



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 875041

D4.1 Nine (9) Demonstration Implementation Plans

June 2020

D4.1 Demonstration Implementation Plans

Document Identification			
Status	Final	Due Date	30.06.2020
Version	1.6	Submission Date	30.06.2020
Deliverable Number	4.1		
Deliverable name	Nine (9) Demonstration Implementation Plans		
Work Package number	WP4		
Delivery due date	30.06.2020		
Actual date of submission	30.06.2020		
Dissemination level	Public		
Lead beneficiary	UITP (UEMI: Kigali, Dar es Salaam, WI: Quito, Montevideo, Kathmandu, CAA: Pasig, UTT: Hanoi, UITP: Hamburg, Madrid)		
Beneficiaries	UEMI, ABB, CAA, CMM, CRF, ITDP, TSY, Pluservice, UTT, WI		
Responsible scientists	CAA: Kathleen Dematera, UEMI: Edmund Teko, Emilie Martin, Juan Carriquiry, Lorena Saavedra, Abhisek Karki, Jacqueline Senyagwa, Oliver Lah, WI: Maria Rosa Munoz Barriga, Alvin Mejia, Shritu Shrestha, Stefan Werland, UTT: Hien Nguyen Thi Thu, UITP: Michele Tozzi,		
Contributors	Bhushan Tuladhar (Sajha Yatayat), Sergio Fernández Balaguer (EMT), Karen van der Linde, Dominik Radzuweit (Hochbahn), Peter Crist (TSY), Will v. Gils (ABB), Chris Kost, Alphonse Nkurunziza (ITDP), Carolina Romero (Montevideo), Fernando Alberto de la Torre Serratore (Quito), Fanuel kalugendo (DART), Anton Siy (Pasig)		
Internal reviewer	Oliver Lah (coordination), input and review by all WP leaders and partner cities		

This document is issued within the frame and for the purpose of the SOLUTIONSplus project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 875041. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the European Commission.

The dissemination of this document reflects only the author's view and the European Commission is not responsible for any use that may be made of the information it contains. This document and its content are the property of the SOLUTIONSplus Consortium. The content of all or parts of this document can be used and distributed provided that the SOLUTIONSplus project and the document are properly referenced.

Each SOLUTIONSplus Partner may use this document in conformity with the SOLUTIONSplus Consortium Grant Agreement provisions.

(*) Dissemination level: **PU**: Public, fully open, e.g. web; **CO**: Confidential, restricted under conditions set out in Model Grant Agreement; **CI**: Classified, **Int** = Internal Working Document, information as referred to in Commission Decision 2001/844/EC.

Table of content

Introduction	5
D4.1 Demonstration Implementation Plan	6
City: Hanoi	6
1. Operating environment	7
2. Demonstration Action	23
3. Preliminary replication opportunities	35
4. Updates	35
5. References	37
D4.1 Demonstration Implementation Plan	39
City: Pasig	39
1. Operating environment	40
2. Demonstration Action	61
3. Preliminary replication opportunities	74
4. Updates	75
5. References	76
D4.1 Demonstration Implementation Plan	86
City: Kathmandu	86
1. Operating environment	87
2. Demonstration Action	100
3. Preliminary replication opportunities	119
4. Updates	119
5. References	120
D4.1 Demonstration Implementation Plan	121
City: Kigali	121
1. Operating environment	122
2. Demonstration Action	132
3. Preliminary replication opportunities	144
4. Updates	145
5. References	146
D4.1 Demonstration Implementation Plan	147
City: Dar es Salaam	147
1. Operating environment	148
2. Demonstration Action	158

D4.1 Demonstration Implementation Plans

3.Preliminary replication opportunities	171
4.Updates	171
5.References	172
D4.1 Demonstration Implementation Plan	173
City: Quito	173
1.Operating environment	175
2. Demonstration Action	196
3.Preliminary replication opportunities	220
4.Updates	221
5.References	223
D4.1 Demonstration Implementation Plan	228
City: Montevideo	228
1. Operating environment	229
2.Demonstration Action	252
3.Preliminary replication opportunities	277
4.Updates	278
5.References	279
D4.1 Demonstration Implementation Plan	281
City: Madrid	281
1.Operating environment	282
2.Demonstration Action	295
3. Preliminary replication opportunities	298
4. Updates	298
5. References	300
D4.1 Demonstration Implementation Plans	302
City: Hamburg	302
1. Operating environment	303
2. Demonstration Action	309
3. Preliminary replication opportunities	312
4. Updates	312

Introduction

This deliverable summarises the on-going activities of Work Package 4 and outlines the key aspects of the demonstration actions in Hanoi (Vietnam), Pasig (Philippines), Lalitpur/Kathmandu (Nepal), Kigali (Rwanda), Dar es Salaam (Tanzania), Quito (Ecuador), Montevideo (Uruguay), Madrid (Spain) and Hamburg (Germany). This work is part of the Task 4.1 “Demonstration implementation plans and set-up of regional platforms” to which the following partners contribute: UEMI, ABB, CAA, CMM, CRF, UITP, ITDP, TSY, Pluservice, WI.

Demonstration implementation plans were developed for all above-mentioned partner cities. These plans were formulated based on identified needs from WP1, preliminary technical specifications and business models from WP3. The plans outline the concrete steps within the demonstration phase, including the impact assessments (WP1), links to the capacity development (WP2) and the adaptation of the business models (WP3). The demonstration activities funded by SOLUTIONSplus include the identification of service, charging and vehicle providers and models for cost reimbursement and sharing. For the demonstration actions funded through other sources, potential funding partners will be identified and steps towards implementation will be identified in Task 4.3. The regional platforms are being established as part of this task, to help organise the regional teams, support partners and coordinate with the GEF-7 sister project and other relevant regional projects to maximise the potential for take-up and replication of the e-mobility innovations tested in this project. A common implementation methodology was developed, with the lead-partners for all regional teams (Europe, Asia, Africa, Latin America). This formed the basis of detailed implementation plans as presented in this document; and include all the activities needed for preparation and execution of the demonstrations, technical and operations issues, business model adaptation, stakeholder engagement and replication. The implementation methodology supports the teams to closely monitor the status of the demonstration projects, identify delays and criticalities and suggest corrective actions. The regional platforms and implementation teams are working closely with the WP2 capacity building team to support the training activities for the Living Lab partner cities and share their experiences with others to replicate innovation actions.

This document reports on the status of the demonstration implementation as of June 2020 and it will be regularly updated during the project lifetime. The next update will be published by the end of 2020.

D4.1 Demonstration Implementation Plan

City: Hanoi

1. Operating environment

1.1 Background

1.1.1 Key facts and figures

The City of Hanoi is the capital of Vietnam, and is home to approximately 7.7 million residents and is the second most populated city in the country (around 8% of the total population of Vietnam). It features an urban area roughly 320 sq. km in size.¹ The city is also the cultural, commercial and educational centre of Northern Vietnam. Its economy is primarily based on tertiary sector industries, and has robustly grown in the last years (7.6% growth in 2018; 21.6% export growth in 2018) (Voice of Vietnam, 2019). The Hanoi Capital Region (or the Hanoi Metropolitan Area) is composed of the City of Hanoi and its adjacent municipalities, and is home to 16.1 million inhabitants (24 thousand sq.km).

It is estimated that 11.5 million trips are conducted each day in the city. Public transport is only estimated to account for 10% of the trips as passenger transport demand is met primarily by private motorized two-wheelers (Ahn, 2019). This mode share has essentially stayed at 10% since 2010 (Molt, 2010 as quoted in Allaire, 2012).

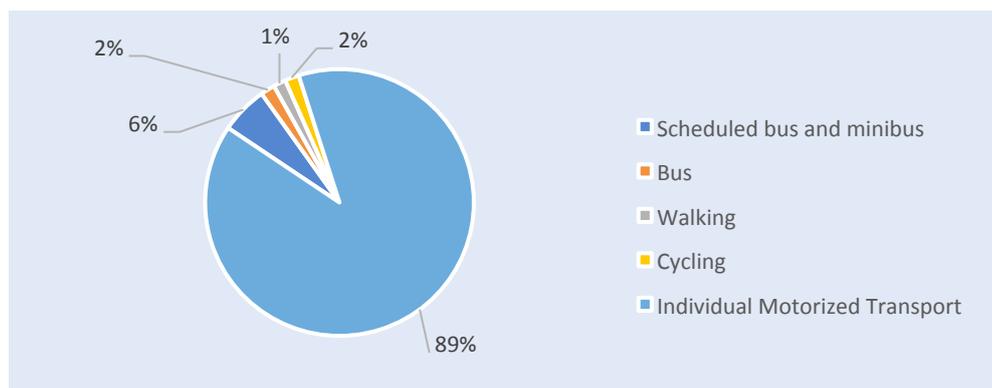


Figure 1. Mode Shares of Trips in Hanoi

Source: Ahn (2019)

A recent survey conducted by Indochina Research (2017) also indicates that only a few people use public transportation - 26% of the interviewees have used public transportation in the past three months prior to the conduct of the survey (albeit 189 respondents only).

Hanoi currently has 91 bus lines, 1,500 buses and 1 BRT line. The City also has 18,000 taxis that serves 120 million passenger trips per year (Ahn, 2019). Approximately 5 million motorcycles are plying in Hanoi's streets (Blain, 2019). In the 1980s, non-motorised and public transport modes – primarily bicycles and trams - dominated the streets of Hanoi. The country underwent a period of economic liberalisation in 1986 which led to the rise of the use of motorcycles which provided affordable, fast and reliable (suited for the urban environment) transportation services. The estimated motorcycle ownership rate in 2009 in the city was 600 per 1,000

¹ In August 2008, the National Assembly passed a decision that increased the area of the capital province of Hanoi to include the neighbouring province of Ha Tay which essentially tripled the area of the City of Hanoi and doubled its population.

inhabitants. Using the known current figures, the motorcycle ownership rate stands at 640 per 1,000 inhabitants.

Table 1. Selected Indicators: City of Hanoi

Indicator	Value
Total population	7,78 million
Total area (sq.km)	3,328 sq.km (total) 319 sq. km (urban)
Number of motorcycles registered in Hanoi	5 million
CO ₂ emissions per capita (kg/person) ²	1,835
Transport CO ₂ emissions per capita (kg/person) ³	350

1.1.2 Overarching issues

Vietnam is experiencing rapid economic growth (6% per annum) and urbanization, which is also coupled by a rapid increase in transport demand. Study estimates that if policy measures are not implemented, the GHG emissions from the transport sector will triple by 2030, from the current level of 32 million tons Carbon dioxide equivalent (CO₂e) per annum. The International Energy Agency (IEA, 2018) estimates that 97% of the transportation GHG emissions are from road vehicles. Essentially, road vehicles contribute 18.5% of the total fuel combustion-related GHG emissions in Vietnam. The per capita CO₂e emissions from transportation is estimated to be 350 kg/year (IEA, 2018). Transportation has also been implicated as a major source of urban air pollution in Hanoi (Clean Air Initiative, 2010).

In 2017, there were 54 million registered motorcycles, 1.5 million cars, 154 thousand trucks, and 1.1 million trucks in Vietnam. From 2007 to 2017, passenger car registration has been growing at a rapid pace of 17% per annum, while motorcycle registration has grown at 10%. The bus fleet is growing by 6% per year, and trucks by 14% per year based on the data collected by the ASEAN-Japan Transport Partnership (AJTP, n.d.). About 96% of the motorbikes in Vietnam belong to the following brands: Honda, Yamaba, Suzuki, Piaggio (Ha, 2017).

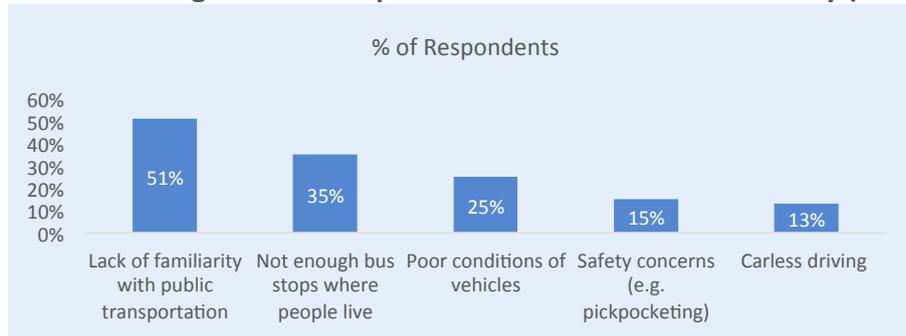
Keeping up with the challenges brought about by further urbanization, particularly in terms of providing proper transport infrastructure and support services, is also becoming a key issue for the country. Land space allocated to urban transport is relatively small as compared to other urban centres in the region (6%-15% as compared to 20%-30%). Ngoc (2019) points out that the passenger public transport system has not been able to fully meet travel demand and that the big mass transit projects have been missing the deadlines. In 2015, 34% of the population were estimated to be living in urban areas, compared to just 24% in 2000 (UNDESA, 2018). Urban areas are estimated to contribute 70%-75% of the total GDP of the country (Ngoc, 2019).

The survey conducted by Indochina Research in Hanoi and Ho Chi Minh provides indicative evidence on the main factors hindering people from using public transportation:

² IEA (2018)

³ Ibid.

Figure 2. Barriers to using Public Transport in Hanoi and Ho Chi Minh City (Sample Survey)



Source: Indochina Research (n.d.)

TRAMOC recently mentioned that only 12% of residents in Hanoi use bus services. Currently, the on-time performance of the buses is a main concern, as more than 50% of the bus schedules are delayed (“Bus commuters in Hanoi”, 2019).

Another key related issue in Vietnam is road safety. While the country has had significant improvements in terms of lowering fatalities and road crashes, approximately 14,000 people still lose their lives every year on Vietnam’s roads (WHO, n.d.). The National Traffic Safety Committee (NTSC) states that around 70% of road crashes involve motorbikes. High school students are the most vulnerable road users in Vietnamese cities like Hanoi (90% of road crash victims are high school students) according to the NTSC (Ha, 2017).

1.2 E-mobility overview

The uptake of e-mobility has been slow in Vietnam. According to the VIR (2018, as quoted in Pastoor 2019), only 1,229 hybrid vehicles and 7 electric vehicles (excluding 2-wheelers) have been shipped to Vietnam from January 2010 and March 2017. The MoT’s five-year plan aims to introduce 200 hybrid and 50 plug-in hybrid buses by 2020. It is interesting to note that there is a dedicated unit focusing on e-mobility within the MoT’s Department of Environment (Bakker et al., 2017).

Honda, which currently dominates the motorcycle market (74% in the first 9 months of 2018), recently launched a hybrid model called PCX (“E-bike brands”, 2018). Electric bikes from China are also imported and sold for 1,500 to 1,950 USD. There are also locally produced EVs such as Pega Aura (fitted with Bosch technology) which sell for approximately 630 USD (“E-bike brands”,). VinFast (see section 3.E) is aiming to capture a significant portion of the local market, as it opens its manufacturing facility in Haiphong. VinFast aims to produce 250,000 motorbikes within a year. Together with the launching of its manufacturing facility, it also launched its electric motorbike model called Klara which retails for 913 USD (lead-acid) to 1,521 USD (lithium ion) (“E-bike brands”, 2018). VinFast is also cooperating with PV Oil to put up 30,000-50,000 charging stations and battery leasing terminals throughout the country (Pastoor, 2019).

1.2.1 Recent Initiatives

Vehicle related Initiatives

The City of Hanoi is currently constructing a 13-kilometre MRT line which is expected to be finished by 2023. The longer-term goal is to develop 9 lines totaling 460 km, 75.69 kilometres of

which would be underground (Anh, 2019). The developments in the MRT network will be complemented by further expansions in the BRT network.

Figure 3. BRT and MRT Network Plans for Hanoi



Source: Anh (2019)

In line with the Hanoi Urban Transport Development Plan (HUTDP), the Hanoi People’s Committee approved a bus development project, which aims for 3.62 million people to travel by bus daily by 2020, or 25% of travel demand. In this project, 100 new bus routes will be introduced to the city’s transport system. Existing bus routes will also be upgraded, with better roads, stations and information systems (Vietnam News, 2011).

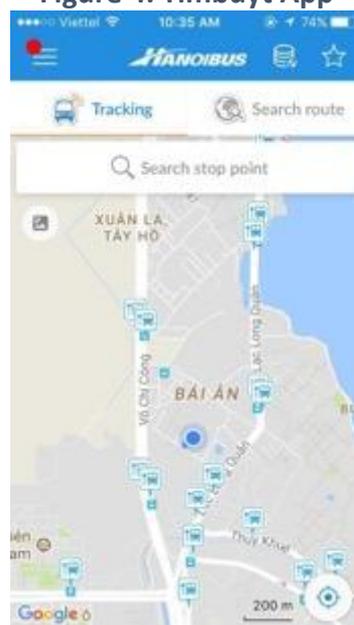
D4.1 Demonstration Implementation Plans

A recent decision (September 2019) by the Hanoi People’s Committee puts on further plans to develop the public transport network in the city and reduce the number of individually-occupied vehicles to 25% by 2020 and encourage the use of public transport and bicycles. The city will be expanding the bus network by adding 45 new routes by 2020, some of which will be incorporating priority lanes for buses. The city is also planning to develop park-and-ride facilities near major public transport stations in order to encourage multimodal journeys (Intelligent Transport, 2019).

The City of Hanoi intends to ban the use of motorcycles in the inner city by 2030. It also intends to introduce bike and e-bike sharing systems in order to improve last mile connectivity to the mass transit systems. A roadmap for phasing out conventional motorcycles is also being developed. Bike lanes are also being developed in several parts of the city. Recent discussions have been conducted regarding implementing congestion charging in the downtown areas of the City (Intelligent Transport, 2019).

In order to address the barriers relating to the lack of familiarity of commuters with the public transport system, TRANSERCO (Hanoi Transport Corporation) released Timbuyt in 2017, an app for bus trip planning in Hanoi.

Figure 4. Timbuyt App



Source: Diem (2017)

Proposed Laws

Import Tariff Incentives for Environment-Friendly Cars:

The Ministry of Finance is in the process of drafting a decree that would provide import tariff incentives for parts to be used to assemble environment-friendly cars (Nguyen, 2019).

E-Mobility Projects

An IKI-funded project on the conversion of internal combustion engine (ICE) 2-wheelers to electric is being led by the United Nations Environment Programme, together with the UTT,

D4.1 Demonstration Implementation Plans

named Integrating electric 2&3 Wheelers into Existing Urban Transport modes in Developing and Transitional Countries.⁴ The project involves a feasibility study, technical assessment, standards and policy support. According to the UTT, Honda also provided 50 e-scooters for the test phase. The city is also looking into the introduction of e-buses.

A pilot involving the testing of electric cars (primarily for tourism purposes) was conducted in the City of Hanoi in 2012. The cars were tested in the Old quarter, and near the Tay Lake. These vehicles have been said to service more than 1.2 million visitors, and generated more than 20.4 billion VND in revenue (UNEP, n.d.).

The project “Promotion of Electric Two-Wheelers and Solar Energy in Vietnamese Cities: an Explorative Project Initiated and Tested in Hanoi” was conducted by Caritas Switzerland together with BK-Holdings between 2013- 2018 (REEEP, 2017).

The “Low-carbon bus” NAMA has been registered by Viet Nam at the UNFCCC, which targets the introduction of 200 hybrid and 50 plug-in hybrid buses in the cities of Hanoi, Hue, and Can Tho. The NAMA also has a component focusing on the introduction of fuel efficiency measures (i.e. use of fuel saving technologies such as low rolling resistance tires, idling devices, etc..) to bus fleets (Duong, 2016). Another registered transport NAMA is focusing on the implementation of mandatory fuel economy standards for vehicles, accompanied by supporting incentives and policies.

Charging Standards and Infrastructure

The Ministry of Industry and Trade and Mitsubishi Corp. are cooperating on a project which involves a research component focusing on EV charging infrastructure for Vietnam.

VinFast and the Vietnam Oil Corporation (PV Oil) are under a Memorandum of Understanding (MoU) that focuses on advancing EV charging and battery leasing. Under the said MoU, PV Oil will be providing more than 600 petrol stations for VinFast for installing EV chargers. VinFast will explore different charging models such as fast charging systems, battery rental and overnight charging. The goal of VinFast is to develop a network of 20,000 stations by 2020, with a longer-term vision of developing up to 50,000 charging stations and leasing terminals across the country (“E-bike brands“, 2018).

Other

The 2019 (12th) Intergovernmental Regional Environmentally Sustainable Transport (EST) Forum in Asia was recently held in Hanoi. The Ministry of Transport expressed its commitment to continue to strive for sustainability in the transport sector.

1.2.2 Policy environment

Existing regulations

Climate Change and Environment

⁴ https://www.international-climate-initiative.com/en/nc/details/project/integrating-electric-23-wheelers-into-existing-urban-transport-modes-in-developing-and-transitional-countries-17_I_288-2851/

D4.1 Demonstration Implementation Plans

- National Target Programme to Respond to Climate Change (NTP – RCC)

The NTP was approved by the Prime Minister back in 2008 and has set forth the country's direction towards combating the impacts of climate change and mitigating the contribution of Vietnam to the said global problem (covering the period up to 2015).

- National Climate Change Strategy

The National Climate Change Strategy 2011 mandates the Ministry of Natural Resources and Environment (MONRE) as the lead (and coordinator) agency for matters relating to climate change mitigation and adaptation. It aimed for a GHG reduction target of 1% - 2% per year (without, and with international support, respectively) (NewClimate, n.d.).

- Vietnam National Green Growth Strategy

The National Green Growth Strategy was approved by the Prime Minister in September 2012 and covers the period up to 2020 (vision up to 2050). The strategy aims for 35%-45% public transport mode share for large and medium sized cities by 2020. The strategy also calls for change in the fuel structure in transportation, mentioning the encouragement of the shift towards the use of Compressed natural Gas (CNG) and Liquid Petroleum Gas (LPG) in buses and taxis, and the advancement of fuel quality and emission standards. The strategy also mentions the application of market instruments to promote changes in energy structure, and to improve overall energy efficiency. The Strategy also promotes the use of green technologies for transportation (new, low emissions energy technologies, among others).

- Intended Nationally Determined Contribution

Vietnam's INDC includes transport-related measures towards achieving the targets set forth by the government and are primarily similar to the measures in the green growth strategy (see above). The INDC states that Vietnam intends to reduce GHG emissions by 8% by 2030 compared to a BAU scenario using domestic resources. With international support, the mitigation potential can be increased up to 25%.

Energy

- Vietnam National Energy Development Strategy to 2020 with an Outlook to 2050

The National Energy Development Strategy aims to increase the share of new and renewable energy sources up to 11% of the total primary energy sources by 2050.

- Revised Power Master Plan No. VII

The plan guides the development of the power sector (efficient and increased generation, transmission and distribution) in the country up to 2020 and 2030.

Transport and Urban Development

- Transport Development Strategy 2020

D4.1 Demonstration Implementation Plans

The Transport Development Strategy aims to provide “modern and high-quality transport system with reasonable cost, safety, reducing environmental pollution and energy saving by application of advanced transport technology, especially multi-modal transportation and logistics.” It also mentions the goal of restraining the growth of private motorized vehicles to 4 million automobiles and 40 million motorcycles by 2020.

- Master Plan for Transport Development of Hanoi to 2030

The master plan was approved by the Prime Minister in March of 2016. It includes a long-term vision for the development of transport up to 2050.

- Hanoi Region Urban Transport Master Plan for 2020

Approved in July 2008 and sets out the strategic development framework for transport in Hanoi and provides for the creation of a mass transit network (originally 8 metro lines: 160 km with 130 stations; 25 km of BRT) which is aimed to be fully operational by 2030. Subsequently, a Hanoi Region Urban Development plan up to 2030 was approved in July 2011.

- Road Traffic Law (Law No. 23/2008)

This law stipulates the road traffic rules in Vietnam.

Automobile Industry

- National Automobile Development Strategy 2025, vision to 2035

This is the overall strategy that aims to boost automobile production in Vietnam. The strategy has an overall objective of enabling the local manufacturing industry to meet domestic demand (65% by 2035), and to move towards exportation (Vietnam Law, 2014).

- Taxes and Tariffs

According to Pastoor (2019), electric vehicles originating from ASEAN, China, and South Korea are exempted from import tariffs (while Japanese cars face 4% tariff), US cars are taxed 70% based on the “most favoured nation” treatment. Aside from the import duties, electric vehicles coming into the country are also subjected to special consumption taxes that range from 15%-70%. Decree 116/2017 introduced strict conditions and regulations relating to car importation.

1.2.3 Policy gaps

Vietnam faces a variety of obstacles to its becoming an EV-friendly country. These include barriers to adoption of electric vehicles, which the electric vehicle market needs more preferential policies from the Vietnamese government and better relations with vehicle manufacturers around the world.

- Lack of enabling policy and regulatory framework for electric vehicles.
- Lack of charging infrastructure: the infrastructure for servicing electric vehicles, such as electric charging stations, service stations, is not keeping up with the growing demand.
- Lack of capacity to coordinate among public entities and private partners.
- Absence of tax incentives and price subsidies for electric vehicles. Specially, import duties on electric vehicles shipped to Vietnam, special consumption tax rates range from 15% to 70%, which raises the prices of vehicles to 20%.

1.2.4 Business environment

Local businesses and start-ups working on e-mobility solutions

Existing Companies Operating in the Vietnamese E-Vehicle Market

- VinFast

VinFast is part of the Vingroup (owned by Mr. Pham Nhat Vuong) which is the largest private enterprise in Vietnam. VinFast aims to become the leading automobile and motorcycle manufacturer in Southeast Asia. VinFast recently signed a strategic partnership with General Motors and has obtained GM's plant in Hanoi. It will also set up a manufacturing and research complement in Haiphong. It is also cooperating with PV Oil (as discussed in 2.D) on vehicle charging network, and battery leasing scheme development.

VinFast also signed supply contracts with Siemens Vietnam in relation to the development of electric buses. It also has an electric motorbike model -Klara- which can be bought either with a lead-acid or lithium battery pack. The company has also integrated an app for opening/locking and locating the Klara scooters.

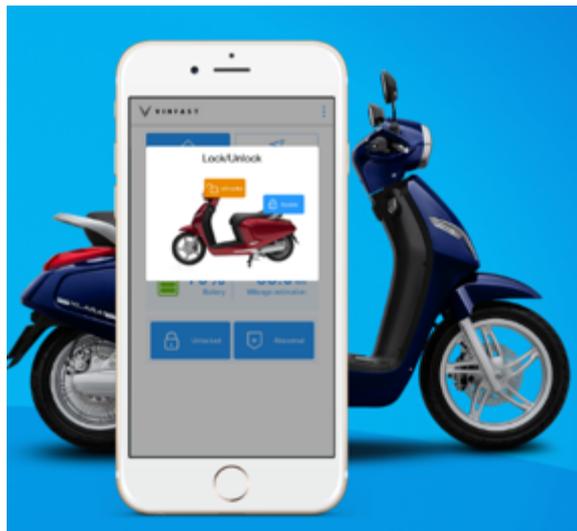


Figure 3. Klara Scooter and App

Source: <https://xemaydien.vinfast.vn/en/klara>

- Mitsubishi

Mitsubishi Corporation is cooperating with the Ministry of Industry and Trade in studying EV use and public policy programs towards accelerating the adoption of EVs in the country (Pastoor, 2019). As part of the cooperation, Mitsubishi will also conduct a research on the charging infrastructure and road systems.

- Honda Vietnam

Honda had 72% of the motorcycle market share in 2017 and 74% during the first 9 months of 2018 ("E-bike brands", 2018). Honda recently introduced a hybrid bike called the PCX model.

- Other Notable E-bike/E-scooter Players
- Yamaha

D4.1 Demonstration Implementation Plans

- Suzuki
- Piaggio
- SYM
- Asama Jiun International Vietnam Co., Ltd.
- CÔNG TY TNHH SX TM DV HIỆP TÂN HITASA
- Pega

Business Associations: Automotive Industry

Vietnam doesn't currently have a specific "electric vehicle association" that represents the e-vehicle industry. Such associations exist in several of its neighbour countries such as Thailand, Philippines, Singapore.

The major developments in the local e-vehicle industry is now primarily being led by VinFast, as it opens its vehicle manufacturing facility in Haiphong, and has introduced its electric motorbike model.

- Vietnam Association of Motorcycle Manufacturers

Members include Piaggio, Suzuki, SYM, Yamaha and Honda. It was reported that these five companies sold over 2.8 million motorbikes in 2015, and nearly 3.3 million in 2017 ("E-bike brands", 2018)

- Vietnam Automobile Manufacturers' Association (VAMA)

VAMA is a non-governmental, non-political and non-profit organization established in 2000 with the aim of supporting the development of the Vietnamese automotive industry, and essentially represents the enterprise members of the organization (VAMA.org.vn).

- Daewoo Bus
- DOTHANH
- Ford
- Hino
- Honda
- Isuzu
- Mekong Auto
- Mercedes-Benz
- Mitsubishi Motors
- Nissan
- Samco
- Suzuki
- THACO – Trung Hai Auto
- Toyota
- VEAM Motor
- VINAMOTOR
- VinFast

1.2.5 E-mobility financing options

Up to now, electric vehicles just receive preferential treatments for excise duty with the rates lower than that applied to regular gasoline/oil-powered vehicles (under the provisions of Law No.106/2016/QH13 dated April 6th, 2016 by the National Assembly on amendments and supplements to a number of articles of Law on Value-Added Tax, Law on Excise Duty and Law on Tax Administration). Some policies considered as contributions to creating favorable conditions for the import of electric vehicles and components of electric vehicle, as well as managing the quality and safety of electric vehicles are presented as below:

- Decree No. 116/2017/ND-CP dated October 17, 2017 by the Government promulgating regulations on conditions of automobile manufacture, assembly, import, warranty and maintenance services. Accordingly, the product quality certificates of vehicles to be imported into Vietnam shall be provided to quality management authorities.
- Circular No. 31/2011/TT-BGTVT dated April 15th, 2011 by the Ministry of Transport promulgating regulations on quality, technical safety and environmental protection of imported motor vehicles. This Circular shall be applied to domestic and foreign organizations and individuals who import motor vehicles and organizations and authorities related to the management, inspection and testing of motor vehicles. On October 20th, 2014, the Minister of Transport issued Circular No. 55/2014/TT-BGTVT on amendment and supplement to a number of articles of Circular No. 31/2011/TT-BGTVT.
- Circular No. 166/2014/TT-BTC dated November 14th, 2014 by the Ministry of Finance promulgating Vietnam's special preferential import tariff to implement the ASEAN – China Free Trade Area in 2015-2018. Accordingly, ACFTA tax rates of 0 ÷ 15% shall be applied to the items in the list of electric vehicle components (sections 8501, 8506 and 8507). However, the tax rate applied to electric motor vehicles is 45% (section 8711).
- Circular No. 239/2016/TT-BTC dated November 11th, 2016 by the Ministry of Finance promulgating the price of testing services, inspection of technical safety and quality as well as environmental protection for all types of motor vehicles used in road traffic, special-use two-wheelers, components used for manufacture, assembly and import.
- Circular No. 44/2012/TT-BGTVT dated October 23rd, 2012 by the Minister of Transport on the inspection of quality, technical safety and environmental protection of imported motorcycles, motor vehicles and imported engines used to produce and assemble mopeds and two-wheelers.

1.2.6 Capacity building (CB)

Current state and initiatives

Currently, the local capacity for EV manufacturing, operation and maintenance is limited in Hanoi. There is no organisation that provides courses on EVs yet. Universities in Hanoi do not have formal degree courses in EVs yet but EV is partly included in engineering degrees (e.g. Automotive engineering). University of Transport Technology (UTT) and other universities in Hanoi are highly interested to collaborate to start with organizing courses (including e-courses) on EVs and organizing workshops targeting different stakeholders.

Current needs and opportunities

Vehicle integration

The integration of shared e-scooters with buses and metros can result in easy route planning and payment through the Mobility-as-a-Service app. Existing apps are available for individual

D4.1 Demonstration Implementation Plans

mode (e.g. Timbuyt for buses) while previous pilot projects on smart ticketing ended without further implementation (e.g. e-ticket system by Transerco with Viettel Group and MK Ticket Group). Under the SOLUTIONSplus, it is necessary to understand the functionality of the currently active application as well as lessons from the failed vehicle integration project and then develop appropriate Mobility-as-a-Service application for Hanoi city.

Charging infrastructure planning and technology

For the growing number of EVs in Hanoi, mainly Vinfast e-2 wheelers, a support on appropriate battery solutions, disposal and charging options are required. Some solutions have been explored in individual e-scooter and under SOLUTIONSplus suitable options for a shared system are needed. EV charging stations for public transport (E-buses) are limited in Hanoi. Besides a demo of ABB charging solutions in Vinfast E-buses, Hanoi city needs support on charging infrastructure planning and technology.

Business model development

EV is still too expensive compared to conventional vehicles for most of the Vietnamese population. The demo on a shared e-scooter system needs a good business case with the involvement of various stakeholders. Support on business model development on shared e-scooter is a need.

EV promotion

Vietnam/Hanoi has a potential of the EV market due to increasing imports as well as local production (Vinfast). Along with appropriate regulations and financial incentives, Hanoi needs supporting policies on communication, advocacy and promotion of EVs. A strategic planning on capacity building activities for various stakeholders on EV promotion is highly desirable. This can include disseminate cost-benefit analysis and reduced life-cycle cost, that shows market potential, environmental and health benefits.

Preferred modality of capacity building activities

- City-to-city exchange (peer-to-peer) after the online theoretical training, given the current COVID-19 condition
- On the job training
- Study tours/site visits

1.3 Key Stakeholders

1.3.1 Local Government bodies and Public organisations

- Hanoi People's Committee

The Committee essentially defines the strategic transport policy.

- Transport Department of the Hanoi People's Committee

The Hanoi Transport Department is the focal local agency that manages the provincial road network.

- Hanoi Bus Joint Stock Company

A bus company that is primarily controlled by the Hanoi People's Committee

- Hanoi Department of Environment

The Hanoi Department of Environment is also a key institution in the vertical integration of climate action.

- TRANSERCO

A company consisting of public transport operators who consolidated in the 2000s and had the monopoly of the bus services in Hanoi up to 2008. It has been restructured to become the parent company of ten subsidiaries. It also collaborates with private companies through joint ventures.

- TRAMOC (Hanoi Urban Transport Management and Operation Centre)

TRAMOC was created in 1998 and has led the reorganization of public transport routes, and improving the overall service quality, frequency and range of these services. It essentially oversees the development of public transport in the City. Its functions are as follows:

Planning, regulating, supervising, and operating public transport schemes

Management and distribution of income from public transport and funding sources

Management of public transport infrastructure

Issuance of bus tickets

Implementing projects

- Hanoi Metropolitan Railway Management Board (MRB)

It was established in February 2012 and is tasked to manage the urban rail system in Hanoi and assist the governing body (Hanoi People's Committee) in the operation of the urban rail network.

- Local Traffic Police Division

The local traffic police are in charge of road rules enforcement.

1.3.2 National Government Departments

- Electricity Vietnam (EVN)

A state-owned corporation that is responsible for the power sub-sector in Vietnam. It was transformed into a holding group in 2006 that is comprised of power generation, transmission, and distribution companies (ADB, 2015).

- Ministry of Construction

The Ministry of Construction is responsible for the state administration on construction, buildings, architecture, urban and rural planning (including urban infrastructure). Building codes would be under the purview of the Ministry of Construction.

- Ministry of Natural Resources and Environment (MONRE)

D4.1 Demonstration Implementation Plans

The Ministry of Environment (in particular, the Department of Climate Change) is the lead agency for matters relating to climate change mitigation and adaptation.

- Ministry of Industry and Trade (MOIT)

The Ministry of Industry and Trade is responsible for the advancement, a regulation of the industries in Vietnam. There are also currently 9 industry research institutions under the Ministry, but none is dedicated to the automotive industry development.

More importantly, the MOIT is the agency responsible for proposing laws, policies and strategies for the Vietnamese electricity market, and has oversight of the state-owned energy enterprises (ADB, 2015).

- Ministry of Planning and Investments (MPI)

The Ministry of Planning and Investment coordinates the country's investments, development strategies, and mobilizes official development assistance and climate finance.

- Ministry of Science and Technology (MOST)

The MOST is the ministry responsible for the development of vehicle emission standards, as well as fuel quality standards.

- Directorate for Standards, Meteorology and Quality (STAMEQ)

The STAMEQ is responsible for overseeing the standards used in Vietnam. Under STAMEQ, its subsidiary, the Vietnam Standards and Quality Institute (VSQI) is responsible for organizing the national technical committee activities which develop, publish, and issue national standards (export.gov, n.d.).

- Ministry of Transport (MoT)

The MoT is responsible for developing the overarching transport policies. It is also responsible for managing, planning and maintaining the national transport infrastructure. The MoT certifies standards for facilities in relation to transport, as well as those related to motor vehicles.

- Department of Environment of MoT

An agency under the MoT which is responsible for implementing the environmental measures in the transport sector

- Vietnam Register

The Vietnam Register is responsible for vehicle type approval, in-use vehicle inspection and the enforcement of vehicle emission standards.

- Transport Development and Strategy Institute

The TDSI is an attached institute to the MoT that assists in the development of strategies and policies for the transport sector in the country. It was established in 1974.

- National Committee for Climate Change

The National Committee for Climate Change is an inter-ministerial committee established in 2012 which serves as the highest body in charge of climate change policy development.

1.3.3 SOLUTIONS+ Consortium

- ABB

ABB operates in Vietnam and has around 900 employees across three regions in the country. Its country head office (and transformer factories) are in Hanoi. It has facilities in Bac Ninh, Danang, and Ho Chi Minh City. ABB focuses on the following areas: Electrification Products, Power Grids, Robotics and Motion, and Industrial Automation & Turbocharging. The vehicle manufacturing facility of VinFast in Haiphong utilizes 1,200 robots of ABB (Onishi and Shiraishi, 2018).

- Bosch

Bosch has been operating in Vietnam since 2007 through its 100% subsidiary Robert Bosch Vietnam Co., Ltd. It has over 3,000 personnel in the country. It also established the “Automotive Research and Development Center” in Ho Chi Minh City in 2014. Bosch has been closely collaborating with VinFast in terms of delivering e-vehicles into the Vietnamese market.

- Clean Air Asia

Clean Air Asia (CAA) works in Vietnam, primarily through its country partner, the Vietnam Clean Air Partnership. CAA is working to assess the emission standards for stationary sources and their enforcement in Vietnam versus international good practice, and is working to strengthen the awareness and capacity of civil society on air pollution and its impacts. Previously, CAA with Norwegian Institute for Air Research (NILU) assisted in the development of the mobile air emission inventory of Hanoi with funding from the World Bank.

- CODATU

A recent proposal submitted by a consortium involving CODATU was approved by the AFD. The proposal is entitled “Definition of a Sustainable Investment Program for the City of Hanoi” and involves activities relating to improving air quality; urban logistics (to be led by CODATU), and waste management. The project involves additional strategic studies including those related to electromobility (CODATU, 2019).

- French Development Agency (AFD)

AFD has been operating in Vietnam since 1994. There are currently 3 AFD-supported projects in Hanoi (2 focusing on education and training, 1 on rivers).

- ICLEI

ICLEI is the leading global network of more than 1,500 cities, towns, and regions committed to building a sustainable future. Hanoi is a participating city under ICLEI’s network.

- Piaggio

Piaggio is active in Vietnam, and is selling motorbike models in the Vietnamese market.

