing and vehicle rentals companies	During the COVID-19 pandemic, three international electric kick scooter rental companies closed their operations in Peru (Movo, Grin, and Lime). CityBike Lima, a bicycle-sharing system, is still operating in Lima. Another company, Bee, which acquired the former Movo fleet, offers monthly rental of electric kick scooters as a means for people travel and for last-mile logistics.
Private	Consulting firms	Consulting firms provide research, design, planning, and development solutions. Some provide services related to cycle infrastructures, such as bicycle parking and cycle track planning. One of these companies is CIDATT.
International	Cooperation agencies and multilateral organizations	Some foreign cooperation agencies, such as the GIZ, provide specialized and economic support to the Peruvian State to develop micromobility. Some multilateral organizations also provide specialized and financial assistance to the Peruvian National Government and local governments. An example is the WB which supported MVCS and MML in the planning process of the cycle network for Lima and Callao.

Source: own elaboration based on consulted people and reviewed literature.

⁸⁰ Congreso de la República, 21 November 2012.

5.2. Electric transport

Table 3. Electric transport actors

Sector	Type	Description
State	National government	In general, to develop electric transport in Peru, it is necessary to articulate the work of several ministries, especially MEF, MINAM, MINEM and MTC. MINEM led the development of the NAMA de Transporte Terrestre Eléctrico (Nationally Appropriate Mitigation Actions of Electric Land Transport). This ministry is in charge of drafting the electric transport regulatory framework related to charging infrastructure and the electric and hybrid vehicles market. MTC will play a central role in preparing a national strategy for electrifying urban transport systems and supporting cities through PROMOVILIDAD. In Lima and Callao, ATU is the State body that will enable the development of electric transport within the integrated public transit system. MINAM is vital for framing the transport electrification within the national environmental goals, the intergovernmental agreements related to climate change, and the NDCs related to mitigation. Finally, MEF is another crucial ministry responsible for financing transport electrification through investment schemes and subsidies.
Private	Vehicle importers, sales stores and manufacturers	Car importers offer some electric and hybrid car models of brands like Hyundai and Toyota in the Peruvian market. Authorized dealers and automobile repair shops are part of the ecosystem of companies. Some companies also participate in the local manufacturing of electric vehicles, which is the case of Modasa - Motores Diesel Andinos SA (a Peruvian private company) and Engie (a French company), which manufactured the first battery-powered electric bus in the country. Modasa - Motores Diesel Andinos SA contributed its experience in bodywork development. EV importers identify some requirements to develop the electric transport industry: charging infrastructure, regulation, and incentives ⁸¹ .
Private	Vehicle rental companies	Car rental schemes are part of shared mobility initiatives. A system of this nature operates in Peru: KINTO SHARE Perú, a service offered by Toyota.
Private	Associations	With a national vision, two associations stand out in the automotive sector. One of them is AAP, which brings together and represents various organizations related to motorized transportation. This association published the "Plan Nacional de Electromovilidad" (National Electric Transport Plan). The other is AEDIVE PERU, focused on electric vehicles, which issued the "Plan Nacional de Masificación de Infraestructura de Recarga PNMIR 2022-2025" (National Plan for the Massification of the Recharging Infrastructure 2022-2025).
Private	Consulting firms	Consulting firms provide research, design, planning, and development solutions. For instance, some firms advise private companies on strategies to introduce electric and hybrid vehicles into their businesses. One of these companies is CIDATT.
Private	Charging infrastructure technology providers and	The development of electric transport requires a vast network of charging infrastructure ⁸² . In this sense, electric transport needs several companies to get involved in transport system conversion from ICEVs to EVs. Some of these companies provide charging technology and

⁸¹ EY, 2021: p. 105.

⁸² The AAP website shares a georeferenced list of the existing charging stations in the country: <https://aap.org.pe/electrolineras-en-el-peru/>.

	institutional customers	implement the required infrastructure. Other companies demand these technologies, such as service stations. Some local initiatives match charging infrastructure providers with institutional customers: the Petroperú and Enel X initiative to implement electric vehicle supply equipment in service stations ⁸³ and the Enel X initiative to provide ministries and National Government agencies with charging infrastructure, like the one implemented in the MINEM headquarters ⁸⁴ . But other spaces will also require electric charging infrastructures, such as residential complexes, shopping centers, and business centers. Institutional customers will also purchase electric and hybrid vehicles to renovate their fleet.
International	Cooperation agencies and multilateral organizations	Some multilateral organizations provide specialized and financial assistance to the Peruvian State for electric transport development. The IADB supported the Peruvian National Government by evaluating the costs and benefits of carbon neutrality, which included an analysis of electric transport. Some initiatives articulate the work of multilateral banks with cooperation agencies, such as the EMOTION project, which brings together the CAF, AFD, KfW, and GIZ.

Source: own elaboration based on consulted people and reviewed literature.

5.3. Last-mile logistics

Table 4. Last-mile logistics actors

Sector	Type	Description
State	National government	Although MTC is responsible for regulating logistics in the national territory, there is no national policy focused on last-mile logistics to date. Both the PNTU and PROMOVILIDAD prioritize the transportation of people. Nonetheless, PROMOVILIDAD could eventually provide specialized support to local governments and channel the aid of foreign and multilateral development agencies to improve urban logistics.
State	Local governments	Municipalities are primarily responsible for regulating last-mile logistics framed in the national regulations defined by the Peruvian National Government. Some local governments are open to receiving support from universities. A good example is the Municipalidad de Miraflores (Municipality of Miraflores) in Lima, which received specialized support from the Universidad del Pacífico (a Lima-based university) to develop the criteria for freight loading and unloading in public spaces ⁸⁵ .
Private	Logistics operators	Several logistics operators provide services in the local market, most of which are small businesses that manage tiny fleets, even only one freight vehicle. Among the large companies, Ransa Comercial S.A.C. is a well-known operator that provides a set of multiple logistics services, including home delivery. There are also app-based companies that offer on-demand home delivery, such as Rappi and PedidosYa. Chazki, a Peruvian startup based on a collaborative economy, also provides last-mile shipping services.
Private	Vehicle rental companies	Vehicle rental is also an opportunity for companies interested in providing home delivery services. Bee is a company that provides business-to-business monthly electric kick scooter rental for last-mile logistics.

