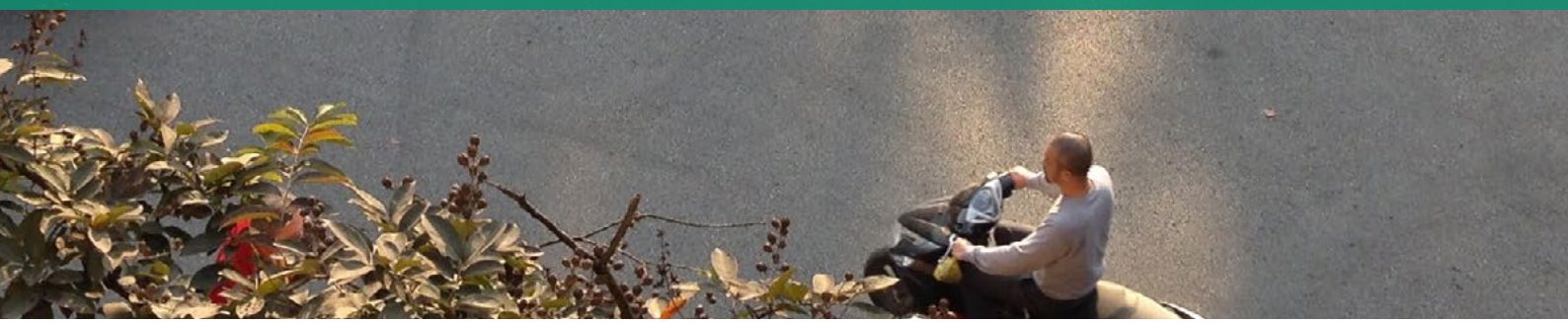
CITY ROADMAP: SHARED E-MOBILITY SERVICE FOR LAST MILE CONNECTIVITY



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PROJECT PARTNERS

ABOUT

To present a roadmap to deploy and scale up Shared E-mobility Service for Last Mile Connectivity in Hanoi

TITLE

CITY ROADMAP: Shared E-mobility Service for Last Mile Connectivity

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LAYOUT

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All the pictures are provided by the SOL+ partners

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CITY ROADMAP:

Shared E-mobility Service for Last Mile Connectivity

July 2024

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Executive Summary

Vietnam is a developing country experiencing a rapid urbanization process. Urbanization in Vietnam has been increasing, with 20% of the population living in urban areas in 2000, 30% in 2010, 41% in 2022, and is expected to reach 45% by 2025 and over 50% by 2030. This rise in urbanization is expected to increase urban person-trips, accompanied by higher fossil fuel consumption intensities and GHG emissions in the transport sector.

Hanoi's 2024 population is now estimated at 8.5 million people, with a population density estimated at 2,398 people per square kilometer. Urban mobility in Hanoi is overwhelmed by private vehicles as a consequence of the underdevelopment of public transportation. Most people drive motor vehicles, with private transport accounting for nearly 92% of people's travel purposes.

Hanoi's modal share is largely dominated by light vehicles, such as bikes and motorcycles. Private vehicles still account for a large proportion and continue to increase rapidly. In December 2020, the total vehicle population registered in Hanoi was 7,160,052 vehicles, including 6,122,936 gasoline motorcycles, 167,211 electric motorcycles, and 869,905 cars.

Since the Paris Agreement, several decisions have been taken at the national level and by the Hanoi People's Committee (HPC) at the local level to accelerate the transition towards a green and sustainable city and a significant reduction of emissions.

The pilot project on shared electric two wheelers under SOLUTIONSplus demonstrated the technical and economic feasibility as well as its social acceptance. It could be envisioned to extend such services at the city level. However, this extension must be included in the electric mobility plan elaborated by the HPC since there are technical and economic relations between electric mobility for all and the specific case of shared system.

To support this action, the roadmap establishes short-, medium-, and long-term goals to understand and address the obstacles and implement specific actions, presenting six focus areas:

- Good governance: Clearly define the position of local authorities regarding potential sharing operators and establish the operational relationship between them.
- Communication: Developed tailored communication strategies for various stakeholders involved in the transition process.

- Regulation: Create a clear framework for deploying of electric two-wheelers, including low emission zones, restricted access areas, and standards for vehicles and batteries, ultimately leading to the ban of traditional internal combustion engine (ICE) vehicles.
- Urban planning: Identify optimal locations for implementing infrastructure for sharing and charging vehicles.
- Economic and financial measures: Establish city-level economic and financial measures that complement to national policies and facilitate the deployment of shared vehicles operators.

Table of Contents

List of figures and tables

List of Abbreviations

BAU	Business-as-usual
BRT	Bus Rapid Transit
CNG	Compressed Natural Gas
COP	Conference of the Parties
DOT	Department of Transport
EV	Electric vehicle
GHG	Greenhouse gas
HPC	Hanoi People's Committee
HPTC	Hanoi Transport Management Center
ITDP	Institute for Transportation and Development Policy
MOC	Ministry of Construction
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade
MOT	Ministry of Transport
MRT	Mass Rapid Transit
NDC	Nationally determined contribution
NSCC	National Strategy on Climate Change
QCVN	Vietnam Technical Regulations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UTT	University of Transport Technology
VGGS	Viet Nam Green Growth Strategy

1. Background

1.1. Urban mobility context in Hanoi

With the rapid development process, Hanoi's population has now reached more than 8.4 million people. According to statistics by November 2022, the Hanoi capital has about 7.78 million vehicles, including over 1 million cars and more than 6.5 million motorcycles, along with nearly 200 thousand electric motorcycles. This figure excludes vehicles with diplomatic, international, or out-of-province plates circulating within the city. To address the growing issue of traffic congestion, Hanoi has prioritized the expansion of its public transportation system to better serve the travel needs of its residents. The city has not only introduced additional bus routes to areas far from the center but also improved the integration of public transportation stations, enhancing convenience for passengers.

Between December 2022 and May 2023, the University of Transport Technology coordinated with Hanoi Department of Transport to implement a pilot action under the SOLUTIONSplus project titled "Shared electric two-wheeler for last-mile connectivity". This demonstration project provides users with free access to shared electric two-wheelers through a management app, facilitating connections between the Van Khe BRT, AEON Mall Ha Dong, and surrounding bus routes. This initiative is part of Hanoi's broader efforts to encourage the use of public transportation by making it more accessible and user-friendly.

Modal Share: In Hanoi, the rate of public passenger transport by bus was only 13.7% in 2018, increasing slightly to 14.75% in 2020. Private vehicles still dominate the transportation landscape and continue to grow rapidly. Transitioning from private to public passenger transport requires a long-term strategy and significant budget, along with appropriate policies and mechanisms to engage the private sector. This includes the development of a traffic management plan and the provision of adequate park-and-ride and accessibility facilities.

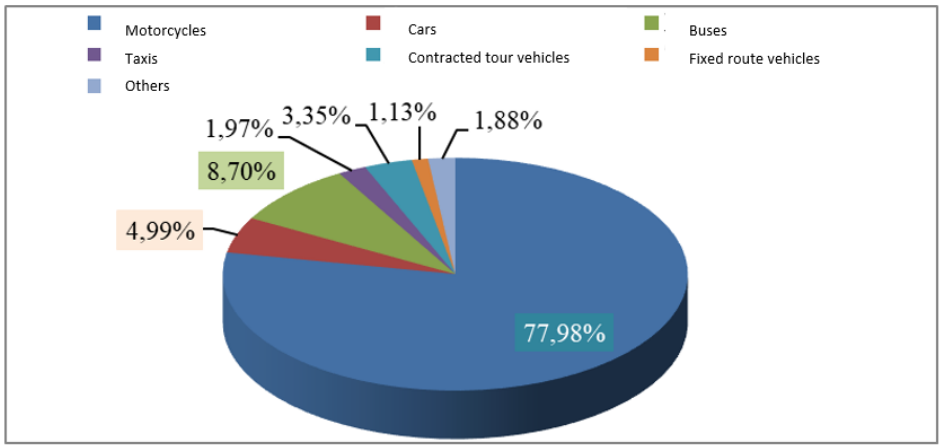


Figure 1: Modal share of transport modes in Hanoi, 2020

Vehicle Fleets: Private vehicles still account for a large proportion and continue to increase rapidly. As of December 2020, the total number of registered vehicles in Hanoi was 7,160,052. This includes 6,122,936 gasoline motorcycles, 167,211 electric motorcycles, and 869,905 cars.