- UN Environment

D4.1 Demonstration Implementation Plans

UN Environment currently has an on-going regional project that also involves testing electric vehicles in several countries that includes Vietnam (Integrating Electric 2 and 3 Wheelers into Urban Transport Modes).

- UN-Habitat

UN-Habitat is the United Nations programme working towards on urban-related issues. Its mission is to promote socially and environmentally sustainable human settlements development and the achievement of adequate shelter for all. UN-Habitat has a Vietnam office in Hanoi since 2007 (UN-Habitat, n.d.).

- Volvo

Volvo cars are being sold in Vietnam, primarily sedans, estate, and SUV models. Volvo also sells its XC40 pure electric car in Vietnam. Volvo has a showroom in Ho Chi Minh City (Volvo, n.d.).

1.3.4 Other Notable International Organizations

- GIZ

GIZ has been quite active in supporting the efforts towards modernizing the public jeepney sector in the Philippines. GIZ led the jeepney NAMA (nationally appropriate mitigation action) project, and is now in the process of developing urban-level mitigation actions as well as actions focusing on green freight.

- UNDP

The United Nations Development Program (UNDP) is currently implementing the Global Environment Facility (GEF)-funded Low Carbon Urban Transport Systems (LCUTS) Project in partnership with the DoTr (GEF, 20). While the project is technology-neutral, it does involve related components such as the development of a national policy framework for facilitating the uptake of low carbon transport systems, and the investigation of appropriate business plans for supporting low carbon vehicles. It also has a project component aimed at establishing EV charging protocols and standards.

- USAID

Through the Private Financing Advisory Network (PFAN) of USAID, GerWeiss Motors Corp. Secured a loan amounting to 330,000 USD from a local finance institution to produce e-tricycles in 2015 (USAID, 2015).

2. Demonstration Action

2.1 Situation analysis

Hanoi city has the current bus network with 127 routes, including 100 subsidized routes, 10 non-subsidized routes, 12 adjacent routes, 2 City tour routes. The bus network covers 34 districts, towns and serves 453/584 communes, wards and towns, reaching 78%; 66/71 hospitals, reaching 93%; 296/708 junior and senior high schools account for 42%; 32/37 industrial zones, accounting for 86%; 82/85 new urban areas, accounting for 96%. In particular, public passenger transport continued to grow, the total volume of public passenger transport throughout the City in 2019 was estimated at 948.5 million passengers, of which buses reached 510.5 million. the number of passengers, meeting 17.03% of the travel needs of the people, increasing by 3.2% compared to 2017. In addition, the urban railway system, BRT bus is also actively implemented and brings certain effects. These results have partly met the travel needs of the people, reduced the number of personal vehicles moving into the inner city, contributing to reducing traffic congestion in the City.

Currently there are 5.3 million gasoline motorcycles per day and this number is increasing rapidly every year, at 10% per year. Forecast has shown that, by 2030, there will be 7.5 million motorcycles, 1 million cars running every day in the city. As a result, air pollution is one of the main problems the city is facing. According to the GreenID report, annual average air pollution in Hanoi in 2017 was four times higher than those deemed acceptable by the World Health Organization's air quality guidelines. Therefore, there is an urgent need to deploy cleaner transportation solutions to the city to improve the air quality. E-mobility solutions are crucial to improve the air quality and sustainable development for the city.

Vehicles:

In Vietnam, electric motorbikes and cars have been well established since the 2000s, however, this industry has recently seen positive and strong improvements, as well as attracting remarkable investments from reputable enterprises in recent years.

VinFast, founded in 2017, is a subsidiary of Vingroup - the largest private enterprise in Vietnam. The company is currently operating in the industry of automotive and electric scooter manufacturing at its factory in Cat Hai - Hai Phong. Since early 2018, VinFast launched its first electric scooter model, VinFast Klara, with a lithium battery version and a lead-acid battery version.

Electric-support bikes have become a popular means of delivery from the beginning of 2020. The company has the ambition that by the end of 2018, 30% of their goods in major cities will be delivered by electric vehicles.

Charging:

In Vietnam, many electric vehicle manufacturers have imported lithium batteries to install to their electric two-wheelers such as Pega, Vinfast, etc. Correspondingly, depending on the technology that uses the traditional battery or lithium battery, the maximum operating range after a single charge is different, charging time is also different. But along with the future trend lithium battery will be a suitable solution for 2-wheel electric vehicles in Vietnam and around

D4.1 Demonstration Implementation Plans

the world. Electric vehicle batteries are tested according to the National Technical Regulation QCVN 91: 2015 / BGTVT on batteries used for electric scooters and electric bikes.

As for Vinfast, charging points have been well installed in convenience stores VinMart+, high schools, and the basements of buildings in Hanoi. In addition, many construction and maintenance projects for electric charging stations are also in progress, ensuring the most convenient transportation conditions for electric vehicles.

Integration:

Regarding Buses: The city is implementing an application software to find bus named “TimBuyt”. Smart ticket system is being researched and implemented.



The “Timbuyt” app has functions: providing routing information for each route, tracking how many vehicles are moving closest to your location and the remaining time to the bus terminal. Buses are equipped with GPS device.

At some bus terminals, there is a electronic board displaying the information on the arriving buses with remaining distance and time.

Regarding Metro: It is planned that electronic ticket (IC card) is used in combination with other utilities, can be purchased at the ticket vending machines. The train route, arrival and departure times are displayed on the electronic boards at the station.

In October 2018, Transerco cooperated with Viettel Group and MK Ticket Group to build and put into use electronic ticket on BRT 01 (Kim Ma - Yen Nghia). The route was equipped with electronic ticketing equipment, replacing all monthly tickets and passengers were controlled their access to shelters with electronic chips. If passengers do not have an electronic card or code, they will buy a ticket and will be issued a ticket with a QR code to the boarding gate. The pilot project ends in July 2019 and has not been widely implemented.

Transerco has tested the application of bus ticket payment by card on the high-quality bus route at 86 Hanoi Railway Station - Bo Ho - Noi Bai Airport. Bus Express 86 applies the card payment system including 2 types: International Cards: Visa, Master Cards, JCB Cards, American Express Cards, Diner Club International, China UnionPay; Domestic card: Including cards of all banks belonging to the union of domestic banks.

There is a traffic control center capable of controlling and flexibly controlling all traffic signal buttons from the center, automatically controlling the signal light cycle in accordance with the

amount of vehicles in from time to time, to enhance the ability to monitor by images (observing traffic conditions and detecting violating vehicles through camera systems).

Barriers to gaps to establish the relevance of the local demo

Barriers of environmental condition, weather and climate:

The extreme weather in Vietnam is also considered as one of the barriers to the development of electric mobility. Northern Vietnam is characterized by a tropical monsoon climate, so the summer is hot, rainy with heavy rainfall. In Southern Vietnam, high tides often occur, causing frequent submergences.

As electric vehicles are used in extreme weather conditions such as rain, wind or flooding, which can cause fire and other damages to the accumulator/battery units and the electrical system.

Using or storing electric vehicles in hot weather also damage the accumulator/battery units, reducing their lifespan, performance and energy discharge duration. The solution for this case is improving the technical quality of electric vehicles, particularly the quality of batteries/electric systems. Note that in the use of electric vehicles, it is necessary to prevent operating them in flooded areas and avoiding long parking in high temperatures or hot weather, etc.

In addition to the natural and environmental barriers, the social environment and transportation culture also exerts impacts on the use of electric two-wheelers. There are many models of electric vehicles with eye-catching designs, requiring small initial investment, which are easy to use and do not require a driver's license, so they are quite popular to students, etc.

Many students using electric bikes in traffic do not comply with Law on road traffic. The popular violations include carrying too many people, not wearing any helmet (even using umbrellas when driving), using phones when driving and zigzagging. Many models of electric bikes do not have turn signals so when students using them cross a road, it is hard for other drivers to realize their intention of direction, causing a risk of crash between electric bikes and other vehicles, etc.

The solution for mitigating this barrier is promoting propaganda on traffic safety for students, developing and issuing regulations on the use of electric bikes in order to enhance the quality of traffic safety management over the use of electric bikes.

Barrier of psychology, awareness on using electric vehicles:

There exists psychology that operating electric vehicles is not as safe as driving gasoline vehicles (electric shock, fire, durability, etc). According to a project of electric vehicle testing at University of Transport Technology, users of electric vehicle are most concerned about safety factors. In the safety group, users are most concerned about the safety of batteries when being charged and moving on roads (risk of fire, electric shock).

In fact, in Vietnam, thanks to compact designs, low cost, no restriction of using age, electric bikes gradually become popular means of transport. For a long time, many providers have

D4.1 Demonstration Implementation Plans

distributed poor-quality electric vehicles with unidentified origins. The common feature of these models is that after about one year of use, most of them are degraded. These vehicles have shown signs of slow acceleration, unstable power supply, lower battery capacity, damage in accumulator, etc. Even some low-quality accumulators cause fire and explosion during charging or use. The lifespan of these products is short, many shall be abandoned or sold at low prices due to failure after just 2 years of use.

Since Circular No. 41/2013/TT-BGTVT dated November 5th, 2013 stipulating technical safety and quality inspection of electric bikes manufactured and assembled domestically and imported became effective on January 1st, 2014, the quality of electric bikes in Vietnam has been increasingly strictly controlled.



Another safety risk is that electric vehicles in traffic almost make no noise, so with the traditional traffic habit, electric vehicles may not attract attention from pedestrians and drivers so that the consequences of traffic safety risks are much higher than that of vehicles with internal combustion engine. The European Union is expecting, by 2021, to enforce a requirement that all the electric vehicles shall be fixed with noise-generating devices to deal with the problem that these new-generation vehicles do not make any sound when moving so that traffic users and other vehicles cannot realize such vehicles, which causes many serious, even fatal accidents.

Barriers related to environmental impacts due to the use of electric vehicles:

Electric vehicles are considered as clean and environmentally friendly transport means. However, electric vehicles also indirectly release gas emissions which cause greenhouse effects due to the charging process for the battery/accumulator system, using power from the grid of power plants that use fossil fuels (coal, oil and gas).

According to reports by the Ministry of Industry and Trade, it is expected that in 2030, the power output generated by coal-fired thermal power plants will account for over 53% of the country's total power output. As such, coal-fired thermal power will still make up more than half of Vietnam's power output by 2030, not to mention coal-fired thermal power plants using coal, oil and gas. Thus, the use of electric vehicles in Vietnam where the power source mainly from thermal power means that the environmental pollution will just move from places where electric vehicles are used to places where power plants (using fossil fuels) are located.

D4.1 Demonstration Implementation Plans

The parts of electric vehicles must be discharged upon their expiration, causing a great risk of environmental pollution, particularly accumulators and lithium batteries which require huge costs and modern technologies to be treated then.

Barriers in policy:

Currently, electric mobility, particularly electric two-wheelers, is quite popular in Vietnam. However, The transport policy system including laws, decrees, directives, etc., on electric vehicles in Vietnam has not been much discussed.

The country needs to have a policy system to support its implementation on e-mobility, namely: policies on transportation, policies on import and export, policies on production, policies on energy and environmental protection, policies on encouraging research and development as well as policies on raising awareness of using electric mobility. This is crucial that allows electric vehicles to be safely operated, meeting people’s travelling demand and protecting the environment.

2.2 Demonstration objectives and logical framework

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to the City)	MILESTONES (and other notes)
OUTCOME 1. E-mobility solutions to enhance the last-mile connectivity <i>Baseline: E-scooters are increasingly used in Hanoi, while there are not any e-scooter sharing services available in the City. The public transportation services are planned with rapid development to meet 25% of people’s travelling demand by the end of 2020.</i> <i>Target:</i> <i>High quality e-mobility sharing system is introduced and used to support the last-mile connectivity.</i>			
1. On-the-ground demonstration of e-scooter sharing	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	1. Hanoi demo launched by June 2020 2. Detailed demonstration mechanics available by Dec 2020 3. Functional requirements to be available by October 2020 (c/o UITP)
	2. Implementation of on-the-ground demonstration activities	1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be submitted April 2023
	3. Call for proposals SMEs with existing charging solutions – innovate and demonstrate	1. Conduct of the call for local SMEs 2. Selection and awarding	1. Call for local SME conducted by October 2020.
	4. Assessment	1. Determination of KPIs 2. Baselining activities 3. Monitoring 4. Analysis of data and evaluation	
2. MaaS/sharing app introduction in Hanoi	1. Preliminary consultations and decision making phase	1. Evaluation of likelihood that Hanoi will pursue MaaS application	

D4.1 Demonstration Implementation Plans

	2. Set-up and implementation		1. To be decided based on the decision phase
	3. Assessment		As above
3. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.
OUTCOME 2. Conditions for enabling accelerated e-mobility uptake and integration are improved.			
<i>Baseline: The current enabling environments for e-mobility (relating to business, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcome.</i>			
<i>Target: Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</i>			
1. Business models and business plans are developed and validated	1. Identification of locally-appropriate transformative business model concepts directly relating to the demonstration activity		
	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021
2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+
3. Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans are developed	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by January 2022.
4. Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institution, and other relevant entities		Note: Hanoi will primarily be consulted in this process.
	2. Drafting and review of recommendations		
OUTCOME 3. Local capacities relating to e-mobility are enhanced.			
<i>Baseline: As e-mobility is still in its infancy stage in the country, capacities are still highly limited.</i>			
<i>Target: Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.</i>			
1. Peer-to-peer exchange program is conducted and documented	1. Visit of representative of partner city to European expert city/cities		1. Visit to European expert city/cities within first 18 months
	2. Visit of European experts to the partner city	1. Planning and development of itinerary 2. Visit	1. Visit of European expert/s to the partner city between month 18

D4.1 Demonstration Implementation Plans

			to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner city and European experts to expert cities outside Europe		1. Joint visit between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
2. Toolkit for e-mobility is developed and shared with local stakeholders	1. Needs assessment		
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

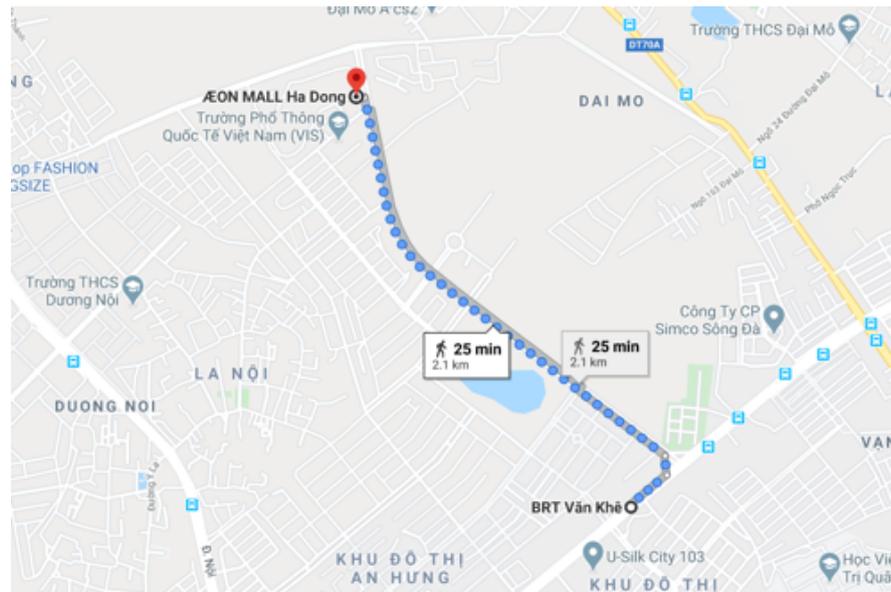
Demo Description: Hanoi e-mobility for last-mile connectivity

Hanoi e-mobility for last-mile connectivity: The demonstration project will focus on boosting the ridership and effectiveness of the currently running BRT and the forthcoming metro rail. The project will be a win-win for both public transport and e mobility. A technical support team will design and develop vehicles that are tailored for the local context and operated under the oversight of the local public transport operator and the city of Hanoi.



Smart services, fleet bundling, E-scooter GPS positioning that support eco-routing will also be part of the project (SOL+ MaaS App). The demonstration project will have a high potential to not only make emobility attractive but also reduce the GHG emissions from transport and increase the share of public transport use.

D4.1 Demonstration Implementation Plans



The demonstration will be conducted in phases. For the first phase, there will be a trail with 50 shared e-scooter to test the sharing system to facilitate the traveling from BRT stop to a shopping mall and vice versa. There will be periodically assessment on the system to see what is good, what needs to be improved for the better pilot. After that the sharing system will be replicated to other locations in the city, probably connecting the Metro terminal with residential areas.

Test scenarios

A test scenario describes the environment in which the SOL+ demonstrations take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Solution: e-scooter sharing system		
Test category	The demonstration of e-mobility solutions for last-mile connectivity will involve simulations, tests in controlled environments, and testing under real operational conditions. These technologies will be assessed as part of the activities.	
Vehicles involved (type)	e-scooters	
Vehicles involved (unit)	50	
Integration with PT system	<ul style="list-style-type: none"> - Bus - BRT - Metro/ Light rail 	
Lines/stops involved (units)	Tentatively 2-4 stops: Aeon Mall - BRT Van Khe	
Time span (testing activities)	June to Dec 2021	
Time span (data collection)	Before Jan to June 2021	After June to Dec 2021

2.3 Vehicles/infrastructure/equipment provision

The table below shows a draft breakdown of the major components needed for the demonstration in Hanoi. Please note that the budget distribution is not final, and can vary depending on the available components and market fluctuations.

The demonstration will use the VinFast Ludo, an electric smart scooter created by a Vietnamese EV company that is founded by Vingroup, one of the biggest companies in Vietnam. The scooter is manufactured in Vietnam in cooperation with Bosch Vietnam. The scooter is powered by a 1,100 watt Bosch electric motor and battery package providing the scooter with optimal reliability. The scooter has a removable Lithium battery made by Bosch and LG. The scooter is equipped with 3G, Bluetooth and GPS connectivity and connects to a smartphone. Everything from battery monitoring to GPS to ride history, the Vinfast app keeps the driver connected and up-to-date with the whereabouts of the scooter. The Ludo is equipped with eSIM.

For the safe operation of the sharing system, there will be insurance for the vehicles and users. Other safety countermeasures will also be equipped such as helmets, smart locks,... for the user's comfort and safety.

The SME calls will also be planned for development of charging and electric vehicles during the implementation of demonstration.

A charging infrastructure for Vinfast E-bus will be sought with SOL+ industry budget.

No.		SME call (EUR)	City Equipment Budget (EUR)	Industry partner (EUR)
	E-scooter			
1.	E-scooter purchasing		51,600	
2	Charging	25,000	4,400	
3	Location, facility, infrastructure		10,000	
4	Insurance, maintenance, electricity...		10,000	
5	Staff time and operation	25,000	14,000	
6	Others		10,000	
	E-bus Charging system			tbc
	GRAND TOTAL	50000	100000	

2.5 Business model plan

The detailing of the business model concepts, and the specific business plans relevant to the pilot will be conducted in 2021. The development of the business model concepts will explore potential emergent concepts relating to several dimensions such as: vehicle assembly/manufacturing; e-vehicle maintenance; ownership and management of shared e-scooters; provision of public charging facilities; and end-of-life resources management. The project will also explore the possibility of establishing specific business opportunities that would involve local SMEs and EU-partner SMEs and industries.

2.6 Team involved

Main Role	Organization	Name	Contact
Demo leader	University of Transport Technology	Vu Ngoc Khiem, Vice Rector	khiemvn@utt.edu.vn
Demo operator	Transerco	Mr. Cuong Nguyen	cuongnm@transerco.com.vn
Coordination	Wuppertal Institute (WI) and Clean Air Asia(CAA)	WI: Shritu Shrestha and Alvin Mejia CAA: Kathleen Dematera	shritu.shrestha@wupperinst.org , and alvin.mejia@wupperinst.org kathleen.dematera@cleanairasia.org
Demo local partners	Aeonmall, Condominium PMUs,	Ms. Tran Huyen Nhung, Aeon Mall Ha Dong	nhungth@aeonmall-vn.com
Vehicle provider	Vinfast, QiQ, Wiibike, Haybike,...	Mr. Le Hoang Long	v.longh3@vinfast.vn
Charging system provider	Vin/ABB		
App/software provider	SOL massapp/ Plusservice/ QiQ		
SME start-ups	Wiibike, QiQ		

2.7 Local Implementation team

- Assoc. Prof. Dr. Vu Ngoc Khiem – Vice Rector, University of Transport Technology, Hanoi, Vietnam
- Ms. Nguyen Thi Thu Hien – Deputy Head, Department of Science, Technology and International Cooperation, University of Transport Technology, Hanoi, Vietnam
- Dr. Nguyen Thi Hai Anh, Lecturer, University of Transport Technology
- Dr. Tran Trong Tuan, Lecturer, University of Transport Technology
- Dr. Nguyen Van Doan, Lecturer, University of Transport Technology
- Dr. Ta Tuan Hung, Lecturer, University of Transport Technology
- Dr. Dinh Quang Toan, Lecturer, University of Transport Technology
- Ms. Ngo Thi Thu Tinh, Lecturer, University of Transport Technology
- Mr. La Quang Trung, Lecturer, University of Transport Technology
- Ms. Phi Luong Van, Lecturer, University of Transport Technology

- Ms. Bui Thi Thu Hang, Lecturer, University of Transport Technology

2.8 Risks Assessment

Risk	Probability assessment	Consequences	Risk mitigation/comments
<i>Competition</i>	<i>Medium</i>	<i>Pressure and threat from other ride-sharing companies like Grabike, Goviet... or traditional motorbikes</i>	
<i>Political/legal risk</i>	<i>Low</i>	<i>Delay in project approvals and permits</i>	<i>Prepare for all papers and establish a close corporation with relevant departments to ensure support for approvals and permits</i>
<i>Technique risk</i>	<i>Low</i>	<i>Injuries or worse; need to redesign; stoppage of demonstration</i>	<i>Technical performance and safety testing Training for operators to be conducted Check if all insurance mechanisms are covered</i>
<i>Lack of commitment from stakeholders</i>	<i>Low</i>	<i>Poor communication among the sharing EV pilot stakeholders</i>	<i>Make the sharing EV pilot stakeholders to be committed to a long-term relationship with each other, and communication is an effective way to maintain the relationship.</i>
<i>Completion risk</i>	<i>Low</i>	<i>Delay in demo process</i>	<i>Keep track of time-plan</i>
<i>Construction/operation cost overrun</i>	<i>Low</i>	<i>Actual costs are higher than expected costs</i>	<i>Have a clear financial plan as well as optimize and control costs</i>
<i>End products not suitable for intended use</i>	<i>Low</i>	<i>SOL E-vehicles are not eventually used</i>	<i>User needs-based assessment at the core of the design phase</i>

2.9 Monitoring

A monitoring plan will be crafted that will be based both on the “global” project key performance indicators (KPIs) to be developed within the Work Package 1 of Solutions PLUS and the main objectives to be co-identified with the Hanoi City. Essentially, a set of highly relevant KPIs will be selected and methodologies (who, what, when, where, how) for collecting data for calculating the indicators will be included in the monitoring plan. To be able to properly assess the impacts of the demos, there would also be a need for baselining activities which would establish the benchmarks for the indicators. The baseline values would essentially capture “what would have happened in case the demonstration was not conducted.”

The KPIs would capture operational performance, and service quality-related perceptions. These KPIs would be selected based on a holistic framework that considers operational (reliability, range, etc...), environment (and energy efficiency); social (e.g. safety, perceptions); and economic (e.g. total costs of ownership, operational costs and considerations, affordability).

3. Preliminary replication opportunities

Opportunities for the production of similar “flexible” vehicles can be explored in different developing countries across the globe. In the region, for example, the lessons learnt can be shared within the ASEAN EV association. As many of the major cities Southeast Asian countries share similar profiles in terms of spatial constraints (i.e. narrow urban roads), perhaps the utilization of integrated logistics concepts that achieve better matching of vehicle sizes with the road infrastructure can be explored. In Vietnam, e-scooters are widely and increasingly used. Therefore, there are great opportunities for the e-scooters sharing to be conducted in the future.

A cross-regional platform involving the different SMEs can be established within SOL+ to facilitate information exchange.

4. Updates

Progress towards implementation

In preparation of the Hanoi demonstration, the University of Transport Technology (UTT) has officially reported to Vietnam Ministry of Transport, Hanoi Department of Transport, National Traffic Safety Committee on the project implementation. At the same time, the UTT has worked and discussed with various stakeholders including: Hanoi Transportation Corporation (Transerco), Vinfast LLC, Aeon-mall Vietnam, management of residential areas, condominiums for their participation in the demonstration.

Hanoi Transportation Corporation (Transerco) is the biggest public transport service provider for Hanoi City, directly under the Hanoi People’s Committee. They manage public transport services including buses and BRT in Hanoi. Transerco will support the locations to place the

D4.1 Demonstration Implementation Plans

shared e-scooters, support UTT in operating the shared vehicles and integrating the public transportation data into the sharing system for buses and BRT.

Vinfast is the biggest e-scooter manufacturer and provider. Vinfast is willing to join and provide the e-2 wheelers for the demonstration in Hanoi. Currently, the e-scooters are installed with the e-sim card, GPS device and with software so that we can lock, manage and check the technical status and the position of the e-scooters online. The company also provides free maintenance and repair for 3 years for most of the e-scooter parts.

The e-scooters will be painted with SOL+ typical color, the project name and logos. Also, UTT is coordinating between ABB and Vinfast for the bus charging.

Site investigation: UTT research team has surveyed the different locations in Hanoi City including BRT stops, Bus terminals, Metro lines, residential areas, condominiums, universities, shopping centers. UTT is also coordinating with relevant stakeholders for detailed surveying the demo locations, users' travelling need assessment, vehicles/equipment installation,... As a result, the locations have been identified for the first phase of demonstration BRT Van Khe (To Huu street) and the Aeon Mall Ha Dong to connect the transport users from the BRT to shopping mall by using the e-scooter sharing system.

Vehicle integration: UTT is working with Wuppertal Institute and Plusservice on Maas App preparation.

Next steps

- SOLUTIONSplus webinar on Demonstrating e-mobility solutions in Hanoi, Kathmandu and Pasig. The event will be on July 3rd 2020, presented by local city partners.

5. References

- Asean-Japan Transport Partnership (AJTP). (n.d.). *Statistics Road Transport*. <http://www.ajtpweb.org/ajtp/statistics/roadtransport/index.html>
- Blain, L. (2018). Hanoi plans to ban motorcycles altogether by 2030. *New Atlas*. <https://newatlas.com/hanoi-2030-motorcycle-ban/55772/>
- Bus commuters in Hanoi remains low. (2019, July 26). <https://vietnamnet.vn/en/society/bus-commuters-in-hanoi-remains-low-553628.html>
- Clean Air Asia. (2010). *Clean Air Management Profile 2010 Edition Vietnam*. <https://www.intelligenttransport.com/transport-news/88234/hanoi-reveals-plans-to-increase-public-transport-use/>
- CODATU. (n.d.). *Codatu will accompany the City of Hanoi in Urban Logistics Issues in Order to Reduce Urban Air Pollution*. <http://www.codatu.org/actualites/codatu-will-accompany-the-city-of-hanoi-on-urban-logistics-issues-in-order-to-reduce-urban-pollution/>
- Diem, L. (2017, September 15). *Smartphone app allows users to find most convenient bus routes in the capital*. <http://vneconomictimes.com/article/society/hanoi-launches-bus-app>
- Duong, T. (2016). *Vietnam Low Carbon Bus NAMA*. http://ccap.org/assets/Vietnam-Bus-NAMA_Vietnam_FinanceSummit2016_20-5-2016.pdf
- Export.gov. (2018, December 7). *Vietnam – Standards for Trade*. <https://www.export.gov/article?id=Vietnam-Standards-for-Trade>
- Ha, T. (2017). *Vietnam Traffic Safety for 2 Wheelers: Challenges and Strategies*.
- Hanoi launches bus app. (2017, September 9). <http://vneconomictimes.com/article/society/hanoi-launches-bus-app>
- Indochina Research. (n.d.). *Public Transportation in Vietnam*. <http://indochina-research.com/public-transportation-in-vietnam/>
- Intelligent Transport. (2019, Sept 15). *Hanoi reveals plans to increase public transport use*. <https://www.intelligenttransport.com/transport-news/88234/hanoi-reveals-plans-to-increase-public-transport-use/>
- International Energy Agency (IEA). (2018). *Fuel Combustion CO2 Highlights*. <https://webstore.iea.org/co2-emissions-from-fuel-combustion-2018-highlights>

- Ngoc, T. (2019). *Challenges and Solutions for Sustainable Urban Transport in Cities of Vietnam*. https://www.unescap.org/sites/default/files/Country%20Report_Viet%20Nam_SUTI.pdf
- Nguyen, D. (2019, March 19). *Vietnam to waive import tariffs for environment-friendly auto parts*. <https://e.vnexpress.net/news/business/industries/vietnam-to-waive-import-tariffs-for-environment-friendly-auto-parts-3896726.html>
- Onishi, T. & Shiraishi, T. (2018, December 13). *BMW and Bosch support Vietnam's vision for homegrown cars*. <https://asia.nikkei.com/Business/Companies/BMW-and-Bosch-support-Vietnam-s-vision-for-homegrown-cars>
- Pastoor, D. (2019). *Vinfast and the Electric Vehicle Market in Vietnam*. <https://www.netherlandsworldwide.nl/binaries/en-nederlandwereldwijd/documents/publications/2019/01/11/vinfast-and-the-electric-vehicle-market-in-vietnam/Evs+-+Vinfast.pdf>
- Renewable Energy and Energy Efficiency Partnership (REEEP). (2017). *Business model for solar-charged e-bikes in Vietnam*. <https://www.ctc-n.org/file/15839/download?token=FtNURIOD>
- UNDESA. (2018). *World Urbanization Prospects 2018*. <https://population.un.org/wup/Download/>
- Voice of Vietnam. (2019, July 02). *Hanoi Aims for 7.6 percent economic growth in 2019*. <https://english.vov.vn/economy/hanoi-aims-for-76-percent-economic-growth-in-2019-391763.vov>
- World Health Organization (WHO). (n.d.). *Road safety in Vietnam*. https://www.who.int/violence_injury_prevention/road_traffic/countrywork/vnm/en/

D4.1 Demonstration Implementation Plan

City: Pasig

1. Operating environment

1.1 Background

1.1.1 Key facts and figures

The City of Pasig is a highly urbanized city within the heart of Metro Manila, Philippines. It has a population of 755 thousand which is about 5% of the total population of Metro Manila, according to the 2015 National Census. Its land area covers 34.32 sq. km. which is comprised of 30 *barangays* – smallest administrative division in the Philippines. The calculated urban population density is 22,008 inhabitants per sq.km (Pasig City, 2019).

Table 1. Selected Indicators: City of Pasig

	Value
Total population	755,300
Population density (persons/sq.km)	22,008
Estimated number of households	180,612
Average household size	4.2
Population growth rate	2.31%
Concreted roads (km)	337.63

There are 4 major thoroughfares of Metro Manila that traverse thru City of Pasig (circumferential road C-5, Ortigas Avenue, Shaw Blvd, and Marcos Highway). These are thoroughfares which are critical to the traffic flows in the whole urban agglomeration. The City of Pasig also developed along the two main rivers in Metro Manila (the Marikina, and Pasig Rivers). No city-specific transport activity and modal share figures are available, but passenger transport constitutes of public utility vehicles (PUVs – jeepneys and UV express or mini-vans), buses, and tricycles (3-wheelers), as well as private modes. Urban freight tasks involve heavy, and light duty trucks, as well as delivery vans, and motorcycles.

1.1.2 Overarching issues

The International Energy Agency (IEA, 2018) estimates that 103 million tons of Carbon dioxide (CO₂) was emitted by fossil combustion-related activities in the Philippines. Thirty percent (30%) of the CO₂e emissions was contributed by the transportation sector, with road transportation contributing 85% of the sector's emissions (25% of the national total). Road transportation has also been implicated as the priority source of air pollutant emissions by the national air pollutant emissions inventory by the Department of Environment and Natural Resources (DENR) which estimates that road vehicles emit 65% of the emissions load (DENR, 2017).

Vehicle motorization in the country has primarily been driven by motorcycle growth in the recent decade. Between 2004 and 2017, the registered vehicle fleet in the country has grown at

D4.1 Demonstration Implementation Plans

an annual rate of 15%, with motorcycles growing at an astounding 18% per annum, with the total registered motorcycles tripling in size within the period – 1.8 million to 6.1 million (see Figure 2). Such growth can potentially be explained by increased access (driven by economic growth and availability of financial schemes that require low down payment) to motorcycles, and also perhaps due to the state of congestion in many of the major urban agglomerations in the country. Recent analyses have pointed to Metro Manila as having one of the worst congestion levels in the world, and Cebu being the worst place in the world to drive in (Waze, 2015; Numbeo, 2019). The use of motorcycles in such heavily congested areas can be seen as the fastest, and most practical means of travel. Rapid motorization, coupled with the lack of alternative transportation choices, then lead to significant negative impacts related to motorized traffic congestion.

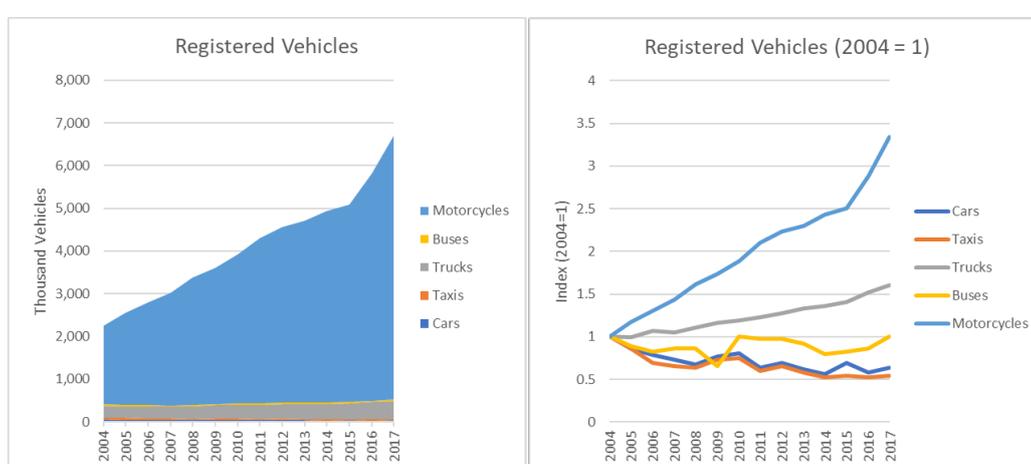


Figure 1. Vehicle Registrations in the Philippines

Source: Data taken from the AJTP (n.d.)

The Digital Economy and Urban Deliveries

The pilot project with PHLPost focuses on urban freight. One of the key drivers spurring urban freight activities is the digitalization of the economy, particularly of consumer goods and products (see Table 4). The digital economy in the Philippines, while still lagging as compared to its Southeast Asian neighbours, is poised to accelerate in the next years (Businesswire, 2019) due to its young population, growing middle class, increasing internet connectivity and speed. In fact, 2018 has seen significant growth in e-shopping.

Table 2. Goods E-Commerce Indicators (Philippines)

	Value	Year-on-year % Change
Total number of people purchasing consumer goods via e-commerce	47.30 million	+3.5%
Value of consumer goods e-commerce market	840 million USD	+22%
Average annual revenue per user of consumer goods e-commerce	18 USD	+18%

Source: Businesswire (2019)

D4.1 Demonstration Implementation Plans

But even with the significant growth in e-shopping in the country, this growth is not being translated into growth by PHLPost which is experiencing significant declines in the recent years in terms of postal traffic (see Figure 4). Domestic and international parcels (which relate directly to e-commerce) constitute only 1% of the total mail volume in 2018.

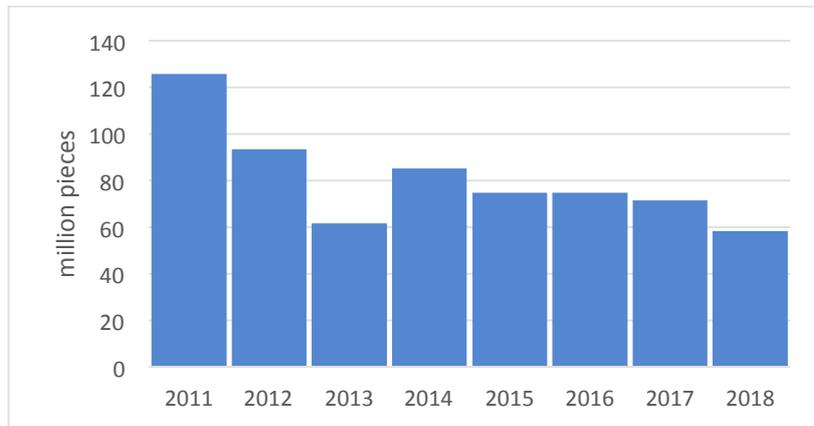


Figure 2. PHLPost Postal Traffic (million pieces)

Source: PHLPost Annual reports

Another significant trend to is that private entities (including individuals) are being tapped to provide delivery services for major e-commerce companies, without much requirements (no experience, basic vehicle requirements) embedded into the approval process, such as Lazada Express (see Figure 5).



Riders / Drivers

No Experience

Lazada Express

Taguig, Metro Manila

Posted on : May 11, 2019

Job ID : 316076

Details

LAZADA is looking for Business Partners like you!

RIDERS / DRIVERS

Vehicle Types Accepted:

- Motorcycles -
- E-Trikes
- Closed Vans (L300 type or any closed vans)
- 6 wheelers Trucks

Qualifications:

- Professional License
- With experience in Delivery is a plus
- Can work independently
- Ability to achieve objective
- Can handle pressure and stress at field

Figure 3. Lazadaexpress Call for Riders/Drivers

Source: Lazada.com

Many courier companies have also taken advantage of the digitalization of the market, and are now offering door-to-door (with origin-pick-up services) express delivery services in major urban areas such as in Metro Manila.

1.2 E-mobility overview

The Land Transportation Office (LTO) registration data shows that the on-road electric vehicle fleet in the country is primarily dominated by electric tricycles (three-wheelers) and electric motorcycles (see Figure 3).⁵ Historical documentation of the growth in registered e-vehicles is not yet available as the rules regarding the registration of e-vehicles have varied over the years. LTO is yet to announce, for example, the adopted rules for registering e-motorcycles. These issues are related to the fact that the underlying national laws still pertain to vehicles as those having internal combustion engines. MMC et al.(forthcoming) has documented 15 models of e-jeepneys, 21 models of e-tricycles, 11 models of electric cars, and 61 models of other two to quadricycle models available in the Philippine market.