⁸³ Enel Perú, 19 March 2021.

⁸⁴ Revista Energiminas, 6 October 2021.

⁸⁵ Municipalidad de Miraflores, 24 July 2020.

Private	Vehicle sale businesses	Although less polluting electric motorcycles are used in last-mile logistics, principally for home delivery, there are technological innovations, such as small electric vehicles that optimize their loadspace. These innovations are considered cleaner and safer than motorbikes, vans, and small trucks, but they are still not offered in the Peruvian market ⁸⁶ . Another group of vehicles precise for distribution to micro-retailers and home delivery is cargo bikes. Cargo Bike Perú is a local business that manufactures a variety of cargo bike models on demand for individuals and companies.
Private	Consulting firms	Consulting firms provide research, design, planning, and development solutions focused on urban freight distribution. One of these companies is CIDATT.
State and private	Higher education	Among the study and research centers, the Universidad del Pacífico (a Peruvian university) stands out with highly qualified researchers on supply chain and last-mile logistics. This university has a local observatory ("Observatorio de Lima") that provides information about research and projects on last-mile logistics.
International	Cooperation agencies and multilateral organizations	EMOTION is a project run by the CAF, AFD, KfW and GIZ that seeks to spread and develop electric transport in several Latin American countries, including urban logistics.

Source: own elaboration based on consulted people and reviewed literature.

6. Initiatives

The following table (Table 5) describes the most outstanding initiatives that have taken place over the last five years (2017-2022) linked to the three fields of study: micromobility, electric transport, and last-mile logistics. The mapped initiatives come from local private organizations, multilateral organizations, and foreign cooperation agencies for development. The table presents the selected initiatives in alphabetical order according to the actors' names.

Table 5. Initiatives

Actor	Initiative	Field	Description
AAP	National electric transport plan ⁸⁷	Electric transport	The study "Plan Nacional de Electromovilidad" (National Electric Transport Plan), issued by APP in 2021, analyzes the main factors that have enabled the transition to electric transport regionally and globally, the entry of EVs into the market, and the implemented policies.
AEDIVE PERU	National plan for charging infrastructure ⁸⁸	Electric transport	This study, released in 2022 by AEDIVE PERU, evaluates costs and proposes actions to implement electric charging stations along the Peruvian coast. The name of the study is "Plan Nacional de Masificación de Infraestructura de Carga

⁸⁶ An example is the city of Gothenburg in Sweden. See Eriksen (18 November 2015).

⁸⁷ EY, 2021.

⁸⁸ AEDIVE PERU, 2022.

			(PNMIC). Propuesta para el Perú: Panamericana Norte y Sur 2022-2025" (National Plan for the Massification of Charging Infrastructure).
BYD	Promotion of electric transport ⁸⁹	Electric transport	BYD and MINEM signed a cooperation agreement in 2022 to promote the benefits of electric transport. As part of this agreement, BYD provided an EV to MINEM for one year. In 2019, BYD provided the Municipalidad de San Isidro (Municipality of San Isidro) an electric bus as part of a pilot project.
CAF, AFD, KfW and GIZ	Program on electric and low-carbon transport ⁹⁰	Electric transport and last-mile logistics	EMOTION is a program developed by the CAF, AFD, KfW and GIZ to accelerate the deployment of EVs in Latin American cities by closing the gap between pilot projects and long-term goals. The program address electric transport and logistics.
Delegation of the European Union to Peru and AFD	Mobility and sustainable urban transport plan for Arequipa ⁹¹	Micromobility and last-mile logistics	EUROCLIMA+ ⁹² is an EU program to reduce the impact of climate change and its effects in Latin America by promoting mitigation and adaptation to climate change, resilience, and investment. Within this program, the EU supported the development of the project "Preparation of the Mobility and Sustainable Urban Transport Plan for the Provincial Municipality of Arequipa", which contributed to the planning process expected to conclude in June 2022. Two aspects addressed in this process are non-motorized transportation and urban logistics ⁹³ .
Enel X	Charging infrastructure development ⁹⁴	Electric transport	Enel X and Petroperú signed a cooperation agreement to develop electric transport in Peru by implementing electric vehicle supply equipment in service stations. These companies inaugurated the first charging station at a service station as part of this initiative. Enel X also implemented a charging point in the MINEM headquarters, an initiative to provide Peruvian Government agencies and ministries with electric charging infrastructure. Enel X has implemented charging points in several Peruvian cities. Additionally, in 2019 Enel X signed an agreement with the Peruvian Government to integrate an electric bus into the public transit system in Lima.
Engie	Local electric bus ⁹⁵	Electric transport	In 2018, Municipalidad de San Isidro (Municipality of San Isidro), with the support

⁸⁹ Gobierno del Perú, 13 May 2022; and EY, 2021.

⁹⁰ CAF - Development Bank of Latin America, n.d.

⁹¹ EUROCLIMA+, n.d.

⁹² For more detailed information, see its website: <https://euroclimaplus.org/en/>.

⁹³ For more detailed information, see its website: <https://pmus.impla.gob.pe/>.

⁹⁴ Enel Perú, 19 March 2021; Revista Energiminas, 6 October 2021; and EY, 2021.