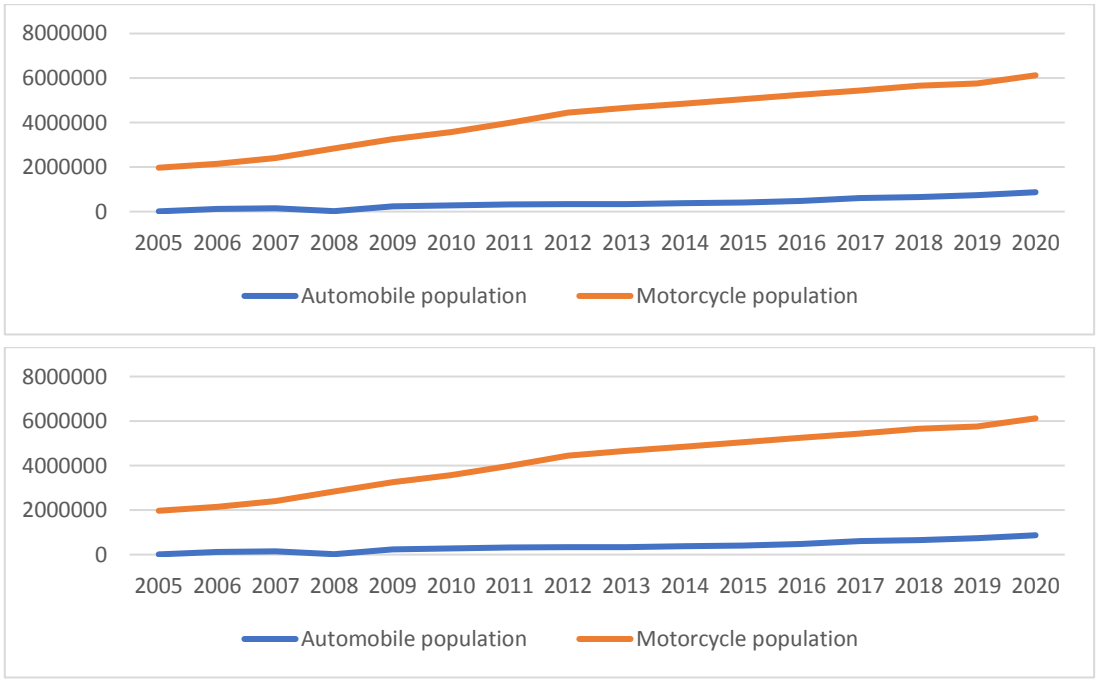


Figure 2: Private vehicle population in Hanoi

This figure does not include the substantial number of vehicles registered in other provinces but operating in Hanoi. From 2011 to 2020, the annual vehicle growth rate was 10,1% for automobile and 4,5% for motorcycle (Hanoi Traffic Safety Unit, 2021). In 2021, Hanoi's bus fleets consisted of 1,966 vehicles, predominantly diesel buses, which accounted for 89% of the fleet. Clean fuel buses made up only 11%, including 148 electric buses and 139 CNG buses.

Public transport: The underdevelopment of public transportation is the main reason for the rapid increase in the number of motorcycles and private cars, causing traffic congestion in major cities of Vietnam such as Hanoi. Currently, the traditional buses (city passenger buses, minibuses, etc.) are the primary public transport model in Hanoi. Other mass public transport modes such as Mass Rapid Transit (MRT) with only one operational line of 12km, and Bus Rapid Transit (BRT) system, with a single 8.5km, are still under development. Additional MRT lines are expected to become operational by 2028.

Figure 3: Public transport

The public transport in Hanoi currently meets only a small percentage of the travel demand. Efforts to increase modal share for bus transport are focusing on improving the coverage and quality of bus services[1]. However, state financial and technical resources for developing new public transport models (such as BRT, MRT) are limited, relying heavily on foreign resources.

To date, bus transport is only publicly organized and managed by Hanoi Department of Transport (DOT). Currently, the city's bus network covers 112 routes, of which 92 lanes receive subsidies. CNG buses are operated by Bao Yen Bus Private Company, and electric buses are managed by Vinbus Private Company, with 148 E-buses operating on

[1] JICA, Technical assistant project to strengthen the capacity of regulator and establish operation and maintenance company of metropolitan railway line in Hanoi city – final report – volume 2, 2016

9 routes around the city. The E-bus has a capacity of 72 passengers, feature 281 kWh batteries and can travel a maximum distance of 220-260 km.

A recent decision (September 2019) by the Hanoi People's Committee outlines further plans to enhance the public transport network in the city and reduce the number of individually-occupied vehicles to 25% by 2020, promoting the use of public transport and bicycles. The city aims to expand the bus network by adding 45 new routes, some with priority lanes for buses. The city also plans to develop park-and-ride facilities near major public transport stations to encourage multimodal journeys (Intelligent Transport, 2019).

Additionally, Hanoi plans to ban the use of motorcycles in the inner city by 2030 and introduce two-wheeler and e-two-wheeler sharing systems to improve last-mile connectivity to mass transit systems. Currently, e-two-wheeler sharing systems are being piloted in Hanoi, offering more options for connecting to public transport.

***Accessibility*:** To enhance the effectiveness of the bus system, MRT and BRT, it is crucial to provide connections with other transport modes or park and ride facilitates. Without these, people will not shift from private vehicles to public transport. Currently, the assessibility of MRT and BRT relies on the bus feeder system rerouted from existing the existing traditional buses system. However, the park-and-ride facilities are not fully equipped along these mass transit system due to lack of an integrated approach to public transport and insufficient reserved land.

In order to address the barriers relating to commuters' unfamiliarity with the public transport system, TRANSERCO (Hanoi Transport Corporation) released Timbuyt app in 2017. This app assists with bus trip planning in Hanoi by providing routing information, tracking the number of vehicles near your location, and estimating the remaining time to the bus terminal. Buses are equipped with GPS devices to support these functions.

Moreover, inadequate land reservation for transport development in the cities, stemming from poor planning in development sectors, has led to subpar urban transport infrastructure and service quality. In Hanoi, land allocated for urban transport developed is around 9.75% of total construction land area. This proportion is quite low compared with other cities of developed countries such as Paris, London, and New York, where it ranges from 20-25%, and even lower than other cities in the Asian region like Bangkok, Jakarta, Taipei, which allocate about 10-15%.[2]

2 D.Thi Phin and E. Dotson. 2013. Urban Transport Institutions and Governance and Integrated Land Use and Transport. Ha Noi. http://www.unhabitat.org/grhs/2013

***Air pollution and GHG emission*:** Greenhouse gas (GHG) emissions from the transport sector have increased faster than any other energy end-use sector. In 2019, emissions were estimated at 45 million tCO_2, with an annual increase rate is 6-7%, projected to reach 90 million tCO_2 by 2030. This will account for 39% of total GHG emissions from energy consumption. Road transport is the largest GHG emission source of transport sector, contributing about 80% of sector's total emissions.[3]

The transport sector is currently the main contributor to CO_2 emissions and other air pollutants. According to a World Bank emission inventory in 2015, the main sources of PM2.5 in Hanoi include industrial activities, straw burning, road dust and traffic, waste burning and other sources (7%)[4].