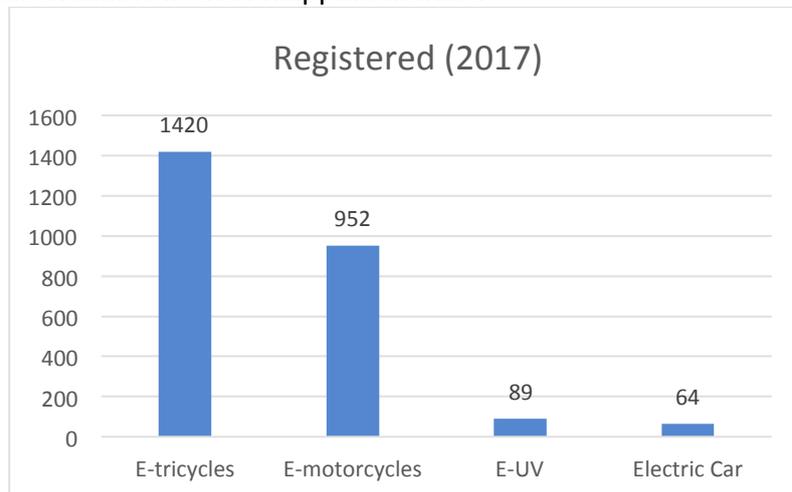


Figure 4. 2017 Registered E-Vehicles

Source: Data from the LTO as quoted by MMC et al. (forthcoming)

E-mobility has been slow in picking up in the country. In 2014, the Electric Vehicle Association of the Philippines (EVAP) forecasted that the e-vehicle fleet in the country would be at approximately 54,000. As seen in the registration figures, the actual registrations have been far off these projections. Multiple significant barriers (i.e. high acquisition costs, limited charging infrastructure, lack of social and technical familiarity, registration issues, lack of financial incentives) have contributed to such a slow uptake (MMC et al., forthcoming). There have been e-jeepney pilot projects in the past in several major cities (e.g. Makati, Pasig), as well as pilots involving e-tricycles. The most recent one, the ADB-DOE project, is discussed in Section 2.E. However, no significant levels of roll-out have been achieved to date.

⁵ Pedelecs are not reflected in the data. UV's are utility vehicles which include the e-jeepneys.

D4.1 Demonstration Implementation Plans

The Philippine Board of Investments state that there are 28 firms that are engaged in the manufacturing of e-vehicles in the country, and 11 companies that are involved in e-vehicle parts and components. There are also 7 registered importers (BOI, 2018).

1.2.1 Recent initiatives

Vehicle related Initiatives

ADB-DOE E-trike Project

The DOE, in partnership with the Asian Development Bank (ADB), and the Clean Technology Fund (CTF), is implementing the “Market Transformation through Introduction of Energy Efficient Electric Vehicles” Project (commonly known as the E-trike project) to promote the electrification of public three-wheeled fleets in the country.

The project originally intended to manufacture and disperse 100,000 units of tricycles amounting to 21.67 billion Philippine pesos. However, in 2016, the then-new DOE leadership decided to scale the project down due to the high per unit costs of the vehicles (only one model allowed under the original loan agreement), and now is rolling out just 3,000 units (1.73 billion pesos). As of early this year, 1,200 of the 3,000 units have been donated to several local government units : Marawi, Muntinlupa, Las Pinas, Pateros, Valenzuela (Umali, 2019).

Public Utility Vehicle Modernization Program (PUVMP)

As mentioned in the previous section, the DoTr is implementing a modernization program for PUVs (primarily jeepneys). The original target was to modernize 170,000 dilapidated jeepneys (15 years or older) by mid-2020. However, the latest estimates show that only 4,000 have been replaced (Valdez, 2019). While the PUVMP itself is not limited to promoting e-jeepneys, the underlying law does mention such suitable replacements. While the Development Bank of the Philippines (DBP) has come up with a supporting financing facility that offers lower interest rates and more lax repayment periods as compared to other private banks, many of the public transport associations and groups have opposed this program and have dubbed it as being anti-poor (see Berdos, 2019 as an example).

Proposed Laws

While there have been several attempts in the recent past to initiate comprehensive legislations relating to electrifying the transport sector, there is none that has been passed. Currently there are three proposed Senate Bills (SB) that are still being discussed:

- SB 678, 2016 – Electric, Hybrid and Other Alternative Fuel Vehicles Promotions Act
- SB 1540, 2017 – Electric and Hybrid Vehicles Including Charging Stations Promotions Act
- SB 2137, 2018 - Electric Vehicles and Charging Stations Act.

E-Vehicle Registration

The Land Transportation Office (LTO) is currently in the process of consolidating its guidelines on the “Recording and Registration of All Types of Electric Motor Vehicles” which considers previous issuances related to the matter (LTO, forthcoming):

- Memorandum Circular No. AVT 2015-1983 entitled “Classification and Registration of Electric Tricycle”

D4.1 Demonstration Implementation Plans

- In 2008, the LTO issued AO AHS-2008-014 which provided guidelines on the registration of low speed vehicles (LSV) which covers 4- wheeled vehicles powered by alternative propulsion systems (including electricity) and has a maximum speed of 40 km/h.
- In terms of electric motorcycles and scooters, the LTO, in 2006, issued AO 2006-01 entitled “Guidelines for the Registration of Light Electric Vehicles (LEV). This defines LEV as two or three-wheeled vehicles powered by a battery-powered motor with no more than 36 voltage output and with amps per hour ranging from 10 to maximum of 60, and does not have pedals. LEV’s are only allowed to be operated on municipal, city, barangay, and provincial roads, and are prohibited from national roads (Consunji, 2017).

The absence of consolidated guidelines, procedures, and limited availability of LTO branches where Evs can be registered have resulted in much confusion for the public. For example, in 2018, only a handful of LTO offices (located in 3 cities in Metro Manila) were able to register LEVs (Genio, 2018). The fact that these LEVs are not allowed on national roads means that it would not be directly possible to go to these LTO branches and have the vehicles registered (even if one is from the same city) without traversing national roads.

E-Vehicle Industry

The electric vehicle industry in the Philippines, as represented by the Electric Vehicle Association of the Philippines (EVAP), has recently been gearing up towards boosting local e-vehicle and vehicle parts production, and is pushing for market reforms and policy recommendations as summarized in the in the image below:

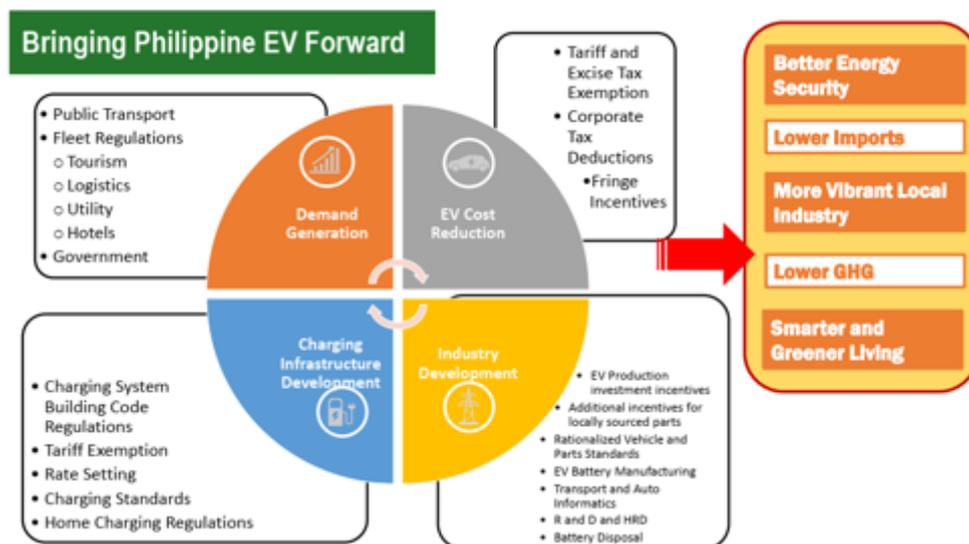


Figure 5. Focus Areas for Action as Recommended by the EVAP

Source: EVAP (2019)

The EVAP initiated a national development program for e-vehicles anchored against the Motor Vehicle Development Program of the Philippines. The initial plan for the program is described in the table 5 below:

Table 3. EV Development Program Timeline as Proposed Originally by EVAP

Period	Description
2013	Launch of the program and needs identification
2014-2015	Build-up of local market and enhancement of the production capacity
2016-2018	Local and export market expansion, horizontal and vertical integration with the local automotive industry
2019-2023	Full integration, regional and global, technological evolution and market size expansion

Source: BOI (2018)

Charging Standards and Infrastructure

The DOE is currently drafting the regulatory framework that will serve as the basis for the standardization of charging stations (Umali, 2019). The DOE intends to cooperate with the ADB in order to secure funding from its 4 million Clean Technology Fund.

The Department has also been seeking support from private sector partners for putting up e-vehicle charging stations. In 2017, DOE formed an Ad-hoc technical working group tasked to determine the suitability of petrol stations, and mall parking areas to serve as charging stations (Rivera, 2018).

The Department of Science and Technology (DOST) is also currently cooperating with the University of the Philippines (UP) in developing a locally made rapid electric vehicle charger called CharM (DOST, n.d.)

Pasig City Initiatives

The City of Pasig is one of the most active cities in the Philippines when it comes to the promotion of sustainable transport. Pasig City is among the few local government units (LGUs) with an office dedicated for transportation concerns, the City Transportation and Development Management Office (CTDMO). It was the first city to require that buildings provide bicycle parking, for example.

The Pasig City government had also implemented several sustainable transport initiatives such as the Carless Sundays and the free bus service featuring Euro-IV buses that shuttle passengers within the Ortigas central business district, launched a bike share system in Ortigas Centre, bike lane/light mobility lane development, and PUV lane planning and inclusive mobility management (UEMI, 2019 & CTDMO, 2019). In 2016, an ordinance aimed at the gradual phase-out of two stroke tricycles has been established to include the introduction of electric tricycles to replace existing gasoline-fed tricycles. Along with this there were programs encouraging the upgrade to e-trikes by provision of financial assistance schemes.

D4.1 Demonstration Implementation Plans

The City of Pasig is also one of the cities involved in the DOE-ADB joint e-trike project. In March 2019 about 200 electric tricycles for the Pasig Electric Tricycle (“E-Trike”) Program. However, no charging stations are widely available hence the hesitation of tricycle drivers to adopt the new technology (UEMI, 2019).

Philippine Postal Corporation (PHLPost)

The introduction and testing of the e-cargo vehicles is directly aligned with PHLPost’s vision of making it the preferred universal delivery service provider in the country. It is intending to develop “specialized delivery services” focusing on efficient, effective, environment friendly, electronic, e-commerce driven operations (PHLPost, 2019).



Figure 6. E-services by PHLPost

Source: PHLPost (2019)

Other

The largest fast food chain in the Philippines, Jollibee, has introduced an initial e-bike fleet (said to be the first road legal e-bikes in the country), in partnership with the ECOS Environmental Foundation, Inc., the Environmentally Sustainable Technology Development Inc., and the DoTr. The Jollibee e-bikes are imported from Japan, will be used for delivery services (BusinessMirror, 2019b).

1.2.2 Policy environment

Existing regulations

Climate Change and Environment

- Republic Act 9729 (Climate Change Act)

The Philippines’ overarching policy framework on climate change is Republic Act 9729 or the Climate Change Act of 2009. It is accompanied by the National Climate Change Action Plan

D4.1 Demonstration Implementation Plans

(2011-2028) which sets out the priority strategies for combating the impacts of, and the country's contribution to climate change.

- National Framework Strategy on Climate Change

The framework identified “environmentally sustainable transport” (EST) as a key result area with the following thrusts related to transportation:

- Promote models to improve the transport sector's efficiency and modal shifts
- Integrate climate change to the formulation of energy and transport policies such as the formulation of a national EST strategy.

- National Climate Change Action Plan

The National Climate Change Action Plan (NCCAP) outlines the Philippines' agenda for climate change adaptation and mitigation for 2011 up to 2028. Formulated by Climate Change Commission (CCC), through the guidance of the Climate Change Act and the National Framework Strategy on Climate Change (NFSCC), the NCCAP sets the country's strategic direction for addressing climate change issues.

One of the agenda areas of the NCCAP is focused on sustainable and renewable energy, and ecologically efficient technologies to be adopted as major components of sustainable development, and the third outcome of this agenda specifies that the government would support the promotion and adoption of environmentally sustainable transport.

- Republic Act 8749 (Clean Air Act)

A key policy related to mitigating the pollution from the road transportation sector is RA 8749 or the Clean Air Act of 1999 (An Act Providing for a Comprehensive Air Pollution Control Policy and for Other Purposes or the Philippine Clean Air Act of 1999). Article four (4) of the Clean Air Act is devoted particularly for addressing pollution from motor vehicles, providing standards for the type approval and in-use emission standards, as well as mandates for establishing a national motor vehicle inspection system.

Energy

- Philippine Energy Plan

The Philippine Energy Plan (PEP) 2012-2030 governs the policies to be implemented that are in line with its thrust of ensuring energy security in the country. The PEP targets 10% savings on total annual energy demand for all economic sectors including transport.

- Philippine Electrical Code

The Philippine Electrical Code is a set of rules that ensure safety in electrical installation and construction as mandated by Republic Act (RA) 7920 (New Electrical Engineering Law).

- Philippine Grid Code

The Grid code governs the reliable operation, maintenance, and development of the high-voltage backbone transmission system and the related facilities as promulgated by the Energy Regulatory Commission as mandated under RA 9136 or the Electric Power Industry Reform Act (EPIRA).

D4.1 Demonstration Implementation Plans

- Power Development Plan

The Philippine Development Plan is an indicative plan for demand-side management of electricity. This plan is formulated and updated yearly by the Department of Energy (DOE) in coordination with the power generators, transmission companies and distribution utilities.

- Distribution Development Plan

This is prepared by the distribution utilities and details the plan for the expansion, reinforcement and rehabilitation of their respective distribution systems. This is submitted to the DOE and is used in the Power Development Plan and the Philippine Energy Plan.

- Philippine Distribution Code

This governs the distribution system as promulgated by the Energy Regulatory Commission (ERC) pursuant to the mandates provided for by RA 9136 (EPIRA).

- Philippine Energy Plan

The Philippine Energy Plan (PEP) sets forth roadmaps for increasing energy access, security, and efficiency in the country.

- Alternative Fuels and Energy Technologies Roadmap 2017-2040

This is a roadmap developed by DOE that includes a long-term goal of mainstreaming alternative fuel-vehicles, including Evs, in the transport sector.

-

Transport

- Republic Act 4136 (Land Transportation and Traffic Code)

The Land Transportation and Traffic Code is the overarching law that controls the registration and operation of motor vehicles, as well as the licensing of relevant entities such as vehicle owners, dealers, conductors, and drivers.

- Republic Act 8794 (Motor Vehicle User's Charge)

This republic act specifies the schedule and rates for fees associated with the use of motorized on-road vehicles.

- Department of Transportation Department Order No.2017-11 (Public Utility Vehicle Modernization Program)

This is also known as the Omnibus Guidelines on the Planning and Identification of Public Road Transportation Services and Franchise Issuance but is also generally referred to as the Public Utility Vehicle Modernization Program (PUVMP). This Department Order is based on the expressed interest of Department of Transport (DoTr) to move toward environmentally-sound mobility solutions in relation to the provision of franchises for public transportation, and includes environmental-soundness (Euro IV and above, and electric and hybrid propulsion) as a key criterion for the issuance of such.

Another implication of the underlying DO 2017-11 is that local governments would be more involved in the planning and management of road public transport (particularly for jeepneys

D4.1 Demonstration Implementation Plans

and buses). Local governments are now encouraged to come up with Local Public Transport Route Plan and a Comprehensive Local Transport Plan. Under the Local Government Code of 1991, the local governments are only responsible for the management of public three-wheelers or tricycles.

- Department of Transportation and Department of Interior and Local Government Joint Memorandum Circular 2017-001

This is known as the “Guidelines on the Preparation and Issuance of Local Ordinances, Orders, Rules and Regulations Concerning the Local Public Transport Route Plan.” One particular rule that is important particularly to tricycles is the clarification that these vehicles are only to be operated along city or municipal roads.

Fiscal and Non-fiscal Incentives

- Investment Priorities Plan

This is a three-year rolling plan prepared by the Board of Investments that identifies specific investment areas (and the corresponding incentives) that are aligned with the priorities of the country.

The current IPP (2017) includes activities for land mass transport including mass transport using brand new buses that run on electric batteries, and similar projects that can be subsumed under the Philippine Public Utility Vehicle (PUV) Modernization program.

- Green Jobs Act RA 10771

The Green Jobs Act provides a policy framework for fostering low-carbon, resilient sustainable growth and decent job creation by providing incentives to enterprises generating green jobs, with focus on developing human capital to enable and sustain the transition to a greener economy (ILO, 2018).

The following incentives are relevant to e-mobility industries:

- Expenditures on skills and R&D are 50% deductible to corporate income tax
- Tariff exemption on capital equipment

- Special Economic Zone Act RA 7916

The Special Economic Zone Act (SEZA) provides for the legal framework and mechanism for the creation, operation, administration and coordination of special economic zones (ECOZONES) in the Philippines. The following incentives are relevant for entities related to equipment manufacturing and importation as quoted in MMC et al. (forthcoming):

- Corporate income tax exemption for 3-6 years and 5% ceiling for succeeding years for economic zone export enterprises
- Deduction of training expenses from corporate income tax for economic zone-registered and located businesses
- Exemption from importation tax and duties on raw materials, capital equipment, machineries and spare parts
- Exemption from wharfage dues and export tax, import or fees

D4.1 Demonstration Implementation Plans

- VAT exemption on local purchases, subject to compliance with the Bureau of Internal Revenue (BIR) and Philippine Economic Zone Authority (PEZA) requirements
- Exemption from payment of all local government imposts, fees, licenses or taxes

- Tax Reform for Acceleration and Inclusion Law (TRAIN) – RA 10963

The TRAIN Law (Republic Act No. 10963) was passed in 2017 as part of the wider Comprehensive Tax Reform Program. The most relevant incentives relating to e-mobility are the following:

- Exemption from excise taxes for battery-electric vehicles
- 50% excise tax deduction for plug-in hybrid electric vehicles.

- Executive Order 488, S. 2006

EO 488 was issued in 2006 which put zero import duties on components, parts and accessories for the assembly of hybrid, electric, flexible fuel and compressed natural gas motor vehicles.

- Philippine National Standards

Last January 2020, the Department of Trade and Industry (DTI) adopted the following standards on electric vehicles (from the International Organisation for Standardisation and the International Electrotechnical Commission – ISO & IEC)

- PNS IEC 61851-1:2019 Electric vehicle conductive charging system – Part 1: General requirements
- PNS IEC/TS 62840-1:2019 Electric vehicle battery swap system – Part 1: General and guidance
- PNS IEC 62840-2:2019 Electric vehicle battery swap system – Part 2: Safety requirements
- PNS ISO/TR 13062:2019 Electric mopeds and motorcycles – Terminology and classification
- PNS ISO 13063:2019 Electrically propelled mopeds and motorcycles – Safety specifications
- PNS ISO 13064-1:2019 Battery-electric mopeds and motorcycles – Performance – Part 1: Reference energy consumption and range
- PNS ISO 13064-2:2019 Battery-electric mopeds and motorcycles – Performance – Part 2: Road operating characteristics

Other Related Policies

- Republic Act 7160 – Local Government Code

The Local Government Code sets out the responsibilities and accountabilities of local government units. In terms of urban transportation management, local governments are responsible for regulating the operations of tricycles and issuing the franchises for the operation thereof.

- Republic Act 7718 – Build-Operate-Transfer Law

This is specifically relevant for BOT projects with the private sector which might come into play in the roll-out phase.

D4.1 Demonstration Implementation Plans

- Republic Act 9184 – Government Procurement Reform Act

This provides the rules and regulations relating to government procurement and contracting which is specifically relevant for the pilot project. See Annex 1 for pertinent selected information from the Act.

- Philippine Development Plan 2017-2022

The Philippine Development Plan (PDP) is the country’s medium-term development plan as consolidated by the National Economic Development Authority (NEDA). The current PDP includes a priority on “enhancing the efficiency of the transport sector through providing adequate, accessible, reliable, and safe access for people and goods.”

Policy gaps

The following points below echo the policy gaps that have been highlighted in MMC et al. (2019) in relation to supporting and expanding e-mobility in the Philippines:

Table 4. Policy Gaps

	Gaps
Fiscal and non-fiscal incentives	<ul style="list-style-type: none"> ● Need to support BEVs and PHEVs by easing import tariffs in comparison with other vehicles ● Formulation and implementation of a program that would provide incentives for greening the PUVs, and utilizing locally sourced major components ● Rationalization of fiscal incentives for EV assembly and parts production ● Development of a charging infrastructure masterplan with accompanying incentives and government co-investment ● Introduction of incentive programs for fleet owners to use Evs <p>Formulation and introduction of fringe benefits for Evs</p>
Regulations	<ul style="list-style-type: none"> ● Harmonization of vehicle classification ● Provision of specific tariff codes for completely built-up units of Evs ● Formulation and implementation of rationalized EV and components standards, and an accompanying testing, and verification programme ● Formulation of installation standards and permitting protocols for EV charging point installation ● Integration of charging system requirements with the local building codes and regulations ● Clarification and formulation of mechanisms and regulations on charging operation and setting rates ● Introduction of industry requirements on the adoption of Evs ● Development of a government procurement program on Evs
Industry development	<ul style="list-style-type: none"> ● Formulation and implementation of a national transport and auto-informatics industry development strategy ● Formulation and implementation of a roadmap for local manufacturing of EV batteries
Information and educational Campaigns	<ul style="list-style-type: none"> ● Development and roll-out of educational programmes for government agencies, including local government units on the regulation, operations, technicalities of Evs and their charging systems ● Establishment of city partnership programs for testing and scaling up e-mobility solutions

D4.1 Demonstration Implementation Plans

	<ul style="list-style-type: none"> • Conduct of dialogue and I for EV IEC purposes with different stakeholders
Human resource development	<ul style="list-style-type: none"> • Formulation and operationalisation of an EV human resource development programme to support local and global requirements • Development of e-learning courses on e-mobility, and explore partnerships with government entities (e.g. TESDA , DILG LGA)
Research and development	<ul style="list-style-type: none"> • Strengthening of the EV technology market intelligence programme to guide R&D initiatives • Create a platform for connecting users (e.g. cities, companies) with R&D entities to facilitate projects with high priority

Source: Adopted from MMC et al. (2019) with additional points by the authors

1.2.3 Business environment

Local businesses and start-ups working on e-mobility solutions

Existing Companies Operating in the E-Vehicle Market

The table below contains information on selected companies that are currently (or had been) involved in e-mobility in the Philippines.

Table 4. Selected Manufacturers, Assemblers, Importers, Dealers of E-Vehicles

Entity	Scope
BEMAC Phils.	E3w charging stations
eSakay Inc.	e2w, charging
EV Wealth Inc.	e3w, battery charging/swapping
Pinoyako Corp.	e3w, charging
Elaia Green Vehicles Corporation	e3w (e-trikes), battery swapping stations
QEV Phils. Electro Mobility solutions and consulting Group, Inc.	e4w, charging stations
360 Eco-loop	e4w public transport
e-Jeepney Ride for Free (e-JRF)	e4w public transport
Philippine Utility Vehicle Inc.	e4w public transport
SunEtrike	e3w (solar)
Talino EV Philippines	EV Battery Management Systems
Le Guider International	e3w
Kymco Phils	e2w *check info
UPEEEI / Charm solutions	Rapid charging system
Eclimo Electric Management Inc	Fleet Management
Joule Labs	Design and prototyping (2/3/4 wheeled e-vehicles)
TOJO Motors	Manufacturing of e-tricycles and jeepneys
GET COMET	Manufacturing of e-buses + digital services (e.g. app)
sakay.ph	mobility app (trip planner)

Business Associations: Automotive Industry

- Electric Vehicle Association of the Philippines (EVAP)

EVAP aims to educate the public on the benefits of e-vehicles, to partner with the government in creating and implementing relevant legislation and to accelerate the transition towards e-mobility. EVAP currently consists of 45 corporate members.

- Philippine Parts Maker Association Inc. (PPMA)

PPMA is formerly known as the Motor Vehicle Parts Manufacturers Association of the Philippines (MVPMPAP). It aims to provide technical and management support to its members and to serve as an effective link between the government and the auto parts manufacturing industry. It has a membership base of 113 parts manufacturers that span across 302 industries (PPMA, n.d.).

- Chamber of Automotive Manufacturers of the Philippines, Inc. (CAMPI)

CAMPI's main objective is to promote the interests of the automotive industry with the end in view of developing a viable domestic industry (CAMPI, n.d.). It is composed of representatives from the major car brands.

Industry Players: Urban Deliveries

Below are some of the major companies that provide similar services to those provided by PHLPost. These are some of the major players in last-mile deliveries of parcels in urban areas: LBC, GrabExpress, Xend Business Solutions, JRS Express, Lalamove, Shopee Xpress, Black Arrow Integrated, Xpost Integrated, Ninja Van Integrated, 2GO Integrated, J&T Express.

Needs and Opportunities

The key policy gaps in terms of stimulating the development of industries related to e-mobility in the Philippines are discussed in table 4. There is also needs in terms of stimulating the demand for e-vehicles, in general. Issues with reliability, range anxiety, and supporting ecosystems (e.g. repair and maintenance), high investment costs (and low awareness of the total ownership costs concepts), are overarching challenges that dampen the potential for adopting electric mobility.

Key opportunities lie in different parts of the supply chain, such as in terms of components manufacturing, vehicle assembly, battery manufacturing, software and smart applications development, as well as in terms of vehicle repair and maintenance and end-of-life management.

1.2.4 Capacity building

Current state and initiatives

Currently, there are only a few training programs that are available to the public/interested entities focusing on e-mobility. The table below shows examples of such training program/activities based on available information.

Table 5. Example of Available E-Mobility Trainings Conducted by Institutions in the PHL

Institution/Entity	Training
TUVRheinland	<u>In-house training</u> /bespoke training on electric and hybrid vehicles – open for interested entities
Technical Education and Skills Development Authority (TESDA) Green Technology Center	Curriculum for technical servicing, maintenance and repairs of electric vehicles being developed together with EVAP
Promotion of Low Carbon Urban Transport Systems in the Philippines (GEF) Project	Business development workshops to be held for transport cooperatives

Needs and opportunities

Technology, infrastructure and network planning

Much of the training needs of the local government unit of Pasig City and PHLPost Pasig relate to the EV technology, the use, troubleshooting and repair, and maintenance of Evs and to the set-up of charging infrastructure. As the technology is rather new to the target users, there are basic questions regarding its operation under certain conditions, such as flooding as well as battery consumption under hot weather. PHLPost also needs more information on electricity cost and maintenance of the units. As PHLPost motorcycles ply along narrow alleys, they also raised concern on Evs being silent while in operation.

Pasig City Transportation and Development Management Office (CTDMO) and PHLPost also need support in planning for the charging infrastructure, specifically in selecting the optimal locations. The objective of Pasig CTDMO is to have a charging infrastructure that would accommodate electric 2- and 3-wheelers, including the public transport electric 3-wheelers. Prior to the pronouncement of enhanced community quarantine in Metro Manila in mid-March 2020, Pasig CTDMO was supposed to conduct an ocular inspection for the location of eSakay, Inc. coin-operated charging infrastructure for the public transport electric 3-wheelers (e-trikes). Then, Meralco (the electric power distribution company) will investigate the feasibility of setting up the charging infrastructure at that location specifically looking at power lines.

There are also questions concerning the policies of the Department of Transportation’s Land Transportation Office (LTO) regarding license and registration of new Evs. As of writing, government vehicles are granted red plates while Evs are granted orange plates, so there are uncertainties regarding government Evs.

Business model development and outreach

In the PHLPost Pasig, specifically, there are 49 personnel, 35 of which are Letter Carriers (of which 31 or 32 have motorcycles; the rest use bicycles or walk). PHLPost Pasig has 2 vans which usually deliver to denser areas like Ortigas Center. The letter carriers use their personal motorcycles and are engaged as contract-of-service (COS) workers and get a maximum of PHP 537 (about EUR 9.55 or USD 10.80) , but there is an additional allowance of PHP 50 (about EUR 0.89 or USD 1.00) for motorcycle users for their gas and maintenance (R. Alfaro, personal communication, April 5, 2019). Motorcycle users are able to take home the change from the fuel allowance; as such, it is anticipated that there will be resistance from them if they will be

D4.1 Demonstration Implementation Plans

shifted to use the Evs, unless their salaries increase. Motorcycle ownership is a requirement for employment and is stated on advertised job postings. Introducing new Evs will require PHLPost to modify this set up.

There is also a need to demonstrate reduced operating costs and increased efficiency through the pilot projects. Fleets and personnel are deemed insufficient. With the incoming Evs, they would be able to hire more postmen, and PHLPost could let them use the new Evs. One of PHLPost' s needs is to be able to compete with other private companies that offer express delivery. As there is an expectation that Evs would be generally less physically taxing to use, PHLPost is also exploring the idea of employing more female or older letter carriers who would operate the Evs.

Some of PHLPost' s other challenges include narrow streets, vicious dogs, addressee as illegal settlers, increasing fuel cost, letter carriers on duty being harassed, costly parking charges, tracking of on-duty letter carriers and lack of fleet to provide to their letter carriers.

Mobile applications and programs for urban mobility

PHLPost is creating a specialized delivery unit (SDU) hubs, one of which will be the Pasig branch, with automated/computerized last-mile delivery management system with the provision of smart mobile devices capable of capturing live data, such as signature, finger print, picture, scanning and printing of receipt, as the case may be, for faster payment scheme and accounting, and a built-in GPS systems for tracking. The integration of solar energy was suggested to be considered for further study in the pilot as PHLPost is exploring solar-powered SDU hubs. Their phased expansion and improvement are as follows:

- Phase 1 micro operations: Pasig City SDU hub.
- 2nd Phase macro Metro Manila operations: Manila City, Quezon City, Makati City, Pasay-DAPO hubs.
- 3rd Phase adjacent cities & municipalities hubs

PHLPost is also planning for a fleet rehabilitation program wherein they will use more efficient vehicles and a computerization program in which they will embark on replacing paper-based operations documentation with electronic/digitized forms and documents. While this does not pertain specifically to electric mobility, PHLPost may include Evs in their 2022 budget if the pilot projects prove to be successful and can explore further funding opportunities from Universal Postal Union if necessary (T. Oseo, personal communication, May 8, 2020).

According to the Chief of Staff at Operations of PHLPost (personal communication, May 8, 2020), PHLPost is planning to outsource in 2021 where they will engage third-party delivery services from local government units (*barangays* of provinces) or small local carriers so they can reach more areas especially in the provinces. For example, in La Union, there are freelance delivery players that get parcels from PHLPost, DHL and FedEx, among others.

As for Pasig CTDMO, they partnered with Sakay.PH (www.sakay.ph) for the tracking of the electric buses from two companies, COMET and Star8, that are lent to the city to serve as free shuttles amid the public transport restrictions during the enhanced community quarantine in Metro Manila. A mobile phone is provided for each e-bus to serve as a tracker. The data is

owned by Sakay.PH but they can provide Pasig CTDMO the data if needed. However, the server in Pasig CTDMO is not sufficient for this type of tracking.

1.3 Key Stakeholders

1.3.1 Local Government Bodies

- PHLPost Pasig

The PHLPost Pasig City office is responsible for the PHLPost postal and parcel deliveries in the city of Pasig. The branch is also expected to be a hub that will also serve deliveries in several other adjacent cities.

- Pasig City Transportation and Development Management Office

The CTDMO's responsibilities include the following: carry out the sustainable transport agenda of the city; provision of advice to the Mayor in matters relating to sustainable transportation; take charge of the development of schemes for the generation of the transport development fees as a source of city revenue.

- Pasig City Environment and Natural Resources Office

Primarily responsible for environment-related permitting. It also carries out environmental programs in the city.

- Pasig City Office of Building Official

Responsible for issuing building permits (particularly important to consider if any infrastructure to be built).

1.3.2 National Government Departments

- PHLPost

The Philippine Postal Corporation (PHLPost) is a government-owned and controlled corporation (GOCC) which is tasked to provide postal services in the Philippines as mandated by Republic Act 7354.

- Climate Change Commission

The Climate Change Commission is directly attached to the Office of the President. It is an autonomous policy making body that is tasked to coordinate, monitor and evaluate programs and plans that are related to climate change mitigation and adaptation.

- Department of Transportation

The DOTr is an executive department that is responsible for maintaining and expanding the transportation systems in the Philippines. The Land Transportation Office (LTO) and the Land Transportation Franchising and Regulatory Board (LTFRB) are sectoral offices under the DoTr. The LTO is primarily tasked with vehicle registration, while the LTFRB is responsible for overseeing transportation industry franchising (i.e. issuance of franchises for public transport, and for-hire road freight transport service providers).

D4.1 Demonstration Implementation Plans

- Department of Energy

The DOE is tasked to prepare, integrate, coordinate, supervise, and control all plans, programs, projects, and activities of the Philippine government in relation to energy exploration, development, utilization, distribution and conservation (DOE, n.d.).

- Department of Environment and Natural Resources

The DENR is responsible for the conservation, management, development and proper use of the country's natural resources. The Department is thus responsible for issuing emission standards, including those for vehicles.

- Department of Interior and Local Government

The DILG is the primary agency that establishes and prescribes rules and programs relating to the supervision of local governments. Exploring options with its Local Government Academy (LGA) might be worthwhile if capacity building programs targeting local governments will be developed.

- Department of Trade and Industry

The DTI is the executive department tasked to enable the continuous development of Philippine industries, promote private sector activity to stimulate growth, and expand domestic and foreign trade.

- Department of Science and Technology

DOST directs and coordinates scientific and technological efforts and ensure that the results of such are used towards the maximum benefit of the country. They are actively involved in developing hybrid trains that are now being used by the Philippine National Railways, as well as in the exploration of rapid charging technology development.

- Metropolitan Manila Development Authority

The MMDA performs planning, monitoring, and coordinative functions, as well as exercise regulatory and supervisory authority in the delivery of urban services in Metro Manila, as defined in Republic Act 7924 (Creating the Metro Manila Development Authority). It cooperates with city governments, and the Philippine National Police in managing traffic in Metro Manila. It is governed by the Metro Manila Council which is composed of the heads of local government of the 16 cities of Metro Manila.

- National Economic Development Authority

NEDA is the primary social and economic development planning and policy coordinating department of the executive branch of government. It is also responsible for programming and coordinating programs with official development assistance.

- Department of Public Works and Highways

DPWH is primarily responsible for planning, design, construction and maintenance of public infrastructure such as roads, bridges and flood control systems.

- Technical Education and Skills Development Authority

D4.1 Demonstration Implementation Plans

TESDA is tasked to manage technical education and skills development in the country. Scaling-up capacity building programs (e.g. E-vehicle maintenance, charging equipment installation, among others) can be developed in partnership with TESDA in the future.

- Land Bank of the Philippines

LBP is a government bank with a specific focus on serving the needs of farmers and fishermen. They also provide loans to transport cooperatives in support to the public utility vehicle modernization program of the government (Valdez, 2018).

- Development Bank of the Philippines

DBP is a government bank with the primary objective of providing banking services to cater to the medium and long-term needs of agricultural and industrial enterprises, particularly small and medium-sized ones. DBP has established its Green Financing Program – meant to support private and public sectors to comply with environmental regulations – which was recently tapped by a local e-jeepney manufacturing company (Tojo Motors) (The Philippine Star, 2016). DBP also established the PASADA (Program Assistance to Support Alternative Driving Approaches) Financing Program to support the PUVMP (DBP, n.d.).

1.3.3 SOLUTIONSplus Consortium

- ABB

ABB operates in the Philippines and has a headquarters in Sucat, Paranaque City in Metro Manila. It has four service points located in the cities of Davao, Cebu, and Cagayan de Oro. ABB focuses on the following areas: Electrification Products, Power Grids, Robotics and Motion, and Industrial Automation & Turbocharging.

- ICLEI

ICLEI is the leading global network of more than 1,500 cities, towns, and regions committed to building a sustainable future. Its Southeast Asia Secretariat is based in Quezon City, Philippines.

- UN Environment

UN Environment currently has an on-going regional project that also involves testing electric vehicles with PHLPPost and Pasig (Integrating Electric 2 and 3 Wheelers into Urban Transport Modes). The City of Pasig requested that SOLUTIONSplus build upon these efforts as the UN Environment pilot will only run up to mid-2020. Tail G is also donating three-wheeler cargo motorcycles to PHLPPost as part of this project.

- French Development Agency (AFD)

AFD has been operating in the country since 2009, where it promotes green and inclusive growth. It supports the Government for its decentralization program, implements disaster management and prevention policies, and promotes sustainable urban development. To enhance the effectiveness of its action, it has established partnerships with the Asian Development Bank and World Bank. AFD has committed EUR 461m in the country via loans (AFD, n.d.).

- UN-Habitat

D4.1 Demonstration Implementation Plans

UN-Habitat is the United Nations programme working towards a better urban future. Its mission is to promote socially and environmentally sustainable human settlements development and the achievement of adequate shelter for all (UN-Habitat, n.d.). UN-Habitat has a Philippines Country Office in Makati, Metro Manila and has programs covering support for development of urban rules and regulations, planning and design and municipal finance.

- Volvo

The Volvo Group engages with the Philippine vehicle market and sells both cars and buses alike.

1.3.4 Other Notable International Organizations

- GIZ

GIZ has been quite active in supporting the efforts towards modernizing the public jeepney sector in the Philippines. GIZ led the jeepney NAMA (nationally appropriate mitigation action) project, and is now in the process of developing urban-level mitigation actions as well as actions focusing on green freight.

- UNDP

The United Nations Development Program (UNDP) is currently implementing the Global Environment Facility (GEF)-funded Low Carbon Urban Transport Systems (LCUTS) Project in partnership with the DoTr (GEF, 20). While the project is technology-neutral, it does involve related components such as the development of a national policy framework for facilitating the uptake of low carbon transport systems, and the investigation of appropriate business plans for supporting low carbon vehicles. It also has a project component aimed at establishing EV charging protocols and standards.

- USAID

Through the Private Financing Advisory Network (PFAN) of USAID, GerWeiss Motors Corp. Secured a loan amounting to 330,000 USD from a local finance institution to produce e-tricycles in 2015 (USAID, 2015).

2. Demonstration Action

2.1 Situation analysis

The demonstration activities in Pasig will primarily work towards contributing towards the following pillars:

1) Availability high quality e-mobility innovations

The uptake of e-mobility in the country (and the city) has been slow, considering the fact that there have been several initiatives in the last decade to promote the adoption of e-mobility. The adoption is also primarily limited to passenger transport, in the form of private e-bikes, public e-tricycles, and e-jeepneys. More often than not, the innovations in the electric versions of the aforementioned vehicles have primarily been limited to the change in the vehicle power train. Systems-based innovations that bring together new technological concepts with business models centred around local empowerment are much needed. The provision of high-quality e-mobility solutions is also a strategic action that would benefit the local e-mobility industry in the country, as it would lead towards better perception and increased demand for such e-mobility solutions.

2) Conditions for enabling accelerated e-mobility uptake and integration

The current enabling environments for e-mobility (relating to business, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcome. In particular, enabling conditions at the local levels need to be strengthened. For example, providing insights as to how local governments have played significant roles in accelerating systemic transformations at the urban level to enable e-mobility uptake is needed.

3) Local capacities relating to e-mobility

The strengthening of local capacities in relation to the different aspects of e-mobility is needed. These include capacities in relation to industries, vehicle users, policymakers, and even financing institutions. As electric vehicles have barely penetrated into the national vehicle stock, all the other supporting systems are all still primarily catering to conventional types of vehicles (e.g. in terms of operations, maintenance, financing, policies, etc...). Wider sensitisation is also needed in order to pave the way towards future societal acceptance of e-mobility, and the changes that they would bring.