⁹⁵ EY, 2021.

			of Engie, started to operate a local transport system with an electric bus.
GIZ	Cities on motion	Micromobility	Ciudades en Movimiento - CIMO (Cities on Motion) is a project that began in April 2022 as a continuation of a previous project. It has several components, including actions on micromobility. The GIZ previously supported the Peruvian State in developing bicycle-oriented infrastructure.
IADB	Transport decarbonization ⁹⁶	Electric transport	The study "Costos y beneficios de la carbono-neutralidad en Perú: Una evaluación robusta" (Costs and benefits of carbon neutrality in Peru: A robust evaluation), published in 2021, evaluates the costs and benefits of decarbonizing transportation, among other sectors. Although the study addresses non-motorized mobility and logistics, its emphasis is on the electrification of vehicles.
KfW	Economic contribution to develop cycling infrastructure ⁹⁷	Micromobility	The KfW contributed EUR 20 million to MML to develop 114 km of cycle tracks and cycle parking.
Lima Cómo Vamos	Recommendations to manage micromobility devices in public spaces ⁹⁸	Micromobility	In 2019, Lima Cómo Vamos published this study that analyses experiences and compares legislation from other countries to identify the required local regulatory framework for introducing micromobility devices in Peruvian cities.
Modasa - Motores Diesel Andinos SA and Engie	Electric bus manufacture ⁹⁹	Electric transport	Modasa - Motores Diesel Andinos SA and Engie manufactured the first battery-powered electric bus in the country.
Taxi Directo	Electric cars for taxi service ¹⁰⁰	Electric transport	Taxi Directo, a taxi service company, started to operate three electric cars.
United Nations Environment Programme	ACCESS: Accelerating Access to Low Carbon Urban Mobility Solutions through Digitalization ¹⁰¹	Electric transport and last-mile logistics	ACCESS is a project aiming to reduce GHG emissions through digitalization, funded by the International Climate Initiative (IKI). The project addresses electric transport and last-mile logistics.
Universidad del Pacífico	Urban logistics observatory ¹⁰²	Last-mile logistics	Universidad del Pacífico (a Peruvian university) has an observatory that provides information regarding studies and projects on urban logistics in Lima.

⁹⁶ Quirós-Tortos et al., May 2021.

⁹⁷ Gobierno del Perú, 19 November 2021.

⁹⁸ Lima Cómo Vamos, 2019.

⁹⁹ Modasa - Motores Diesel Andinos SA., n.d.

¹⁰⁰ EY, 2021.

¹⁰¹ International Climate Initiative, n.d.

¹⁰² For more detailed information, see its website: <https://www.observatoriodelima.org/>.

WB	Proposal to update the cycling infrastructure plan in Lima and Callao ¹⁰³	Micromobility	The WB supported MML in formulating a strategy to update the cycling infrastructure plan for Lima and Callao. The study was published in 2020 with the name "Propuesta de actualización del Plan de Infraestructura Ciclovía para Lima y Callao" (Proposal to update the Cycle Infrastructure Plan for Lima and Callao).
WB	Recommendations to develop a bicycle strategy in Lima ¹⁰⁴	Micromobility	The WB supported MML in formulating a strategy to increase cycling in the city. The study was published in 2020 and defined a vision, approach, objectives, actions, and indicators. The resulting document name is "Propuesta y recomendaciones para la formulación de una estrategia para la Bicicleta en Lima Metropolitana" (Proposal and recommendations for the formulation of a strategy for the Bicycle in Metropolitan Lima).
WB	Study on urban logistics and cargo bikes	Micromobility and last-mile logistics	It is a study in progress, soon to be published. It includes last-mile logistics and micromobility and analyzes the legal framework, international actors, and experiences.
WB	Study on electrification of conventional transport	Electric transport	It is a study in progress about the potential for electrification of conventional transport in support of ATU.
WHO, Bloomberg Philanthropies and Vital Strategies	Partnership for Healthy Cities ¹⁰⁵	Micromobility	This initiative addresses various issues, including active mobility. In the context of the COVID-19 pandemic, the WHO realized the case study "Expanding cycling infrastructure to fight the COVID-19 pandemic: Lima, Peru" ¹⁰⁶ .

Source: own elaboration based on consulted people and reviewed literature.

7. Economic findings

This chapter presents some economic findings related to transport infrastructure in each of the three fields of study, based on the reviewed literature and information obtained from the consulted organizations. It also addresses the changes required, the challenges, and the possible consequences of not implementing such changes.

7.1. Micromobility

¹⁰³ Targa et al., 2020a.

¹⁰⁴ Targa et al., 2020b.

¹⁰⁵ For more detailed information, see its website: <https://cities4health.org/>.

¹⁰⁶ World Health Organization, August 2020.

The WB study "Propuesta de actualización del Plan de Infraestructura Ciclovía para Lima y Callao" (Proposal to update the Cycle Infrastructure Plan for Lima and Callao), published in 2020, identifies the costs of implementing the required cycling infrastructure in Lima and Callao. The study proposes a cycling network of 1,173.2 km of new cycle tracks. The cost of developing the proposed network is between PEN 806 million and 1,666 million¹⁰⁷. Based on information obtained from MML, the local government manages a budget of PEN 1.1 million to create new cycle tracks during the year 2022. It shows the considerable difference between the annual budget of MML and the required investment to complete the cycling network. One way to deal with this shortage of financial resources for the development of micromobility is to receive financial contributions from foreign organizations, such as the contribution of EUR 20 million from the KfW. In addition, it is worth saying that the Peruvian Government allows the use of PMDs in cycle tracks.

Through PROMOVILIDAD, the Peruvian National Government transferred PEN 22 million¹⁰⁸ to 25 local governments¹⁰⁹ in 2020 to support the development of cycling infrastructure in medium-sized cities. While the required cycle network for these cities is difficult to know since planning cycling infrastructure is not common, three urban characteristics of these cities make it reasonable to think that the required investment could be similar to that for Lima and Callao: first, the combined population of these cities is smaller but close to that of Lima and Callao; second, the combined territories of these cities exceed that of Lima and Callao; and third, the pre-pandemic infrastructure in these cities was less developed than that of Lima and Callao. In this sense, if the investment for the development of the new cycle infrastructure in these 25 cities were the same as the maximum projected for Lima and Callao (PEN 1,666 million), the transferred amount from the Peruvian National Government (PEN 22 million) would represent little more than 1%.