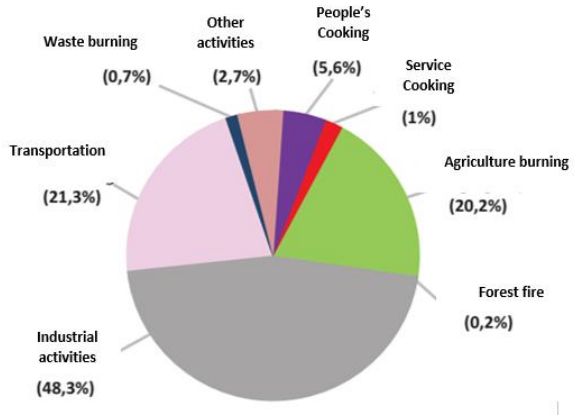


Figure 4: Air pollutant emission sources in Hanoi

The annual average PM2.5 concentrations of every district in the city were higher than the national standard, with the number of days with good air quality in 2021 only accounting for 42.2% of the total days of the year[5].

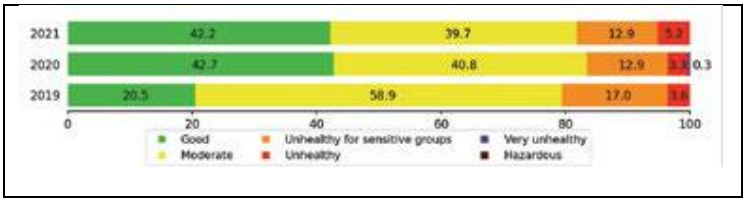


Figure 5: Status of PM2.5 and Its Impact on Public Health

1.2. Current situation of e-mobility in Hanoi

3 Updated Vietnam's NDC report, 2022

4 WorldBank, 2021. Ô nhiễm không khí hà nội: Thực trạng và gợi ý chính sách

5 USAID, 2021,Status of PM2.5 and Its Impact on Public Health in Vietnam 2021 report

Nationally, according to VAMM, the total electric motorcyles and bikes sold in Vietnamese market was 500,000 vehicles in 2017 and increased by 40% in 2018. By the end of 2020, the population of electric motorcyles and bikes reached 3 million vehicles, with an estimated annual addition of 250,000 to 300,000 vehicle.

The electric vehicle feet in Hanoi includes electric motorcycles and electric bikes, cars and buses. However, only 89 e-buses are operating, and the number of e-cars is small. The dominated vehicle are electric motorcycles and bikes, whose numbers are steadily increasing. Ownership of smaller pedal electric 'xe dap dien', which can be ridden by teenagers without a driving license, along with electric motors in general, is an emerging trend[6].

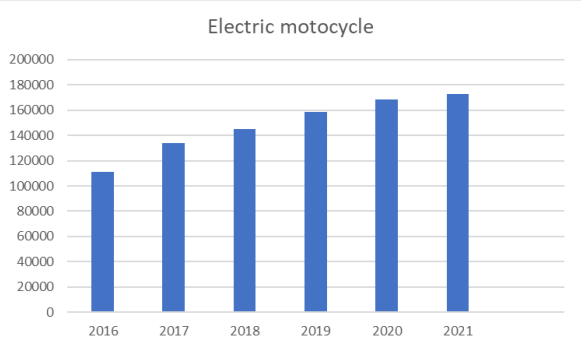


Figure 6: Electric motorcycle fleet in Hanoi

VinFast, founded in 2017, is a subsidiary of Vingroup - the largest private enterprise in Vietnam. The company operates in automotive and electric scooter manufacturing industry at its factory in Cat Hai - Hai Phong. Since early 2018, VinFast has launched its first electric scooter model, the VinFast Klara, available in both lithium battery and a lead-acid battery versions. Vinbus, another Vingroup company, operates electric buses and taxis in Hanoi and Ho Chi Minh ciy.

Selex Motor, founded in 2018, is a Hanoi-based startup developing an optimal e-mobility ecosystem for urban transport using electric two-wheelers. This ecosystem includes four key elements: a novel electric scooter optimised for both cargo and passenger transport, a compatible battery pack, an automatic battery swapping station and an IoT management platform. This system helps users save 30-40% operational costs, reduces charging time from 3-8 hours to less than 2 minutes thanks to the battery swapping solution, and

[6] The WB, Motorization and urban transport in East Asia: Motorcycle, Motor Scooter and Motorbike Ownership and Use in Hanoi, 2014

improves load capacity by 50%. Selex Motors focuses on the fast-growing segment of last-mile delivery in Vietnam, with plans to expand to South East Asia region. It is estimated that for every gasoline motorcycle replaced by Selex e-mopeds reduces the CO_2e footprint by 4 tons per year. Officially launched in November 2022 as the first and only provider of battery swapping service in Vietnam, Selex aims to establish at least 200 swap points and power 3000 electric mopeds by 2023. Selex Motors receives funding from regional venture capitals, including Asian Development Bank Ventures. Electric-assisted bikes have become a popular means of delivery since early 2020, providing delivery in major cities.

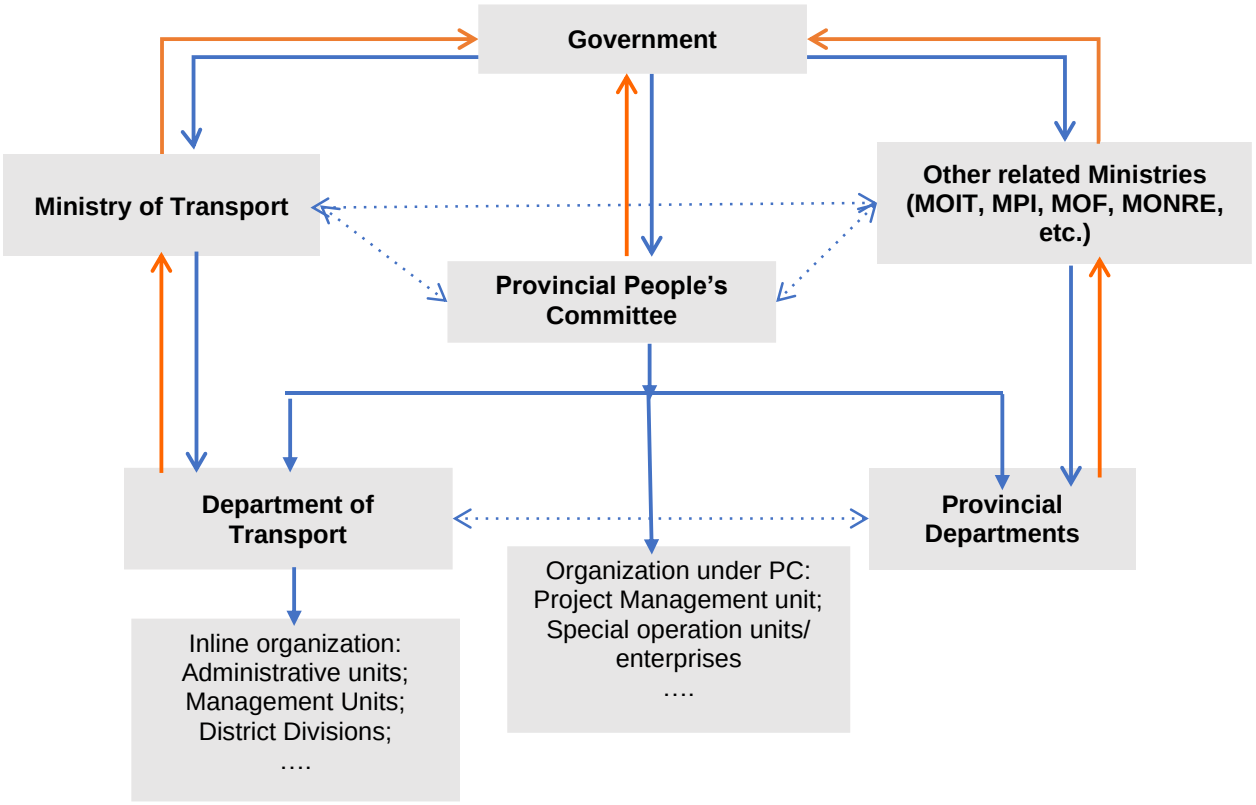
Urban transport management institution in Hanoi