2.2 Demonstration objectives and logical framework

Table 6. Logical Framework

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to the City)	MILESTONES (and other notes)
OUTCOME 1. Availability high quality e-mobility innovations is increased and integrated.			
<i>Baseline:</i> In terms of vehicles , the current e-mobility solutions in urban areas are primarily limited to passenger transport. Charging solutions available to the public (as well as public transport operators) are still quite limited.			
<i>Target:</i> High quality e-mobility solutions developed by local industries are made readily available to the market.			
1. Locally produced vehicles (quadricycles) for urban logistics use is developed and tested	1. Call for local SMEs to design, develop, test prototypes, and produce the on-the-ground units for the demonstration.	1. Conduct of the call for local SMEs 2. Selection and awarding	1. Call for local SME conducted by October 2020.
	2. Design, prototyping, testing phase	1. Design 2. Prototyping 3. Internal/ in-facility testing and validation	2. Design available by Dec 2020 3 Final prototypes available by March 2021
	3. Production of units for demonstration		1. Demonstration units available by June 2021
2. On-the-ground demonstration of vehicles for urban logistics is conducted and assessed	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	1. Pasig demo launched by June 2020 2. Detailed demonstration mechanics available by Dec 2020 3. Functional requirements to be available by October 2020 (c/o UITP)
		2. Research support conducted by ZLC on the shared e-logistics vehicles concept	
		3. TU Berlin Design studio supporting study – data and participation from Pasig	1. Results of study available by July 2020
	2. Implementation of on-the-ground demonstration activities	1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be submitted April 2023
	3. Assessment	1. Determination of KPIs 2. Baseline activities 3. Monitoring 4. Analysis of data and evaluation	1. KPIs from SOL+ to be available by month 12
3. Innovative charging facilities are demonstrated and assessed	1. Call for proposals SMEs with existing charging solutions – innovate and demonstrate	1. Conduct of the call for local SMEs 2. Selection and awarding	1. Call for local SME conducted by October 2020.
	2. Planning for the installation and		

D4.1 Demonstration Implementation Plans

	implementation		
	3. Installation and monitoring		
	4. Assessment		
4. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.
<p>OUTCOME 2. Conditions for enabling accelerated e-mobility uptake and integration are improved.</p> <p><i>Baseline: The current enabling environments for e-mobility (relating to business, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcome.</i></p> <p><i>Target: Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</i></p>			
1. Business models and business plans are developed and validated	1. Identification of locally appropriate transformative business model concepts directly relating to the demonstration activity		
	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021
2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+
3. Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans are developed	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by January 2022.
4. Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institution, and other relevant entities		Note: Pasig will primarily be consulted in this process.
	2. Drafting and review of recommendations		
<p>OUTCOME 3. Local capacities relating to e-mobility are enhanced.</p> <p><i>Baseline: As e-mobility is still in its infancy stage in the country, capacities are still highly limited.</i></p> <p><i>Target: Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.</i></p>			
Peer-to-peer exchange program is conducted and	Visit of representative of		Visit to European expert city/cities within first 18

D4.1 Demonstration Implementation Plans

documented	partner city to European expert city/cities		months
	2. Visit of European experts to the partner city	1. Planning and development of itinerary 2. Visit	1. Visit of European expert/s to the partner city between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner city and European experts to expert cities outside Europe		1. Joint visit between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
2. Toolkit for e-mobility is developed and shared with local stakeholders	1. Needs assessment		
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

1.4.3 Demo Description: Shared Use of E-cargo Quadricycles

The demonstration in Pasig will focus on integrated and shared urban logistics solutions, as well as investigate the potential for public charging solutions. The activities on-the-ground will also include those that aim at improving the enabling conditions for e-mobility, and enhancing local capacities related to e-mobility.

Locally Developed/Assembled E-Cargo Quadricycles

Locally appropriate solutions addressing urban logistics are deemed to be quite important, as conventional vehicles that are currently being used are not particularly effective in conducting efficient movements considering the local conditions in the urban areas. The SOL+ demo will aim at producing and testing urban cargo quadricycles that are suited to the local conditions and can potentially transform how urban deliveries are done in the country.

These quadricycles combine the nimbleness of smaller vehicles and the carrying capacity of larger vehicles that are currently being used in conducting urban deliveries in Pasig (e.g. motorcycles, cargo tricycles, and mini vans). An example of a small L6 cargo quadricycle is provided on the picture on the right.



Figure 7. Example of an E-Quadricycle Used for Urban Logistics

The quadricycle will also be designed to have a base that can carry different types of cargo, and can be utilized to fit a cargo box that can be transferred into other, larger vehicles. The SOL

The SOL+ project will support local SME/s that will be selected to design and production of the quadricycle/s through the SOL+ Call for SMEs. The winning consortium will be granted funds to produce and test vehicle prototypes. The final prototypes will then be used as the basis for the production units. SOL+, through the City's equipment budget, would be funding the procurement of several produced units (initial calculations indicate 20 units).

The design process will take into consideration the needs of the primary intended users, and will utilize a combination of European (e.g. Valeo motor), regional, and local components. The vehicles will also be equipped with appropriate sensors that can provide vital information needed for assessing the performance of the vehicles (e.g. for recording geo-spatial

D4.1 Demonstration Implementation Plans

information, battery and motor performance, among others). Digital solutions that would help the fleet owner (e.g. PHLPost) will be developed as well.

The Zaragoza Logistics Centre (ZLC) has also expressed interest in providing assistance to the demonstration activities in Pasig in terms of assessing potential schemes that would involve micro hubs that are enabled by the use of use small e-vehicles. The details of the initial research concepts proposed by ZLC are contained in Annex 3.

Potential Use Cases

The electric quadricycle vehicles to be developed will primarily be used for delivering parcels and letters within the City of Pasig. Other use cases will be explored as well, such as the shared use with the nearby public market, as well as waste collection.

A “shared vehicle use” concept will be investigated for feasibility in the Pasig pilot This concept would centre on the shared use system that would feature the use of the vehicles by PHLPost during the normal delivery hours of the day, and the conduct of last-mile deliveries for the Pasig City public market during the early hours of the morning (e.g. 3 am to 5 am). This concept is being explored as such shared usage would lead towards optimised total costs of ownership. This concept is also seen as a solution that can significantly alleviate urban congestion around public markets.



Figure 8. E-Pasig City Mega Market

The layout of the relevant facilities is provided below. The PHLPost office is depicted by the yellow circle, and is only a couple of hundred meters away from the public market. The city-owned multi-storey parking building is also within the same area. A concept to be explored is to work with a few trucking companies (and their respective customers/market shop owners) to make the parking building as the final destination for the trucks, and the goods will ultimately be delivered to the market using the quadricycles.



Figure 9. Pilot Area

Waste collection, particularly in areas that are only served by very narrow streets, is another option for studying. Currently, waste collection activities are primarily being conducted by collection service providers through the use of large dump trucks. Utilizing smaller e-vehicles to collect waste can potentially alleviate congestion caused by trucks as they go through the narrow streets, and can potentially transform how waste is collected in the City.

Flexible Electric Van

SOL+ will also be supporting a proposal being led by the De La Salle University to a funding mechanism of the Department of Science and Technology to develop a “flexible electric van” (FLEV proposal) which features a chassis that can be used for multiple purposes (e.g. passenger/ cargo). Essentially, the vision is to make the FLEV also compatible for handling the cargo boxes to be used in the SOL+ quadricycles. SOL+ can provide a couple of units of the Valeo motors to the FLEV proposal. SOL+ (through the city equipment budget) can also purchase a unit of the FLEV for the use of PHLPPost, which can replace one of their dilapidated minivans.⁶

Charging Facilities

The provision of public charging facilities is something that that City of Pasig is aiming for. During the planning phase of the demo (i.e. up to October 2020), decisions on what type of facility (e.g. whether focused on public transport vehicles, for public use, or combination of both) and where such facilities would be located, would be made. The integration of innovations into the concept would also be key considerations. One idea being explored is the installation of charging points that are integrated with cash and digital payment mechanisms. The Technical University of Berlin has been tapped, through a student “design studio” to

6

D4.1 Demonstration Implementation Plans

support Pasig in identifying suitable locations for charging stations in the city. ZLC has also expressed its interest in providing expert advice in terms of locating charge points for the e-cargo bike (further discussions in terms of considering other types vehicles are to be made).

The SOL+ SME call (planned in October 2020 or before) shall also cover the provision of the public charging facility/facilities for the demo will be organised. The charging mechanism for the quadricycles would most probably be lumped with the call for the vehicle production.

1.4.3 Test scenarios

Table 7. Test Scenarios

Solution: E-quadricycles for Urban Logistics			
Test category	<ul style="list-style-type: none"> a) simulations b) tests in controlled environment, c) tests under real operational conditions d) feasibility study, assessment of technological concepts, , code of practice and specifications e) etc. <p>The development of the quadricycle prototypes (and the charging facility/ies) will involve simulations, tests in controlled environments, and testing under real operational conditions. These technologies will be assessed as part of the activities.</p>		
Vehicles involved (type)	e-cargo 2/3W		
Vehicles involved (unit)	The current design is aiming for 20 units		
Integration with PT system	Currently, investigations for pursuing the Mobility-as-a-Service concept are ongoing. In such a case that the national government is interested in pursuing the MaaS discussions, the integration of the geolocation of the SOL+ Pasig vehicles will be investigated.		
Lines/stops involved (units)	n/a		
Time span (testing activities)	June to Dec 2021		
Time span (data collection)	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Before Jan 2021 to June 2021</td> <td style="width: 50%;">After June 2021 to Dec 2021</td> </tr> </table>	Before Jan 2021 to June 2021	After June 2021 to Dec 2021
Before Jan 2021 to June 2021	After June 2021 to Dec 2021		

1.4.3 Vehicles/infrastructure/equipment provision

The table below shows a draft breakdown of the major components needed for main components for the demonstration in Pasig. Please note that the distribution is not final, and can change. Essentially, the quadricycles will utilize motors from Valeo, while the other needed components will be sourced either locally (e.g. metal works for the body), and from other countries in the region (e.g. motor controller).

In terms of the process of developing the e-quadricycle demo units, a local SME will be tapped through the SOL+ SME call to design, develop, and test the initial prototypes. Once these have been developed and tested, the production of the actual units to be used in the on-the-ground

D4.1 Demonstration Implementation Plans

demonstration will be done by the SME and/or by an established local vehicle assembler/manufacturer. The City of Pasig will then utilize a specific portion of its equipment budget from SOL+ to purchase the demo units (e.g. ~20 units) from the production entity.

Further decisions relating to the flexible e-van would be contingent on whether the proposal is awarded to DLSU. In the case that it is approved, SOL+ can contribute a few units of appropriate motors (also from Valeo) to the vehicle development process. Similar to the quadricycles, once the production units are ready, the City of Pasig can use the equipment budget to purchase at least 1 unit. This unit is envisioned to be used during the SOL+ demonstration activities as well.

For the public charging facility, SMEs with existing solutions are envisioned to participate in the same SME call, wherein a consortium (that can consist of multiple SMEs) will be awarded the funds to develop both the e-quad vehicle and charging solutions needed for the demonstration. The call will centre on the integration of new innovations into existing charging solutions such as the integration of digital and card payments into time-based charging solutions (e.g. currently there are coin-operated, time-based charging solutions available in the Philippines).

The table below shows the indicative (proposed) distribution of the funds for the development of the proposed quadricycle, and the e-van.⁷ Essentially, the staff costs, components and other incidental costs for the prototyping of the quadricycles will be covered. Funds are also allocated for buying the final produced units (20 units).⁸ For the van, SOL+ will provide a couple of units of motors for the prototyping as the rest will be covered by the DOST funding. Funds from SOL+ are allocated for purchasing 1 final unit of the e-van.

Table 8. Indicative Distribution of Internal SOL+ Funds for the Pasig Demo

	SME Call	City Equipment Budget	Industry partner		SME Call	City Equipment Budget	Industry partner
Quadricycle				Multi-cab/Van			
Staff time & inhouse facility	25,000	-	-	Staff time & inhouse facility	-	-	-
Design	-	-	-	Design	-	-	-
Development of prototypes	-	-	-	Development of prototypes	-	-	-
Testing of prototypes	-	-	-	Testing of prototypes	-	-	-
Prototyping and In-house testing	-	-	-	Prototyping and In-house testing	-	-	-
All other components/costs	-	6,364	-	Prototypes	-	-	-
Batteries	-	5,818	-	Batteries	-	-	-
Motor	-	-	3,600	Motor	-	-	12,000
Production (for demo units)	-	-	-	Production (for demo units)	-	-	-
Purchase cost	-	51,636	-	Purchase cost	-	7,091	-
Motor	-	-	-	Motor	-	-	-
Actual cost of motor	-	-	18,000	Actual cost of motor	-	-	10,000
Other costs of motor	-	-	9,000	Other costs of motor	-	-	91
SUB-TOTAL	25,000	63,818	30,600	SUB-TOTAL	-	7,091	22,091

⁷ The table only includes the City's equipment budget, the budget for the SME call, and the indicative budget to be covered by Valeo for the motors.

⁸ At least 30 units of the quadricycle motors would be requested for two reasons : a) to ensure that there are spare motors in cases of breakdown; b) so that the possibility of testing the motors in other similar vehicles can be explored.

D4.1 Demonstration Implementation Plans

		Other		
Charging (and other costs)		25,000	29,091	-
SUB-TOTAL		25,000	29,091	-
GRAND TOTAL		50,000	100,000	52,691

1.4 Business model and plan

The detailing of the business model concepts, and the specific business plans relevant to the pilot will be conducted in 2021. The development of the business model concepts will explore potential emergent concepts relating to several dimensions such as: vehicle assembly/manufacturing; e-vehicle maintenance; ownership and management of shared e-cargo vehicles; provision of public charging facilities; and end-of-life resources management. The project will also explore the possibility of establishing specific business opportunities that would involve local SMEs and EU-partner SMEs and industries.

1.4 Team involved

Table 10. Team Members and Contact Details

Main Role	Company	Name	Contact
Demo leader	Pasig City Government	Robert Anthony C. Siy, Chief Transport Planner, Pasig City	rsiy01@gmail.com
	PHLPost Pasig	Rosemarie Alfaro, Postmaster	pasigcpo@yahoo.com
Coordination	Clean Air Asia (CAA) and Wuppertal Institute (WI)	CAA: Kathleen Dematera WI: Alvin Mejia and Shritu Shrestha	kathleen.dematera@cleanairasia.org alvin.mejia@wupperinst.org and shritu.shrestha@wupperinst.org
Vehicles provider*	Talks with Joule Labs (local SME) being conducted (but local assembler would ultimately be chosen through the SOL+ local SME call in Oct2020)	Dr. Manny Biona	jose.bienvenido.biona@dlsu.edu.ph
Charging system provider*	Potential providers for the public charging demos are being investigated (e.g. E-sakay; Charm; Eklimo)	Raia Marien S Galang (eSakay) Rovina Janel Cruzate (CharM) Edmund Araga (Eclimo)	rmsgalang@e-sakay.ph janel@charmsolutions.tech edmundaraga@gmail.com
App/software provider *	Local app development for PHLPost to be done through the SME call		

* Potential and not final. Only included due to preliminary discussions.

1.4 Risks Assessment

Table 11. Risks and Mitigation Strategies

<i>Risk</i>	<i>Probability assessment</i>	<i>Consequences</i>	<i>Risk mitigation/comments</i>
<i>Valeo components not delivered on time</i>	<i>Medium</i>	<i>Prototype developments would be delays</i>	<i>Incorporation of lead times for delivery, customs clearance ; Clarification of regulations regarding importation</i>
<i>End products not suitable for intended use</i>	<i>Low</i>	<i>SOL E-vehicles are not eventually not used</i>	<i>User needs-based assessment at the core of the design phase</i>
<i>On-road crash during actual demonstration</i>	<i>Low</i>	<i>Injuries or worse; stoppage of demonstration</i>	<i>Safety testing incorporating operational scenarios to be done; Check if all insurance mechanisms are covered; Training for operators to be conducted Public / road users' sensitization activities to be conducted</i>
<i>Hazards related to charging</i>	<i>Low</i>	<i>In the case of PHLPost, this may result in fire</i>	<i>Standards to be complied with and best practices in terms of installation and subsequent checking are to be aimed for</i>
<i>Operators refusing to use the vehicle</i>	<i>Low</i>	<i>Not all the end prototypes are used</i>	<i>Prior consultation meetings and workshops will be conducted</i>
<i>Vehicles will not be permitted on-the-road</i>	<i>Low</i>	<i>The e-vehicles will not be able utilized within the intended area</i>	<i>City to issue special operating permits; coordination with other relevant authorities will be done when necessary</i>
<i>Delays due to procurement processes</i>	<i>Medium</i>	<i>Delays in the whole prototyping/development and demo processes</i>	<i>Lead time to be accounted for in the planning of the procurement.</i>

1.4 Monitoring

A monitoring plan will be crafted that will be based both on the “global” project key performance indicators (KPIs) to be developed within the Work Package 1 of Solutions PLUS and the main objectives to be co-identified with the City of Pasig and PHLPost. Essentially, a set of highly relevant KPIs will be selected and methodologies (who, what, when, where, how) for collecting data for calculating the indicators will be included in the monitoring plan. To be able to properly assess the impacts of the demos, there would also be a need for baselining activities

which would establish the benchmarks for the indicators. The baseline values would essentially capture “what would have happened in case the demonstration was not conducted.”

The KPIs would capture operational performance, and service quality-related perceptions. These KPIs would be selected based on a holistic framework that considers operational (reliability, range, etc...) , environment (and energy efficiency); social (e.g. safety, perceptions); and economic (e.g. total costs of ownership, operational costs and considerations, affordability).

3.Preliminary replication opportunities

Opportunities for the production of similar “flexible” vehicles can be explored in different developing countries across the globe. In the region, for example, the lessons learnt can be shared within the ASEAN EV association. As many of the major cities Southeast Asian countries share similar profiles in terms of spatial constraints (i.e. narrow urban roads), perhaps the utilization of integrated logistics concepts that achieve better matching of vehicle sizes with the road infrastructure can be explored.

In the Philippines, there are huge opportunities for the adoption of small and flexible urban delivery vehicles, due to the increasing demand, and considering the current alternatives. Success in the demo can be a trigger towards further electrification in the operations of PHLPost. Replication opportunities geared towards the private urban delivery companies may also be significant.

This also holds true in relation to the potential for replicating successful solutions for first and last mile solutions for public market logistics, as well as for urban waste collection. Collaboration can be sought with organisations such as the League of Cities of the Philippines, and the League of Municipalities, which can facilitate the dissemination of the developments in the demonstration projects to essentially all the local governments in the country.

A cross-regional platform involving the different SMEs can also be established within SOL+ to facilitate information exchange. For example, Pasig and Quito are conducting similar activities, and are focusing on urban freight.

4. Updates

June 2020

Progress towards implementation

- The City Treasury Department has advised SOL+ that the transfer of funds can be made to the City's existing bank account and thus eliminates the need to create a new one. Funds, however, are still going to be ring-fenced and are dedicated only to covering costs associated with SOL+.
- The proposal to the DOST by DLSU (prototyping and development of a flexible electric van) was submitted is now undergoing review.
- Initial communications with one of the Undersecretaries of the Department of Transport regarding the national government's interest in adopting a MaaS platform reveal that they are indeed open to the concept. Further information on the associated long-term costs are still being awaited from Pluservice.
- The initial design ideas by the TU Berlin Design Studio are to be presented to the City of Pasig on June 26, 2020.

Next steps

- Transfer of the SOL+ funds (first tranche) to be facilitated
- City of Pasig to hire project staff to assist in the implementation of the activities
- Local meetings to be held by Pasig to further thresh out a detailed plan, and to establish coordination with the local stakeholders
- SOLUTIONSplus webinar on Demonstrating e-mobility solutions in Hanoi, Kathmandu and Pasig. The event will be on July 3rd 2020, presented by local city partners.

5. References

- ASEAN- Japan Transport Partnership (AJTP). (n.d.). Statistics Road Transport. Retrieved from <https://www.ajtpweb.org/ajtp/statistics/roadtransport/index.html>
- Berdos, E. (2019, July 15). Jeepney drivers protest PUV Modernization anew. Retrieved from the Rappler website. <https://www.rappler.com/nation/235447-jeepney-drivers-protest-puv-modernization-july-2019>
- Board of Investments (BOI). (2018). E-vehicles. Retrieved from: <http://boi.gov.ph/uFAQs/e-vehicles/>
- BusinessMirror. (2019, October 24). *Delivering an eco-friendly solution: Jollibee rolls out E-bike Delivery*. Retrieved from: <https://businessmirror.com.ph/2019/10/24/delivering-an-eco-friendly-solution-jollibee-rolls-out-e-bike-delivery/>
- Businesswire. (2019). *Philippines B2C E-Commerce Market Report 2019*. <https://www.businesswire.com/news/home/20190909005723/en/Philippines-B2C-E-Commerce-Market-Report-2019->
- Chamber of Automotive Manufacturers of the Philippines (CAMPI). (n.d.). About CAMPI. Retrieved from the CAMPI website: <https://www.campiauto.org/about-us/>
- Climate Change Commission (CCC). (2012). *National Climate Change Action Plan 2011-2028*. <http://www.emb.gov.ph/portal/Portals/54/Images/NCCAP.pdf>
- Climate Change Commission (CCC). (n.d.). *Climate Change National Framework Strategy on Climate Change 2011-2022*. Retrieved May 2014, from National Economic and Development Authority: http://www.neda.gov.ph/wpcontent/uploads/2013/10/nfsc_sgd.p
- Consunji, R. (2017, January 10). *Rechargeable E-bikes and Scooters*. Retrieved from <https://www.facebook.com/notes/robby-consunji/rechargeable-e-bikes-and-scooters/10158093291495204/>
- Department of Energy. Mandate, Mission and Vision. Retrieved from: <https://www.doe.gov.ph/transparency/mandate-mission-and-vision-0>
- Department of Environment and Natural Resources (DENR). (2017). *Air Quality Management Status Report 2008-2015*.
- Department of Transportation (DoTr). (2014). Promotion of Low Carbon Urban Transport Systems in the Philippines Project Identification Form. Retrieved from: https://www.thegef.org/sites/default/files/project_documents/PIMS_5304_PHIL_LCT_PIF_v4_FINAL_Resubmission_170314.pdf

D4.1 Demonstration Implementation Plan (Kathmandu)

Development Bank of the Philippines (DBP). (n.d.). DBP PASADA Financing Program (Program Assistance to Support Alternative Driving Approaches). Retrieved from: <https://www.dbp.ph/developmental-banking/infrastructure-and-logistics/pasada/>

DOE gets 27% discount on 3,000. (2015, December 8). *Rappler*. Retrieved from the Rappler website. <http://www.rappler.com/business/industries/173-power-and-energy/115123-doeetrike-bid-cost-neg>

EU Gateway. (2018). *Environment & Water Technologies Philippines Market Study*. <https://www.eu-gateway.eu/file/30502/download?token=ewtNonnc>

Genio, J. (2018, February 7). LTO releases rules on e-bike registration. Retrieved from the *Motopinas.com* website <https://www.motopinas.com/motorcycle-news/lto-releases-rules-on-e-bike-registration.html>

Government of the Republic of the Philippines (GoP). (2015). *Republic of the Philippines Intended Nationally Determined Contributions*. Communicated to the UNFCCC on October 2015. <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Philippines/1/Philippines%20-%20Final%20INDC%20submission.pdf>

Inquirer (2019, June 10). Toyota PH launches its Hybrid Electric Vehicle at technology conference. Retrieved from: <https://business.inquirer.net/272322/toyota-ph-launches-its-newest-hybrid-vehicle-in-technology-conference#ixzz63pgBu2De>

International Energy Agency (IEA). (2018). *CO2 Emissions from Fuel Combustion Highlights*. Accessed through: <https://webstore.iea.org/co2-emissions-from-fuel-combustion-2018-highlights>

International Labor Organization (ILO). (2018). Multi-stakeholder consultation on the development of the Green Jobs Act Assessment and Certification System and Guidelines. Retrieved from the ILO website: https://www.ilo.org/manila/eventsandmeetings/WCMS_631373/lang-en/index.htm

Land Transportation Office (LTO). (forthcoming). Draft Guidelines on the Recording and Registration of All Types of Electric Motor Vehicles.

Mitsubishi Motors Corporation (MMC), De La Salle University (DLSU), University of the Philippines (UP), Ateneo de Manila University (ADMU), Mapua University, Technical University of the Philippines (TUP). (forthcoming). *Draft Philippine Electric Vehicle Policy Analysis Report*.

Mitsubishi Motors Philippines, Inc. (MMPC). (2012). Mitsubishi Motors Philippines Collaborates With DoE And Meralco On I-Miev Electric Car Evaluation. Retrieved from:

<https://mmpc.ph/pressrelease/mitsubishi-motors-philippines-collaborates-doe-meralco-miev-electric-car-evaluation/>

Numbeo. (2019). <https://www.numbeo.com/traffic/rankings.jsp>

Pasig City. (2019). Facts and Figures. <https://www.pasigcity.gov.ph/facts-and-figures>

Philippine Parts Maker Association, Inc. (PPMA). (n.d.). About PPMA. Retrieved from the PPMA Website <https://www.philippinepartsmaker.com/about>

PHLPost. (2019). *PHLPost Presentation*. Delivered at the UNEP Workshop on Efficient 2 and 3 Wheelers Workshop in Manila held in July 2019.

Rivera, D. (2018, February 25). DOE seeks more partners for e-vehicle charging stations. <https://www.doe.gov.ph/energist/doe-seeks-more-partners-e-vehicle-charging-stations>

The Manila Times. (2019, June 25). Hyundai PH, ,EVAP push for electric vehicle adoption, incentives. <https://www.manilatimes.net/2019/06/25/weekly/fast-times/hyundai-ph-evap-push-for-electric-vehicle-adoption-incentives/574270/>

The Philippine Star. (2016, January 30). E-vehicle firm gets DBP financing. Retrieved from: <https://www.philstar.com/business/2016/01/30/1547976/e-vehicle-firm-gets-dbp-financing>

Umali, T. (2019, February 11). Standardising charging stations to support the electric vehicle industry. Retrieved from *Openasiagov* website. <https://www.opengovasia.com/standardising-charging-stations-to-support-the-electric-vehicle-industry/>

Urban-electro Mobility Initiative (UEMI). (2019). *Philippines Project Scoping : Pasig E-cargo Services*. Retrieved from: http://www.uemi.net/uploads/4/8/9/5/48950199/uemi_project_scoping_pasig.pdf

USAID. (2015). Electric Vehicles Surge Ahead In The Philippines. <https://2012-2017.usaid.gov/results-data/success-stories/driving-clean-energy-philippines>

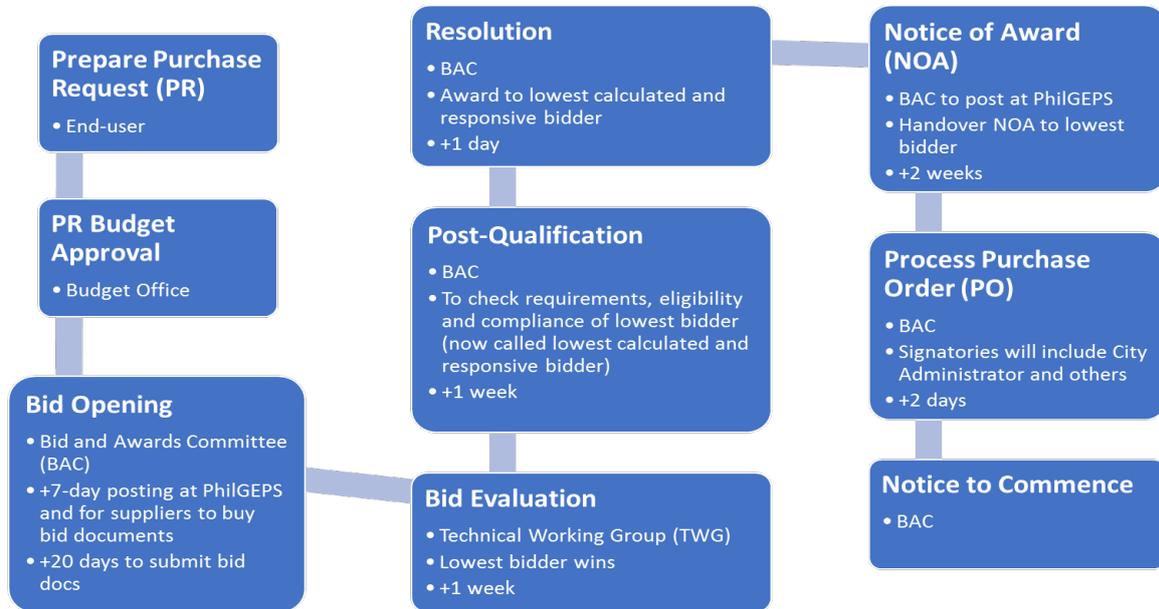
Valdez, D. (2018, July 11). Landbank approved two loans for jeepney modernization with co-ops. Retrieved from <https://www.bworldonline.com/landbank-approves-two-loans-for-jeepney-modernization-with-co-ops/>

Valdez, D. (2019, July 15). LTRFB firm on June 2020 deadline to complete jeepney modernization. Retrieved from the BusinessWorld Online website. <https://www.bworldonline.com/ltrfb-firm-on-june-2020-deadline-to-complete-jeepney-modernization/>

Waze. 2015. Global Driver Satisfaction Index. Retrieved from: <https://inbox-static.waze.com/driverindex.pdf>

Annex 1: Excerpts from the Government Procurement Law

Procurement Process for >1 Million Peso Value Goods and Services



Eligibility Requirements Checklist

COMPANY : _____
 ADDRESS : _____
 OWNER : _____
 REPRESENTATIVE : _____
 TELEPHONE NO. : _____ FAX NO. _____
 LINE OF BUSINESS : _____
 PRODUCTS : _____
 CLASSIFICATION : _____

ELIGIBILITY REQUIREMENTS

(* Authenticated Copy from Concerned Agencies)

1. *Valid Certificate of Registration-DTI (attached application) of Certification of Accreditation from Department of Trade and Industries # _____ Date: _____
2. *Valid Incorporation of Partnership papers duly registered from S.E.C. # _____ Date: _____
3. *G-EPIS Registration Certificate # _____
4. *Tax Clearance (BIR) Certified True Copy by the Company # _____
5. *Latest Financial Statement (Fully stamped "Received" by the BIR)
6. *Latest Income Tax Return (ITR) (Including confirmation receipt)
7. *Certificate of Registration/Copy of TIN ID (BIR) # _____
8. Latest VAT Return (mo./qtr./annual)
9. *Valid Mayor's Business Permit # _____
 Cedula/Residence Certificate # _____ Date: _____ Place: _____
10. Yearly/Quarterly Mayor's Business Tax Receipt (D.R.)
11. Certificate of Credit Lines/Bank Certificate from any reputable banking institution (Original Copy) Bank: _____ Date: _____
12. Recent Photo of Office (showing business signboard) and working area. (Attached in Long Bond Paper)
13. Notarized Certificate of Ownership (if owned).
14. List of Customers/Clients (With address and contact number)
15. Special Power of Attorney/Authorization Letter from the Proprietor/President, General Manager giving permission to the Authorized Representative to transact business on behalf of the company. It must bear the specimen signature and 2x2 ID photo/s of the representative/s.
16. Other Appropriate License:
 - a. _____
 - b. _____
 - c. _____
17. Date Inspected : _____

NOTE: THE BAC, IS MEMBERS AND STAFF OF THE SECRETARIAT DOES NOT REQUIRE ANY PAYMENT FOR THE SUBMISSION OF ELIGIBILITY REQUIREMENTS. ACCREDITATION IS FREE OF CHARGE.

Annex 2: Philippine National Standards Relevant to E-mobility (Vehicles and Charging)

Philippine National Standard	Title
PNS ISO 6469-1:2012	Electrically propelled road vehicles – Safety specifications – Part 1: On-board rechargeable energy storage system
PNS ISO 12405-1:2012	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 1: High-power applications
PNS IEC 62576:2012	Electric double-layer capacitors for use in hybrid electric vehicles – Test methods for electrical characteristics
PNS ISO 18300:2018	Electrically propelled vehicles – Test specifications for lithium-ion battery systems combined with lead acid battery or capacitor
PNS ISO/PAS 19295:2018	Electrically propelled road vehicles – Specification of voltage sub-classes for voltage class B
PNS ISO 12405-2:2018	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 2: High-energy applications
PNS ISO 12405-3:2018	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 3: Safety Requirements
PNS ISO/IEC PAS 16898:2018	Electrically propelled road vehicles – Dimensions and designation of secondary lithium-ion cells
PNS IEC 61851-21-1:2018	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 2: Safety performance requirements
PNS IEC 61851-1:2012	Electric vehicle conductive charging system – Part 1: General requirements
PNS IEC 61851-21:2012	Electric vehicle conductive charging system – Part 21: Electric vehicle requirements for conductive connection to an AC/DC supply
PNS IEC 61851-22:2012	Electric vehicle conductive charging system – Part 22: AC electric vehicle charging station
PNS ISO 7637-1:2018	Road vehicles – Electrical disturbances from conduction and coupling – Part 1: Definitions and general considerations
PNS IEC 61851-23:2018	Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station
PNS IEC 61851-24:2018	Electric vehicle conductive charging system – Part 24: Digital communication between a DC. EV charging station and an electric vehicle for control of DC charging
PNS ISO 17409:2018	Electrically propelled road vehicles – Connection to an external electric power supply – Safety requirements
PNS IEC 62196-1:2019	Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements
PNS IEC 62196-2:2019	Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability requirements for AC pin and contact-tube accessories
PNS IEC 62196-3:2019	Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 3: Dimensional compatibility and interchangeability requirements for DC and AC/DC. Pin and contact-tube vehicle couplers
PNS ISO 15118-1:2019	Road vehicles – Vehicle-to-grid communication interface – Part 1: General information and use-case definition
PNS ISO 15118-2: 2019	Road vehicles – Vehicle-to-grid communication interface – Part 2: Network and application protocol requirements
PNS ISO 15118-3:2019	Road vehicles – Vehicle-to-grid communication interface – Part 3: Physical and data link layer requirements
PNS ISO 15118-	Road vehicles – Vehicle-to-grid communication interface – Part 4: Network and

D4.1 Demonstration Implementation Plan (Kathmandu)

4:2019	application protocol conformance test
PNS ISO 15118-5:2019	Road vehicles – Vehicle-to-grid communication interface – Part 5: Physical and data link layer conformance tests
PNS ISO 15118-8:2019	Road vehicles – Vehicle-to-grid communication interface – Part 8: Physical layer and data link layer requirements for wireless communication
PNS ISO 11898-1:2019	Road vehicles – Controller area network (CAN) – Part 1: Data link layer and physical signalling

Annex 3: ZLC's Proposed Research Concepts to Assist the Demonstration in Pasig City/ PHLPost

Pasig: Redesign of the last mile delivery system

Pasig: Redesign of the last mile delivery system

Phase 1:

- 1.1 Optimal location of micro hubs for last mile deliveries;
- 1.2 Optimal location of charge points for e-cargo bikes and vehicles.

Postal companies perform a lot of vehicle trips in cities which contribute to vehicle derived emissions, congestion, and other negative impacts. In stage 1.1, the solution comprising the use of several micro hubs in the city center in combination with e-cargo bikes will be assessed. The idea is to replace, partially or completely postal vans in the city center of Pasig with e-freight bikes. These e-freight bikes will distribute mail and parcels from micro hubs located in the city centre.

The aim of micro hubs or micro consolidation centers is to reduce the amount of traffic related to the delivery of shipments and thus affecting the environmental impacts related to that traffic. Micro hubs should be located close to the area they serve with good access to the strategic road network. Micro hubs serve smaller size areas and handle small and lightweight goods. Large freight vehicles (vans and minivans) leave the shipments during the night or scheduled delivery windows in the micro hubs. Cargo bikes should then be used for last mile.

Regarding the purpose and sizing of micro hubs, they can be low cost mobile micro hubs parked on the street, in a parking garage or the parking lot of existing retail stores. Their size can vary depending on the demand density for a given area. On the other side, micro hubs can be established at cycle logistics hubs which will include space for short-term storage, sorting, entry/exit of cargo bikes and parking, loading/unloading operations, limited warehousing, office and a rest area for bike riders. An additional feature is also the possibility to accommodate one larger freight vehicle (truck, vans) through additional parking and maneuvering space.

The aim of stage 1.1 is to propose an optimization scheme for determining suitable micro hub locations.

Therefore, the work in this stage includes:

- Analysis of the spatial and temporal distribution of deliveries;
- Analysis of structure (size and type) of deliverables;
- Analysis of potential locations of transshipment hubs and finding the subset of optimal locations minimizing the average distance between micro hubs and delivery points; •
- Analysis of structure (capacity and coverage) of micro hubs positioned in selected locations;
- Assessment of the effects of the new solution.

D4.1 Demonstration Implementation Plan (Kathmandu)

A first step includes the analysis of the study area and operational data analysis. Specifically, spatial and temporal dimensions, size and type of deliverables for one of the recent years will be analysed.

The problem of finding optimal locations for micro hubs will be solved mathematically. The problem belongs to a class of facility location problems and can be modelled as a p-median problem. P-median problem (PMP) is a classical combinatorial problem whose objective is to find p locations out of a set of potential locations for transshipment points such that the sum of weighted distances between each demand point and its closest facility is minimized. The distances between each demand point and its closest facility location will be weighted by the demand that is sent to that point.

Data requirements can be summarized as:

- The area, the streets (slope) location of delivery points.
- Historical data: Spatial and temporal distribution and structure (type and size of shipments) of deliveries. Delivery points – structure and preferences regarding the delivery time;
- Potential locations for micro hubs.

This stage can be extended by last mile routing optimization.

The **second stage (1.2)** of the Pasig' last mile system redesign includes determining of charging infrastructure placements. The problem of building a charging infrastructure will be considered from the aspect of:

- Subproblem 1: the first/last mile distribution and determining the optimal number and placement of charging units for e-cargo bicycles;
- Subproblem 2: electric mobility in general in order to support improving air quality and fighting climate change in Pasig.

Two key considerations for charging infrastructure placements are the density of charging units and economic feasibility.

In the literature there are two interchangeable terms for charging units' placements:

- Location: Broader area where charging units can be located (for example, around a shopping center);
- Siting: More specific position within a location (for example, parking spot close to the west entrance of the shopping center).

Therefore, location represents a finding an optimal number of stations to the areas so that the demand for recharging can be met. On the other side, the siting is determining the exact spots for charging unit considering the cost of connection, accessibility, visibility, safety to maximizing the level of utilization and economic feasibility of the charging units.

There are three possible approaches to determining the location and sites of e-bikes/e-vehicles charging units:

1. **Expert approach based on local stakeholders' knowledge.** This approach is appropriate for smaller communities with limited budgets. It involves four steps:

- 1.1 Engagement of stakeholders. Educating of stakeholders and potential partners about e-cargo bikes/electric vehicles, charging units and how these will contribute to broader community goals. This step may also help to identify local partners for deployment of charging infrastructure.
- 1.2 Vision, goals and objectives. Relates to the current and future role that cargo bikes/electric vehicles play in the area.
- 1.3 Determining preferred locations. Relates to the current and future role that electric vehicles/e-cargo bikes play in the area. Determining promising sites. Based on a set of criteria (determined by the stakeholders) and ranking a set of potential locations stakeholder goals can be achieved.
- 1.4 Identification of preferred sites. This step begins with identifying possible sites at high potential locations. If there are more possible sites they can be evaluated and ranked against a set of defined criteria.
2. **Optimization approach.** Availability of the data on potential e-cargo biking/e-vehicle patterns (output of e-cargo bike routing) enables the development of an optimization approach. This model-based approach requires less involvement of local stakeholders but requires extensive datasets on locations and potential e-cargo bikes/e-vehicles trajectories. Optimization approach can be appropriate if the planning area is too big for relying only on local knowledge and when reliable inputs can be easily collected. For this purpose, we will construct a mixed integer programming model (MIP) of the problem, implement this model in an appropriate interface and compute the optimal subset of charging units' locations.
3. **Hybrid approach.** It includes both participation of the local stakeholders and optimization with limited available data. Optimization outputs are applied to transform inputs into potential siting suggestions for a specific area, and then local knowledge can be used to verify and refine the solutions from the model, while taking into account stakeholder inputs and factors specific to an area. On this way, the gaps between modelling results and reality.