The previous analysis shows the need to allocate more budget to cover the micromobility infrastructure gap in Peruvian urban settlements. The Dutch company Decisio analyzed the social costs-benefits of developing the proposed cycling infrastructure in Lima and Callao by the WB. The estimation considers the construction and maintenance costs of the proposals. The benefit-cost ratio was 19, meaning that investing PEN 1 will provide a return of PEN 19¹¹⁰.

Although the development of cycle tracks and parking is essential when fostering traveling on cycles and PMDs, the success of micromobility depends on redesigning the entire urban road networks of each city and the investment in the transport system as a whole¹¹¹. A key issue is the reduction of the maximum speeds allowed in cities. In this regard, MTC established the new top speed limits in urban areas (30 km/h on streets and 50 km/h on main roads) in 2021¹¹². On the one hand, this change in regulation is a challenge for local governments since the term to adapt their urban road networks expires in July 2022. On the

¹⁰⁷ Targa et al., 2020a: p. 55.

¹⁰⁸ Gobierno del Perú, 13 August 2021.

¹⁰⁹ Arequipa, Cajamarca, Chachapoyas, Chiclayo, Coronel Portillo, Cusco, Huancavelica, Huancayo, Huamanga, Huaraz, Ica, Juliaca, Mariscal Nieto, Maynas, Moyobamba, Pasco, Pisco, Piura, Puno, San Martín, San Román, Santa, Sullana, Tacna and Trujillo.

¹¹⁰ Targa et al., 2020a: p. 116.

¹¹¹ A global study by Ipsos (May 2022) identified that, for 86% of Peruvian survey respondents, "new road and infrastructure in their area should prioritize bicycles over automobiles".

¹¹² Ministerio de Transportes y Comunicaciones, 3 July 2021.

other, it is an opportunity for the private sector, such as construction companies and road engineering consulting firms. It is also necessary to invest in vehicle-sharing systems (either public, private-public, or private investments) and integrate micromobility travels with public transit. Vehicle-sharing systems must respond to daily trips (such as those for work and study) and be accessible to the entire population and not only to wealthy people living in more affluent neighborhoods.

The main risk of not investing in the required micromobility infrastructure (cycle tracks, bike parking, redesigning road networks to reduce the speed limits, vehicle-sharing systems, and integration of micromobility with public transit) is the reduction of micromobility travels. It would be a setback for growing micromobility journeys seen during the COVID-19 pandemic. Cities would lose micromobility benefits, such as improvements in health, air quality, road safety, and household expenses.

7.2. Electric transport

Developing electric transport requires significant investments in charging infrastructure and electric vehicles. Although not explicitly focused on cities, some studies provide relevant data about the investments necessary to develop the electric charging infrastructure network¹¹³. An IADB study that addresses transport decarbonization by 2050 pays attention to electrification and infrastructure development. It estimates the additional investments related to infrastructure at around USD 47,000 million¹¹⁴. As part of an analysis of the impact on tax collection, the study published by AAP estimates the cost of setting up a charging station (taking a 110 kWh charger as a reference and considering issues such as installation, assembly, and engineering) at USD 32,290¹¹⁵. A study released by AEDIVE PERU estimates the cost of implementing charging stations with two types of energy supply, including the connection permits and installation expenses. A charging station with a 120 kW charger and a photovoltaic solar plant connected to the grid without batteries would cost USD 232,548¹¹⁶. A charging station with a 120 kW charger and a photovoltaic solar plant connected to the grid with 2 hours of batteries would cost USD 486,681¹¹⁷. According to AEDIVE PERU, the total investment of installing 24 charging stations along the Panamericana Norte and Panamericana Sur roads (roads that connect the northern and southern Peruvian borders) would require an investment of USD 16.5 million. To develop electric transport, the study published by AAP recommends the creation of an Electric Transport Fund to centralize the management of funds¹¹⁸.

The AAP and IADB studies present some benefits of investing in electric transport. According to the study published by AAP, in a scenario of high intervention to electrify the

¹¹³ Schmerler et al. (2019) and EY (2021) make a significant effort to identify the actions implemented in other countries to develop the charging infrastructure and the required investments in acquisition and operation.

¹¹⁴ Quirós-Tortos et al., May 2021: p. 93.

¹¹⁵ EY, 2021: p. 248.

¹¹⁶ AEDIVE PERU, 2022: p. 78.

¹¹⁷ AEDIVE PERU, 2022: p. 82.

¹¹⁸ EY, 2021: p. 299.

industry between 2020 and 2030, reducing CO2 emissions would save USD 8.59 million due to lower social costs¹¹⁹. This estimation includes three types of vehicles: light vehicles (especially sedans), buses (12 meters long), and trucks (4.5 t). The IADB study estimates that decarbonizing transportation (private, public and freight transport) by actions such as electrifying the vehicles would provide a net benefit of USD 92 billion between 2020 and 2050¹²⁰. Benefits include savings in operating and maintenance costs, improved health, increased productivity, and reduced accidents. While the first study focuses exclusively on transport electrification, the second one recommends several actions, such as increasing active mobility, fostering remote work, and improving freight transport.

People interested in electric transport need to know that charging infrastructure will be deployed in the entire territory to invest in EVs since the availability of a vast network of charging points guarantees their autonomy. It is vital not only for individual users but for public transit operators. Public transit companies need a charging infrastructure network to operate their fleet. As mentioned before, the primary Peruvian State efforts should be focused on electrifying public transit and promoting EV-sharing systems instead of fostering the private use of electric cars. Not investing in the transition towards electric transport could bring several negative consequences to Peruvian society, such as a greater vulnerability to fossil fuel scarcity and increasing GHG emissions.