The Ministry of Transport (MOT) is responsible for the governmental management of the transport sector. According to Decree No. 12/2017/NĐ-CP by the Prime Minister dated 10/2/2017, the MOT's responsibilities include:

- Preparation of transport development policies, strategies, master plans, long-term and short-term public investment programs,
- Management of the implementation of government policies, technical regulations in the transport sectors
- Oversight of the development, management and maintenance of national transport infrastructure across five sub-sectors: road, railway, inland waterway, maritime and aviation
- Regulation of the operation of transport systems, and handling of environmental issues related to transport

For the development and implementation of transport-related policies, strategies and master plans, MOT cooperates with other line ministries such as the Ministry of Industry and Trade (MOIT), the Ministry of Natural Resources and Environment (MONRE), the Ministry of Science and Technology, and the Ministry of Finance (MOF), as well as provincial management agencies.[7]

[7] GIZ, Tracking Sustainable Transport in Vietnam: Data and Policy Review for Energy and Climate Change, 2015.



Note: Direct instruction or command

Directly report to

Cooperate

Figure 7: Urban transport management institution in Hanoi

Sources" MRV institution system report for Hanoi Metroline 3, ADB, 2020

At the provincial and city level, the City People's Committee manages transport functions within its jurisdiction, with the DOT serving as an advisory body.[8] The DOT, as a line agency of the MOT, oversees road, urban railway, and inland waterway transport infrastructure, including i) direct organization and implementation of transport infrastructure development planning; ii) appraisal and approval of transport construction investment projects as authorized by the City People's Committee; iii) technical managemen, supervision, and quality control of transport construction works in in the city.

[8] Joint Circular No. 42/2015/TTLT-BGTVT-BNV guiding functions, responsibilities, powers and organization structures of specialised agencies transport of the PPC of provinces, cities directly under the central

The governance structure of Hanoi city is similar to other urban areas in the country. The Hanoi People's Committee (HPC) is responsible for infrastructure and service delivery across various sectors/departments. Specialized agencies support the city government in performing specific function. State-Owned Enterprises reporting directly to the HPC in provising bus services and developing the urban rail system. Key departments involved in urban public transport within Hanoi oversees both infrastructure construction and service operation.

Hanoi DOT is a specialized agency under the HPC. The DOT is in charge of direction and management on organizing, staffing and working for the People's Committee; at the same time, it is under direction, inspection and guidelines for professional competence and skills of MOT. Hanoi DOT has the function to advise and assist HPC in the state management on transport including roads, waterways, urban railways, transport, traffic safety in Hanoi city area (Decision No. 17/2008/QD-UBND dated 29 September 2008 of HPC).

Within DOT, the organizational units are grouped in two types of divisions: Administrative Divisions responsible for on-going governmental management functions, and the other Divisions responsible for business enterprises and project management. This organizational arrangement aims to separate the on-going policy making, planning and administrative or 'government' functions of DOT from the 'enterprise' functions, and 'project' functions that could also be contracted out. This arrangement facilitates the department's transition from implementating public works to managing the transport system.

1.3. General Policies on Two-wheelers and Electric Mobility in Hanoi

The Paris Agreement on Climate Change was adopted by the states in COP 21, is the first global legal document regulating responses to climate change. Decision No. 1/CP21 of the Paris Agreement requires all parties to review and update their Nationally Determined Contributions (NDCs) at least every five years, with the aim of increasing their ambition to mitigate greenhouse gas (GHG) emissions.

Viet Nam updated its NDC in 2022, raising its targets for GHG emissions reduction by 2030 compared to the business-as-usual (BAU) scenario. The new targets are a 9% reduction unconditionally (equivalent to 83.9 million tonnes of CO_2eq) and a 27% reduction conditionally, depending on an adequate foreign financial support (equivalent 250.8 million tonnes of CO_2eq). At the 2021 United Nations Climate Change Conference (COP26) in Glasgow, Viet Nam's Prime Minister made ambitious and highly commendable commitments that include setting the national target of net-zero emissions by 2050, joining the global pledge to cut emissions of the powerful greenhouse gas

methane by 30 per cent by 2030, and pledging to halt and reverse forest loss and land degradation by 2030. The Prime Minister has recently established a new National Steering Committee for the implementation of Viet Nam's Commitment at COP26.

In the Viet Nam Green Growth Strategy (VGGS), approved in 2021, clearly outlines the target of reducing GHG emissions. The goals set by the government include reducing the intensity of GHG emissions and promoting the use of clean and renewable energy, with the following short-, medium- and long-term targets:[9]

- Reduce the greenhouse gas emissions intensity per unit of GDP:
    - Target until 2030: The greenhouse gas emissions intensity per unit of GDP reduces at least by 15% compared to 2014;
    - Target until 2050: The greenhouse gas emissions intensity per unit of GDP reduces at least by 30% compared to 2014
- Greening economic sectors:
    - Key target until 2030: Reduce primary energy consumption per unit of GDP by 1.0-1.5% annually (2021-2030); increase the proportion of renewable energy in the total primary energy supply to 15-20%; ensure the digital economy accounts for 30% of GDP; maintain forest cover at 42%; and apply advanced and water-saving irrigation methods in at least 30% of the total irrigable dryland crop area.
    - Key target until 2050: Reduce primary energy consumption per unit of GDP by 1.0% annually for each 10-year period; increase the proportion of renewable energy in the total primary energy supply to 25-30%; strive for the digital economy to account for 50% of GDP; maintain forest cover at 42-43%; and apply advanced and water-saving irrigation methods in at least 60% of the total irrigable dryland crop area.

The National Strategy on Climate Change (NSCC) until 2050, approved in 2022, which is aligned with the Carbon Neutral target by 2050, identifies achieving net-zero emissions by 2050 as an inevitable development goal. This is realized mainly through a strong energy transition, low emission development, transforming economic growth models. The NSCC equally considers adaptation and mitigation, focusing on reducing vulnerability, loss and damage due to climate change, and achieving the net-zero emission target by 2050, while actively and responsibly contribute to the international community.

[9] National Green Growth Strategy for the 2021-2030 period, vision towards 2050.

Government of Vietnam recently issued decision No. 888/QD-TTg signed by Deputy Prime Minister on 25 July 2022, approving the Proposal on tasks and solutions to implement COP26 commitments, the tasks and solutions, including:

- Improve policies, laws, promote administrative procedure reform, improve business investment environment;
- Develop new renewable, zero-emission energy sources; energy storage technology and carbon capture, storage and use technology;
- Promote emission reduction in transportation and mitigation of greenhouse gas emissions in the field of building materials production; urban development and green construction;
- Promote ecological, circular, low-carbon agriculture; forest protection, conservation, use and sustainable development;

Decision No.888/QĐ-TTg on Approving the Scheme on tasks and solutions to implement the results of the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change, set out the main tasks to promote emission reduction in transportation and mitigation of greenhouse gas emissions in the field of building materials production; urban development and green construction

- Promote the transformation of transport modes from road to railway, inland waterway and coastal transport; strengthen the connection of modes of transport combined with high-quality logistics services, reducing the empty running coefficient of vehicles. Converting the use of private means of transport to using public transport, increasing the market share of public passenger transport in urban areas; expansion and development of non-motorized traffic.
- Promote the transformation of activities according to green criteria, low carbon emissions for ports, wharves, and stations. Develop infrastructure to provide green energy for means of transport; development of green, low-carbon transport infrastructure.