The final approach for the charging infrastructure placements of the e-cargo bikes and vehicles will depend on the pilot conditions and a hybrid of two of the above approaches is under consideration.

D4.1 Demonstration Implementation Plan

City: Kathmandu

1. Operating environment

1.1 Background

1.1.1 Key facts and figures

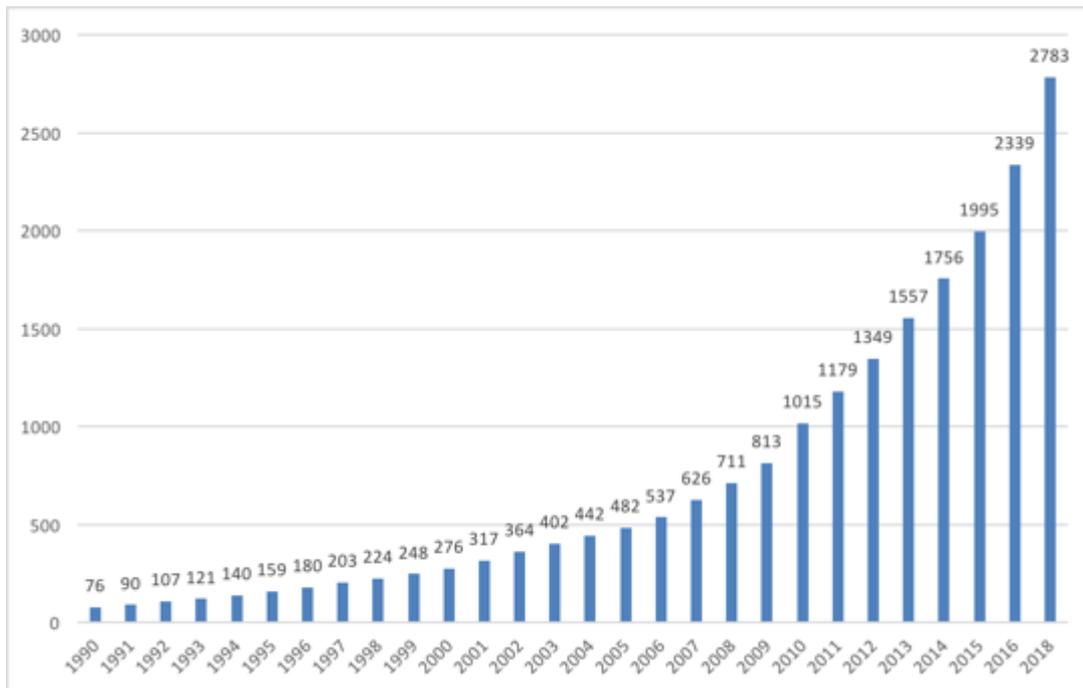
The Kathmandu valley includes 18 municipalities – including the capital city of Kathmandu – is the biggest urban centre in Nepal with a combined population of more than 2.5 million. Nepal’s GDP per capita is US\$835 (2017) and the country’s CO₂ emission is about less than 0.1% of global emissions (Ministry of Science, Technology and Environment, 2014). Nepal does not have fossil fuel reserves so relies on imports, at an average annual growth rate (AAGR) of more than 8% since 1991 (GGGI, 2018). The majority of Nepal’s electricity is from hydropower generated within the country. In the near future, Nepal will have surplus electricity (mainly in wet season and during off-peak hours) through hydropower projects which are in different stages of development and construction.

Road transport dominates transport mode in Nepal, accounting for over 90% of the movement of passengers and goods (ADB, 2013). Buses are one of the main modes of public transportation in the valley, followed by micro-bus, vans and three wheelers. According to JICA/Department of Roads, about 27% of trips in Kathmandu are made on public transport – out of which bus was 16.6%, mini-bus was 8%, tempo was 2.3%. In comparison, the percentage of trips by motorbikes was 25.8% (JICA, 2012). The modal share of motor bikes increased almost three folds in two decades between 1991 and 2011 and it has probably increased further since 2011 as the number of motorcycles have continued to increase rapidly. Private vehicles (cars and two-wheelers) make up 78% of the vehicle fleet but they carry upto 10 percent of the daily trips (CSE, 2012).

1.1.2 Overarching issues

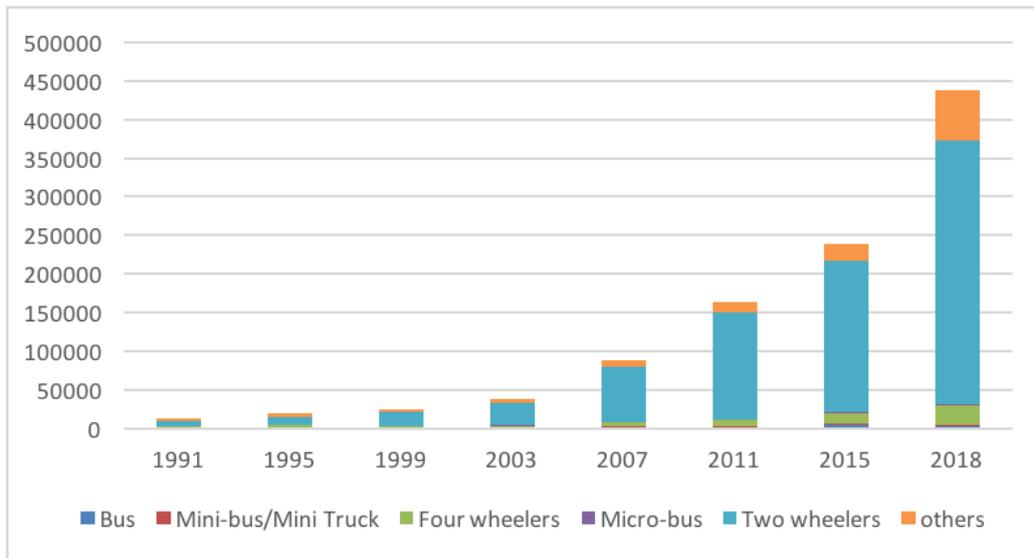
With the growing urbanisation and higher incomes, the demand for vehicles is increasing in Nepal. Vehicle registration – primarily private vehicles – is increasing tremendously, causing air pollution and health impacts. According to the Department of Transport Management (DoTM) 2019), during 1990-2018 the number of total vehicles registration yearly grew by 16% per year. In the same period, the number of motorcycles grew at an annual rate of 17%, which is higher than the overall vehicular growth rate of 14% per year (see Figure 1 and 2). According to DoTM records, as of March 2019 the number of motorcycles were 78.57% of the total number of vehicles registered. By March 2019 there were a total of 3,539,519 vehicles registered in Nepal. From the total vehicles registered in Nepal, a major share is concentrated in the Kathmandu valley.

D4.1 Demonstration Implementation Plan (Kathmandu)



Source: DoTM 2019

Figure 1: Total vehicles in Nepal (thousand)



Source: DoTM 2019

Figure 2: Increase in the registration of two wheelers compared to other modes in Nepal

In Kathmandu, the number of buses rose from 4000 units in 1990, to more than 35,000 units in 2015. This category includes full size buses, minibuses, microbuses and three-wheelers, called tempos. However, as a share of the total vehicle fleet, buses have declined from 11% of the total in 1990, to only 3% in 2015 due the rise of private vehicles (GGGI, 2018).

According to recent data, the national public and private vehicle fleet, excluding commercial vehicles (like trucks and mini trucks, construction machines), contributes about 4.5 million tonnes CO₂ emissions per year, and 1.9 million tonnes in the Kathmandu valley.⁹

Sajha Yatayat buses

Sajha Yatayat, a cooperative public transportation organization of Nepal, is a local SOLUTIONSplus project partner. It was established in 1962 to provide efficient and affordable public transportation (buses) to commuters in Kathmandu Valley, as well to inter-district travellers. Sajha currently has 71 diesel buses from Indian automobile manufacturers. These buses operate across nine routes, travelling more than 6000 kms daily and serving an average daily ridership of 18,498 passengers. A study by GGGI (2018) showed that if all 58 buses that Sajha Yatayat had then, were to switch to electric, a reduction of 2,537 tons of CO₂e per year would be possible. The calculation is based on a weighted average fuel economy of 2.8 liters per bus, over a total annual distance of 2.5 million kilometers.

1.2 E-mobility overview

E-mobility started in Kathmandu Valley in 1975 with the introduction of trolley buses along a 13 km route between Kathmandu and Bhaktapur. Battery powered 12-seater capacity (including driver) three-wheelers (named Safa Tempo) was introduced in Kathmandu in 1995 (project started in 1993) to ban and replace the city's diesel-run the worst polluter three-wheelers. With the support from Global Resources institute (GRI) from the USA, they were manufactured in Kathmandu by assembling imported components. The main body was built in Kathmandu and chassis was imported from India, while electric components such as the battery, converter, motor, controller, fuel gauge, connector contact, carbon brush, etc. were imported (GRI, 2006). More than 700 Safa Tempos still run in Kathmandu. Once the fossil-fuelled micro-buses were on the streets, Safa Tempos could not compete with the comparative comfort and speed of the micro-buses and thus, Safa Tempo manufacturing has slowed down. As a result, out of 7 Safa Tempo manufacturing plants and 38 charging stations, currently there are only 2 manufacturing plants and 28 charging stations. Some of those *Tempos* need refurbishment. To date, 25 of them have their battery replaced from lead acid to lithium ion (TKP, 2019).

The provincial government of Bagmati Province, which includes Kathmandu Valley, has pledged to replace all vehicles in the four major urban centres in the province – Kathmandu Valley, Kavre, Narayanghat and Hetauda – with Evs by 2028, and in 2019, it committed funds to buy 30 electric buses. The National Government also announced that it would buy 300 electric buses (Bhattarai, 2019). However, the procurement process for both the central government and provincial government is on hold. Currently, four E-Buses from a private operator (named Sundar Yatayat) are running in the valley.

Few private E-four wheelers and E-two wheelers (motorcycle, scooter and bicycles) are in operation in the city and the set-up of charging stations is also growing. According to the Electric Vehicle Association of Nepal (EVAN), the number of Evs in the country, including private

⁹ Calculated based on many research reports including Sadavarte, P., Rupakheti, M., Shakya, K., Bhawe, P.V., Lawrence, M.G.: Nepal Emission (NEEM): A high resolution technology-based bottom-up emissions inventory for Nepal, Atmos. Chem. Phys., in prep., 2018.

D4.1 Demonstration Implementation Plan (Kathmandu)

two- and four-wheelers and public vehicles, reached 21,000 in 2017. In 2018, that number crossed 45,000 (TKP, 2019). It is estimated that around 600 electric four-wheelers and 10,000 two wheelers are plying on the Kathmandu valley’s road. Most of these Evs have been forced to charge their vehicles at home due to the lack of charging stations. Nepal Electricity Authority (NEA) plans to set up 50 charging stations across Kathmandu valley and also outside the valley in Pokhara, Nepalgunj, Chitwan and Biratnagar. It plans to establish the EV charging station every 100 to 200 kilometres along the highways (THT, 2019).

Beside Safa Tempos, the local research and development efforts involving different types of vehicles into Evs have been on-going, such as 1st Electric car by Electric Vehicle Development Group in 1992, Electric vans by Hulas Motors and Shree Eco Visionary in 2006, Electric Bus by Himalayan Light Foundation in 2007 and AC-Drive Tourist Tempo by Shree Eco Visionary in 2008 (See figure 3). Recently, universities in Nepal (Kathmandu University) have been pursuing research to convert conventional buses to electric. In 2019, locally manufactured 1st e-motorcycle was introduced, named Yatri motorcycles, under Project zero. It was designed and assembled entirely in Nepal while a few of the complex parts were imported from abroad, including the complex components such as ‘Brema Brakes’ and ‘Metzler tires’ (Shrestha, 2019). Likewise, Hulas motors, local manufacturer of Nepal, is also going to introduce e-car soon.



Source: Tuladhar, 2019

Figure 3: EV introduction in Nepal

1.2.1 Recent transport related Initiatives

The Metropolitan city of Lalitpur is planning to introduce electric mini shuttle buses by early 2020 in the core area of the city, with the demonstration action support from Sajha Yatayat. It is delayed due to the COVID pandemic. Talks are also underway to have a similar service in Kathmandu Metropolitan City.

Sajha Yatayat has received around 30M USD from the government to purchase E-buses. The procurement process is currently in halt, but it might resume soon.

D4.1 Demonstration Implementation Plan (Kathmandu)

Lalitpur Metropolitan city (LMC) inaugurated the first bicycle lane of 4.7km in November 2019. In June 2020, LMC announced a study of Phase II of 25 km of bicycle lane. Likewise, Kathmandu Metropolitan City also proposed a 3.1km bicycle lane connecting further the route from Lalitpur.

Ride-sharing App

Ride-sharing Apps – Tootle and Pathao have been recently introduced in the Kathmandu valley. Tootle app has services for motorbikes only yet but Bangladesh based Pathao provides services for motorbikes and cars. For both the services, the ride fare is charged according to distance covered. Discussion on the legalisation of such apps to use private vehicles for revenue generating purposes is on-going.

E-Mobility Projects

Global Green Growth Institute (GGGI) (Nepal branch office), in partnership with the Ministry of Physical Infrastructure and Transport and Ministry of Forest and Environment, launched the joint Electric Mobility Program (EMP) for Nepal in 2017 to support a transition towards clean and sustainable transportation in Nepal, mainly to boost the adoption of electric vehicles. Under EMP Phase I and II two notable studies related to Evs in Nepal were published.

- [Deploying Electric Buses in the Kathmandu Valley: A Pre-Feasibility Study](#) in January 2018

This study was undertaken to support public and private transport operators (e.g. Sajha Yatayat) to shift towards E-buses. It showcased numerous operational benefits which operators may expect and leverage to off-set the higher upfront costs of electric vehicles, as well as benefits to accrue to the government, the economy and society.

- [Accelerating Implementation of Nepal’s Nationally Determined Contribution: National Action Plan for Electric Mobility](#) in April 2018.

This study charts a path ahead for the achievement of the ambitious electric mobility targets that was adopted under NDC, supported by policy from the Ministry of Physical Infrastructure and Transport. It identifies the major barriers for the deployment of Evs as well as proposed ideas and strategies for solutions and opportunities to lead forward.

GGGI Nepal is planning for EMP phase III (2021-22) activities, where collaboration opportunities for SOLUTIONSplus will be explored.

Charging

The Electricity Regulatory Commission (ERC) recently approved a special tariff for EV charging stations. This provides lower tariff for charging Evs, particularly during off-peak hours (11 pm to 5 am) ([ERC 2019](#)).

1.2.3 Policy Environment

Existing regulations

National policies

- Nepal’s NDC target for low-carbon sustainable transport

Nepal’s Nationally Determined Contribution includes ambitious targets for low-carbon sustainable transport. Out of 14 targets in Nepal’s NDC, four targets are focused on the transport sector:

D4.1 Demonstration Implementation Plan (Kathmandu)

- NDC Target 9: By 2020, Nepal aims to increase the share of electric vehicles up to 20% from 2010 level;
- NDC Target 10: By 2050, Nepal will decrease its dependency on fossil fuel in the transport sector by 50% through mass public transport, while promoting energy efficient and electric vehicles;
- NDC Target 11: Nepal will develop its electrical (hydro-powered) rail network by 2040 to support mass transportation of goods and public commuting;
- NDC Target 14: By 2025, Nepal will strive to decrease the rate of air pollution through proper monitoring of sources of air pollutants like wastes, old and unmaintained vehicles, and industries.

Nepal is currently in the process of upgrading its NDC and a new target for E-mobility is being considered.

- **National Transport Policy**

The national Transport Policy was issued by the Department of Roads in 2001 to develop a sustainable transport system and improve clean transport services (powered by gas, electricity and solar). The specific provisions for electric mobility included in the policy:

- Expanding the use of electric vehicles, using electricity from renewable energy sources;
- Operating electric bus, tram and other public transport vehicles, especially in cities;
- Planning for an electric rail service, utilizing hydropower.

- **Environment Friendly Transport Policy**

The Environment Friendly Transport Policy of Nepal was issued by the Ministry of Physical Infrastructure and Transport in 2014 to promote environment-friendly vehicles and to set out more detailed targets and directions. The specific provisions and targets for electric mobility included in the policy are:

- Increasing the share of what the policy terms “environment friendly vehicles” to a minimum of 20% of the total vehicle fleet by 2020;
- Encouraging manufacturing of environment friendly vehicles, which include electric vehicles;
- Encouraging private sector to invest in construction and management of electric vehicle parking stations and service centres;
- Facilitating land for the construction of ten charging stations in Kathmandu, under a pilot initiative;
- Installing charging stations in retail outlets such as shopping malls, hotels and large parking areas;
- Improving the possibility of local assembly by improving access to required vehicle parts, including batteries.

- **National Sustainable Transport Strategy (Draft)**

This policy was prepared by the Ministry of Physical Infrastructure and Transport in 2015 (currently still awaiting final approval) to set out a long-term strategic vision for the transport

sector, and provide a range of sustainable transport solutions. The specific provisions for electric mobility included in the policy are:

- Promoting electric vehicles across all systems;
- Undertaking feasibility studies for alternative, electric transport initiatives;
- Encouraging the development of a high-priority, national electric rail system and developing required institutional structures and support for electric mobility;
- Introducing electric bus public transportation in urban areas and providing electric vehicle options in priority tourist destinations;
- Aligning and integrating the development of hydropower with the development of electric mobility (vehicles) ;
- Introducing electric rickshaws in small and medium-sized cities.

- Other national policies

National Urban Development Strategy, 2017, National Energy Strategy, 2013, Climate Change Policy, 2011, Bank Monetary Policy has made a positive provision for development of electric mobility. Bank Monetary Policy has set the maximum loan-to- value ratio for personal electric vehicles loan has been increased to 80 percent whereas fossil fuel vehicles are set at 65%. The Budget speech of 2016/2017 has made following provisions for electric mobility for electric vehicles for public and private transport:

- A customs/import duty of 1% is in place compared to a customs duty of 5% for fossil fuel vehicles with more than 40 seats for public transport mentioned in the Budget Speech for FY 2015/16. For private transport, it is 10% compared to customs duty of 80% for fossil fuel vehicles;
- Exemption of value added tax compared to a VAT of 13 % levied on fossil fuel vehicles for public and private transport;
- A customs duty of 1% is in place on machinery and equipment used for the recycling of batteries.

- National Annual budget 2020/21

The new budget for the upcoming fiscal year 2020/21 has, however, increased the customs duty on private electric vehicles to 40%, added an excise duty ranging from 30 to 80 percent depending on the power of the motor and increased the road tax to 5 percent. Although the new customs duty for Evs is still lower than that for ICE vehicles, the drastic increase in customs duty and excise duty will almost double the price of Evs and make them less competitive in the market.

Policy gaps

Barriers for adoption of electric mobility

The study by GGGI (2018) identified various barriers that restrict greater adoption of electric mobility, across four major areas – a) policy and governance; b) infrastructure and markets; c) financing and resources; and c) data and monitoring. They are listed in the table 1 and initiatives in bold text (suggested in GGGI (2018)) are the one which SOLUTIONSplus demonstrations action in Kathmandu could take into consideration:

Table1: Barriers and suggested Initiatives for the adoption of electric mobility in Nepal

Barrier		Initiative	
Policy and Governance	Limited operational action	Absence of directives and legislation for electric mobility	1. Develop directive for electric mobility 2. Change legislation for police empowerment on polluting vehicles 3. Develop guidelines for vehicle conversion and/or hybridization
		Absence of dedicated electric mobility plan	
		Absence of programs to operationalize policy and targets	
		Absence of performance standards and guidelines for electric vehicles and facilities	
		Absence of regulation for vehicle conversion and hybridization	
	Insufficient management of vehicle operators	Sub-optimality of route and permit management	4. Reform route and permit management for electric public transport 5. Reconsider ban on additional electric three- wheelers
		Ban on registration of new three wheelers (including electric)	
	Limited governance of vehicle distributors	Elevated prices of electric vehicles	12. Incentivize new entrants on the electric mobility market
	Restrained political support and coordination	Limited political commitment	See 1
		Limited prioritization of air quality at the local level	
Inter-ministerial coordination is ad hoc			
Infrastructure and Markets	Insufficient investment in facilities	Insufficiency of charging facilities	7. Identify and co-fund charging infrastructure projects 8. Identify and co-fund battery recycling 19. Improve banking for electric mobility businesses
		Absence of battery recycling or processing facility	
	Insufficient investment in mass transportation	Limited development of electric rail	9. Advance electric rail initiatives 10. Advance electric urban mass transportation initiatives
		Limited development of electric mass transport (bus)	
	Electric vehicles proceed as luxury goods	Unreasonably priced electric vehicles	11. Support local electric vehicle assembly or manufacturing projects 12. Incentivize new entrants on the electric mobility market
		Inadequate competition in the market	
		Absence of local manufacturing	
	Under development of markets	Inadequacy of public awareness and understanding	15. Develop informational campaign for electric mobility 16. Develop government fleet of electric vehicles 19. Improve banking for electric mobility businesses
		Limited electric mobility leadership on the roads	
		Inadequacy of electric vehicle spare parts market	
Under-development of electric two-wheeler market	Undersupply of electric two-wheeler market	6. Ease restrictions on electric two-wheelers 17. Foster supply of electric two-wheelers	
	Rigorousness of testing for electric two-wheelers		

D4.1 Demonstration Implementation Plan (Kathmandu)

			19. Improve banking for electric mobility businesses
Financing and Resources	Limited government incentive	Absence of national subsidy for electric vehicles	18. Establish a national subsidy scheme
		Absence of national fund or financing vehicle for electric mobility	
		General unwillingness to unlock financing	
	Vulnerability of federal revenue	Structure of tax renew to government	20. Undertake an economic analysis of long-term implications
	Limited human resources	Limited availability of electric vehicle engineers	21. Establish centres of excellence 22. Develop training program for engineers
		Absence of technical centre for electric vehicle engineering	
		Limited capacity amongst engineers for emissions reduction	
		Limited understanding amongst traffic police	
	Restrained entrepreneurship	Political, regulatory and business uncertainty	19. Improve banking for electric mobility businesses
		Limited start-up culture and commercialization	
Limited banking for electric mobility businesses			
Data and monitoring	Insufficient data collection and access	Lack of data on electric vehicles	23. Improve data collection on vehicle registration and scrapping
		Lack of data on current vehicle stock	
		Inadequacy of air quality and emissions data	24. Establish data collection and sharing protocol for air quality data
		Sub-optimality of access to data	

Source: GGGI, 2018

1.2.4 Business Environment

Local businesses and start-ups working on e-mobility solutions

Existing Companies Operating in the E-Vehicle Market

The table below contains information on selected companies that are currently (or had been) involved in e-mobility in Nepal.

Table 3. Selected Manufacturers, Assemblers, Importers, Dealers of E-Vehicles

Entity	Scope
<i>EV manufacturer/assembler</i>	
Shree Eco-Visionary	e-3 wheeler
Abhyantriki karmashala PVT. Ltd	e-2 wheeler
Yatri	e-2 wheeler (e-motorcycle)
Asta Automobile Pvt. Ltd	e-2 wheeler

D4.1 Demonstration Implementation Plan (Kathmandu)

Green energy industry	e-3 wheeler
Clean Energy Pvt. Ltd. (mero bike)	e- 2 wheeler (e-moped)
Hulas motors	e-2/3 wheeler (Designing e-4 wheeler)
Thee-Go	e-4 wheelers (also imports EV)
<i>EV importer</i>	
pancbike	e-bicycle
Sipradi Trading	e-4 wheeler
CIMEX	e-4 wheeler
Terra Motors	e-2/3 wheeler
Agni Energy	e-3/4wheeler
Eco Infinity Pvt. Ltd.	e-2 wheeler (NIU)
Laxmi Hyundai	e-4 wheeler
MG Motors	e-4 wheeler
<i>EV Service/Operator</i>	
Sundar Yatayat	e-bus (4 in operation)
Electric Vehicle Association Nepal (EVAN)	e-3 wheeler (Safa Tempo)
<i>Vehicle application</i>	
tootle	ride-hailing app
pathau	ride-hailing app
mero Sajha app	app for bus (under Sajha Yatayat)
nCloud Pvt. Ltd	Mobile based payment system

Business Associations: Automotive Industry

- Electric Vehicle Association of Nepal (EVAN)

EVAN is the networking platform for various stakeholders related to electric vehicles in Nepal. EVAN supports the local EV industry and also seeks infrastructure (charging stations) and the route permit form the Department of Transport Management (DoTM) for promotion of electric vehicles. Umesh Raj Shrestha is the chairperson of EVAN.

E-mobility financing options

Many banks in Nepal provide loans for the purchase of electric vehicles. The central Bank, Nepal Rastra Bank (NRB) has fixed the loan-to-value ratio for private electric vehicles at 80%, which means that customers can receive financing of up to 80% of the vehicle cost. In the case of petrol/diesel vehicles this is only 50%. Recently, NRB has also directed banks and financial institutions to give priority in issuing loans to establish charging stations as well.

1.2.5 Capacity building (CB)

Current state and initiatives

Currently, the local capacity for EV manufacturing, operation and maintenance is limited or weak in Nepal. Electric vehicles are not yet in the official curriculum in the university as well as there are very few or none that provide technical training locally. However, universities (e.g. Kathmandu University, Tribhuvan University) and local NGOs (e.g. CEN) are highly interested to

D4.1 Demonstration Implementation Plan (Kathmandu)

collaborate to start with organizing e-courses on Evs and organizing workshops targeting different stakeholders. A collaboration with Global Green Growth Institute (GGGI) Nepal's Electric Mobility Program (EMP) phase III (2021-22) will be sought to support capacity building activities on Evs in Nepal.

Needs and opportunities

Technology, Operation and maintenance

The training on planning, technical specification, procurement, operation, and infrastructure of E-bus is the need in Kathmandu. Good knowledge of technology, operational, and maintenance set-up will support proper planning for Sajha before E-bus procurement. Besides a good understanding of differences between buses and providers, Kathmandu needs capable staff for regular maintenance too. The conversion of old diesel bus to E-bus is being carried out locally for the first time in Nepal. Technical support on this is highly desirable to guide the conversion and to increase the local capacity in the vehicle conversion.

Business model and financing

The current E-3 wheelers (Safa Tempos) are quite old and the redesign is highly necessary to increase vehicle efficiency, comfort, and safety. Local manufacturers will redesign upto 14 E-3 wheelers under SOLUTIONSplus. However, they would be comparatively costlier than conventional E-3 wheelers. The case is similar for forthcoming E-buses (new and converted) compared to conventional diesel buses. Therefore, a proper business model and financing options are needed to increase the share of Evs in Kathmandu, including developing frameworks that encourage private sector involvement.

Charging infrastructure and planning

EV charging standards, mainly hardware standards, and communication standards are new for Kathmandu. Training in charging standards and necessary infrastructure development is a need – both theoretical and on-site to understand it well. For E-3 wheelers battery bank (battery swapping) has potential in Kathmandu for public vehicles, but has not been explored yet.

Integration

Vehicle integration (Mobility-as-a-Service) is not practiced yet in Kathmandu. The city is planning to explore smart payment (ticketing) under SOLUTIONSplus with the support from Pluservice. However, to define which service would be best suitable for the case of Kathmandu and how the service functions, a thorough study, and understanding is necessary.

Preferable type of Training and suggestion from the city

- On-site study and face-to-face training are preferable after the online theoretical training, given the current COVID-19 condition
- Interactive training is desirable to adjust the language barrier (some have a limited level of English). The suggested option also includes organizing training with an external expert and local resource person
- 'Train the trainer' options will be very useful to build local capacity

- Organize local training by the locals, such as training to EV drivers (encourage women drivers) to understand technical aspects of Evs

1.3 Key Stakeholders

1.3.1 Local Government Departments

- Lalitpur Metropolitan City (LMC) and Kathmandu Metropolitan City (KMC)

LMC and KMC are key local government organisations in the Kathmandu Valley. They provide advisory support for the implementation process of short and long-term plans on urban services and facilities as well as budget. They are also shareholders of Sajha Yatayat.

1.3.2 National Government Departments

- Ministry of Physical Infrastructure and Transport

The Ministry of Physical Infrastructure and Transport prepares plans, policies and programs regarding development of physical infrastructures, Transport (except Air Transport) and transit management and its operation related plans, policies and programs; its implementation; monitoring and evaluation; inspection.

- Department of Transport Management

Department of Transport Management, which is under the Ministry of Physical Infrastructure and Transport, was established to provide safe, reliable and easy transportation service to the public and goods carrier.

- Department of Environment

The Department of Environment was established under the Ministry of Forest and Environment to outreach the concept of environmental management in grass root level, to resolve the problems created by climate change and due to anthropogenic factor, to coordinate between governmental, non-governmental and private organizations and to effective monitoring of environmental management¹⁰.

- Alternative Energy Promotion Centre

Alternative Energy Promotion Centre (AEPC) is a Government institution established in 1996, under the Ministry of Science and Technology with the objective of developing and promoting renewable/alternative energy technologies in Nepal.

- Department of Electricity Development

The Department of Electricity Development is under the Ministry of Energy, Water Resources and Irrigation to develop and promote the electricity sector and to improve financial effectiveness of this sector at the national level by attracting private sector investment.

¹⁰ At the time of establishment, the Ministry was called MoSTE, but now it is called Ministry of Forest and Environment.

- Nepal Electricity Authority

Nepal Electricity Authority (NEA) was created in 1984 under Nepal Electricity Authority Act. 1984 to generate, transmit and distribute adequate, reliable and affordable power by planning, constructing, operating and maintaining all generation, transmission and distribution facilities in Nepal's power system both interconnected and isolated.

To address the increasing demand of Electric Vehicles in Nepal and to support government's policy to promote Evs and build charging infrastructure, NEA has made a rigorous study on the types of Evs imported in Nepal, their charging protocols, worldwide trend of charging protocols etc. To enable EV charging based on all three modes of charging viz CHAdeMO, CCS and GB/T using DC boost charge technology, the department is planning to build charging stations in all seven provinces of Nepal so as to facilitate public charging of Evs, both small vehicles and large buses (NEA, 2019).

1.3.3 Other Notable NGO and International Organizations

- Clean Energy Nepal (CEN)

CEN is an independent, non-profit service oriented, policy, research and implementation organisation focusing on research-based education and advocacy campaigns with policy inputs and implementation on issues related to sustainable energy use and environmental conservation. CEN is promoting clean air and electric vehicles. Since its inception, CEN has been promoting clean air and electric vehicles through various research and advocacy campaigns. CEN is also coordinating the Clean Air Network Nepal, which is an informal group of individuals and organizations engaged in air quality management.

- Global Green Growth Institute (GGGI)

GGGI Nepal (head office in South Korea) is currently working with Ministry of Forest and Environment, Ministry of Physical Infrastructure and Transport, Sajha Yatayat and Province 3 of Nepal on 'Electric Mobility Program (EMP), with Phase I 2017-2018 and Phase II 2019-2020. EMP focuses on three areas:

- Building government policy, planning and capacity for electric mobility at all levels
- Supporting transport operators to procure and deploy electric vehicles and operate their fleets
- Fostering the development of Nepal's electric mobility ecosystem

1.3.4 Industry (European and international) – SOLUTIONSplus Partners

- Valeo Group

Valeo Group is involved in four different core businesses: Visibility Systems, Powertrain Systems, Comfort Driving Assistance Systems and Thermal Systems. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2 emissions and to the development of intuitive driving. In Kathmandu, Valeo will work with local partners to design, develop and test electric powertrain solutions (48V) for e-3 wheelers and e-shuttle vans.

- UN-Habitat

UN-Habitat, the United Nations agency for human settlements, helps the urban poor by transforming cities into safer, healthier, greener places with better opportunities where everyone can live in dignity. Under Urban Mobility, UN-Habitat seeks to promote a paradigm shift away from the movement of vehicles to equitable and sustainable access of citizens to workplaces and services and improved movement of goods within the city. UN-H will be responsible for the capacity development component under SOLUTIONSplus and will also contribute actively to the demonstration activities and the development of business models and plans.

- UNEP

UNEP is the principal environment agency of the United Nations, established by the UN General Assembly in 1972. UNEP is implementing its global electric mobility programme, supporting more than 45 low and middle-income countries with the introduction of electric mobility. UNEP is supporting more than 35 countries with the introduction of national policies and standards to promote electric light duty vehicles – in all regions.

- Clean Air Asia

Clean Air Asia (CAA) works in Nepal, primarily through its country network partner, the Clean Air Network-Nepal (CANN). CANN was formed in 2004 and is hosted by the Clean Energy Nepal (CEN) in Kathmandu. CANN is a network of individuals, experts, national and international nongovernmental organizations, governmental organizations and private sector engaged in clean air activities. It's scope and priorities is to strengthen Public Transport System, Non-Motorized Transportation in Kathmandu and Integration of Co-benefits of Air Pollution and Climate Change Mitigation.

2. Demonstration Action

2.1 Situation analysis

2.1.1 Vehicles

E-3 wheelers

Locally assembled electric 3 wheelers (named Safa Tempo) have been in operation as a public transport in Kathmandu for 20 years. Most of the 12 seater Safa tempos are quite old and are still using lead-acid batteries. But they need to increase the quality and efficiency of the Safa Tempo. For the last three years, some of the Safa Tempos have been undergoing remodelling, mainly the old power train system powered with DC brushed motor has been replaced by BLDC and induction motor propulsion system, mostly with 7.5 KW rated power. And very few have been remodelled with Li-ion battery packs of 23 kw replacing old lead acid battery packs. Beside these, other configurations have not been addressed. The drive train systems were imported from China.

Suggestion for demo action

Complete redesign or remodel e-3 wheelers considering efficiency, comfort and safety. The following remodelling activities that will be performed, such as

D4.1 Demonstration Implementation Plan (Kathmandu)

- Drivetrain system (provided by Valeo)
- Battery replacement (Li-ion in place of Lead-acid)
- Body modification (exterior and interior)
- Testing and documentation
- Appropriate business model

Bus/mini-bus

Most of the buses in Kathmandu are run by diesel and are quite old too. Few E-buses run in Kathmandu by private operators. Government regulation allows/supports conversion of diesel buses not more than 7 years old to e-bus.

Suggestion for demo action

The demo case in Kathmandu is to introduce E-buses and slowly replace diesel buses in the public transport sector. For this, a demonstration action on conversion of a 20-seater diesel bus to e-bus will take place as a research project. It would be an opportunity for human resource development /local capacity development in Kathmandu (mainly for Sajha Yatayat – a public transport operator and SOLUTIONSplus Partner) where the local manufacturers and university will be involved.

2.1.2 Charging

Besides home charging, limited public EV charging facilities for smaller vehicles (e-cars) are available in Kathmandu at shopping centers and tourist attractions areas. Nepal Electricity Authority is setting up charging stations for private vehicles and the bidding call has just opened. NEA also introduced lower tariff charges for electricity use at night time (between 11 pm to 5 AM). The proposal also includes a decrease in the tariff rate if the overall electricity consumption increases.

Currently most Safa Tempo owner owns 2 sets of 23kwh lead-acid battery packs. One is charged while the other one is in use. Therefore, the batteries are swapped at charging stations with their own batteries, unlike battery banks. Some even charge their batteries overnight at home. This model makes the Safa Tempo owner take care of the lead-acid batteries and maintain the battery life.

Suggestion for demo action

Charging solutions for E- 3 wheelers

The major challenge has been to replace the current lead-acid battery system with a li-ion battery pack in an E-3 wheeler. Besides home-based overnight charging, another charging solution would be common public charging stations at different locations like parks, shopping malls, public charging stations. The integration of hybrid charging stations that use Solar-AC E-3 wheeler charging stations could bring a game-changing scenario in EV charging systems.

Battery Swapping charging system with private-customer partially owning batteries could also bring some innovation and solution to charging and range anxiety as li-ion battery packs are getting penetration due to low cost.

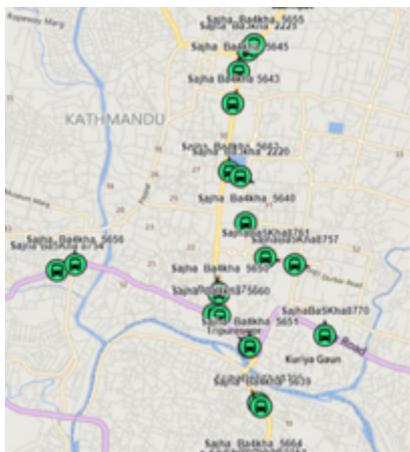
D4.1 Demonstration Implementation Plan (Kathmandu)

Charging solutions for E-Bus

For the demo case of converted E-bus, a battery pack of 120 kwh will be used (depending on drivetrain and battery pack during the integration process). The charger will be provided by the battery pack supplier and could be home based or garage based overnight charging. This is only realistic with the limited number of converted E-buses. When the project gets multiplied in the near future, a proper public charging facility is required. The best solution would be an introduction of a smart charging management system (also Hybrid system of solar and AC could be best) which could monitor all the charging process monitoring the peak load in the grid, managing the network thus making the best use of hydro electricity from the grid in a more economical way.

2.1.3 Integration

Use of apps for individual vehicles are available. Vehicle integration is not yet established in Kathmandu. Sajha Yatayat, public-private transport operator and SOL+ city partner, currently has installed GPS tracking systems in most of the buses in Kathmandu. The 'Mero Sajha app' (for Android) shows the real time location of Sajha buses with bus number and estimated arrival time to the bus station. To ease the bus ticketing, Sajha Yatayat also introduced a smart card named 'Yatra card'. Paid by tapping on the machine each time. But currently, not all the buses have a machine to tap the card. It is planned to install an automatic machine to charge per ride/use.



Bus location shown in 'Mero Sajha app' ([source](#))



Smart ticket card by Sajha Yatayat ([source](#))

Suggestion

Essentially, an app for providing digital services for bus commuters (and ideally, for integrating other modes), is something that is needed in Kathmandu. The primary intended users would be the public transport (buses) users. For the demo, most likely the Sajha Yatayat would utilize the data/ help manage the backend.

An app will be developed for the buses under Sajha Yatayat and will be integrated with the current 'mero Sajha app' with real time location/timing for Sajha buses and other modes

(routing feature). An option for additional features will be sought to integrate other public transport. The app will introduce cash-free Integrated ticketing (e.g. use of Beacon) for Sajha buses and gradually for other public transport (e.g. minibus, safa tempo etc) – single ticket for all.

2.2 Demonstration objectives and logical framework

2.2.1 Demo Description: Kathmandu e-mobility in public transportation

In Kathmandu, a demonstration action will contribute to create an ecosystem for electric mobility in Kathmandu by demonstrating different Evs to enhance public transport, as well as suitable charging solutions and related services. The main demo activities include conversion of diesel bus to E-bus and production of remodeled e-3 wheelers, e- shuttle van and e-micro bus carried out by local manufacturers with the technical support from the consortium and equipment imported. As mentioned in the study by GGGI (2018), the local manufacturing of Evs in Kathmandu offer direct benefits such as increased affordability, generation of local employment, increased industrial independence, increased scope of customization, improved after-sales vehicle servicing, increased economic development, and reduced trade deficit long-term.