7.3. Last-mile logistics

Whereas some studies in micromobility and electric transport that estimate infrastructure costs come from 2020-to 2022, the most comprehensive study in last-mile logistics with infrastructure cost estimations for Lima and Callao comes from 2016, a study prepared for MTC by Táryet and Teirlog Ingeniería. According to the experts' opinion, the COVID-19 pandemic changed the dynamics of urban logistics due to physical distancing, electronic commerce, and home delivery growth, which could have affected the findings and proposals of the 2016 study. Thus, although this study estimates the required investment for building three intermodal logistics platforms (roughly USD 82 million each¹²¹), it does not estimate additional facilities costs related to distribution to micro-retailers and home delivery: micro-hubs, micro-warehouses, dark stores, pickup points, and on-street loading and unloading zones.

Unlike electric transport, whose success relays on substantial public investments in infrastructure (since BEVs cannot operate without charging points), last-mile logistics grow with or without public investment plans (since people, no matter what, demand goods not locally produced). Access to goods transported to cities from other territories cannot be easily replaced in the short term by a local production of such goods. Thus, the Peruvian State must rapidly invest in enhancing last-mile logistics infrastructure. Otherwise, cities will be more affected by congestion, pollution, and road accidents in the coming years.

¹¹⁹ EY, 2021: p. 10.

¹²⁰ Quirós-Tortos et al., May 2021: p. 86.

¹²¹ Táryet and Teirlog Ingeniería, 2016.

8. Sustainable mobility in the Netherlands

Based on reviewed literature and the mission to the Netherlands, this chapter describes the context of sustainable mobility in the Netherlands related to the three fields of study.

8.1. Micromobility

Dutch cities are well-known for their achievements in urban cycling policies. As in many parts of Europe, the motorization of the urban milieu during the 20th century affected bicycle usage. A rapid decline came from the 1950s, recovery took place in later decades, and a significant shift in infrastructure arrived from the 1990s onwards with the national transportation plan¹²². Today, Dutch cities lead urban cycling in European countries and are a model for other countries¹²³. In line with the growth of cycle journeys, the cycling industry also flourished in Dutch cities. Currently, several companies produce and sell a variety of cycles, such as conventional urban bicycles, electric bicycles, utility bicycles, and cargo bikes for transporting goods and people. Examples of companies and brands are Gazelle, Sensa, Veloretti, VanMoof, Volare Bicycles, Azor Bike, Urban Arrow, and Bakfiets.nl The interest of foreign companies in acquiring Dutch cycling businesses shows the economic success of this industry. In January 2022, Accell Group, a former Dutch company that owns several cycle brands, announced its acquisition by the American KKR & Co.

The development of urban cycling also requires the provision of other services and products related to planning, design, and management. Companies like Connection Systems and Cycle Data BV provide services for monitoring cycling flow. IP Parking and Monit data provide solutions for bicycle parking. Companies such as Toogethr develop app-based solutions for urban cycling. And advising on infrastructure development is provided by companies like Witteveen+Bos. Other organizations focus on defending and promoting the cycling culture locally (such as the Fietzersbond, which represents and protects the interests of the Dutch cycling community) and abroad (such as the Dutch Cycling Embassy and BYCS). Unlike cycles, the Dutch Government does not foster PMD use, particularly electric kick scooters. This context contrasts with other European countries that opened their doors to electric kick scooters and other innovative micromobility devices during the last years.

8.2. Electric transport

Although other European countries have a more developed automotive industry, the Netherlands stands out due to its research on electric and hybrid vehicles, particularly

¹²² Oldenziel and de la Bruhèze, 2011.

¹²³ A 2022 study by Decisio (UCONSULT, 2022) found that the Dutch cycling sector has a significant export value and that the Netherlands' contribution to other countries through growth in bicycle use has several positive social effects.

driving systems, batteries, lightweight materials, and automated transport systems¹²⁴. In line with the above, RVO points out the following: "The Netherlands is one of the leading electric transport players in the world. This makes us an interesting business partner. For over a decade the Netherlands has been investing in electric vehicles, charging infrastructure and the development of new technologies and connectivity"¹²⁵. A study published by Osinergmin summarizes the development process of electric transport in the Netherlands. The Dutch State carried out several actions: fiscal incentives that progressively went from PHEVs to BEVs, subsidies for investment in charging stations, investment in research for the development of the industry, clear goals in terms of GHG reduction, electric transport local planning, and electric public transit development¹²⁶. The expansion of electric transport in the Netherlands seems to come from EV rental companies rather than individual purchases¹²⁷. car2go was an EV-sharing company that operated in the Netherlands that later merged with DriveNow to become Share Now, a German company that operates in Amsterdam with BEVs. But Dutch companies also provide this service in the Netherlands, such as MyWheels, which operates in several Dutch cities.

The current state of the Dutch electric charging infrastructure results from a variety of initiatives and the participation of several companies. ElaadNL is an initiative of the charging network operators (Coteq Netbeheer, Liander, Enexis Groep, Westland Infra Netbeheer, TenneT Holding, Stedin, and RENDO Groep) that researches and produces knowledge about charging infrastructure. The Open Charge Alliance is an organization that seeks the development, adoption and compliance of communication protocols in the EV charging infrastructure. Another initiative funded by electric charging operators is eViolin, seeking unrestricted access to EV charging points in publicly accessible spaces. e-clearing.net is a German and Dutch Government funded initiative aiming to provide unhindered access to EV charging infrastructure. PARKnCHARGE offers charging stations and places for EVs. Finally, other companies provide supplementary services such as data management and certification of electric charging solutions, such as TomTom, Monit data and NMi.