Decision No. 876/QD-TTg on the Action Programme for Green Transformation, Carbon and Methane Reduction in the Transport Sector, approved by the Prime Minister on July 22, 2022. The general objectives of the Action Programme aim to develop a green transport system to contribute to achieving net-zero emissions in the transport sector by 2050. The action plan includes two implementation phases:

- 2022 to 2030: Focus on enhancing fuel efficiency and transitioning from conventional fuels to electricity and other green energy sources for technologically

ready subsectors, institutional support, and resources to achieve NDC commitments and methane reduction objectives.

- 2030 to 2050: Aim for a complete switch to electricity and green energy for all transport vehicles and equipment to achieve the zero-emission target.

The Adjusted Strategy for Development of Vietnam's Transport through 2020, with a Vision toward 2030, also sets objectives for climate change mitigation and adaptation.[10] For mitigation, the strategy's focus are to:

- improve energy efficiency in transport on the basis of reasonable transport organization, and take advantage of water and railway transport; rapidly develop public transport in cities, and apply multimodal transport;
- reasonably develop urban transport and public transport infrastructure, allocate 16% - 26% of urban land for urban transport. Rapidly develop bus systems in major cities; quickly invest in bulk public routes such as elevated railway and subway in order to undertake 25% - 30% of public passenger transport;
- control the development of private motorbikes and cars, especially in Ha Noi and Ho Chi Minh City;
- efficiently manage urban transport using modern technologies and instruments such as signals, control stations, camera systems, and Intelligent Transportation System (ITS);
- promote the application of technologies and the use of vehicles that use energy efficiently; use clean energy, renewable energy, and other alternative energy in transport.

The Hanoi urban transport infrastructure development master plan until 2030 and oriented to 2050 approved by Decision No. 519/QĐ-TTg dated 31/03/2016. The main tasks include prioritizing the development of the public passenger transport system to achieve:

- A 30-35% share of total travel demand in the core urban area by 2020, 50-55% by 2030, and 65-70% after 2030.
- A 15% share in satellite citiey ba 2024, 40% by 2023, and up to 50% after 2023.

[10] Government of Viet Nam. 2013. Decision No. 355/QD-TTg dated 25/2/2013 on approving the Adjusted Strategy for Development of Vietnam's Transport through 2020, with a Vision toward 2030**.** Ha Noi.

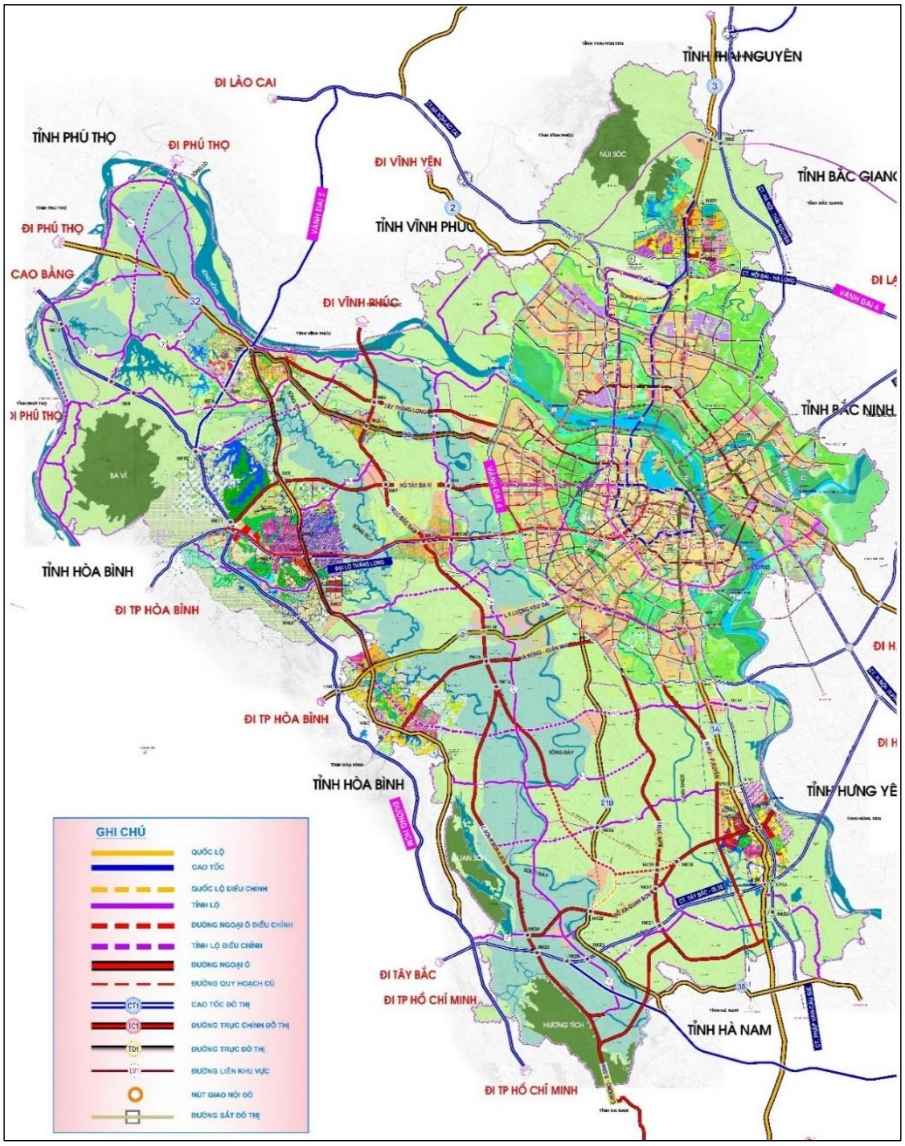


Figure 8: Urban transport network

1.4. Hanoi Demonstration project: Shared e-two wheelers for last mile connectivity

In many cities, the two wheeler-share system plays a critical role in reducing vehicle travel demand, enhancing accessibility to public transport, and effectively connecting various points within the city. These system encourage people to live car free, contributing to reductions of GHG emissions, congestion, traffic injuries and deaths. The cities offer two-wheeler share programs to residents and visitors alike, employment centers, and even residential developments.

The importance steps for development of two-wheeler/e-two-wheeler sharing system:

- Political will to support active transportation initiatives
- Commitment to investing in necessary infrastructure
- Integrated in the city transport development plan
- Consistent with the city's density, topography, and weather conditions

Description of the pilot project

The demonstration activity in Hanoi is promoting shared electric two-wheeler services for last-mile connectivity and enhancing accessibility along the Hanoi BRT route by providing a pilot measure to connect between a BRT station to a shopping mall. The project has three main objectives: i) use shared e-two wheelers connecting public transport (buses, BRT…); ii) Increasing public transport use, minimizing private vehicle use and iii) contribute to reduce GHG emission, and improve air quality.