Conversion of diesel bus to E-bus

An old diesel bus will be converted to E-buses, mainly replacing the drive system (motor, transmission and rear axle). The required components for the conversion will be imported and assembled locally. As charging infrastructure is poor or non-existent in public, suitable options for charging Evs and batteries will be suggested. Some of the initial technical detail of the bus conversion are:

- Seating capacity: 20 passengers (+15 standing)
- Length: 8.5m
- Required top speed for city drive: 55km/hr
- Total driving distance per day: 120 km (at an avg speed of 35-40 km/hr)
- Kerb weight: 8500 kg
- Gross vehicle weight: 7400-8000 kg
- Drive train: 80 kw rated power (PMSM/AC Asyn)
- Battery system and charging: Lithium ion phosphate 120 Kwh, battery charger and battery management system. The battery large enough to allow for the daily operation

D4.1 Demonstration Implementation Plan (Kathmandu)

(without charging) up to 14 hours will be sought, together with charging strategies such as plug-in overnight charging located in the depot.

- Other electrical cables, pumps etc
- Body repair work /modification using light weight Fiberglass material. Both exterior and interior, Dashboards, lights, passengers' seat.

For this research and development project, appropriate simulation software (e.g. Matlab and ANSYS) will be used for the design, optimisation and model development. Data loggers will be manufactured to measure and develop local drive cycles. Electro-mechanical systems will be developed to measure road gradeability as Nepal has uncertain road gradeability.

Route for E-bus

Among the 6 routes for Sajha bus, the test phase will be run in the route of 17km (from Lagankhel to Budhanikantha, which takes almost an hour to complete a single trip (i.e. one way, from terminal to terminal). The initial study was carried out by GGGI (2018) and it will be further discussed later.

Remodel E-3 wheeler

Under the SOLUTIONS plus project, complete remodeling of Safa tempo will be carried out with the use of Power train from Valeo (iBSG4W @48V) and other components either imported or locally manufactured. The initial analysis of Valeo powertrain indicated the seating capacity of e-3 wheelers of upto 6 passengers, with the good trade-off ratio 15:6 to have good performance between 600kg and 1215kg.



Powertrain performance (with IBSG air cooled)	
Peak Output torque (Nm)	550 - 1100
Continuous Output torque (Nm)	160 - 350
Continuous power output (kW)	Up to 6.5
Peak power output (kW)	Up to 12.5
Reducer	
Weight (kg)	9
Oil quantity (cc)	300
Lifetime (hr)	>10 000
Maintenance (hr)	3500

Upto 6 new E-3-wheelers with Li-ion batteries will be equipped with a fast charging system together with innovative business model, such as battery leasing/pay-per-use model. This will provide better services for E-3-wheelers as public transportation in the city. The route for the remodelled e-3 wheeler will be discussed and defined later.

E-shuttle van

The 6-seater e-shuttle van will be developed with local manufacturers, using Power train from Valeo (iBSG4W @48V) and other components either imported or locally manufactured. This will be basically used for heritage site-seeing purposes. Lalitpur Municipality is willing to develop more such vehicles in Kathmandu. Therefore, the replication of this demo is high.

E-microbus

SOLUTIONSplus will collaborate with local manufacturers to develop an electric modular concept of microbus (16 seater). The e-microbus will be used as a public transportation (feeder) and has a high potential to replace thousands of diesel-powered micro buses running in different routes of the Kathmandu valley. The project has a high potential of replication and the local partner wishes to develop involving local manufacturers (who will also carry out Conversion of diesel bus to E-bus). SOLUTIONSplus will invest 7500 EUR as a Lumpsum and the local manufacturer (Shree-ecovisionary) will provide the rest of the budget.

Promote E-moped

E-moped sharing system, that reduces the dependence on owning private vehicles, will also be sought in the demonstration project with state-of-the-art technologies. Together with the current ride-hailing system, a financing model will be developed for those who will provide service with e-moped.

Smart payment system

The public transport system in Kathmandu needs to upgrade its payment system. Under SOLUTIONSplus, Pluservice will support the development of MaaS app including features such as a smart payment system. Various options for app based ticketing will be sought, such as Prepaid mobile ticketing with voluntary validation with app, Prepaid mobile ticketing with automatic validation (beacon), and no prepaid mobile ticketing (beacon). The complete solution includes features such as: Travel planner, Travel routing engine module (for journey reconstruction), Fare management/ fare calculation module, Money transaction (financial gateway), Equipment management module (beacons), Clearing, Business Intelligence, and Customer service module (for Help Desk B2C). Sajha Yatayat will work together with local app developers to implement the SOL+ MaaS app developed by Pluservice.

Logical Framework

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to the City)	MILESTONES (and other notes)
<p>OUTCOME 1. Availability of high quality e-mobility innovations is increased.</p> <p><i>Baseline:</i> In terms of public electric vehicles, the current e-3 wheelers in Kathmandu are quite old and inefficient (lead-acid batteries) and e-buses are still in nascent phase. Charging solutions available to the public (as well as public transport operators) are still quite limited.</p> <p><i>Target:</i> High quality e-mobility solutions (remodeled e-3 wheelers and conversion of diesel bus to e-bus) developed by local industries are made readily available to the market.</p>			
1. Locally produced (remodelled e-3 wheeler and e-shuttle van) for passenger connectivity are developed and tested	1. Call for local SMEs to design, develop, test prototypes, and produce the on-the-ground units for the demonstration.	1. Conduct of the call for local SMEs 2. Selection and awarding	1. Call for local SME conducted by October 2020.
	2. Design, prototyping, testing phase	1. Design 2. Prototyping 3. Internal/ in-facility testing and validation	2. Design available by Dec 2020 3 Final prototypes available by March 2021
	3. Production of units for demonstration		1. Demonstration units available by June 2021
2. Diesel bus to E-bus converted + E-micro bus developed and tested	1. Contact local SME that has experience in vehicle conversion in Kathmandu to design, develop, test prototypes, and produce the on-the-ground units for the demonstration.	1. Selection and awarding	
	2. Design, prototyping, testing phase	1. Design 2. Prototyping 3. Internal/ in-facility testing and validation	2. Design available by Sept 2020 3 Final prototypes available by March 2021
	3. Production of unit for demonstration		1. Demonstration units available by June 2021
3. On-the-ground demonstration of for public transport is conducted and assessed	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	1. Kathmandu demo launched by June 2021 2. Detailed demonstration mechanics available by Dec 2021 3. Functional requirements to be available by October 2021 (c/o UITP)

D4.1 Demonstration Implementation Plan (Kathmandu)

		2. Research support conducted by (SOL+ partner) on the e-bus concept	
	2. Implementation of on-the-ground demonstration activities	1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be submitted April 2023
	3. Assessment	1. Determination of KPIs 2. Baseline activities 3. Monitoring 4. Analysis of data and evaluation	1. KPIs from SOL+ to be available by month 12
4. Innovative public charging facilities planned and installed	1. Study and plan appropriate public charging solutions	1. Consult Nepal Electricity Authority (NEA) for charging infrastructure planning	
	2. Planning for the installation and implementation		
	3. Installation, monitoring and assessment		
4. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.
<p>OUTCOME 2. Conditions for enabling accelerated e-mobility uptake are improved.</p> <p><i>Baseline:</i> The current enabling environments for e-mobility (relating to business, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcome.</p> <p><i>Target:</i> Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</p>			
1. Business models and business plans are developed and validated	1. Identification of locally-appropriate transformative business model concepts directly relating to the demonstration activity		

D4.1 Demonstration Implementation Plan (Kathmandu)

	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021
2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+
Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans are developed	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by January 2023.
Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institution, and other relevant entities		Note: Kathmandu will primarily be consulted in this process.
	2. Drafting and review of recommendations		
<p>OUTCOME 3. Digital application used for vehicle integration</p> <p><i>Baseline:</i> The use of digital application is limited for individual vehicle (ride-hailing app). Such applications are not advanced in public transportation, available with limited features in buses (public and private)</p> <p><i>Target:</i> Develop Mobility as a Service (MaaS) app considering local priority, mainly focus on smart ticketing and payment</p>			
1. Localized MaaS app developed	1. Identification of local needs and digital advancement	1. Facilitate frequent contact with local partner and PLUSSERVICE	
	2. Local hackathon to adapt app to local conditions and to initiate new business partnerships and models		
	3. Required equipment (smart ticketing device) installed in the vehicle		
	4. Testing the app		
2. Required data collected	1. Before the apps development	1. Contact authorities for the relevant data	

D4.1 Demonstration Implementation Plan (Kathmandu)

	2. After the apps have been taken into use	2. Monitor the apps in use	
<p>OUTCOME 4. Local capacities relating to e-mobility are enhanced.</p> <p><i>Baseline:</i> As e-mobility is still in its infancy stage in the country, capacities are still highly limited.</p> <p><i>Target:</i> Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.</p>			
Peer-to-peer exchange program is conducted and documented	1. Visit of representative of partner city to European expert city/cities		1. Visit to European expert city/cities within first 18 months
	2. Visit of European experts to the partner city	1. Planning and development of itinerary 2. Visit	1. Visit of European expert/s to the partner city between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner city and European experts to expert cities outside Europe		1. Joint visit between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
2. Toolkit for e-mobility is developed and shared with local stakeholders	Needs assessment		
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

2.2.2 Test scenarios

A test scenario describes the environment in which the SOL+ demonstrations take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Solution: e-bus conversion					
Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i> <i>e) etc.</i>				
Vehicles involved (type)	e-bus (20 seater)				
Vehicles involved (unit)	1				
Integration with PT system	Digital application development for smart ticketing and travel planning for Sajha buses				
Lines/stops involved (units)	n/a				
Time span (testing activities)	From/to				
Time span (data collection)	<table border="1"> <tr> <td>Before</td> <td>After</td> </tr> <tr> <td>Jan to June 2021</td> <td>June to Dec 2021</td> </tr> </table>	Before	After	Jan to June 2021	June to Dec 2021
Before	After				
Jan to June 2021	June to Dec 2021				

Solution: e-3 wheelers	
Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i> <i>e) etc.</i>
Vehicles involved (type)	e-3 wheelers (6 seater)
Vehicles involved (unit)	upto 6
Integration with PT system	The possibility to integrate with buses and other public transportation through digital application development will be sought, for smart payment and travel planning etc.
Lines/stops involved (units)	n/a
Time span (testing activities)	From/to

D4.1 Nine (9) Demonstration Implementation Plans

Time span (data collection)	Before Jan to June 2021	After June to Dec 2021
-----------------------------	----------------------------	---------------------------

Solution: e-3 shuttle		
Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i> <i>e) etc.</i>	
Vehicles involved (type)	e-3 shuttle (6 seater)	
Vehicles involved (unit)	2	
Integration with PT system	The possibility to integrate with buses and other public transportation through digital application development will be sought, for smart payment and travel planning etc.	
Lines/stops involved (units)	n/a	
Time span (testing activities)	From/to	
Time span (data collection)	Before Jan to June 2021	After June to Dec 2021

Solution: e-microbus		
----------------------	--	--

Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i> <i>e) etc.</i>	
Vehicles involved (type)	e-microbus, 16 seater	
Vehicles involved (unit)	1	
Integration with PT system	The possibility to integrate with buses and other public transportation through digital application development will be sought, for smart payment and travel planning etc.	
Lines/stops involved (units)	n/a	
Time span (testing activities)	From/to	
Time span (data collection)	Before Jan to June 2021	After June to Dec 2021

2.2.3 Vehicles/infrastructure/equipment provision

The table below shows a draft breakdown of the major components needed for the demonstration in Kathmandu. Please note that the budget distribution is not final, and can vary depending on the available components and market fluctuations.

Essentially, the E-3 wheelers and E-shuttle van will utilize powertrain from Valeo, while the other needed components will be sourced locally (e.g. metal works for the body), and from other countries in the region (e.g. motor controller). In terms of the process of developing the E-3 wheelers and E-shuttle van demo units, a local SME will be tapped through the SOLUTIONSplus SME call to design, develop, and test the initial prototypes. Assumed time for the prototype development is 2 months. Once these have been developed and tested, the production of the actual units to be used in the on-the ground demonstration will be done by the SME and/or by an established local vehicle assembler/manufacturer, with the support from SOL+ city partner – Sajha Yatayat.

For the bus conversion, Sajha will assign a local SME to design, prototyping and testing a demo unit. An old 20 seater diesel bus will be bought and the needed components will be sourced locally, and from other countries in the region. Once the bus is completely converted, the on-the-ground demonstration will be done by the SME. With the same SME, e-microbus will be manufactured. A unit of e-microbus will be developed partly with the investment of SME and SOL+ city budget.

D4.1 Nine (9) Demonstration Implementation Plans

Sajha will cooperate with ride hailing application companies and local banks to provide support to e-moped drivers. The financial support includes for example monthly fee waiving for the demonstration period. A more detailed work on appropriate financial models is to be done.

	SME call	City Equipment Budget	Industry partner
E-3 Wheelers (6 seater, Demo units upto 6) + E-4 Wheelers/ e-shuttle van (6 seater, Demo units 2)			
Staff time and inhouse facility			
Design	1500		
Development of prototypes (including technician charge)	4400		
Testing of prototypes	1500		
SUB-Total	7400		
Prototyping, testing and production (e-3 Wheeler)			
Powertrain (Valeo)			tbc
Battery (Li-ion 10 kwh)	16500		
Chassis	6600		
Body (exterior and interior)	5800		
SUB-Total	28900		
Prototyping, testing and production (e-4 wheeler / e-shuttle van)			
Powertrain (Valeo)			tbc
Battery (Li-ion 10 kwh)	5500		
Chassis	3600		
Body (exterior and interior)	4600		
SUB-Total	13420		
Diesel bus to E-bus conversion (20 seater, Demo unit 1) + Remodelling of e-microbus (16 seater, Demo unit 1)			
Staff time and inhouse facility		10000	
Design		-	
Development of prototypes		-	
Testing of prototypes		-	
Prototyping, testing and production (Diesel bus to E-bus conversion)			

D4.1 Nine (9) Demonstration Implementation Plans

Old bus		3700	
Components -Power train		15000	
Battery (Li-ion 70kwh)		22000	
Other components		4400	
SUB-Total		54100	
Prototyping, testing and production (e-microbus)			
Powertrain		3654	
Battery (Li-ion 30 kwh)		8770	
Chassis and body		2558	
Body (exterior and interior)		4385	
SUB-Total		19367	
SOL+ lumpsum contribution from the sub-total		7500	
E-moped (units tbd)			
Finance		8400	
GRAND TOTAL	50000	70000	

2.3 Detailed Time-plan

D4.1 Nine (9) Demonstration Implementation Plans

Implementation of on-the-ground demonstration activities	Assessment	RP1 Definition & Baseline	Ex-ante Assessment	Monitoring phase	Ex-post Assessment
Live charging facilities planned and installed	Study and plan appropriate public charging solutions	Planning for the installation and implementation	Installation, monitoring and assessment	Pre-feasibility study for scale-up is developed*	Preparation of the pre-feasibility study
ME 2. Conditions for enabling accelerated e-mobility uptake are improved	Models and business plans are developed and validated	Identification of locally-appropriate transformative business model concepts directly relating to the demonstration activity - data collection	Business plan development and preparation of commercial operation	Stoektaking of SMEs	Start-up incubator set-up (c/o ERTICO)
Regional hackathons	Recommendations for policy development, institutionalization and integration of e-mobility in national plans are developed	Consultations with local and national entities	Drafting and review of recommendations	Financing and procurement for e-mobility program proposal is developed	ME 3. Digital application used for vehicle integration
Identified needs and digital advancement partnerships and models	Testing the app	Identified data collected	Before the apps have been taken into use	After the apps have been taken into use	Identifying device installed in the vehicle
ME 4. Local capacities relating to e-mobility are enhanced.	Peer exchange program is conducted and documented	Visit of representative of partner city to European expert city/cities	Visit of European experts to the partner city	Joint visit of partner city and European experts to expert cities outside Europe	For e-mobility is developed and shared with local stakeholders
Needs assessment	Training on the toolkit	Identifying activities directly related to the demonstration action is developed and delivered	Training activities identification	Conduct of training activities	

2.4 Business model plan

The detailing of the business model concepts, and the specific business plans relevant to the pilot will be conducted in 2021. The development of the business model concepts will explore potential emergent concepts relating to several dimensions of such as: vehicle assembly/manufacturing; e-vehicle maintenance; finance; ownership and management of e-3 wheelers, e-bus and e-scooters; public charging facilities; and end-of-life resources management (including batteries). The project will also explore the possibility of establishing specific business opportunities that would involve local SMEs and EU-partner SMEs and industries.

2.5 Team involved

Main Role	Company	Name	Contact
Demo leader	Sajha Yatayat	Bhushan Tuladhar	bhushan.tuladhar@gmail.com
Coordination	Wuppertal Institute (WI), Clean Air Asia (CAA) and UEMI local staff	WI: Shritu Shrestha, and Alvin Mejia CAA: Kathleen Dematera UEMI local staff: Abhisek Karki	shritu.shrestha@wupperinst.org , and alvin.mejia@wupperinst.org kathleen.dematera@cleanairasia.org abhisek.karki@uemi.net
Vehicles provider	Valeo (powertrain for e-3 wheelers and E-shuttle van) Talks with local SME (Shree Eco-Visionary) being conducted	Valeo: Simon Midrier Shree Eco-Visionary:: Umesh Raj Shrestha	simon.midrier@valeo.com umeshsev@yahoo.com
Charging system provider	tbc	tbc	tbc
App/software provider	Pluservice Talks with local app developer (nCloud Pvt. Ltd) for smart ticketing being conducted	Pluservice: Daniela Vasari and Paulo Cantillano nCloud: Dipendra Shrestha	d.vasari@pluservice.net and P.Cantillano@pluservice.net dipendra.shrestha@ncloud.com.np

2.6 Risks Assessment

Risk	Probability assessment	Consequences	Risk mitigation/comments
Components not delivered on time, such as Valeo Powertrain, bus conversion equipment	Medium	Delay in prototype development	Incorporation of lead times for delivery, customs clearance ; Clarification of regulations regarding importation
On-road crash during actual demonstration	Low	Injuries or worse; stoppage of demonstration	Safety testing incorporating operational scenarios to be done; Check if all insurance mechanisms are covered; Training for operators to be conducted Public / road users' sensitization activities to be conducted
Vehicles will not be permitted on-the-road	Low	The prototypes will not be able to run on the ground after test run	City to issue special operating permits; coordination with other relevant authorities will be done when necessary
Delay in opening of local organizations and businesses due to COVID-19 pandemic	Low	Delay in prototype development, data collection and necessary arrangement on the ground	Utilize the time for detailed demo planning before the things starts to get normal again

2.7 Monitoring

A monitoring plan will be crafted that will be based both on the “global” project key performance indicators (KPIs) to be developed within the Work Package 1 of SOLUTIONSplus and the main objectives to be co-identified with Sajha Yatayat. Essentially, a set of highly relevant KPIs will be selected and methodologies (who, what, when, where, how) for collecting data for calculating the indicators will be included in the monitoring plan. To be able to properly assess the impacts of the demos, there would also be a need for baselining activities which would establish the benchmarks for the indicators. The baseline values would essentially capture “what would have happened in case the demonstration was not conducted.”

The KPIs would capture operational performance, and service quality-related perceptions. These KPIs would be selected based on a holistic framework that considers operational

D4.1 Nine (9) Demonstration Implementation Plans

(reliability, range, etc...), environment (and energy efficiency); social (e.g. safety, perceptions); and economic (e.g. total costs of ownership, operational costs and considerations, affordability).

3.Preliminary replication opportunities

The designed and developed prototype for locally produced efficient E-3 wheelers and E- micro bus for public transport (last mile connectivity), E – shuttle van for heritage sightseeing and converted E-bus will be replicated in other cities of Nepal, as well as in different developing countries across the globe.

4.Updates

(until June 2020)

Progress towards implementation

- Local manufacturers in Kathmandu have been contacted and initial discussion carried out for the Evs local production as well as bus conversion
- Selection of old diesel bus for the conversion to E-bus is at the final stage
- SOLUTIONSplus industry partner (Valeo) has conducted simulation for the appropriate powertrain for 6 seater e-3 wheelers
- SOLUTIONSplus industry partner (Pluservice) has suggested solutions for smart ticketing and payment for Sajha buses, beacon based App Solution, as a part of Mobility-as-a-Service (MaaS). nCloud Private Limited in Kathmandu, a Payment Technology Advisor for Sajha Yatayat, showed interest in implementing this solution. A detailed discussion on business cases and the possibilities of cooperation after the project's life is on-going.

Next steps

- Sajha Yatayat to hire project staff to assist in the implementation of the activities (delay due to COVID)
- Local meetings to be held by Sajha (Kathmandu) to further thresh out a detailed plan, and to establish coordination with the local stakeholders
- SOLUTIONSplus webinar on Demonstrating e-mobility solutions in Hanoi, Kathmandu and Pasig. The event will be on July 3rd 2020, presented by local city partners.

5. References

- ADB. (2013). *Country Partnership Strategy 2013-2017: Sector Assessment (Summary) – Transport and Information and Communication Technology*. Retrieved December 05, 2019, from <https://www.adb.org/sites/default/files/linked-documents/cps-ind-2013-2017-ssa-02.pdf>
- Bhattarai, A. (2019, August 26). *When Kathmandu Was ,Shangri-La for Electric Vehicles‘*. Retrieved October 28, 2019, from Citylab.
- CSE. (2012, July 27). *Kathmandu can manage its urban transportation and become pollution-free if it builds on its strength – its emission. Free non-motorised transport: says CSE*. Retrieved November 16, 2019, from Centre for Science and Environment: <https://www.cseindia.org/kathmandu-can-manage-its-urban-transportation-and-become-pollution-free-if-it-builds-on-its-strengths-its-emission-free-non-motorised-transport-says-cse-4395>
- Department of Transport Management. (2014). *Vehicle Registration Number*. Ministry of Physical Infrastructure and Transport.
- GGGI. (2018). *National Action Plan for Electric Mobility: Accelerating Implementation of Nepal’s Nationally Determined Contribution*. Seoul: Global Green Growth Institute.
- GGGI. (2018a). *Deploying Electric Buses in the Kathmandu Valley: A Pre-Feasibility Study*. Seoul: Global Green Growth Institute.
- GRI. (2006). *Promoting Electric Vehicles in the Developing world*. Global Resources Institute. Retrieved January 2020, from <http://www.grilink.org/ev.htm>
- JICA. (2012). *Data Collection Survey on Traffic Improvement in Kathmandu Valley*. Final report, Japan International Cooperation Agency.
- Ministry of Science, Technology and Environment. (2014, December). Retrieved February 18, 2020, from <https://unfccc.int/resource/docs/natc/nplnc2.pdf>
- NEA. (2019). *Nepal Electricity Authority: A year in review – Fiscal Year 2018/2019*. Kathmandu: Nepal Electricity Authority.
- Shrestha, N. (2019, December 20). *After months of anticipations, Yatri Motorcycles finally showcases the Project Zero!* Retrieved December 21, 2019, from Gadgetbyte: <https://www.gadgetbytenepal.com/yatri-motorcycles-project-zero-nepal/>
- THT. (2019, September 27). *NEA to build 50 charging stations*. Retrieved October 28, 2019, from The Himalayan Times: <https://thehimalayantimes.com/business/nea-to-build-50-charging-stations/>
- TKP. (2019, October 26). *Electric vehicles are the future of mobility, but is Nepal ready?* Retrieved October 28, 2019, from The Kathmandu Post: <https://kathmandupost.com/climate-environment/2019/10/26/electric-vehicles-are-the-future-of-mobility-but-is-nepal-ready>
- Tuladhar, B. (2019, July 26). *E-mobility in Kathmandu: Challenges and Way Ahead*.

D4.1 Demonstration Implementation Plan

City: Kigali

1. Operating environment

1.1 Background

1.1.1 Key facts and figures:

As the country's commercial and administrative hub, Kigali is rapidly urbanizing as a result of a growing population and increasing economic activities (World Population Review, 2019). Consequently, the city's major economic sectors are challenged with issues ranging from congestion, pollution, deteriorating infrastructure, among others. The transport and energy sectors, especially, have become stressed over the years, thus, prompting major reforms. It is estimated that Rwanda's electricity mix is about 52% hydro and 48% percent thermal, with thermal power generated using imported diesel fuel.

City: Kigali

Population: 1 million (2012)

GDP per capita: \$2,251.55 (2018)

CO2 emissions (per capita): 0.074 metric tons in 2014

1.1.2 Overarching issues

The main form of public transportation throughout Rwanda and in Kigali is the minibus system, which runs both scheduled and unscheduled services according to a shared taxi system. Vehicle number is increasing in Rwanda; and by 2030, it is projected that the annual increase in vehicles will reach 16.5% from the current 12%, and light-duty vehicles will increase by 20%. Rwanda's CO2 emissions per capita is estimated at 0.074 metric tons in 2014; and in Kigali, the transport sector is said to contribute about 52% of CO2 emissions.

In response to the high cost of fuel and pollution, Kigali is promoting electric mobility by testing the use of electric motorbikes, known as e-moto. The aim is to provide a low cost and environmentally friendly mode of transport, mainly for motorcycle taxi riders. This initiative is being driven by private investors such as Ampersand which is an electric vehicle company with the mission to develop "mass-market shifts from petrol vehicles to direct, cheaper, better electric replacements". Also, the German car maker Volkswagen established an assembly plant in Rwanda in 2018, and has plans for the manufacturing of electric cars in the future (Krauß, 2018). The company is currently involved in Kigali in a pilot project on eGolfs and charging stations, together with Siemens. The presence of such an investor-friendly environment in Rwanda makes it favourable to develop electric mobility in the country.

1.2 E-mobility Overview

1.2.1 Policy environment

Kigali has been implementing the "City Development Plan 2013-2018"; and as part of its goals, planned to become a city of green transport. The city is therefore making efforts to shift from small minibus services and private cars to buses; and in the long-term, provide only public transport services for city dwellers. As stipulated in its Development Plan, the city's transport priorities include improving road network, reducing traffic congestion and integrating the public transport system (City of Kigali, 2013). It is expected that such priorities will stimulate concerted synergies aimed at implementing innovative transport actions and policies for building a sustainable transport system.

D4.1 Nine (9) Demonstration Implementation Plans

Rwanda's Intended Nationally Determined Contributions (INDCs) identifies the transport sector as key to achieving climate change goals; as such, the country has set out to build an efficient and resilient transport system by promoting public transport, developing transport infrastructure and setting emission standards and regulations for vehicles within an integrated national transportation planning context. The country plans to construct a 17 km BRT with modern interchanges, install solar powered streetlights, enforce vehicle fleet renewal and scrappage, and adopt low carbon technologies for new vehicles. Rwanda also envisages introducing a subsidy to encourage the use of clean vehicles and piloting the Green Transport Fund to encourage the introduction of innovative transport technology among others (Republic of Rwanda, 2015). In this vein, Kigali plans to limit the use of private transport and increase patronage of public transport.

Recent efforts to improve the transport sector in Rwanda have seen the Rwanda Utilities Regulatory Authority (RURA) carrying out different reforms aiming at restructuring and enhancing road transport service delivery. According to RURA, a good number of tertiary legislations in terms of regulations and guidelines have been developed and include those for public transport operation, upon which tremendous transformation in the road transport sub-sector were achieved (RURA, 2020). RURA reports the following as some of its achievements:

- The number of licensed road transport operators keeps increasing
- Road transport operators were grouped into companies and cooperatives
- ICT is being applied in road transport
- Reorganization of public transport into operational zones and corridors
- Complaints handling in road transport is improved
- Improvement in service delivery by road transport operators

1.2.2 Business environment

An Initial scan conducted to identify local businesses and start-ups working on e-mobility solutions in Kigali revealed that there exist a few of such organizations in the city and are mostly privately owned. There are also existing transport operators, service providers and associations including motorcycle taxi associations, bike rider groups and other relevant transport associations in Kigali. Among the local start-ups involved in the city's urban mobility sector include the following:

Gura:

Gura is a green e-mobility ride-share transport system company, committed to the sustainability of Green Mobility over Africa and is based in Rwanda. The company aims to „reduce carbon emission, improve air quality, and ease congestion by developing alternative means of green transportation (Green E-mobility) using advanced-innovative technology“. Gura brings the benefits of the vibrant and unique technological change and combines smart gear-assist bikes, electric scooters and electric bikes sharing in a single-app to enable users to choose their ride preference.

Gura has been involved in the implementation of micro-mobility in Rwanda and is committed to changing the cycling culture in Africa with the strong backing of the Government of Rwanda and various districts. The company sees this more as a socially impactful project to encourage

D4.1 Nine (9) Demonstration Implementation Plans

everyone to participate. Gura has done extensive R&D in Kigali owing especially to the unique terrain in Rwanda, nicknamed as „Land of a thousand hills“. Due to this uniqueness, certain E-bikes may not be suitable for Rwanda. This has prompted Gura to invest more money and time in trying to develop E-bikes to suit this market area.

Gura believes in capacity building and training, women empowerment and job creation are part of its value chain of this project, hence the company has been collaborating with Kigali Employment Service Center, Ministry of Gender Equality as well as other NGOs in driving these initiatives. The company’s activities have largely been self-funded by the directors of Gura; as such, the company is open to explore collaboration that can support its activities in order to make its plans a reality for all in Kigali.

Safi

SAFI, founded in 2018, is an e-mobility rideshare company committed to sustaining the environment using electric motorcycles for its services. The company uses cutting-edge technology to provide on-demand ride request services, products for mobile app solutions, cashless easy to use payment system, transport services for Corporate Businesses and Organizations. Its goal is to cause a transition in transportation using innovating technology from fossil fuel-based energy to other renewable low carbon transport options. Safi brings the benefits of the vibrant and unique technological change and hopes to capitalize on the growing technological trends in the taxi industry by aggregating multiple services into a user-friendly application that reaches captive users of millions.

Safi aims at impacting the transportation sector by innovating and re-inventing mobility in Africa alongside providing customers a sense of belonging, comfort and safety while enjoying every ride with pride. The company envisions to become: a leader in the revolution and transitioning of transportation sector to e-mobility in Africa, Africa’s largest one-stop E-Mobility rideshare platform, Africa’s largest operator of E-Motorcycle networks, as well as the continent’s leader in smart innovative transportation technologies.

Safi plans to deploy Electric Motorcycle on-demand taxi transport services in Rwanda, while playing a major role in the Vision Green Transport set out in the shift towards e-mobility. This project will introduce on-demand e-Mobility rideshare to the citizens of Rwanda with the aim of adding it to one of the most used means of transport in Rwanda.

Ampersand

Ampersand has been analysing the potential for electric vehicles in Africa combining research, customer interviews, and on the road testing to identify an ideal setting and vehicle fleet to go electric first, and the technology and business model to do it profitably at the right price. Ampersand’s first market is Kigali, which has more motorcycles than all other vehicles combined. Considering that there are progressive government policies towards mobility in Rwanda which has the highest fuel and motorcycle prices in the region, Ampersand believes that Rwanda is ripe for the electric age. As such, the company is using state-of-the-art battery technology to provide riders with a seamless experience to change from petrol to electric. Combining analytics from millions of motor rides in the city, the company provides the optimum vehicle for the everyday motorist.

Ampersand aims to build affordable electric vehicles and charging systems for the three million motorcycle taxi drivers in East Africa, starting with Rwanda. By using a battery swap model, the company makes it cheaper to buy and operate an electric motorcycle than a petrol motorbike. The motorcycles are designed to outcompete the incumbent 125cc and 150cc petrol motorcycles on power, durability and performance; and cost less than petrol motorcycles to lease or buy and about half as much to power. Per Ampersand's business model, customers do not need to buy vehicle batteries, or wait around while recharging batteries. Instead they rent batteries from a network of simple battery swap stations which look and feel like normal petrol service stations. The company launched commercially with 20 electric motorcycles in May 2019, following a testing phase of prototypes in 2018. These motorcycles have already run about 400,000 km on the road as of February 2020.

Rwanda Electric Mobility (REM) Company

REM has introduced electric mobility vehicles, specifically electric motorcycles and the supporting infrastructure into Rwanda. The motorcycles are assembled locally in Kigali and are being promoted as a Green product of Rwanda. REM has established a factory at Kicukiro for assembling electric motorcycles; and which will host a main charging station. The company has established three stations (Remera, Kicukiro and Nyabugogo) where the batteries will be exchanged. These locations were identified by the company as the busiest within the city. The company is targeting mostly Moto-Taxi Cooperatives and the business institutions especially those in courier services.

REM's electric motorcycles are designed in more friendly and flexible manner with two batteries that can cover 120 km; and whenever one battery gets depleted, it is switched to the second battery giving a rider the opportunity to move to the next station to drop the depleted battery and get a fully charged one to continue the trip with no interruptions. REM planned to launch its activities in March 2020 but could not do so due to the Covid-19 pandemic. The plan was to give out 120 electric motorcycles to Moto taxi cooperatives during the launch. The company still hopes to realize its plans and believes that E-mobility is the future of transportation not only in Rwanda, but also around the globe.

REM has engaged and created a link with different stakeholders including the Federation of all motor taxi drivers especially the cooperatives in Kigali City as well as the government Ministries and institutions such as MININFRA, MINICT, RDB, REMA, RURA, FONERWA as well as banks and Micro-finance institutions. The company aims to expand its collaboration with different organizations to promote green initiatives in Kigali and in the region.

1.2.3 Capacity building (CB)

Current state and initiatives

In recent times, the Government of Rwanda increasingly recognizes the importance of promoting sustainable transportation as such has been creating the enabling environment for private investments into the sector. This has seen the likes of the German car manufacturer VW

D4.1 Nine (9) Demonstration Implementation Plans

entering the electric mobility sector in Rwanda with the establishment of environmentally compatible local vehicle production facilities and possibilities of training initiatives for the local population (Volkswagen, 2016).

Though there are no structured training programmes on e-mobility in Kigali, some forms of capacity building activities have been ongoing in the city including local training sessions organized by local start-ups such as those mentioned above; as well as workshop sessions held by local and national level authorities and organizations. An example of such workshops is the Electric Mobility Workshop in Kigali on the 25th February 2020. The workshop was organized by the Ministry of Infrastructure and the International Growth Centre (IGC). It was aimed to discuss, learn, and exchange with relevant stakeholders from the Government of Rwanda, private sector, development partners and NGOs about scaling up transport systems in an environmentally and financially sustainable way. The workshop discussed the introduction of electric mobility in Rwanda and its challenges, opportunities, environmental and economic impacts that the Government vision for scaling up electric mobility will encounter as it begins implementation in partnership with the private sector. The workshop also discussed the financial sustainability of local urban roads by exploring options that have worked in other countries and comparing these with the unique challenges faced in Rwanda.

Current needs and opportunities

As Rwanda aims to promote electric mobility, it will become imperative to start aiming at building the capacity of institutions and people in all relevant aspects of transport electrification to cover among others areas on vehicles development and maintenance, charging infrastructure, operations integration, business modelling. In support of this aim, a survey was conducted under the SOLUTIONSplus project to assess the training needs for electric mobility development in Kigali and the following are some of the results:

Possible Major obstacles to e-mobility transition in Kigali

- Insufficient personnel
- Limited knowledge/ skills on e-mobility
- Limited knowledge on business cases
- Reluctance of transport operators (due to fear of job loss and lack of knowledge)
- Limited maturity of technology
- Lack of suitable technologies
- Limited financial means
- High upfront investment cost

Areas with highest need for trainings for Kigali

1. Vehicles and infrastructure technologies (incl. charging)
2. Operations
3. Battery disposal / recycling
4. Business modelling
5. Communication, Advocacy and Promotion

Training topics for Kigali

- Maintenance of Evs – e-bikes and e-motos

D4.1 Nine (9) Demonstration Implementation Plans

- EV Charging
- Charging standards
- Batteries
- Electricity grid
- Business models
- Financing options
- Financing requirements
- Fiscal incentives
- Developing frameworks that encourage private sector involvement

Preferred forms of capacity building activities for Kigali

- Face-to-face trainings
- Study tours / site visits
- Practical workshops
- City-to-city exchange (peer-to-peer)
- On the job training
- Guidelines and user manuals

The areas with the highest need for training for Kigali as identified in the survey will require concerted efforts from all relevant stakeholders for improvement. There exist opportunities for the city both locally and internationally to get engaged in capacity building especially for key officials, personnel and interested individuals. Under the SOLUTIONSplus, several capacity building activities and opportunities will be made available for the city of Kigali and could help boost the uptake of electric mobility in Kigali and to a large extent in Rwanda. Some of these training opportunities and tools are summarized as follows:

Table1: Training Opportunities

Areas with highest need for trainings in Kigali	SOL+ topics (Learning Modules)	Existing courses	webinars/E-	Factsheets – WP3	Trainers & experts
1.Vehicles and infrastructure technologies (incl. charging) 2.Operations 3.Battery disposal / recycling 4.Business modelling 5.Communication,	Vehicles Electric 2- and 3-wheelers	https://www.itdp.org/event/plugging-e-bikes-and-e-scooters-into-sustainable-transport-networks/		Electric 2-wheelers / electric 3-wheelers (FIER / CAA) Electric E-scooters Sharing (WI) https://www.itdp.org/publication/electric-assist/	UNEP, Valeo, WI, CAA
	Operations Use of existing systems and (PT) grids for the charging of Evs	http://event.seev4-city.eu/#webinars		Multi-purpose charging with public transport grids (RC)	RC, T-Systems, Dynniq
	Seamless charging and shared			Factsheet on e-Mobility Solutions – Hot Spot Charging Network	Volvo, Dynniq

D4.1 Nine (9) Demonstration Implementation Plans

Advocacy and Promotion	charging			
	Mobility as a Service	<ul style="list-style-type: none"> • eHUBS: What are they and how do they connect different modes in a MaaS landscape? • MaaS Alliance podcasts • Webinar MaaS all-hands • What role will playments play in delivering MaaS? 	Factsheet on “MaaS” guidelines Factsheet on “Eco-Routing in public transport”	PLUS, ERTICO, V2C2, UNH
	Business modelling and planning Developing e-mobility business models (incl. Multi-purpose charging/ shared DC infrastructures)			VTT, RC
	Policy integration and finance Sustainable Urban Mobility Planning	The SUMP Topic Guide on Electrification (RC, Polis) e-course on “Advancing electric mobility in the context of SUMP”		RC, CODATU, TUB, Polis
	Financing innovation in e-mobility	<ul style="list-style-type: none"> • SUITS – Public Procurement & Innovative Financing • SPICE Webinar: How can cities obtain innovative mobility solutions by applying new procurement approaches • SUMPs UP. Financing and funding for sustainable urban mobility 	SUMP topic guides: financing and funding for sustainable urban mobility; Innovative procurement for sustainable urban mobility	TUB, ERTICO, UITP, Polis, WI
	eMobility4All Inclusion, affordability and public acceptance		Ensuring inclusion in e-mobility projects (UNH)	UNH, RC, TUB

Table2: Useful Tools

Area	Useful Tools	Partners and Experts
Vehicles	Guidelines for vehicle selection Fleet sizing guidelines	IDIADA
	e-mob calculators (LDVs, buses 2&3 wheelers)	UNEP
	Smart Emission Measurement System (SEMS)	TNO
Operations	<ul style="list-style-type: none"> National requirements for smart charging spots Guidelines for charging equipment planning and installation 	DTU
	Strategic map charging infrastructure for Electric Vehicles	FIER
	Guidelines on charging solutions	IDIADA
Integration	GoodMoovs integral sharing platform	FIER
	MaaS	Pluservice
	Collection of factsheets on e-mobility, infrastructure, mobility management and planning	UEMI
Business Models	<ul style="list-style-type: none"> CBA method MCDA method 	DTU
	<ul style="list-style-type: none"> Funding and Financing of SUM Measures Public Procurement of SUM Measures 	WI
	FESTA Handbook	ZLC

Again, under the SOLUTIONSplus project, there are opportunities for the local stakeholders in Kigali to get engaged in building partnerships with European start-ups and organizations involved in development mobility solutions. Among some of these are the following which were identified in an initial scan carried out:

Initial Scan – Potential EU Partnerships

Electric 2wheelers (battery)

- Spike / KIBO (Amsterdam)

Electric 2wheelers (cargo bike)

- o Urban Arrow (7 EU cities)

Spike is active in battery development for special electric vehicles such as motorcycles. They implemented the driveline and battery packs in the KIBO motorcycle as the first pilot for use in urban mobility. Whilst Urban Arrow developed an electric two-wheeler cargo bike in 2010 and is currently operational in more than 7 European cities. The SOLUTIONSplus project partner FIER is in contact with both organizations.