8.3. Last-mile logistics

The Netherlands has a recognized experience in urban logistics. Herce highlights the experience of Amsterdam in setting requirements such as emission standards and maximum freight vehicle dimensions to operate in certain areas¹²⁸. He also highlights Amsterdam's municipal logistics management system that created an urban distribution center¹²⁹. Infrastructure development has played a central role in the success of urban logistics in Amsterdam, such as the Amsterdam Logistic Cityhub, acquired by CTP in 2021. Last-mile logistics is one of the concerns of the Amsterdam Economic Board that, together with various other organizations, fosters the adoption of cleaner vehicles (such as electric vans and cargo bikes) and smart driving. An entire ecosystem of Dutch organizations has

¹²⁴ Schmerler et al., 2019.

¹²⁵ Netherlands Enterprise Agency, 11 February 2022.

¹²⁶ Schmerler et al., 2019.

¹²⁷ Schmerler et al., 2019: p. 145.

¹²⁸ Herce, 2009: p. 280.

¹²⁹ Herce, 2009: p. 287.

emerged, covering various key aspects of last-mile logistics. Andes is a company that provides software services and data management for logistics. MAAT is a logistics operator with different small electric commercial vehicles for covering the last leg of freight distribution. City Hub, another company, offers storage and distribution services by using BEVs, including electric cargo bikes. Finally, Het Nieuwe Rijden is an initiative to train drivers in eco-driving, including freight transport drivers.

Cargo bikes for last-mile logistics have a long history in the Netherlands. Cargo bikes started to gain relevance in Dutch cities during the first decades of the 20th century. Later, with changes in society and the growing use of cars, cargo bike use declined¹³⁰. In recent years, the interest in cargo bikes has come back due to new electric storage technologies and global concerns about GHG emissions related to transportation. The Amsterdam Economic Board promotes cargo bikes as part of the Green Deal on Zero Emission City Logistics (Green Deal ZES). The International Cargo Bike Festival is an annual event where businesses and other organizations worldwide share their experiences in the cargo bike industry. Some companies within the sector are DOCKR, which offers flexible contracts and electric cargo bikes to companies without fleets; Fulpra, a company that provides large loadspace cargo bikes; and Cargo Cycling, which offers innovative vehicles for delivery. Finally, Fiets Diensten.nl is an organization that promotes the use of all these vehicles.

9. Bilateral collaboration opportunities

This chapter identifies potential areas of private sector development and bilateral collaboration between Peru and the Netherlands based on the theoretical approaches adopted and the six criteria defined for this study. Tables 6, 7 and 8 organize the opportunities according to each field of study.

9.1. Micromobility

Table 6. Opportunities in micromobility

Opportunity	Netherlands	Peru
MO1. Cycle design and manufacturing	Due to their experience, cycle companies in the Netherlands could advise Peruvian companies on design and manufacture. Some Dutch high-end cycle products could enter the Peruvian market.	Local businesses that manufacture cycles could benefit from knowledge transfer from the Netherlands.
MO2. Cycle facility and policy planning and design	Dutch firms could provide consulting services to the Peruvian Government and the private sector in cycle facility and policy planning and design and partner with their Peruvian equals. There are already Dutch firms with	Peruvian provincial and district municipalities and private initiatives, such as business centers and shopping malls, require specialized advising for developing micromobility projects. Peruvian consulting firms could learn

¹³⁰ Kirkels, September 2016.

	working experience in Peru.	from Dutch equals.
MO3. Cycle and PMD flow management and monitoring	In the Netherlands, several companies provide cycle flow management and monitoring technologies. These companies could provide traffic management solutions to Peruvian municipalities.	Peruvian cities need to optimize traffic management, particularly micromobility vehicle journeys. In that sense, traffic departments in local governments could benefit from Dutch companies.
MO4. Micromobility infrastructure development	Dutch cities have a long experience developing cycling infrastructures, such as cycle track surface, demarcation and signaling. Dutch companies could export their experience to Peru through specialized advising.	Cycle tracks in Peruvian cities frequently lack proper design and materials. Local governments could benefit from Dutch experience in developing cycle track networks.
MO5. Regulatory framework development	The Netherlands has vast experience in developing a regulatory framework that favors the use of cycles over motorized transportation, so the Dutch Government and consulting firms could advise the Peruvian Government.	The Peruvian Government lacks experience in developing a sound micromobility regulatory framework related to traffic codes, traffic rules enforcement, vehicle standards, and safety accessories.
MO6. Vehicle-sharing systems development	Although individual ownership of bicycles prevails in the Netherlands, its experience with its bicycle-sharing national program connected to the public transit system can help the Peruvian Government develop a similar national program for bicycle rental in cities.	Peruvian cities have to make cycles and PMDs accessible to everyone and connected to public transit. Some private companies and Peruvian municipalities have operated electric kick scooter rental and bicycle-sharing systems. Nevertheless, these experiences have been local and focused on upper-class neighborhoods of Lima. Thus, Peru's private and state sectors could learn from the Dutch experience.
MO7. Micromobility vehicle parking systems	Dutch companies focused on developing parking systems for micromobility vehicles could provide specialized advice to Peruvian private companies and local governments to introduce top-quality and innovative designs in Peruvian cities.	A weak point in the micromobility infrastructure development is the provision of proper parking: accessible for all, connected to public transit, safe and sufficient. Several urban spaces and facilities lack micromobility vehicle parking, such as business centers, shopping malls, schools, residential complexes, and bus stops. The Peruvian State and private companies managing these spaces and facilities could benefit from the Dutch experience.
MO8. Micromobility and public transit integration	Bicycle and public transit use integration is a central piece of the Dutch mobility system. The Netherlands has experience designing mass transit vehicles with room for bicycles, large bicycle parking spaces near mass transit lines, and bicycle rental for the last mile. The Dutch expertise is key to Peruvian National Government agencies and provincial municipalities.	Peruvian National Government agencies and provincial municipality departments focused on public transit play a vital role in developing integrated transportation systems. Through policies, regulation, financing and planning, the Peruvian State could integrate micromobility with public transit systems.
MO9. Promotion of	Bicycle culture in the Netherlands is a	Through public and private campaigns,