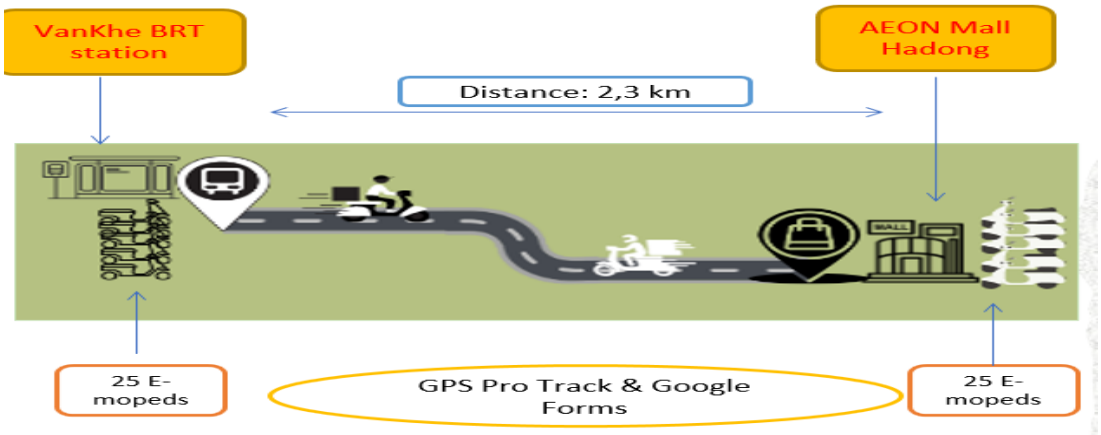


Figure 7. Shared e-two wheeler services for last-mile connectivity in Hanoi

50 shared e-mopdes have been deployed to connect between Van Khe BRT station to Aeon Mall with distance about 2.3 km to enhance the connection between BRT and commercial area. National partner to implement activity in Hanoi is University of Transport Technology (Hanoi UTT), who is in charge of concept note preparation, selection of location/route, complete all administrative requirements, and manage activities on the site during demonstration period.

International partners supporting the implementation under SOLUTIONSplus project are: UNEP, UN-Habitat, Clean Air Asia, Wuppertal Institute - Germany, TNO Research Institute - Netherlands. Domestic partners supporting the implementation are Hanoi Department of Transport, Hanoi Public Transport Management Center, Hanoi Transport

Corporation, QIQ Joint Stock Company, AEON Commercial Center. QIQ provided software infrastructure such as App and IOT development for vehicle monitoring systems and users, at the initial phase.

The main features of the demo are as below:

- **Vehicle fleet**: 50 Ludo e-mopeds, with the battery: 22Ah, 50.4V, 55 kWh
- **Infrastructure**: physical infrastructure include parking areas and charging stations. Two parking areas are located at Van Khe BRT stop station (sidewalk, in front of Anland Complex Building) (any facilities are provided) and at Ha Dong AEON Mall. However, the only one charging station is located in Ha Dong AEON Mall parking lot, which allow to charge 50 vehicles on time, and vehicle will be fully charged at this station.
- **Application development**: At the pilot phase from November 28, 2022, the “Pro-Track” software was connected to IoT devices for vehicle management and monitoring; and the mobile application "V-share" for user management. Users can register, automatically borrow and return vehicles throught the app. This system records the user information and execution details such as vehicle status (stop, move, position, distance traveled, travel time, vehicle history...); and issues warnings (e.g., locking/unlocking the vehicle, vehicle out of range movement). The operator can indirectly track users through real-time vehicle location monitoring. However, QiQ, the company committed to providing V-Share software, failed to fulfill its commitment shortly after the pilot began. Consequently, from December 14, 2022 until the end of the pilot, the team switched to Google Forms and UTT’s IOT. These alternatives allowed users to register accounts, borrow/return vehicles, and supported the system's operation, monitoring, and user information storage.
- **Operation system**: The system is not fully automated during the pilot phase, requiring at least one staff member to manage and monitor remotely and another to support and guide users directly at the borrowing/returning point.

1.5. E-mobility service providers in Hanoi

Selex Motors' electric motorcycle system for urban delivery:

Selex Motors has focused on building a comprehensive ecosystem for smart electric motorcyles to promote their adoption in Vietnam. This ecosystem aims to address the current hindrances of electric vehicles, such as charging inconvenience and high costs. Additionally, it offers users new experiences and novel benefits through data mining and the application of the latest technologies, including IoT, AI, and big data. The company's

vision is to make electric motorcyles easily accessible to everyone, enabling them to enjoy the positive values enabled by smart and sustainable mobility.

Electric motorcycles *+ Provide urban delivery services.* *+ Has a system of Battery charging stations.* *+ Expanded orientation to serve the needs of individual passengers.*	Hanoi & HCM City	• Based on rented stations, change the battery. • Developed and operated by Selex Motors • Currently only serving customers who buy / rent vehicles for inner city transportation needs. • Self-negotiate and hire, set up PIN exchange stations with private. Applicable technology: GPS tracking, mobile app, QR code scanning, electronic payment with flexible rental forms (according to time and travel distance) • Customers can look up complete information about the service and perform leasing and changing/changing Batteries through the App application developed by Selex Motors.

Vinbus

Vinbus, a non-profit subsidiary of Vingroup, is operating electric buses in Hanoi, Ho Chi Minh City and Phu Quoc with the aim to reduce greenhouse gas emission, noise and pollution from transport vehicles

VinBus Ecology Transport Services LLC operates in the field of public transport by bus and was established in April 2019. Just over a year later, the first electric bus had its trial run in Hai Phong. In April 2021, VinBus operated its pilot project in Ocean Park (Hanoi). Six months later, the first electric bus line in Phu Quoc was put in service.

At the end of 2021, VinBus opened the first electric bus line in Hanoi, then three months later opened the first electric bus line in Ho Chi Minh City (HCMC). By the end of June 2022, Hanoi has about 100 VinBus electric buses on eight routes, HCMC has 20 cars on one route and Phu Quoc has 30 buses running in the area

The electric bus battery has a capacity of 281kWh, and only takes two hours to full if charged by the 150kW charging station, with a range of 220–260km. The bus is quiet, emission-free, has an IoT system to control the driver's behavior, give warnings about the

risks of unsafe driving (unfocused driving, drowsiness, fatigue), and has various cameras to assist the driver during operation

GMS

GSM is a green and smart mobility joint stock company established by VinGroup to provide car rental services, electric motorcycles and electric taxi services with an investment scale of 10,000 cars and 100,000 motorbikes. Green Taxi SM brand of GSM company officially operates from April 14, 2023 in Hanoi. In the immediate future, 500 VFe34 vehicles and 100 VF8 vehicles will be in operation in Hanoi, expanding operations in other provinces and cities in 2023.

2. Approach

The roadmap draws a review of relevant official documents, insights gained from the pilot implementation of shared e-two wheelers under the SOLUTIONSplus project, and the scale-up approach concept. It also incorporated the DOT's action plans for developing electric two-wheelers in Hanoi.

While the pilot project focused on shared electric two-wheelers within the limited area and timeframe, the roadmap aims for broader scope, expansion and implementation. Achieving this requires adequate resources, regulatory reform, urban planning, public land acquisition, and consideration of technological and social aspects.

Thus, this roadmap addresses these factors and sets short-, medium-, and long-term goals to understand and overcome the obstacles, ensuring the successful implementation of the envisioned actions.

3. The Roadmap

3.1 Vision

The Hanoi People's Committee aims to achieve net zero emissions by 2050, as outlined in Decision No. 888/QD-TTg, signed by the Deputy Prime Minister on July 25, 2022. This vision aligns with the Action Program on green transformation (decision No 876/QD-TTg) and involves transforming the transport system in Hanoi towards zero emission. Key initiatives include implementing new metro lines, transitioning to 100% electric or green buses in both public and private fleet, integrating electric taxis, and developing adequate charging infrastructure. The goal is to increase the modal share of public transport to at least 40% by 2030.