1.3 Key Stakeholders

1.3.1 Local government departments

The City of Kigali

The City of Kigali is the administrative entity responsible for the overall development of the areas under its jurisdictions. The City is made up of three districts namely Gasabo, Kicukiro and Nyarugenge. Administratively, the City of Kigali is structured under the following: the Council,

D4.1 Nine (9) Demonstration Implementation Plans

the Executive Committee, the Security Committee and the Executive Secretariat. Considered as a model modern city in Africa, the City of Kigali envisions to make Kigali the “Centre of Urban Excellence in Africa” through Social Inclusion, Sustainable Development, and Economic Growth (City of Kigali, 2013). The responsibilities of the City of Kigali involve among several others the following: supervising the implementation of national policies in the Districts; preparing the development plan of the City; providing guideline and coordinating planning activities; monitoring activities and the functioning of the Districts; providing services that are not delivered by other administrative entities in the City of Kigali; developing and implementing transportations plans; promoting and following up on investment activities. Under SOLUTIONSplus, the project team will work in close coordination with all administrative structures of the City of Kigali to ensure smooth implementation of planned demonstration actions

1.3.2 National government departments

Rwanda’s Ministry of Infrastructure

The demonstration actions in Kigali will be implemented with active engagement of Rwanda’s Ministry of Infrastructure which is responsible for the transport and energy sectors. The Ministry of Infrastructure is in charge of the overall transport policy and strategic planning, the creation of a transport enabling environment, and setting of transport rules, regulations and standards. The Ministry performs among others the following responsibilities: initiating programs to develop, rehabilitate and maintain an efficient and integrated national transport infrastructure network, including roads, bridges, airports, railways, and water transportation; initiating, developing and maintaining sustainable power generation facilities to supply clean, cost-effective and uninterrupted energy for the country and the region; supervising the implementation of quality standards and norms, and issues relating to cost effectiveness, environmental sustainability, safety and cross-cutting issues in infrastructure development. The Ministry also facilitates, promotes and engages the private sector to attract the needed investments in infrastructure.

Other national-level institutions which will be engaged under SOLUTIONSplus include the Rwanda Transport Development Agency (RTDA) and the Rwanda Utility and Regulatory Authority (RURA).

Rwanda Transport Development Agency (RTDA)

The RTDA is responsible for the management and administration of the transport sector. The RTDA also carries out duties in the maintenance and development management of transport infrastructure excluding air transport, and also undertakes tactical functions for transport services.

Rwanda Utilities and Regulatory Authority (RURA)

The RURA is the regulatory authority for the transport sector which ensures that utilities including transport related entities provide goods and services to meet the demands and needs of users.

1.3.3 Industry (European and international) – SOLUTIONSplus Partners

Valeo Group

Valeo Group is involved in four different core businesses: Visibility Systems, Powertrain Systems, Comfort Driving Assistance Systems and Thermal Systems. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2 emissions and to the development of intuitive driving. In Kigali, Valeo will work with local partners to design, develop and test electric powertrain solutions (48V) for e-motorcycles.

UN-Habitat

UN-Habitat, the United Nations agency for human settlements, helps the urban poor by transforming cities into safer, healthier, greener places with better opportunities where everyone can live in dignity. Under Urban Mobility, UN-Habitat seeks to promote a paradigm shift away from the movement of vehicles to equitable and sustainable access of citizens to workplaces and services and improved movement of goods within the city. UN-H will be responsible for the capacity development component under SOLUTIONSplus and will also contribute actively to the demonstration activities and the development of business models and plans.

ITDP

The Institute for Transportation and Development Policy works with cities worldwide to bring about transport solutions that cut greenhouse gas emissions, reduce poverty, and improve the quality of urban life. Given ITDP's core competencies and track record, a new area of focus will be on the electrification of high-use vehicles, specifically formal and informal public transport and shared two- & three-wheeled "micro-mobility" fleets, and the design of city policies that incentivize electric vehicles and other low carbon mobility modes. In Rwanda, ITDP is collaborating with government ministries to develop national standards for street design and TOD and best practices for BRT corridors. In Kigali, ITDP is providing technical assistance to the city to implement and scale up best practice NMT projects that increase low-carbon mobility and integrate with transit.

UNEP

UNEP is the principal environment agency of the United Nations, established by the UN General Assembly in 1972. UNEP is implementing its global electric mobility programme, supporting more than 45 low and middle-income countries with the introduction of electric mobility. UNEP is supporting more than 35 countries with the introduction of national policies and standards to promote electric light duty vehicles – in all regions.

AfDB

Implementation platforms will be established with the African Development Bank (AfDB) which is a partner development bank under GEF-7 project. The involvement of AfDB will ensure that the demonstration actions can be sustained and scaled-up to achieve transformational change in the partner and replication cities.

2. Demonstration Action

2.1 Situation analysis

2.1.1 Vehicles

While nearly no electric vehicles could be found on the African continent until recently (Black et al, 2018), the situation has started changing locally, with a few start-ups developing battery electric motorcycles in East-African countries over the last few years. In Kigali (Rwanda), the company Ampersand, established in 2016, has started testing prototypes in 2018 and is commercially operational since May 2019, with a result of 400,000 km driven on their 20 electric motorcycles as of early 2020. The next phase is to scale up the number of motorcycles in 2020.

The higher upfront investment cost required for EV purchase is identified as one of the most significant uptake barriers, also in African contexts (Wahab and Jiang, 2019). This is even more the case for vehicles using Li-ion batteries instead of lead-acid ones, even if Li-ion battery prices have been decreasing (Black et al, 2018). However, electric two-wheelers compensate this competitive disadvantage through significantly lower operational and maintenance costs (Black et al., 2018). The amount of possible gains, including the break-even point, depend on local conditions (fuel, electricity prices) and business models. In Kigali, Ampersand estimates net economic gains of yearly 634.22 USD for its drivers, representing a 108% net benefit for them. Enabling economic gains is likely to prove as the most critical driving factor to the take-up of electric motorcycles. Ampersand states that fiscal measures (lower electricity tariffs and VAT on import and charging) could permit reaching 95,000 e-motorcycles in Kigali by 2025.

With regards to electric bicycles, recent efforts by some private investors to revolutionize mobility in Rwanda have seen the likes of Gura initiating green mobility options such as electric bikes in Kigali. The company has developed 200 base models bike ready for deployment with 5 E-bikes prototypes which have gone through several modifications to make them suitable for the hilly Kigali terrain. The e-bikes are expected to have a rechargeable battery using solar power panels installed at the docking stations and can go up to 150km on a single ride without shutting down. Gura targets to roll out 300 E-bikes for the commencement of a first phase for the Kigali city area. Kigali, the District of Musanze and the Citadel of academic excellence in Rwanda Huye are the areas already mapped out.

2.1.2 Charging

Charging or swapping batteries are two available options for electric two-wheelers, the latter having been largely explored in East-African countries; and also in Rwanda. A significant advantage of electric two-wheelers lies in the detachable characteristics of the battery which may be charged at home or swapped. The smaller size of the batteries, compared with cars or buses, also has an impact on the costs and the economic viability of electric motorcycle projects. A swapping option, giving the possibility to exchange a depleted battery against a fully charged one at a swapping station, bears the substantial advantage that batteries can be owned by the company (mobility, energy provider or a third entity), and rented out to the driver, therefore removing the upfront investment barrier for the latter. This is a key advantage in a context of economic development and transportation informality, with limited individual purchase capacity. In addition, swapping may be realized in a very short time i.e. 2 minutes often cited, therefore not immobilizing vehicles – and requiring corresponding – space for

D4.1 Nine (9) Demonstration Implementation Plans

charging. Some East-African projects use lithium-ion batteries, recognized for their longer lifespan, capacity and energy density compared with lead-acid batteries, as well their decreasing prices. Reuse for stationary energy storage purposes is feasible. There are also opportunities to explore solar energy for charging considering the local availability of this type of energy source

2.1.3 Integration

Recent efforts to integrate public transport systems in Kigali include plans by the Rwanda Utilities Regulatory Authority (RURA) to deploy a mobile application intended to provide public transport users information on bus itineraries and schedules. There is limited information as to whether the mobile application is currently operational in the city. Other integration initiatives are being explored by local start-ups such as Gura which is developing a Mobile Application for the operation of its intended bike sharing system in Kigali.

To conclude this section, it must be mentioned that the potential of two-wheeler electrification to curb carbon emissions has been well documented. In East-Africa, this low-carbon opportunity has already been assessed in Kigali at 157,000 tons of CO₂-e that can be cut out every year if the city's 30,000 motorcycle taxis are converted to electric mobility (Ampersand, 2020). In Kigali, motorcycle taxis are said to contribute 16 times more than cars to air pollution, while transportation is responsible for approximately half of air pollutants. Promoting the agenda to electrify the transport system in Kigali as envisaged in the SOLUTIONSplus project will therefore significantly help reduce transport-related emissions in the city and contribute to climate change mitigation efforts both locally and globally.

2.2 Demonstration objectives and logical framework

2.2.1 Short outline of the main objectives.

The demonstration action in SOLUTIONSplus focuses on e-mobility for last-mile connectivity in Kigali. It will have a systemic approach integrating the Public Bus System with electrified feeder-services provided by 30 e-moto taxis (20 new and 10 remodelled) and 100 e-bikes that support first/last mile connectivity. With support from city authorities, transport operators and bus manufacturing companies, a suitable business model for e-Buses for the city's current bus transport administration will be explored. Expectedly, the project will create a good precursor to public transport electrification in Kigali. The business model for e-moto taxi will also be developed in the demonstration project. Together with riders, transport associations and other relevant institutions, 10 existing motorcycles will also be remodelled into e-motorcycles – with the possibility to easily swap and charge batteries (Lithium-ion) and considering local-EU prototypes with Valeo 48V. The demonstration project will also test the establishment of an e-Bike sharing scheme along the most widely used bus corridors with charging points fitted with solar power energy to provide seamless charging service to riders and patrons. For the wider use of E-Moto taxis and E-Bikes, smart services applications will be explored that support eco-routing.

The demonstration project will involve existing transport operators, service providers and associations including motorcycle taxi associations, bike rider groups and other relevant transport associations in Kigali. In partnership with local investors such as those outlined above,

D4.1 Nine (9) Demonstration Implementation Plans

the demonstration project will introduce e-moto taxis in the city and support the installation of fast charging infrastructure at public places and vantage points. Other stakeholders of relevance to the project will include international vehicle manufacturers and local vehicle manufacturers and suppliers.

2.2.2 Logical Framework

Table3: Logical framework

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to Kigali)	MILESTONES (and other notes)
<p>OUTCOME 1. Availability of high-quality e-mobility innovations is increased.</p> <p><i>Baseline:</i> In terms of vehicles, the current e-mobility solutions in urban areas are primarily limited to passenger transport. Charging solutions available to the public (as well as public transport operators) are still quite limited.</p> <p><i>Target:</i> High quality e-mobility solutions (100 e-bikes and 20 E-moto taxi: 10 new and 10 remodeled) developed by local industries are made readily available to the market.</p>			
1. Locally produced vehicles (e-bikes and e-motorcycles) for last mile connectivity is developed and tested	1. Call for local SMEs to design, develop, test prototypes, and produce the on-the-ground units for the demonstration.	1. Conduct of the call for local SMEs 2. Selection and awarding	1. Call for local SME conducted by October 2020.
	2. Design, prototyping, testing phase	1. Design 2. Prototyping 3. Internal/ in-facility testing and validation	2. Design available by Dec 2020 3. Final prototypes available by March 2021
	3. Production of units for demonstration		1. Demonstration units available by June 2021
2. On-the-ground demonstration of vehicles for last mile connectivity is conducted and assessed	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	1. Kigali demo launched by June 2020 2. Detailed demonstration mechanics available by Dec 2020 3. Functional requirements to be available by October 2020 (c/o UITP)
		2. Research support conducted by DLR on the integration concept	
		3. TU Berlin Design studio supporting study – data and participation from Kigali	1. Results of study available by July 2020
	2. Implementation of on-the-ground demonstration activities	1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be

D4.1 Nine (9) Demonstration Implementation Plans

			submitted April 2023
	3. Assessment	1. Determination of KPIs 2. Baselining activities 3. Monitoring 4. Analysis of data and evaluation	1. KPIs from SOL+ to be available by month 12
3. Innovative charging facilities are demonstrated and assessed	1. Call for proposals SMEs with existing charging solutions – innovate and demonstrate	1. Conduct of the call for local SMEs 2. Selection and awarding	1. Call for local SME conducted by October 2020.
	2. Planning for the installation and implementation		
	3. Installation and monitoring		
	4. Assessment		
4. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.
<p>OUTCOME 2. Conditions for enabling accelerated e-mobility uptake are improved.</p> <p><i>Baseline:</i> The current enabling environments for e-mobility (relating to business, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcomed.</p> <p><i>Target:</i> Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</p>			
1. Business models and business plans are developed and validated	1. Identification of locally appropriate transformative business model concepts directly relating to the demonstration activity		
	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021
2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+
3. Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by

D4.1 Nine (9) Demonstration Implementation Plans

are developed			January 2022.
4. Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institution, and other relevant entities		Note: Kigali City will primarily be consulted in this process.
	2. Drafting and review of recommendations		
OUTCOME 3. Local capacities relating to e-mobility are enhanced. <i>Baseline:</i> As e-mobility is still in its nascent stage in the city/country, capacities are still highly limited. <i>Target:</i> Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.			
1. Peer-to-peer exchange program is conducted and documented	1. Visit of representative of partner city to European expert city/cities		Visit to European expert city/cities within first 18 months
	2. Visit of European experts to the partner city	1. Planning and development of itinerary 2. Visit	1. Visit of European expert/s to the partner city between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner city and European experts to expert cities outside Europe		1. Joint visit between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
2. Toolkit for e-mobility is developed and shared with local stakeholders	1. Needs assessment		
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

2.3 Demo Description: Feeder-services provided by 30 e-moto taxi (20 new and 10 remodelled) and 100 e-bikes run on sharing system to support first/last mile connectivity

2.3.1 Test scenarios

A test scenario describes the environment in which the SOL+ demonstrations take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Table4: Test Scenario

Solution: e-motorcycle sharing system			
Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i> <i>e) etc.</i>		
Vehicles involved (type)	e-motorcycles and e-bikes		
Vehicles involved (unit)	30 e-motorcycles, 100 e-bikes		
Integration with PT system	Bus Transport System		
Lines/stops involved (units)	Most widely used corridors (tbc)		
Time span (testing activities)	From June to December 2021		
Time span (data collection)	<table border="1"> <tr> <td>Before Jan. to June 2020</td> <td>After June to Dec 2021</td> </tr> </table>	Before Jan. to June 2020	After June to Dec 2021
Before Jan. to June 2020	After June to Dec 2021		

2.3.2 Vehicles/infrastructure/equipment provision

- *What is needed with regard to equipment overall?*
 - 30 e-motorcycles and 100 e-bikes
 - Batteries (with swapping options)
 - Charging equipment with possibilities for solar powered solutions
 - MaaS App to integrate services
 - Business models
- *What is available already?*
 - There are private initiatives on e-moto taxi provided by Ampersand which have 20 e-motorcycles with 3 battery swapping stations; and Gura which is also developing prototypes of electric motorcycles. Currently, there are no initiatives by the local authorities (City of Kigali) itself with regards to electric mobility.
- *What needs to be purchased by the city (100,000 EUR budget)?*
 - 30 e-moto taxi (20 new and 10 remodelled) and 100 e-bikes
 - Batteries
 - Charging infrastructure
 - MaaS App
- *What could be contributed to demo cities from a European start-up, SME.*

D4.1 Nine (9) Demonstration Implementation Plans

- Valeo will be involved in providing vehicles powertrain solutions.
- Pluservice will contribute to the development of a MaaS App or integrate MaaS App feature into existing local Applications.
- Partnerships from EU SMEs such as Spike and Urban Arrow will be sought. Spike is active in battery development for special electric vehicles such as motorcycles whilst Urban Arrow is into electric two-wheeler cargo bikes. Support on capacity building for local start-ups in Kigali will be explored.

	SME call	City Equipment Budget	Industry partners
Staff time and inhouse facility			
Design	-	-	-
Development of prototypes	-	-	-
Testing of prototypes	-	-	-
30 e-motorcycles (20 new and 10 remodelled)			
E-motorcycles (20 new and 10 remodelled) including batteries, GPS monitoring device, and other accessories	24,000	30,000	-
Charging Infrastructure and Installation	-	10,500	-
Helmets		1,250	-
100 e-bikes			
E-bike equipped with smart lock and GPS tracker	8,325	27,100	-
Swap battery for bikes	2,775	15,725	-
Helmet for users	375	2,125	-
E-Locker charging station for battery	10,000	13,300	-
Bike dock station for pickup and drop-off of bikes	3,200		-
Powertrain Components	-	-	tbc
All other components	1,325		
GRAND TOTAL	50,000	100,000	tbc

The budget presented in the table above is indicative. Initial plans would explore the possibility of locally assembling the e-motorcycles and e-bikes through the participation of local start-ups. Some of these e-motorcycles and e-bikes could be equipped with Valeo powertrains (from the Valeo project budget). The city's 100,000 EUR budget could be used towards a call for local innovators for the provision of charging infrastructure, batteries and other vehicle parts and accessories. The SME Call for Innovators would also complement these activities and would be funded from the budget of partners such as UNEP and UN-Habitat.

2.4 Detailed Time-plan

The Gantt chart below details the different demo phases.

2.5 Business model plan

Business plans for the demonstration actions in Kigali will lay out concrete steps to seize business opportunities that have been identified. The plans will also identify local businesses, EU partnerships and specific envisioned services and products relevant for the demonstration actions. Some preliminary opportunities and business ideas that could be explored within the East African region and also for Kigali are explained as follows:

- Start-ups working on electric two-wheelers adapted to East-African contexts, have some similar innovative characteristics which could be relevant to explore for the business models development in this project. One first feature is the swapping of batteries, i.e. the exchange of depleted batteries against charged ones at dedicated locations. This may be undertaken in a very short time, comparable to time of refuelling (2 minutes according to Ampersand), instead of having to wait for charging purposes. In Kigali, Ampersand uses former shipping containers as swapping infrastructure. This is innovative as swapping has not much emerged as a popular system yet (Eccarius and Lu, 2020).

Other options that may be envisaged for the demonstration especially at the replication stage are:

- Classical individual purchase by the driver. To finance the investment differential when switching to Evs, financing support and loans may be explored through Savings and Credit Cooperative Organization (SACCOs), commercial or cooperative banks, or microfinance institutions.
- Rental or leasing of vehicles and/or batteries. Battery rental has the advantage of lifting the barrier of upfront investment cost for the driver, an important factor in contexts of limited individual purchase power. In addition, renting the battery removes anxiety over its lifespan and warranty for the driver, since the battery is owned, maintained, and replaced by the rental company. It may also facilitate the battery end-of-life management. Several models may be explored for the pricing, including yearly subscription combined with a daily fee allowing a (limited/unlimited) number of swaps, or pay-as-you-go, a model where fees vary depending on energy consumption (pay per kWh).
- Lithium-ion batteries, whose price has been decreasing and which are more efficient and environmentally friendly than lead-acid batteries, can be rented out to the drivers. By renting this expensive component, the upfront investment cost – one of the typical highest barriers to electric mobility take-up -, is shifted from the driver to the mobility or energy provider. Designing models that de-risk operations for informal transport drivers and economically benefit them from the start is a key advantage in a context of limited individual financial resources.

D4.1 Nine (9) Demonstration Implementation Plans

- Regarding bike sharing systems, the business models to explore in Kigali could follow the mainstream models where estimating the costs of a bicycle-sharing system depends on a number of factors, such as the size of the system (number of stations and bicycles) and the type of stations and bicycles (infrastructure and technology). Operating costs include maintenance, distribution, staff, insurance, office space, storage facilities, website hosting and maintenance, and electricity (if necessary). A key factor that will also be considered for the operational and economic success of the system is redistribution, which consists in rebalancing the bicycles that are near capacity to stations that are empty.

2.6 Team involved

The table below provides a distribution of responsibilities.

Table5: Responsibilities

Main Role	Company	Name	Contact
Demo leader	City: Kigali city Implementation: UN-H, ITDP, UNEP	Christopher Kost Alphonse Nkurunziza	chris.kost@itdp.org alphonse.nkurunziza@itdp.org
Vehicles provider	Initial scans show that there are possibilities of engaging local start-ups such as Gura, Safi, Ampersand, REM in the demonstration. The selection of the start-ups will be done through the Innovation Call. SOLUTIONSplus partner Valeo will also be involved in providing vehicles powertrain solutions.	Simon MIDRIER	simon.midrier@valeo.com
Charging system provider	Charging infrastructure solutions will be sought locally and also possibly within the East African region.	Tbc	tbc

D4.1 Nine (9) Demonstration Implementation Plans

	Some prototype charging solutions dependent on solar energy have been developed by local start-ups such as Gura. Possible collaborations will be explored in this regard.		
App/software provider	Local start-ups will team up with SOLUTIONSplus partner Pluservice to develop a MaaS App through the Innovation Call. Initial engagements show the possibility to improve on existing local Applications under development.	Paulo Cantillano Daniela Vasari	p.cantillano@pluservice.net d.vasari@pluservice.net
City support	UEMI	Edmund Teko, Emilie Martin, Oliver Lah (UEMI)	Emilie.martin@uemi.net, edmund.teko@uemi.net, oliver.lah@uemi.net

2.7 Risks Assessment

Table6: Risk Assessment

<i>Risk</i>	<i>Probability assessment</i>	<i>Consequences</i>	<i>Risk mitigation/comments</i>
Delay in importation of projects equipment due to shutting down of global business caused by COVID-19	Medium	SOL+ vehicle prototype development delays	Initiate importation process well in advance of planned vehicle prototyping schedule

D4.1 Nine (9) Demonstration Implementation Plans

			Get guidance on customs clearance procedures and identify alternatives
Bureaucracy of local institutions e.g. those involved in providing the infrastructure (eg. Charging points, licenses) for the demonstration	Medium	Untimely execution of project deliverables which in turn adversely affects delivery of other project activities	Early engagement of stakeholders that play crucial roles in the project and effective communication of the vital role they are going to play.
Changes of leadership in key implementing partner institutions (especially before and after local elections) leading to implementation gaps	Low	Delay in project implementation	Clearly identify and actively engage from the project onset stakeholders (officers, staff, ...) whose positions are not affected by leadership changes

2.8 Monitoring

To ensure that the demonstration actions are carried out effectively and achieve its aims, a continuous monitoring of key performance indicators (KPIs) will be carried out against baseline indicators. These KPIs will be defined in close cooperation with the city of Kigali and all other relevant local stakeholders to ensure that the city's specific needs and objectives are duly incorporated. The KPIs will be developed under the WP1 and will cover environmental, social and economic aspects and will include both quantitative and qualitative indicators on energy/fuel consumption, costs/benefits of EV use, user acceptance, perceived safety, among others. The monitoring activities will aim to ensure a smooth implementation of planned activities including full compliance with schedule, milestones and deliverables.

3. Preliminary replication opportunities

It is anticipated that the demonstration actions implemented in Kigali will create a good precursor to public transport electrification in Kigali and also beyond. Knowing that there is growing demand for 2 and 3 wheelers and there already exists quite a number of local start-ups working on e-mobility in Kigali such as Gura, Safi, Ampersand, REM is indicative of the appreciation for urban electric mobility development in the city. As such, it is expected that the opportunities to replicate the solutions developed under the project in other parts of Kigali as

well as other cities in Rwanda will receive local support especially as local and national authorities continue to create the enabling environment for such innovations.

4.Updates

This section will be periodically updated.

4.1 Progress towards implementation

- Held call between Valeo and Start-ups in the East African region to explore potential partnerships on vehicle development
- Information on drivetrains/powertrains for e-motos and e-bike (Valeo) shared with some identified local start-ups
- Possibilities are being explored on how to integrate Valeo powertrain products into existing prototype bikes and motorcycles of some of the local start-ups
- Discussions ongoing with Pluservice to integrate features of MaaS App into Apps hosted by some local start-ups
- Discussions on how SOL+ can help with trainings, App development and business model development

4.2 Next steps

- There is need to define which of the corridors best suit the integration drive with the Public Bus System
- Explore Business models (on-demand or sharing schemes) with DART
- Call for local innovators upcoming to select local start-ups for the demonstrations

5. References

Ampersand, 2020. Electric in Arica? <https://ampersand.solar/>

Black, A., Barnes, J., Makundi, B., Ritter, T. (2018). *Electric two-wheelers in Africa? Markets, production and policy*. <https://www.greengrowthknowledge.org/sites/default/files/Electric%20two-wheelers%20in%20Africa.pdf>,

City of Kigali 2013: City Development Plan (2013-2018). Available at:

http://www.kigalicity.gov.rw/fileadmin/Template/Documents/policies/Kigali_City_Development_Plan_2013-2018_City_development_Plan_.pdf . Retrieved on 28th February 2019.

Eccarius, T., Lu, C.-C. (2020). Powered two-wheelers for sustainable mobility: A review of consumer adoption of electric motorcycles. *International Journal of Sustainable Transportation*, 14(3), pp.1–17

Krauß Maria Susanne, 2018: Volkswagen in Rwanda: Car-sharing and a future in e-mobility. Available at:

<https://www.dw.com/en/volkswagen-in-rwanda-car-sharing-and-a-future-in-e-mobility/a-42224583>

Republic of Rwanda 2015: Intended Nationally Determined Contribution (INDC) for The Republic Of Rwanda. Available at:

https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Rwanda%20First/INDC_Rwanda_Nov.2015.pdf.

Rwanda Utilities Regulatory Authority (RURA), 2020. RURA's Responsibilities in road transport Regulation. <https://rura.rw/index.php?id=81>

Volkswagen, 2016. Developing new market potentials: Volkswagen plans integrated mobility concept in Rwanda. Available at: <https://www.volkswagenag.com/en/news/2016/12/developing-new-market-potentials-volkswagen-plans-integrated-mobility-concept-in-rwanda.html#>

Wahab, L., Jiang, H. (2019). Factors influencing the adoption of electric vehicle: the case of electric motorcycle in Northern Ghana. *International Journal for Traffic and Transport Engineering*, 9(1), pp.22–37

World Population Review, 2019: Rwanda Population. Available at:

<http://worldpopulationreview.com/countries/rwanda-population/>

D4.1 Demonstration Implementation Plan

City: Dar es Salaam

1. Operating environment

1.1 Background

1.1.1 Key facts and figures:

Dar es Salaam, with a population of around 4.3 million (annual growth rate 5.6%), is the largest city in Tanzania. In 2017 Tanzania's GDP per capita amounted to \$2,945. CO₂ per capita in Tanzania was estimated at 0.221 metric tons in 2014 with the transport sector contributing 57% of the total CO₂ emissions from fuel combustion. With renewable electricity output currently at 43 % of total electricity output, the country's aim is to increase its share of renewable energy production through increased use of hydropower, solar and other renewable energy sources.

City: Dar es Salaam

Population: 4.3 million (World Population Review, 2019)

GDP per capita: \$2,945 (2017)

CO₂ emissions (per capita): 0.221 metric tons in 2014

1.1.2 Overarching issues

Due to rapid urban growth and growing individual motorisation, the transport system in Dar Es Salaam suffers from chronic congestion. This has led Dar es Salaam City Council to introduce a Bus Rapid Transit (BRT) scheme in 2016 (named DART). 140 fossil fuelled buses are currently running, connecting the city centre with the Western suburbs (phase 1). The existing BRT stations and terminals are therefore important transport hubs. Further plans include expansion to new routes and the addition of 150 buses, which could be powered by compressed Natural Gas (CNG). The city however also considers other sustainable solutions including electric mobility solutions (e.g. e-Feeder to BRT, e-BRT-Busses, e-bike sharing).

Apart from the BRT, public transport predominantly depends on a large fleet of privately-owned minibuses (so-called dala-dala), which are often not roadworthy and contribute to congestion and air pollution. In the medium to long term, public authorities envisage to phase-out the minibuses on all major roads and replace them with BRT buses. In addition to these bus services, motorised two- and three-wheeler taxis (Boda boda and Bajaji respectively) are very common since the mid of the 2000s. They are being used by the population for shorter distances and they enable feeder-connectivity into DART and the paratransit buses. In areas not served by buses, motorcycle-taxis are the only publicly available mode of transportation and hence offer a de-facto public transport service filling a gap in the transport system. Despite these obvious benefits for people's mobility, the two- and three-wheelers have contributed to increased pollution in the city with the transport sector contributing 57% of the total CO₂ emissions from fuel combustion.

1.2 E-mobility Overview

1.2.1 Policy environment

To tackle the challenges and address climate change related issues especially in its urban areas, Tanzania has been implementing several environmental related policies and action plans; and in its Intended Nationally Determined Contributions (INDCs), has committed to reduce GHG emissions between 10-20% relative to the Business-As-Usual scenario of 138 – 153 MtCO₂e by

D4.1 Nine (9) Demonstration Implementation Plans

2030. In doing so, Tanzania has pledged to among other solutions, mitigate transport sector emissions through the development of Mass Rapid Transport Systems (United Republic of Tanzania, 2015). As part of this drive, DART Interim Services started on 16th May 2016 with 140 buses comprising 39 Articulated (18M), 76 rigid (12M) and 25 feeder buses. The services are provided on 7 trunk routes/lines covering 20.9km of trunk routes, 27 stations and 5 terminals. Since commencement of Interim Services Provider (ISP) operation, there has been a continuous rise in passenger ridership on the BRT sections. The daily average ridership has crossed the 200,000 passengers per day on many occasions.

With regards to electric vehicles, the Tanzanian government has indicated to prospectively support electrification as a means to achieve sustainable mobility and to accomplish its commitments with regard to the Sustainable Development Goals (SDGs) and the New Urban Agenda (Habitat III). The national transport regulatory authority of Tanzania SUMATRA indicated the integration of electric vehicles in the upcoming revision of its road service regulations. As a first step, the Tanzania Bureau of Standards (TBS) has revised its vehicle standards to permit the certification of electric three-wheelers and has confirmed supporting a pilot project in the short term by a temporary certification process.

On energy regulations, renewable energies are strongly promoted by public authorities and associations such as the Tanzania Renewable Energy Association (TAREA). To further increase the share of renewable energy, the energy regulatory authority EWURA recently revised regulations to support net metering, thereby supporting small-scale (solar) energy production. As a result, the national energy supplier TANESCO anticipates the implementation of a net metering programme. Procedures to register energy selling or reselling kiosks are in place and TANESCO has the mandate to process applications. It is expected that a combination of such transport or mobility initiatives with the development and deployment of cleaner energy solutions such as electrification, will engender greater benefits and support the local and global agenda to reduce the impact of climate change.

Also, the Tanzania Climate Change Strategy among other things pledge to improve the energy diversity and efficiency in major energy consuming sectors including power generation, manufacturing, and transportation; the latter is also identified as a notable source of emission. One of the mitigation objectives is to promote the use of other clean technologies. Specifically, on transport, the goal aims at building a transport system with minimum GHG emission. The Climate Change Strategy also underpins research innovations and technologies on eco-friendly energy sources which are not limited but include transport sector innovations that render the sector climate smart.

Infrastructure gaps still exist in the transport sector (National Five-Year Development Plan 2016/2017- 2020/2021). Other plans like the Dar es Salaam Transport Policy and System Development Master plan which is the key document that has been instrumental so far in implementing projects to improve the city's transport provides a roadmap to 2030 but has limitations to the technologies suggested especially in terms of integration to renewable energy technologies in its implementation. There is mention of integrating CNG in city busses through DART, but the omission of the rest of clean technologies may omit the opportunity to develop an infrastructure for other technologies like electricity alongside road network development.

Some strategic intervention mentioned in the transport sector from the Tanzania Climate Change Strategy include promoting fuel switch in transport facilities, promoting use of mass transport facilities and proper urban transport planning to facilitate efficient and low GHG modes of transportation. The country is in the mist of implementing these strategic interventions; however, the current infrastructure development in the public transport sector exhibits inconsistencies with regards to concurrent investments enhancing low emission in mass transport facilities. Despite the mention of promotion of centres of excellence and establishment of government system to incentivise system for appropriate technologies, established centres still require technical and financial support to incubate young innovators not to mention the ill funded research and centres of excellence. Most innovators rely on short term grants without necessarily having the know-how in accessing the same.

1.2.2 Business environment

Generally, the business models in the 3-wheeler-market have developed within the past 10-15 years and are well established. Hence, the current equilibrium between drivers, drivers' associations and investors should be handled with care, as destroying these complex interrelations could decrease the acceptance and provoke resistance of those fearing to lose their source of income. Looking at the vehicles, the conventional 3-wheeler vehicle market is dominated by three manufacturers: the Indian brand TVS King, the Indian company Bajaj and the Italian company Piaggio.

Compared to 2-wheelers, 3-wheelers are more sustainable as they have the capacity to carry three passengers plus the driver and provide easier access for disabled persons. Apart from increasing mobility, 3-wheeler-motor taxis provide much-needed employment opportunities. Till date, the market had already created an estimate of about 50,000 direct jobs. The growth has been fuelled by a large number of mainly small-scale investors who offer vehicles to drivers who cannot afford their own vehicle. Besides a minor share of independent owner-drivers, the two- and three-wheeler market, therefore, is dominated by drivers who rent a vehicle or have a hire-purchase contract, where ownership of the vehicle is transferred from the initial owner/investor to the driver (typically) after 18 months. Recently, registered drivers' associations have started copying these business models and providing vehicles for their members at better conditions.

Despite the commitment of the country in supporting lower emissions in the transport sector, research and innovations in e-mobility is sporadic, un-coordinated and carried out by national institutions, academia, private sector and NGOs. The involvement of these organisations in e-mobility is driven out of personal initiatives and interests ranging from technology upgrading and awareness raising, innovation in productive uses of electricity especially in rural areas and addressing pollution issues. There is no clear road map on how emission reductions in high emitting sectors like the transport are going to be met although opportunities are numerous. It is also not clear how existing infrastructure is going to integrate clean technologies except for isolated efforts by interested organisations. The communication of e-mobility innovations in the country is still a new concept to many and data of companies involved is scarce and difficult to obtain on public sources such as the internet or in innovation centres.

1.2.3 Capacity building (CB)

Current state and initiatives

E- mobility is a relatively new concept in the transport sector in Tanzania. However there have been some few local initiatives with capacity building elements. The National Transport Institute of Tanzania has developed an electric car prototype, and is conducting further research to improve it. Such initiatives are few and rare and are pursued by individual institutions, NGO or private sectors who are aware of the technology and have interest. Also, CNG prototype cars have been developed and tested by national institutions but electric (hybrid) cars are largely owned by few individuals who are attracted by the low running fuel costs. The idea of electric cars apart from the NIT who are trying out their innovation is a relatively new concept especially at institutional level and few who are involved in e- mobility initiatives are aware and even there are limitations to this new concept in the mobility sector in the country.

Current needs and opportunities

Promoting electric mobility in Dar es Salaam will require concerted efforts aimed at building the capacity of institutions and people in all relevant aspects of transport electrification to cover among others areas on vehicles development and maintenance, charging infrastructure, operations integration, business modelling. In support of this aim, a survey was conducted under the SOLUTIONSplus project to assess the training needs for electric mobility development in Dar es Salaam and the following are some of the results:

Possible Major obstacles to e-mobility transition in Dar es Salaam

- Lack of intersectoral coordination (transport / energy / planning)
- Lack of enabling policy and regulatory framework
- Limited knowledge/ skills on e-mobility
- Reluctance of transport operators (due to fear of job loss and lack of knowledge)
- Difficulty / resistance of passenger to adapt to new technology (e.g. range anxiety)
- Limited maturity of technology
- Difficult supply of batteries/ battery materials
- Limited financial means
- High upfront investment cost

Areas with highest need for trainings for Dar es Salaam

1. Vehicles and infrastructure technologies (incl. charging)
2. Operations
3. Business modelling
4. Integration in policies and plans
5. Procurement & contracting

Training topics for Dar es Salaam

- Vehicle and Infrastructure Technology
- Mechanics (services and maintenance)
- Battery

D4.1 Nine (9) Demonstration Implementation Plans

- Charging standards
- Charging system
- Charging points
- Business Model
- Attracting startups
- Procurement and Contractors

Preferred forms of capacity building activities for Dar es Salaam

- City-to-city exchange (peer-to-peer)
- Study tours / site visits
- Face-to-face trainings
- Online courses / digital platforms
- Guidelines and user manuals

The areas with the highest need for training for Dar es Salaam as identified in the survey will require collaborative efforts from all relevant stakeholders for improvement. There exist opportunities for the city both locally and internationally to get engaged in capacity building especially for key officials, personnel and interested individuals. Under the SOLUTIONSplus, several capacity building activities and opportunities will be made available and could help boost the uptake of electric mobility in Dar es salaam and to a large extent in Tanzania. Some of these training opportunities and tools are summarized as follows:

Table1: Training Opportunities

Areas with highest need for trainings in Kigali	SOL+ topics (Learning Modules)	Existing courses	webinars/E-	Factsheets – WP3	Trainers & experts
1.Vehicles and infrastructure technologies (incl. charging) 2.Operations 3.Business Modelling 4.Integration in Policies and Plans 5.Procurement and Contracting	Vehicles Electric 2- and 3-wheelers	https://www.itdp.org/event/plugging-e-bikes-and-e-scooters-into-sustainable-transport-networks/		Electric 2-wheelers / electric 3-wheelers (FIER / CAA) Electric E-scooters Sharing (WI) https://www.itdp.org/publication/electric-assist/	UNEP, Valeo, WI, CAA
	Operations Use of existing systems and (PT) grids for the charging of Evs	http://event.seev4-city.eu/#webinars		Multi-purpose charging with public transport grids (RC)	RC, T-Systems, Dynniq
	Seamless charging and shared charging			Factsheet on e-Mobility Solutions – Hot Spot Charging Network	Volvo, Dynniq
	Mobility as a Service		<ul style="list-style-type: none"> ● eHUBS: What are they and how do they connect different modes in a 	Factsheet on “MaaS” guidelines Factsheet on “Eco-Routing	PLUS, ERTICO, V2C2,

D4.1 Nine (9) Demonstration Implementation Plans

		MaaS landscape? <ul style="list-style-type: none"> • MaaS Alliance podcasts • Webinar MaaS all-hands • What role will payments play in delivering MaaS? 	in public transport”	UNH
	Business modelling and planning Developing e-mobility business models (incl. multi-purpose charging/ shared DC infrastructures)			VTT, RC
	Policy integration and finance Sustainable Urban Mobility Planning	The SUMP Topic Guide on Electrification (RC, Polis) e-course on “Advancing electric mobility in the context of SUMP”		RC, CODATU, TUB, Polis
	Financing innovation in e-mobility	<ul style="list-style-type: none"> • SUITS – Public Procurement & Innovative Financing • SPICE Webinar: How can cities obtain innovative mobility solutions by applying new procurement approaches • SUMPs UP. Financing and funding for sustainable urban mobility 	SUMP topic guides: financing and funding for sustainable urban mobility; Innovative procurement for sustainable urban mobility	TUB, ERTICO, UITP, Polis, WI
	eMobility4All Inclusion, affordability and public acceptance		Ensuring inclusion in e-mobility projects (UNH)	UNH, RC, TUB

Table2: Useful Tools

Area	Useful Tools	Partners and Experts
Vehicles	Guidelines for vehicle selection	IDIADA
	Fleet sizing guidelines	
	e-mob calculators (LDVs, buses 2&3 wheelers)	UNEP
	Smart Emission Measurement System (SEMS)	TNO
Operations	<ul style="list-style-type: none"> • National requirements for smart charging spots • Guidelines for charging equipment planning and installation 	DTU

D4.1 Nine (9) Demonstration Implementation Plans

	Strategic map charging infrastructure for Electric Vehicles	FIER
	Guidelines on charging solutions	IDIADA
Integration	GoodMoovs integral sharing platform	FIER
	MaaS	Pluservice
	Collection of factsheets on e-mobility, infrastructure, mobility management and planning	UEMI
Business Models	• CBA method	DTU
	• MCDA method	
	• Funding and Financing of SUM Measures	WI
	• Public Procurement of SUM Measures	
	FESTA Handbook	ZLC

Again, under the SOLUTIONSplus project, there are opportunities for DART and other local stakeholders to get engaged in building partnerships with European start-ups and organizations involved in developing mobility solutions. Among some of these are the following which were identified in an initial scan carried out:

<p>Initial Scan – Potential EU Partnerships</p> <p>Electric 3wheelers</p> <ul style="list-style-type: none"> • Tripl (Denmark) <p>Battery</p> <ul style="list-style-type: none"> • Betteries (Germany)

TRIPL is a Danish designed three-wheel electric vehicle, developed as an emission free solution for Last Mile Delivery whilst Betteries has developed mobile and affordable batteries for developing and emerging economies based on upcycling EV batteries.