micromobility	national common. Some Dutch companies and associations that focus on cycle use promotion can export their experience to Peru.	the Peruvian State, companies and NGOs try to foster bicycle use. Although promotion cannot magically resolve all urban mobility problems, when properly designed can help the overall process of changing urban travel patterns. On this matter, the Dutch experience could enlighten the Peruvian mobility transformation process towards cycle and PMD use.
MO10. Association of service and goods providers	All types of Dutch companies within the urban cycle industry (such as cycle manufacturers, micromobility software providers, and cycle logistics operators) could share their expertise regarding partnering and lobbying with Peruvian counterparts. Although not mainly focused on business articulation, some Dutch associations that bring together different cycling actors and stand up for the community could serve as a reference for the Peruvian business sector linked to micromobility.	The lack of businesses articulated in associations within the field of micromobility makes their relations with the Peruvian State a complex issue. The Dutch experience could help Peruvian private businesses to organize collective demands and relate with other actors such as NGOs and research centers.
MO11. Research on micromobility	Dutch universities have vast experience studying urban cycling and providing educational programs and training to individuals and organizations. Additionally, some organizations research the social and economic impacts of micromobility. These research organizations could support the Peruvian Government in studying the social and economic benefits of investing in micromobility.	Local governments must conduct comprehensive studies to identify the social and economic benefits of investing in micromobility projects. These studies could help local authorities convince the private sector and the Peruvian National Government to invest in micromobility. Dutch consulting firms and research centers could provide services to Peruvian local governments in this field.

Source: own elaboration based on consulted people, reviewed literature, and the theoretical framework.

9.2. Electric transport

Table 7. Opportunities in electric transport

Opportunity	Netherlands	Peru
EO1. Vehicle-sharing systems development	EV rental services in the Netherlands could serve as a model for Peruvian initiatives.	In Peru, where electric transport is still in the early stages, EV and HEV rental services could be a promising sector if the electric charging infrastructure expands. Current Dutch initiatives could partner with Peruvian companies.
EO2. Public transit systems development	The Netherlands has a long experience with electric mass transit and, more recently, with the shift toward renewable energy. Its territory has a vast electrified rail network, and its national government has well-developed institutions for planning and managing this service. The Dutch Government and the companies in the	The Peruvian State has shown interest in developing urban and commuter rail systems in recent years, although with more political will than sound arguments. Several Peruvian cities are designing and planning their bus-based public transit systems. Thus, the Dutch experience could help the Peruvian State agencies, ministries, and local

	industry could help their Peruvian counterparts to develop electric rail networks in cities and between them. Similarly, its most recent experience operating electric buses could help Peruvian cities implement BEV technologies in tender public transit processes.	authorities to develop a specialized approach to planning urban rail projects and adopt electric transport technologies in the design of public transit systems.
EO3. Data management for decision making	Some Dutch companies provide solutions on BEV data management based on collecting data from parking, charging points and vehicles.	A recurring problem in Peruvian cities is not having reliable data and proper management of these. When electric transport develops, proper data management will be essential. Dutch companies will have opportunities to invest in Peru.
EO4. Electric charging infrastructure development	The Netherlands has extensive experience in developing charging infrastructure for EVs. Some Dutch companies provide various services related to the design, planning, installation, connection permits, assembly, management and maintenance of the required infrastructure. The Peruvian electric transport sector, still in its infancy, could be an exciting market for these companies in the coming years.	A few public and private initiatives in charging infrastructure are taking place in Peru. Some articulate Peruvian National Government agencies and ministries with energy and utility companies, and others invest in electric charging points. The Peruvian State and private companies could benefit from Dutch companies' services in the field.
EO5. Electric transport actors coalition	The experience of Dutch charging network operators joining together through funding and fostering initiatives to develop electric charging infrastructure could serve as a reference for creating and strengthening local coalitions supporting electric transport in Peru.	Some associations bring together automotive actors in Peru. The interest in electric transport of various actors, not only those related to the automotive industry, could produce coalitions. Dutch experience could serve as a model.
EO6. EV manufacturing	Although EV manufacturing is not a significant industry in the Netherlands as in other European countries, its research and innovations in the electric transport sector related to batteries, materials, and energy sources could help the Peruvian market develop EV manufacturing.	The local expertise in bodywork manufacturing for public transit vehicles and, recently, in the assembly of electric buses could be enriched by Dutch innovations and research.
EO7. Regulatory and policy framework development	After developing the electric transport industry for years, the Netherlands is a world-class reference in developing policies and regulations. Dutch Government actions such as researching, investing, subsidizing, and regulating electric transport could help the Peruvian Government to adjust best practices to the local context.	Peru is currently developing a regulatory framework to implement electric charging infrastructure. Any national policy on electric transport exists up to date. Thus, Dutch expertise could enrich this blooming sector.
EO8. Subsidies and loans	The Netherlands has vast expertise in designing economic incentives for mass EV adoption. The Dutch Government and companies could advise Peruvian National Government and companies in developing	The Peruvian National Government recently provided subsidies to public transit operators during the COVID-19 pandemic, and some private companies offer loans to taxi drivers for new car purchases. Similar instruments could

	instruments, such as subsidies and loans.	perform well for a mass EV acquisition for public transportation.
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Source: own elaboration based on consulted people, reviewed literature, and the theoretical framework.