Several actions are already planned, such as banning ICE vehicles, upgrading the electricity grid, and supporting Vietnamese design and manufacturing for new vehicles and related new technologies. However, to ensure Hanoi remains as a livable city, electrified or non-electrified light vehicles must not contribute to street. Therefore, these vehicles, mainy e-two-wheelers could be used for:

- Last mile travel: Complementing collective transport modes (tram, BRT) for individual purposes such as leisure or shopping. Mass transport is intended for longer, regular distances, with shared e-two wheelers facilitating last-mile connections.
- Goods delivery: Organized through a structured network of proximity storage warehouses fed with electric utility vehicles from external logistic platforms and light e-vehicles (eg e-cargo bikes) for the last mile delivery

Vehicles sharing is a solution to reduce the overall of number when integrated with other mass transport modes like buses (BRTs), trams or metro systems. However, sharing systems may not be effective when commuter flows are unbalanced. Thus, the focus is on promoting shared electric motorcyles or mopeds at high densed area with good commuters flow, also targeting occasional travels. Further surveys could evaluate the feasibility of sharing for commuters.

The vision of this roadmap is to provide all citizens with access to shared electric two-wheelers, enabling them to reach other transport modes for work or travel locally for various purposes such as shopping or leisure.

3.2 Objectives

The utilisation of shared two-wheelers is influenced by various factors linked to the topology, the culture, the availability and accessibility of vehicles. Some countries have progressively adopted the shared-system. For instance, in China, 38% of the population uses shared bicycles in 2022 (source Vélo : taux d'utilisateurs de vélos en libre-service par pays en 2022 | Statista)

To achieve the envisioned goal and establish a fluid and efficient sharing system, it will be necessary to provide a maximum 30 shared electric two-wheelers for 1000 inhabitants (cf Policy Paper), total around 500 000 vehicles. This objective aligns with two-wheeler usage practices in Asia. In comparision, an efficient ratio in major European cities is around 10-15 vehicles per 1000 inhabitants.

Realistically, it is forecasted that 40- 50% of the population will use shared e-motorcycles by 2050. While this may not reduce the ownership ratio, if traffic flow measures are implemented, it could significantly reduce congestion.

The deployment of this sharing system must be coherent with the overall electric mobility strategy developed by the Hanoi Population Council and other initiatives aimed at reducing the number of circulating vehicles in Hanoi. The main actions are pointed out in six focus areas :

- Governance
- Communication and public awareness
- Urban planning and charging infrastructure
- Regulatory measures
- Economic and financial measures

These actions will be elaborated in the following chapter.

3.3 Timeline

The roadmap can be implemented according the timeline presented below. It is organized by focus areas, as are described in the following section, with milestones in the short, medium and long term. This table provides a summary of the measures, with detailed information in the implementation plan section for each focus area.

Phase	***Demonstration (2024-2026)***	***Scale-Up (2027-2030)***	***Mainstream (2030-onwards)***
Focus area 1: Governance	- *Issue a plan to deploy shared two-wheeler activities in Hanoi* - *Determine the relationship between the DOT and operators, particularly regarding the operation and management of the shared systems (establish a a steering committee)* - *Select a pilot operator for one district* - *Elaborate a governance plan* - *Observe and monitor the deployment of paratransit services*	- *Analyse the results of first implementations and adjust the regulations within the overall transport system (Steering Committee)* - *Set up the plan for the implementation in identified locations based on the learning from the outcomes of the pilot operation* - *Follow the technical implementation and technical evolutions (Technical C)*	- *Continue the steering & Technical committees, integrating various stakeholders* - *Analyse outcomes and propose technical or strategic improvements* -
Focus Area 2: Regulatory measures	- *Determine the type of specific regulations to be applied for the deployment of shared electric two wheelers* - *Elaborate the schedule of their implementation* - *Define vehicles and charging standards, including battery swapping*	- *implementation of first access-controlled zones* - *Ban the sale of ICE 2-3 wheelers* - *follow up the implementation and the integration of standards*	- *Extend the network of sustainable areas for electric two-wheelers* - *Monitor the evolution of regulatory measures*

Phase	***Demonstration (2024-2026)***	***Scale-Up (2027-2030)***	***Mainstream (2030-onwards)***
Focus area 3: Partnerships and public awareness	- *Stakeholders detailed analysis* - *Define target groups and prioritize, create customised awareness raising campaign;* - *Implement communications campaigns to prioritized target groups;*	- *Develop a public awareness campaign* - *Continue implementation of communication campaigns and expand to other target groups;* - *Set up training sessions for the various target groups*	- *Continue implementation of communication campaigns* - *Continue training sessions*
Focus area 4: Urban Planning and charging infrastructure	- *Develop master plan to determine the most suitable locations for the shared e- two wheelers stations* - *Identify key locations for shared vehicles stations parking spaces, mobility e-hubs* - *Implement the pilot shared vehicles system and inter-modality concept* - *Detail the operating and management activities of the charging stations*	- *Prioritise the sites for pilot extension, and define their implementation, financial plan.* - *Purchase or develop (renting) agreements with the owners of the sites* - *Implement new sharing stations and related charging stations* - *Implement and monitor level of success (first sites)*	- *Deploy full network of shared vehicles system and charging stations*

Phase	***Demonstration (2024-2026)***	***Scale-Up (2027-2030)***	***Mainstream (2030-onwards)***
Focus Area 5: Economic and Financial measures	- *Develop specific facilitation strategy for operators* - *Include shared electric two-wheelers system in local-level incentives, grants and taxes* - *Elaborate accompaniment measures to incentivise start ups*	- *Explicit mention of LEVs financial incentives in national-level economic plan* - *Accompany the deployment of e-hubs and electric two-wheeler fleet*	- *Financial incentives plan in national-level economic plan* - *Monitor the incentives*

4. Implementation plan

The development of shared electric two- wheelers should be a part of a broader transition towards electric mobility for all vehicle types. Customers will use these vehicles for different purposes. Initially, the proposed shared system will be station-based and reserved for subscribers.

However, this setup may not be convenient for shopping or leisure activities, as stations are not always located near attractive centers. To enhance the usability of shared vehicles, it is essential to provide facilities such as secure parking places, charging stations, and urban logistics for transporting purchased items.

These facilities should also be available to other e-driver with their own vehicle. Therefore, the implementation plan must consider shared systems as facilitators for a larger deployment of electromobility.

4.1. Focus area 1: Governance

Private actors are already providing e motorcycle shared services. The plan to develop "shared electric bicycles and motorcycles" in Hanoi city, currently under elaboration, must align with Plan 201/KH-UBND dated October 16, 2020, from the Hanoi People's Committee regarding the "Development of public passenger transport in Hanoi from 2021 to 2030".

In this context, the Department of Transportation (DOT) must clarify its position on integrating these services into Hanoi's overall mobility framework. A specific strategy should be established before further deployment to structure the services and ensure efficient coverage of travel demands throughout the city. It would be counterproductive to have a proliferation of independent sharing operators concentrated in the most attractive areas, unable to provide adequate coverage of overall demand.

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in the most interesting areas, which might not provide adequate coverage of overall demand.

This strategy on the ownership and operation of the shared fleet should addres the following key topics:

- Coherence between the operation areas and practices,
- Interoperability between systems (digital access, payment)
- Management of related infrastructure and competences (e.g., depots, maintenance),
- Connections for grid access:
- Allocation process of licenses to operate sharing stations

Monitoring and observation on the utilization of shared electric motorcycles should be established. Appropriate indicators and measurement methods should be developed, and the technical devices allowing the tracking of the vehicles can be installed for operational data collection. The operators can share the collected data and operational report.

Such a strategy will acknowledge the political significance of shared systems and provide general guidelines and conduct modes for all operators which intend to enter this business.

4.2. Focus Area 2: Regulatory measures

The deployment of shared electric two-wheelers stations should be integrated into the broader transition towards electric mobility and must be supported by regulatory measures to facilitate their inclusion in the Hanoi's overall mobility system. Four types of regulations should be progressively established:

- Access control regulations: These should be linked with urbanization and traffic management, including dedicated lanes, low emission zones, congestion zones, delivery hours. The objectives of such measures are to limit the accessibility of ICE vehicles and to facilitate the use of electric vehicles for passengers and goods
- Vehicles Standards:
    - Vehicle frame and performances standards (dimensions, max speed, max load, etc.)
    - Battery standards, especially for swapping, covering everything from assembly (or importation) to the end of battery life.
- Interoperability Standards:

    - Between batteries (connections to motorisation, performances, installation on vehicles)
    - Charging protocols, ensuring interoperability between providers and equipment, which is crucial for installing powerful charging stations to minimize the charging time.
    - Payment systems to foster the competition between providers
- Charging Equipment Standards: These should guarantee interoperability in all aspects (technical/plugs, payment, accessibility…) and ensure accessibility

Additionally the ban of non-electric two wheelers should be considered and implemented, starting with prohibiting their importation and sales, and imposing taxs on spare parts

Measure related to standards should be included in the specifications or Terms of Reference for any tenders related to shared vehicle systems.

4.3. Focus area 2: Communication and public awareness

The primary target audience comprises customers who either own or do not own motorcycles. Several barriers hinder drivers from adopting shared vehicles, including behaviour change, anxiety about vehicle availability for the return trips, technical concerns such as range anxiety. To address these issues, a robust communication strategy must be developed to encourage the shift towards vehicle sharing. The main components of this strategy could include :

- Practical benefits: Demonstrating how shared vehicles can reduce congestion and lead to shorter travel times for everyone
- Environmental impact: Inform the public about the reduction of emissions at city level
- Concrete vision: Organizing events and demonstrations to showcase the performances and capabilities of these vehicles, even in lending vehicles for a short period to allow drivers to familiarise themselves with the vehicles
- Economic advantages: Comparing the cost of travel, parking spaces, maintenance with shared vehicle use.

The second target audience includes other stakeholders involved in the deployment of two-wheelers :

- Operators
- Vehicles sellers who can promote and explain the advantages of these vehicles

- Manufacturers of two-wheelers who can start producing or assembling these new vehicles
- Delivery clients (shopkeepers) or passengers who can request that their services are conducted with electric vehicles

Additionally, the implementation of e shared services may more easily convince individuals to shift to electric mobility which is the ultimate objective of HDOTCP

At short term, Hanoi city will issue a Plan to deploy shared two-wheeler activities. The plan should include:

- Dissemination and promotion actions of the master plan for shared two-wheeler stations.
- Development and implementation of communication activities.
- Organisation of seminars and training sessions to build capacity among stakeholders.

4.4. Focus area 4 : Urban Planning and charging infrastructure

The main concern on urban planning would be to identify and provide dedicated spaces for the shared vehicles stations. Additionally, it is necessary to offer parking spaces for customers who need to stop between two stations.

Shared vehicle stations

The locations of stations should be determined /agreed by Local Authority to ensure a coherent city-wide mapping. This requires a detailed analysis of the potential demand in each area, as well as the availability of the land and energy.

Charging stations: Two charging modes may be used in Hanoi :

- Battery swapping: Suitable for electric two-wheelers, as their battery packs are relatively light (less than 10 kg)
- Charging stations: Necessary for intermediate charging, basically needed for commercial vehicles

Both charging modes may be used by the shared electric two-wheelers depending on the power requirements of the vehicles. Charging stations can be located on-street or in parking areas and should align with the broader electric mobility plan, accommodating shared vehicle services.

These spaces need to be clearly identified based on potential user demand, to the operators requirements, technical constraints on electricity accessibility, and land ownership.

Several types of parking spaces should be considered, which can also be utilized by other electric vehicle:

- Parking areas: Secured parking spaces or waiting places for travelers; prioritizing electric motorcycles. These should be near attractive locations with high mobility demands or entry points for collective transport.
- Small e-hubs: Equipped with charging facilities, automated battery storage for swapping, and secured parking or access. These hubs may also include e-two-wheeler sharing stations for different operators.
- Complete e-hubs: Extended facilities that include services such as vehicle maintenance/ repair services, driving and the charging advice, and ownership assistance. These hubs can also offer charging stations for cars or light utility vans.

In order to achieve this, the following actions are necessary:

- Define guidelines to determine the most suitable locations for shared vehicle stations
- Identify key requirements for the surfaces and facilities of these stations;
- Engage landowners in both the private or public sector who own land in suitable sites and encourage their involvement
- Choose the sites with the highest probability of success, and develop their implementation, financial plan, and deployment plan.

4.5. Focus Area 5: Economic and Financial measures

The city needs to propose a set of policies that create an enabling environment to encourage private sector and other stakeholders to invest in and provide services for shared electric two-wheeler.

Smaller electric two-wheeler sharing systems, such as e-bicycles and e-mopeds or e-motorcycles, can be funded through a mix of public and private sources, including government subsidies, corporate sponsorships, and public-private partnerships. However, e-moped/motorcyle sharing systems primarily depend on private funding sources, including venture capital investment and investments from companies and individual shareholders

Regarding electric mobility, financial measures such as purchases incentives or tax exemptions, are more often decided at national level than at city level. However Local Authorities may also contribute to the economic support of the deployment of two-wheelers. Actions can be taken in several domains, such as

- Develop specific partnerships with the operators like Vinfast , for instance for the exploitation of e-hubs or implementation of charging stations on public properties
- Facilitate to obtain banks' loans for operators, especially the smaller ones, by ensuring warranties;
- Exempt local taxes like parking fees, tolls.
- Facilitate the negotiations with electricity providers to secure specific rates for fleet operators
- Support the creation of start-ups that intend to manufacture parts, assemble vehicles, or set up importation trades (e.g., for battery cells)

5. Conclusion and next steps

This roadmap has provided an overview of the current situation in Hanoi regarding the deployment of e-motorcycles and their integration into the broader transport system over the long term. The demonstration project confirmed the technical feasibility of the social-economic viability of introducing shared vehicle systems in the city.

However, the deployment of e-two-wheelers sharing systems must be integrated in the DOT’s overall electric mobility strategy, requiring several measures to facilitate acceptability among operators. To better understand the implications of such shared vehicle systems and identify success factors and constraints, comprehensive pilot project implementation should be launched. This pilot should be follow a "living lab " approach, involving various stakeholders from the initial design (e.g., choosing locations or operators) to operational phases (e.g., validating of other pilot projects or monitoring indicators)

At short term, the Hanoi Department of Transport, in collaboration with relevant departments, can advise the City of Hanoi on the policy advices developed under the SOLUTIONSplus project. Following this, a workshop with relevant stakeholders in Hanoi can be organized to make adjustments according to the City's direction. The Guidance based on the suggested policy advise paper can be developed and published, and finally the city can issue official policy.

Once the plan is approved, the pilot project can be launched for a period sufficient to reach a maturity that allows for drawing accurate learnings from the operation (one year should be enough)

To maximise the learnings from the pilot and prepare for the deployment of additional shared vehicle systems, the following steps should be taken:

- Establish a Steering Committee composed of key stakeholders to determine the scope of the pilot, validate the outcomes of the operation, and prepare for the deployment of future shared vehicle systems
- Creat a Technical Committee responsible for monitoring the progress of the pilot shared vehicle system and charging infrastructure (e.g., charging stations), as well as tracking technical advancement in electric mobility, to inform the Steering Committee of any developments that should be considered for the future.

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