9.3. Last-mile logistics

Table 8. Opportunities in last-mile logistics

Opportunity	Netherlands	Peru
LO1. Logistics infrastructure development	Based on their local experience, Dutch companies could provide specialized advice in the planning, design and management of micro-warehouses, dark stores, collection points, and loading and unloading zones related to the last leg of freight distribution.	Peruvian cities require infrastructure to distribute goods to micro-retailers and home delivery. Last-mile logistic facilities could replace some public and private car-oriented spaces in disused or inefficiently used.
LO2. Regulatory and policy framework development	The Dutch Government has experience developing freight vehicle standards, goods distribution regulations, and policies to foster the use of lighter and cleaner vehicles for urban logistics. These experiences could be exported to Peru by government-to-government collaboration and Dutch consulting firms advising local governments.	The Peruvian National Government lacks a national last-mile logistics policy, while provinces lack proper local regulations. The Netherlands' support through its government and private companies could help the Peruvian Government develop better last-mile logistics policy and regulations.
LO3. Urban logistics in cargo bikes and PMDs	The bicycle culture that includes cargo bikes for last-mile logistics is one of the main achievements of Dutch cities in sustainable urban mobility. The Dutch Government and private companies could advise Peruvian equals to adopt cleaner and lighter vehicles, such as cargo bikes, PMDs, and other electric small freight vehicles.	On the one hand, Peruvian logistics operators interested in providing more environmentally friendly last-mile logistics solutions could benefit from Dutch companies' expertise. On the other, Peruvian manufacturers could learn from light and cleaner freight vehicle innovations in the Netherlands.
LO4. Last-mile logistics management	In the Netherlands, some companies provide software and data management solutions to optimize urban logistics.	Fleet management is a frequent problem in Peruvian last-mile logistics operators. Dutch solutions could optimize the freight distribution in Peruvian cities.
LO5. Driving training	The Netherlands has extensive experience in eco-driving, including freight transport driving. Dutch initiatives could apply their knowledge in the Peruvian context.	Peruvian freight vehicle drivers lack adequate training. Peruvian logistics operators could benefit from Dutch training programs on eco-driving.
LO6. Teaching and research centers cooperation	Dutch universities and research centers have vast experience in the transport sector, including urban logistics. They could exchange knowledge and partner with Peruvian equals.	Some higher education centers provide educational programs and research on supply chain and last-mile logistics. Peruvian and Dutch universities could partner for research and teaching.

Source: own elaboration based on consulted people, reviewed literature, and the theoretical framework.

10. Conclusions

This chapter presents the most relevant information for the project's next stage. The conclusions are focused on the criteria to identify areas for Peruvian urban mobility development and bilateral collaboration between Peru and the Netherlands and the key opportunities in this regard according to each field of study.

It is necessary to combine the green growth, circular economy, and degrowth approaches according to local needs to achieve sustainable mobility in Peru. The private sector that provides goods and services related to micromobility, electric transport, and last-mile logistics must adapt to the approaches. The following criteria based on the reviewed theory are crucial to identifying opportunities for bilateral collaboration between Peru and the Netherlands on sustainable mobility development:

- C1. Human-powered and partly motorized means of transport are, in general, more desirable for urban journeys than motorized vehicles.
- C2. Transport public, cooperative or collective ownership is a preferable option to a private for-profit or single-person ownership.
- C3. Vehicle-sharing, vehicle-pooling and public transit systems are more sustainable options than personal motorized vehicle use.
- C4. As far as possible, local production must replace imported transport goods, services and technologies in the long term.
- C5. Urban transport must stop using polluting technologies to start using technologies that require less use of raw materials and fossil fuels.
- C6. The redesign of cities should go hand in hand with the shift toward sustainable urban transport.

Potential areas for private sector development and bilateral collaboration for the development of sustainable urban mobility in Peru are classified according to each field of study.

Opportunities in micromobility:

- MO1. Cycle design and manufacturing
- MO2. Cycle facility and policy planning and design
- MO3. Cycle and PMD flow management and monitoring
- MO4. Micromobility infrastructure development
- MO5. Regulatory framework development
- MO6. Vehicle-sharing systems development
- MO7. Micromobility vehicle parking systems
- MO8. Micromobility and public transit integration
- MO9. Promotion of micromobility
- MO10. Association of service and goods providers
- MO11. Research on micromobility

Opportunities in electric transport:

- EO1. Vehicle-sharing systems development
- EO2. Public transit systems development

- EO3. Data management for decision making
- EO4. Electric charging infrastructure development
- EO5. Electric transport actors coalition
- EO6. EV manufacturing
- EO7. Regulatory and policy framework development
- EO8. Subsidies and loans

Opportunities in last-mile logistics:

- LO1. Logistics infrastructure development
- LO2. Regulatory and policy framework development
- LO3. Urban logistics in cargo bikes and PMDs
- LO4. Last-mile logistics management
- LO5. Driving training
- LO6. Teaching and research centers cooperation

The road map will explore these opportunities in more detail.

Appendix

Consulted people and organizations

People consulted for this study:

- Alfonso Córdova Rau
- Helliot Lévano Vásquez
- Jaime Polo Fernández
- Javier Chacón Marcés
- Jorge Ignacio Asmat
- Mario Chong
- Max Elías Figueroa Huamán
- Michelle Rodríguez Serra

Organizations consulted for this study:

- Autoridad de Transporte Urbano para Lima y Callao - ATU
- AEDIVE PERU
- Bike House Perú
- BYCS
- CAF - Development Bank of Latin America
- Cargo Bike Perú
- CIDATT
- Emove
- Fundación TRANSITEMOS
- German cooperation for international development, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
- GreenLine
- Grupo Crosland
- Kallpa Móvil
- Ministerio de Vivienda, Construcción y Saneamiento
- Ministerio del Ambiente
- Modasa - Motores Diesel Andinos SA
- Municipalidad Metropolitana de Lima
- Ransa Comercial S.A.C.
- Run City
- Scooterland
- Transportes Platinum SAC
- World Bank

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