1.3 Key Stakeholders

1.3.1 Local government departments

- *DART Agency*

The planned project activities will be coordinated and supported by DART Agency which has oversight responsibility for the whole transport system in Dar es Salaam including general traffic management and planning duties, in close collaboration with NIT – Tanzania National Institute of Transport. Dar Rapid Transit (DART) Agency is a government entity established by GN No. 120 of 25th May 2007 under the Executive Agencies Act No. 30 of 1997 and its subsequent amendments. The key role of the DART Agency is to establish and operate the Bus Rapid Transit (BRT) system for Dar es Salaam City. The Agency aims at achieving the following objectives: establish and operate Bus Rapid Transit (BRT) system for Dar es Salaam, branded Dar Rapid Transit (DART); ensure orderly flow of traffic on urban streets and roads; and ensure effective Management of the Agency (DAR Rapid Transit Agency, 2019). The Agency operates under the guidance of the President’s Office, Regional Administration and Local Government (PO-RALG). The Agency’s mission is to have a modern public transport system at reasonable cost to the users and yet profitable to the operators using high-quality capacity buses which meet international standards, are environmentally friendly, and operate on exclusive lanes, at less travelling time.

- *Dar Es Salaam City Council*

The Dar es Salaam City Council is the decentralised local government institution in charge of coordinating developmental issues cutting across the five municipalities (Kinondoni, Ilala, Ubungo, Kigamboni and Temeke) under its jurisdiction. The five municipalities are responsible for the provision of basic social services including waste management, district roads, primary education, and primary health care, monitoring of economic development activities, recreational parks, and urban planning. The main functions of the Dar es Salaam City Council include among others the following: coordinating the powers and functions of municipalities with respect to infrastructure, preparing coherent framework for sustainable development, maintaining peace and providing security, emergency, fire and rescue services. The City Council's functions also extend to promoting cooperation among local authorities and supporting and facilitating the overall performance of local authorities under its jurisdiction (Dar es Salaam City Council, 2019). Under SOLUTIONSplus, the Council will facilitate local stakeholder identification and engagement and provide guidance in the development of demonstration actions.

1.3.2 National government departments and institutions

Other stakeholders envisaged for the demonstration action include the Land Transport Authority of Tanzania (LATRA) which regulates land transport sectors; Tanzania Bureau of Standards (TBS) which is responsible for vehicle standards permitting and certification and will assist in the certification process of electric three-wheelers. Also, Tanzania's scientific institutions that have a strong interest in electric mobility will be worth engaging. These include institutions such as the National Institute of Transport (NIT) which is carrying out research on e-mobility and has prototype electric cars that they are advancing; Tanzania's National Transport Research Centre; and the Department of Electrical Engineering at the University of Dar es Salaam (UDSM). Other institutions include the following:

- *TANESCO*

The Tanzania National Electric Supply Company is entrusted with the responsibility to generate, transport and distribution of electricity. The company will work with the project to establish strategic charging points for the three wheelers within the existing infrastructure.

- *Ministry Of Works, Transport And Communication*

The Ministry is responsible for management of the transport sector at the national level. It is the key institution through which e- mobility policies can be advocated and integrated into national plans for funding and further development.

- *COSTECH*

The Tanzania Commission for Science and Technology promotes research and technology development activities and their application to social economic development. The organisation will play a role in furthering coordination in e-mobility research and innovation.

1.3.3 Industry (European and international) – SOLUTIONSplus Partners

The demonstration action in Dar es Salaam will involve industry player Valeo Group and implementation partners DLR, ITDP and UNEP; whilst financing partners will include AfDB and AFD. The activities and products of these partners are briefly described below.

- *Valeo Group*

Valeo Group is involved in 4 different core businesses: Visibility Systems, Powertrain Systems, Comfort Driving Assistance Systems and Thermal Systems. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2 emissions and to the development of intuitive driving. In Dar es Salaam, Valeo will design, develop, and test a complete electric powertrain solution (48V) for 3-wheelers. Integrated in a fleet of 3-wheelers, the solutions and the vehicles will be tested in Dar Es Salaam to validate the requirements and specifications, based on the local market specific needs. After the modification of the powertrain to better suit local needs, Valeo will work with local partners to deliver 10 e-Tuktuks that integrate the modified powertrain for Dar Es Salaam.

- *DLR*

The German Aerospace Center (DLR) is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport, security, and digitalisation is integrated into national and international cooperative ventures. In the SOLUTIONSplus project DLR act as the: lead in the piloting of the demonstration case in Dar-es-Salaam in relation to the e-3 wheelers; scientific advisor especially on informal transport, micro-informal transport, mode integration and methodological issues; scientific lead on data collection. Ex-ante and ex-post evaluation of these data; and contributor to planning on the integration of formalized trunk-routes along with new mobility concepts.

- *ITDP*

The Institute for Transportation and Development Policy works with cities worldwide to bring about transport solutions that cut greenhouse gas emissions, reduce poverty, and improve the quality of urban life. ITDP is composed of some of the world's leading experts in sustainable urban transportation and urban development. Given ITDP's core competencies and track record, a new area of focus will be on the electrification of high-use vehicles, specifically formal and informal public transport and shared two- & three-wheeled "micro-mobility" fleets, and the design of city policies that incentivize electric vehicles and other low carbon mobility modes. These areas offer benefit to the most people, particularly in urban contexts, and can maximize the value of government support most effectively. This new work on electrification will be integrated across and additive to ITDP's existing core strategies, including public transport, cycling, walking, travel demand management, and transit-oriented development.

- *UNEP*

UNEP is the principal environment agency of the United Nations, established by the UN General Assembly in 1972. UNEP is implementing its global electric mobility programme, supporting more than 45 low and middle-income countries with the introduction of electric mobility. UNEP is supporting more than 35 countries with the introduction of national policies and standards to promote electric light duty vehicles – in all regions.

- *UN-Habitat*

UN-Habitat, the United Nations agency for human settlements, helps the urban poor by transforming cities into safer, healthier, greener places with better opportunities where

D4.1 Nine (9) Demonstration Implementation Plans

everyone can live in dignity. Under Urban Mobility, UN-Habitat seeks to promote a paradigm shift away from the movement of vehicles to equitable and sustainable access of citizens to workplaces and services and improved movement of goods within the city. UN-H will be responsible for the capacity development component under SOLUTIONSplus and will also contribute actively to the demonstration activities and the development of business models and plans.

- *AfDB and AFD*

SOLUTIONSplus will establish implementation platforms with key regional finance actors, such as the African Development Bank (AfDB) which is a partner development bank under GEF-7 project; and the Agence Française de Développement (AFD) which is involved in the MobiliseYourCity partnership. AFD is France’s inclusive public development bank. The bank commits financing and technical assistance to projects that genuinely improve everyday life, both in developing and emerging countries and in the French overseas provinces. AFD has financed mass public transport infrastructure including metros, tramways, BRT systems and has announced a new intervention framework that has extended the bank’s scope of interventions in the transport sector. The framework includes supporting the definition and implementation of public policies for sustainable mobility, at national and local level (planning, governance, financing mechanisms, capacity building for actors); financing all the components of a sustainable mobility policy: optimization of traffic flows, paths for pedestrians and cyclists, electric mobility; making mobility contribute to the “quality of the city” and build a long-term vision integrating transport and urban planning; supporting the modernization of small-scale and informal transport; systematically seeking to integrate innovation in terms of the digital and energy transformation of mobility services. The involvement of these finance institutions will ensure that the demonstration actions can be sustained and scaled-up to achieve transformational change in the partner and replication cities.

1.3.4 Local businesses and start-ups

The project will require the collaboration and cooperation with existing transport operators and companies from the public and private sectors, amongst others, motorcycle-taxi drivers and their associations, vehicle owners, vehicle assemblers and distributors. The project will involve MAPIMAMATA – National motorcycle-taxi drivers’ association (12,750 members in Tanzania; 6,900 members in Dar es Salaam), solar energy companies based in Dar es Salaam, and at a later stage a recycling company for vehicles and batteries. Some other ongoing initiatives in the country whose information became available are briefly described below:

- *ELICO*

ELICO is a company that deals with reverse technology in rural areas converting equipment that uses fossil fuel into solar powered equipment including hatching and milking machines. Their current technology is on e-mobility, converting fossil fuel tricycles to e-tricycles. The organisation is partnering with two companies from Germany (Micro-energy International and BATTERY) to pilot conversion of fossil fuel Bajajis to E-Bajaji.

- *PowerCorner*

Another player in the sector is PowerCorner, a company that provides electricity in rural Tanzania through solar-powered mini-grids. PowerCorner is an internal start-up of ENGIE

D4.1 Nine (9) Demonstration Implementation Plans

Group. They have been involved in e-mobility as a solution to increase productive use of electricity in Southern Tanzania. They have pioneered a charging technology of e-bicycles and bikes from the grid in Southern Tanzania. The company is aware of challenges and can share lessons from the same. The company is also working on a model to use the e-bikes and motorbikes in town.

- *TFL*

TFL motors is a company that imports vehicles into the country for business. It has been on the lead in pioneering e-motor bikes in the country. The company imports and sells e-motorcycles.

2. Demonstration Action

2.1 Situation analysis

The BRT services in Dar es Salaam operate on 20.9km trunk corridor with 27 stations, 5 terminals, 1 depot, 4 transfer stations and expected to have a total of 305 fossil fuel buses (177 on the trunk and 128 feeder buses) as phase one of infrastructure project aiming at improving Dar es Salaam mobility and accessibility. Users on the BRT join the trunk system by feeder buses and in other places customers use motorbikes and three wheelers for their last mile connection. Three wheelers and motorcycles are also commonly used in peak hours when transport is highly on demand from the BRT trunk to off road settlements.

The current BRT infrastructure and the 5 phases to follow covering major routes in Dar es Salaam will provide the needed reliable public transport to majority of city dwellers. However, there is always going to be a need for the last mile connection as Dar es Salaam is one of the fastest growing cities in Africa and it is impractical to reach out to all parts of the city by the trunk system. The current motorbikes and 3-wheelers serving the last mile connection offer an opportunity for DART to adopt a sustainable model through e-3 wheelers which will not only contribute towards emission reduction in the transport sector but also offer jobs throughout the value chain. One of the advantages of the existing infrastructure is that it allows for easy integration of e-3 wheelers into the BRT system through the provision of charging points in some of the terminal stations.

Having mentioned the above, it must be noted that capacities to develop e-mobility integration is still limited in terms of both soft and hard infrastructure. The SOLUTIONSplus project is the first to conduct a demonstration on e-mobility in the BRT system through the last mile connection initiative. Currently, little is known about the e-mobility industry and its potential to contribute towards the local economy and establishing a sustainable transport sector. Hence the demonstration in Dar es Salaam will contribute immensely to exploring the benefits of the e-mobility integration agenda.

On the policy side, there are also no explicit policies that support, incubate, and develop the policy and institutional environment for e-mobility and other cleaner technologies. With regards to technology, very basic trials are ongoing and have just started and some of the key

D4.1 Nine (9) Demonstration Implementation Plans

technologies important for a sustainable e-industry are yet to be developed e.g. batteries, maintenance, charging technologies etc.

Concerning vehicles, it is a common practice in Tanzania for one motorbike to be used by more than one passenger (which is standard practice) raising safety issues by consumers of the service. The 3-wheelers are considered safer than the motor bikes for many reasons; the dangerous habits of maneuvering through traffic without taking into consideration the traffic rules, the inappropriate number of passengers they carry, poor infrastructure to support them just to mention a few. Reported number of deaths between 2008 and 2014 caused by motor bike accidents more than triples within 6 years, yet these remain an important means of transport to bridge the transport gaps. The three wheelers are also more inclusive in their design in terms of gender and marginalized groups, more women and people with physical disabilities own and ride three wheelers.

The numbers of motorbikes and tricycles in the country have been on an exponential rise (AFCAP, 2015). Most three wheelers run on internal combustion engines emitting substantial amounts of particulate matter and black carbon (UNEP, undated). With the current increase in use of 2 and 3 wheelers it is strategic for the BRT in Dar es Salaam to initiate electric 3-wheelers in the system. Engaging electric three wheelers will save the city emission burden that fossil fuel 3-wheelers would have caused. It may also provide profitable business models to the communities and employment to a number of people involved in the value chain especially where local innovation is encouraged.

2.2 Demonstration objectives and logical framework

2.2.1 Short outline of the main objectives.

The demonstration project in Dar Es Salaam will focus on e-mobility for last-mile connectivity. The demonstration aims at integrating 60 electric feeder/e-3-wheeler and distribution services with Dar es Salaam's BRT (DART) to support first/last mile connectivity. The e-3-wheelers (newly built 50 imported/provided by DART and 10 newly built with Valeo components), will be an integral part of public transport. Under SOLUTIONSplus, the deployment of e-3 wheelers will happen at 5 DART stations considering urban locations: a) in the city centre, where fossil-fuelled 3-wheelers are currently banned for environmental reasons and where accessibility to/from the BRT stations can be limited due to longer distances; b) in peri-urban areas where combustion-fuelled 3-wheelers are currently very common as feeder-modes. Also, a feasibility study on the electrification with respect to vehicle specifications (range, speed), charging infrastructure (type and location) will be carried out. As part of this, state-of-the-art data collection methods using geo-localization devices will be applied for a detailed derivation of the systems specifications. Subsequently, an implementation plan for the introduction of e-3-wheelers will be developed. This will follow a systemic approach and include the development of business models (vehicle ownership, rental schemes, and maintenance), the charging infrastructure and localisation.

D4.1 Nine (9) Demonstration Implementation Plans

Further aspects to be assessed under the demonstration relate to the battery type (fixed vs. battery swapping), ownership models (leasing/pay-per-use model), the use of existing telecom and power distribution boxes to accommodate vehicle charging, fleet bundling, and eco-routing. Interaction with the passengers and the system will be fostered through the SOLUTIONSplus-MaaS-smartphone application that will consider the growing smartphone ownership of Dar es Salaam’s population, to allow a maximum spread of the use and increase smart metering services. An open Application Program Interface (API) will be made available to allow 3rd-parties/software programmers to develop further services. The demonstration project will furthermore include local stakeholders as much as possible to increase the acceptance of the system: The current 3-wheeler market employs many people in Dar and the inclusion of current drivers will be a crucial target of the project. Furthermore, capacity building on sustainable maintenance of the vehicles will be carried out, building on the current structures of OEMs in Tanzania. Tanzania has already a high share of renewable energies through hydropower which will be used for the services.

The demonstration action will address two highly important challenges of urban mobility: Firstly, how to overcome the last-mile connectivity issue of mass-transit services such as BRT, secondly the issue of sustainability for combustion fuelled small-scale vehicles. Innovative aspects of the project are as follows: it will make electric 3-wheelers appear on the streets of Dar es Salaam for the first time, showcasing the suitability and advantages of electric vehicles; and also it will be placed in different locations in the city (central/down-town, commercial, residential and sub-urban) to test various types of locations and environments with respect to the usability of electric three-wheelers. This includes BRT stations and terminals that are served by 3-wheeler-taxis already and where e-mobility can easily adapt to the micro-local context and integrate into the existing system. The city centre will become accessible for electric 3-wheelers exclusively.

2.2.2 Logical Framework

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to the City)	MILESTONES (and other notes)
OUTCOME 1. Availability of high-quality e-mobility innovations is increased. <i>Baseline:</i> E-mobility is currently limited to a few passenger and private cars in urban areas and few safari cars and there are no public charging infrastructures available. <i>Target:</i> 60 electric feeder/e-3-wheeler integrated into the Dar es Salaam’s BRT (DART) to support first/last mile connectivity. 50 imported/locally assembled and 10 from Valeo.			
1. Locally assembled/imported vehicles (e-3 wheelers) for last mile connectivity is developed and tested	1. Procurement of vehicles and charging infrastructure 2.	1. DART to order and procure using government procedures	Vehicles and Charging devices imported or locally sourced by DART
2. Suggested business model for demonstration discussed and decided	2. Consultation with various stakeholders especially the taxi, bajaj, and boda boda associations	1. Consultation with leaders of the relevant institutions on successful business models used	1. Business model to be used ready for demo

D4.1 Nine (9) Demonstration Implementation Plans

		2. Modifying and outlining the business model of choice	
3. On-the-ground demonstration of vehicles for last mile connectivity is conducted and assessed	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	Dar es Salaam demo launched by June 2020
		2. Stakeholder consultation and assessment of existing business models	1. Identified business models tested
	2. Implementation of on-the-ground demonstration activities	1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be submitted April 2023
	3. Assessment	1. Determination of KPIs 2. Baselining activities 3. Monitoring 4. Analysis of data and evaluation	1. KPIs from SOL+ to be available by month 12
4. Development and Testing of the SOL+-MaaS App	1. Launch of the MaaS smartphone app within the BRT system. 2. Open API to allow 3rd-parties to develop further services.		Third parties have access to API and have developed other services by the end of pilot phase
5. Innovative charging facilities are demonstrated and assessed	1. Call for proposals for private sector, SMEs academia with existing charging solutions – innovate and demonstrate	1. Conduct of the call for private sector, and academia 2. Selection and awarding	1. Call for local implementers conducted by October 2020.
	2. Planning for the installation and implementation		
	3. Installation and monitoring		
	4. Assessment		
6. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.

D4.1 Nine (9) Demonstration Implementation Plans

<p>OUTCOME 2. Conditions for enabling accelerated e-mobility uptake are improved.</p> <p><i>Baseline:</i> The current enabling environments for e-mobility (relating to business, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcomed.</p> <p><i>Target:</i> Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</p>			
1. Business models and business plans are developed and validated	1. Identification of locally appropriate transformative business model concepts relating to the demonstration activity		Business models validated with feedback from the demonstration phase ready for application
	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021
2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+
3. Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans are developed	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by January 2022.
4. Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institution, and other relevant entities		Note: DART will take the lead while working with Dar es Salaam city council, LATRA and the Ministry of works and infrastructure
	2. Drafting and review of recommendations		
<p>OUTCOME 3. Local capacities relating to e-mobility are enhanced.</p> <p><i>Baseline:</i> As e-mobility is still in its infancy stage in the country, capacities are still highly limited.</p> <p><i>Target:</i> Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.</p>			
1. Peer-to-peer exchange program is conducted and documented	1. Visit of representative of partner city to European expert city/cities		1. Visit to European expert city/cities within first 18 months
	2. Visit of European experts to the partner city	1. Planning and development of itinerary 2. Visit	1. Visit of European expert/s to the partner city between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner		1. Joint visit between

D4.1 Nine (9) Demonstration Implementation Plans

	city and European experts to expert cities outside Europe		month 18 to the latter part of the SOL+ project (ideally up to June 2023)
2. Toolkit for e-mobility is developed and shared with local stakeholders	1. Needs assessment		
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

2.3 Demo Description: Integration of e-3-wheeler services with Dar es Salaam's BRT (DART):

2.3.1 Test scenarios

A test scenario describes the environment in which the SOL+ demonstrations take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Solution: Integration of e-3-wheeler services with Dar es Salaam's BRT		
Test category	a) simulations b) tests in controlled environment, c) tests under real operational conditions d) feasibility study, assessment of technological concepts, , code of practice and specifications e) etc.	
Vehicles involved (type)	e-3 wheelers	
Vehicles involved (unit)	60	
Integration with PT system	BRT System	
Lines/stops involved (units)	5 DART stations (tbc)	
Time span (testing activities)	From June to December 2021	
Time span (data collection)	Before Jan. to June 2020	After June to Dec 2021

2.3.2 Vehicles/infrastructure/equipment provision

- What is needed with regard to equipment overall?

D4.1 Nine (9) Demonstration Implementation Plans

- 60 e-3 wheelers (50 by DART and 10 by Valeo)
- Identification of best battery technology (swapping or installed)
- Identifying convenient charging technology (grid integration or use of existing system and grids for charging 3-wheelers) and installation of the same
- Development and launching of a mobile app for the BRT system
- Business models

- *What is available already?*
 - Electricity distribution systems already exist in areas where 3-wheelers can be tested.
 - DART has developed the DART City Navigator App that will need improvement

- *What needs to be purchased by the city (100,000 EUR budget)?*
 - 50 e-3 wheelers
 - Batteries
 - Charging Infrastructure
 - MaaS App features integration

- *What could be contributed to demo cities from a European start-up, SME.*
 - Valeo will be involved in providing vehicles powertrain solutions.
 - Pluservice will contribute to the development of a MaaS App or integrate MaaS App feature into existing DART App
 - Partnerships from EU SMEs such as TRIPL and Betteries will be sought. TRIPL is a Danish designed three-wheel electric vehicle, developed as an emission free solution for Last Mile Delivery whilst Betteries has developed mobile and affordable batteries for developing and emerging economies based on upcycling EV batteries.
 - Support on capacity building for DART and other local start-ups in Dar es Salaam will be explored.
 - Development of technologies that can later be tailored to fit specific context.
 - Stimulation of e-mobility sector and contribution to sustainable transport system

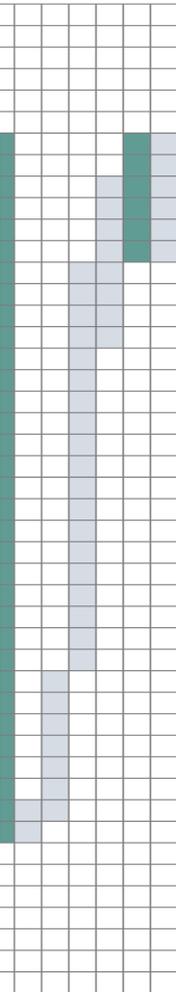
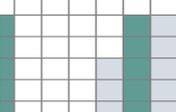
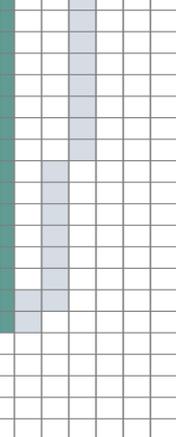
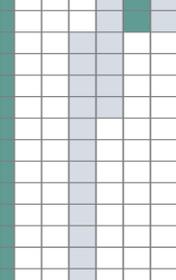
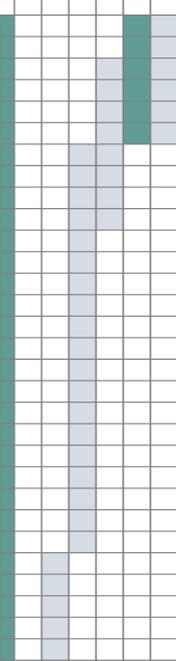
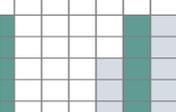
	SME call	City Equipment Budget	Industry partners
Staff time and inhouse facility	-	-	-
Design	-	-	-
Development of prototypes	-	-	-
Testing of prototypes	-	-	-
Vehicles	-	-	-
10 of Valeo prototype			tbc
50 Imported/Locally Assembled	22000	50000	-
Batteries	13000	30000	-
Charging Infrastructure and Installation	10000	20000	-
Powertrain Components	-	-	tbc
All other components	5000	-	-
TOTAL	50,000	100,000	tbc

The budget presented in the table above is indicative. Initial plans would explore the possibility of acquiring a first tranche of 10 e-3wheelers made of Valeo components and would be funded from the budget of Valeo. For the second tranche of vehicles, the 100,000 EUR in DART's budget could then be used towards a call for local innovators for the provision of charging infrastructure, batteries and e3-wheelers. These vehicles could also be equipped with Valeo powertrains (from the Valeo project budget). It is expected that the second tranche of vehicles and other equipment are sourced ideally from Tanzania but could also come from the region if needed. The SME Call for Innovators would also complement the demonstration activities and would be funded from the budget of partners such as UNEP and UN-Habitat.

2.4 Detailed Time-plan

The Gantt chart below details the different demo phases.

D4.1 Nine (9) Demonstration Implementation Plans

<p>are demonstrated and assessed including macro app integration</p> <p>MEs with existing charging solutions/Apps – innovate and demonstrate</p> <p>ation and implementation</p> <p>itoring</p>	
<p>or scale-up is developed</p> <p>e-feasibility study</p>	
<p>abling accelerated e-mobility uptake are improved.</p> <p>ess plans are developed and validated</p> <p>ration activity + data collection</p> <p>opment and preparation of commercial operation</p> <p>ustry and local businesses are established and documented</p>	
<p>i-up (c/o ERTICO)</p> <p>id start-up events</p> <p>development, institutionalization and integration of e-mobility in</p> <p>veloped</p> <p>ocal and national entities</p> <p>if recommendations</p>	
<p>relating to e-mobility are enhanced.</p> <p>am is conducted and documented</p> <p>e of partner city to European expert cities/cities</p> <p>erts to the partner city</p> <p>ity and European experts to expert cities outside Europe</p> <p>oped and shared with local stakeholders</p>	
<p>it</p> <p>ly related to the demonstration action is developed and delivered</p> <p>ification</p> <p>cities</p>	

2.5 Business model plan

Business plans for the demonstration actions in Dar es Salaam will lay out concrete steps to seize business opportunities that have been identified. The plans will also identify local businesses EU partnerships and specific envisioned services and products relevant for the demonstration actions. Business models for electric 3-wheelers in Dar es Salaam will reflect the current ownership structures of the 3-wheelers market and focus on the inclusion of drivers and other existing stakeholders to increase the acceptance. Business models would be designed to be affordable for the operators and would assure that rental costs are lower (or at least not higher) as compared to the current situation. Evaluation of the battery type as well as the development of business models for the battery (ownership, battery swapping) will be explored with leasing/pay-per-use models, using existing telecom and power distribution boxes or bus stations to accommodate vehicle charging, among others. The demonstration project will consider sustainable life-cycle-coverage from assembling the vehicles up to the disassembling and recycling of sorted-out vehicles and batteries. The business models will explore how to increase the local added value in the vehicle assembling and knowledge about the maintenance. Collaboration with existing local vehicle assemblers and distributors is therefore envisaged. Inclusion of the electric 3-wheelers in app-based on-demand mobility services or fixed scheduling (hailing, intermodal planning, payment, routing, pre-price prediction) will be explored including the provision of an open API for third-party developers to foster intermodal routing.

2.6 Team involved

The table below provides a distribution of responsibilities.

Table5: Responsibilities

<i>Main Role</i>	<i>Company</i>	<i>Name</i>	<i>Contact</i>
Demo leader	City: Dar Rapid Transit Agency (DART) Implementation: DLR, ITDP, UNEP	Fanuel O.S. Kalugendo	fanuel.kalugendo@dar.t.go.tz
Technology provider	Valeo will support with powertrain solutions and electric three-wheelers	Simon MIDRIER	simon.midrier@valeo.com
City support	UEMI	Edmund Teko, Jacqueline Senyagwa, Oliver Lah (UEMI)	jacqueline.senyagwa@uemi.net, edmund.teko@uemi.n

D4.1 Nine (9) Demonstration Implementation Plans

	ITDP	Chris Kost (ITDP)	et, oliver.lah@uemi.net chris.kost@itdp.org
Charging system provider	TANESCO, Power Corner, Dynniq and T-systems Charging infrastructure solutions will be sought locally and also possibly within the East African region. Possibilities of having the Solar powered charging system would be explored	tbc	tbc
App/software provider	DART, Pluservice, Wide Information Network	Paulo Cantillano Daniela Vasari	p.cantillano@pluservice.net d.vasari@pluservice.net
Testing of business models	DART, NIT, ELICO, Power Corner, Association of Bajaj drivers,	tbc	tbc
Testing of technology (e- mobility technology innovations)	DART, SIDO, NIT, COSTECH, FAB LABS, ELICO, Power Corner	tbc	tbc

2.7 Risks Assessment

Table6: Risk Assessment

<i>Risk</i>	<i>Probability assessment</i>	<i>Consequences</i>	<i>Risk mitigation/comments</i>
Delay in importation of projects equipment	Medium	SOL+ vehicle prototype	Initiate importation process well in

D4.1 Nine (9) Demonstration Implementation Plans

due to shutting down of global business caused by COVID-19		development delays	advance of planned vehicle prototyping schedule Get guidance on customs clearance procedures and identify alternatives
Bureaucracy of local institutions e.g. those involved in providing the infrastructure (eg. Charging points, licences) for the demonstration	Medium	Untimely execution of project deliverables which in turn adversely affects delivery of other project activities	Early engagement of stakeholders that play crucial roles in the project and effective communication of the vital role they are going to play.
Changes of leadership in key implementing partner institutions (especially before and after local elections) leading to implementation gaps	Low	Delay in project implementation	Clearly identify and actively engage from the project onset stakeholders (officers, staff, ...) whose positions are not affected by leadership changes

2.8 Monitoring

To ensure that the demonstration actions are carried out effectively and achieve its aims, a continuous monitoring of key performance indicators (KPIs) will be carried out against baseline indicators. These KPIs will be defined in close cooperation with the DART and all other relevant local stakeholders to ensure that the city's specific needs and objectives are duly incorporated. The KPIs will be developed under the WP1 and will cover environmental, social and economic aspects and will include both quantitative and qualitative indicators on energy/fuel consumption, costs/benefits of EV use, user acceptance, perceived safety, among others. The monitoring activities will aim to ensure a smooth implementation of planned activities including full compliance with schedule, milestones and deliverables.

3. Preliminary replication opportunities

The integration of electric 3 wheelers into the BRT system in Dar es Salaam through SOL+ demonstration is expected to serve as a foundation to integrate the entire BRT routes especially for the future phases of BRT development in Dar es Salaam and possibly in other cities in Tanzania. Replication activities could therefore aim at future expansion of the BRT system in Dar es Salaam especially in providing feeder services to new BRT routes using electric 3 wheelers.

4. Updates

This section will be periodically updated.

4.1 Progress towards implementation

- Possibilities to acquire first tranche of vehicles (e-tuk-tuks) from India with Valeo components are being explored
- Started scanning for potential companies in Tanzania and the region that are keen to develop vehicles together with SOL+
- Discussions have been held between Valeo and Start-ups in the East African region to explore potential partnerships on vehicle development
- DAR City Navigator App was launched beginning of May 2020
- Discussions ongoing with Pluservice to integrate MaaS App features into Dar App

4.2 Next steps

- Explore Business models (on-demand or sharing schemes) with DART
- Explore possibilities to integrate a map/network for all the charging points for e-3wheelers into Dar App
- Call for local innovators upcoming to select local strat-ups for the demonstrations

5. References

African Community Access Partnership (2015). Opportunities to improve road safety through boda-boda' associations in Tanzania. Thames

Dar Es Salaam City Council, 2019: City Profile. Available at: <http://www.dcc.go.tz/city-profile>

DAR Rapid Transit Agency, 2019: Who We Are? Available at: <https://www.dart.go.tz/pages/dart-profile>

UNEP, undated. Electric two and three wheelers. Available at: unenvironment.org/pt-br/node/562

United Republic of Tanzania, 2015: Intended Nationally Determined Contributions (INDCs). Available at: <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/The%20United%20Republic%20of%20Tanzania%20First%20NDC/The%20United%20Republic%20of%20Tanzania%20First%20NDC.pdf>

URT, Vice Presidents Office, 2012: National Climate Change Strategy.

World Population Review, 2019: <http://worldpopulationreview.com/world-cities/dar-es-salaam-population/>

D4.1 Demonstration Implementation Plan

City: Quito

D4.1 Nine (9) Demonstration Implementation Plans

1. Operating environment

1.1 Background

The Metropolitan District of Quito (MDMQ), the capital and largest city of Ecuador, has 2.7 million inhabitants. Since 1995, Quito has a BRT system composed of 5 lines, one of which runs with trolleybuses. Despite its continuous expansion, the system has already reached capacity and 40% of its fleet will soon reach the end of its useful life. As part of international negotiations, Quito committed to replace the BRT fleet with e-buses by 2025 to achieve the goal of zero emissions by 2030. In order to achieve this, an ordinance for the gradual decarbonisation of transport in Quito is currently being discussed in the Municipal Council. The ordinance includes the pedestrianization of the Historic Center of Quito, where it will only be allowed the circulation

1.1.1 Key facts and figures

Population: 2.781.640 (estimation 2020)¹¹

GDP per capita: USD 24.572.229 (2018)¹²

CO2 emissions (total and per capita): Total (2011): 5,164,946 tCO_{2-eq}¹³; per capita (2011): 2.1 tCO_{2-eq}

Modal shares: Public transport: 52.2%; School and institutional buses: 9.3%; Private cars: 19.5%; Taxis: 3.3%; Walking: 15.3%; Cycling: 0.3%¹⁴

1.1.2 Overarching issues

Mobility

Quito is the second city in Latin America to have implemented a BRT system, which has been expanded over time, increasing the served area and number of passengers. At present, the system is composed of 5 BRT lines, which cover 136 km with exclusive lanes that cross the city in a north-south direction, completing 1 million trips on a regular working day (Havela Rodríguez 2019).

The first BRT line -Trolebús- was implemented in 1995 with 113 trolleybuses running on 37 km of exclusive lanes connected to the electricity grid. This is the only BRT line, which runs on electricity. However, the diesel engines supposed to be used only in case of emergency, were used more frequently than needed. Furthermore, due to the age of the trolleybuses running on this line, many have been replaced by diesel buses. In the past years, 80 biarticulate (18m) diesel buses were bought to replace some of the oldest buses and increase capacity (Bravo 2017).

¹¹ INEC, Proyecciones Poblacionales (2010-2020)

¹² Cuentas cantonales, Banco Central del Ecuador (2018)

¹³ Secretaría de Ambiente (2015)

¹⁴ Municipio del Distrito Metropolitano de Quito (2011)

D4.1 Nine (9) Demonstration Implementation Plans

Currently, the BRT system counts on 324 buses (feeder buses not included), from which 87 are 19 years old or older and 37 are 14 years old. These represent 38% of the total fleet of the BRT system. Moreover, there are 2.380 diesel buses that make part of the public transport system, which are run by private operators and conduct a total of 1.6 million trips on a regular working day (El Comercio 2019).

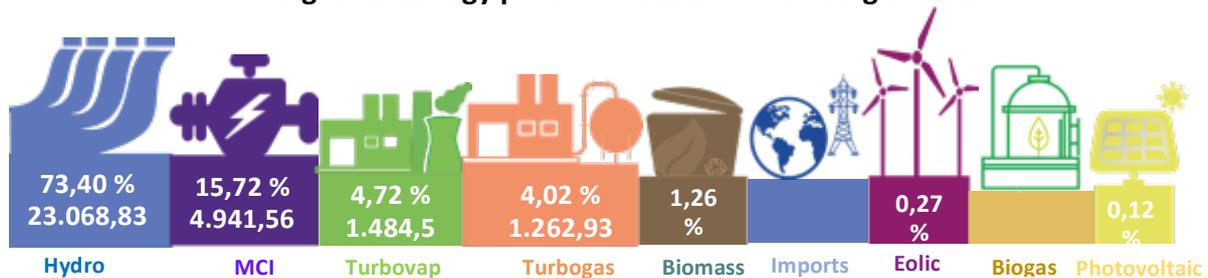
The current public transport system in Quito has already reached capacity, and has not been able to provide safe and comfortable travels to its passengers, generating an important shift towards private cars in the past years. Thus, in 2010 the municipality decided to build the first subway line. The works started in January 2016 and it is supposed to be ready by the end of 2020. It is a 23 km long line with 15 stops and will cost USD 2 billion. The line crosses the city from north to south, serving a similar route than the one done by the BRTs. However, the subway line is not planned to replace the BRT system, but to complement it. Accordingly, the whole public transportation system is being restructured to integrate the new subway line in the most efficient way possible (Metro de Quito 2020).

Moreover, in October 2017 in a high-level event organized by C40, the previous mayor of Quito, Mauricio Rodas, committed to renew the bus fleet with electric buses until 2025 to achieve the goal of zero emissions by 2030 (El Comercio 2017). Thus, the first electric bus (BYD) runs operative since November 2017 in one of the BRT lines and other buses have been tested in regular bus routes (EPMTTP 2018).

Energy

According to data from August 2019, 75% of the energy produced in Ecuador comes from renewable sources, mostly from hydropower as it can be observed in Figure 1.

Figure 1: Energy production in Ecuador – August 2019



Source: (ARCONEL 2019)

However, when it comes to the total energy consumption in the country, transport continues to be the sector with the highest energy consumption with 46% of the total amount of oil consumed annually, from which 31% corresponds to diesel oil and 27% to gasoline. Accordingly, the National Energy Efficiency Plan (PLANEE) has defined the transport sector as one of its main lines of action with a strong focus on new technologies (MTOP, GIZ Ecuador, and b4future 2018).

GHG emissions

D4.1 Nine (9) Demonstration Implementation Plans

Moreover, the National GHG Inventory of 2012 showed that the energy sector was responsible for 46.3% of GHG emissions from which transport accounted for 45.2%, with a total of 37.6 million tCO₂eq. By 2015, land transport consumed 87% of the energy of the subsector, from which heavy freight was responsible for 44% (MTOP, GIZ Ecuador, and b4future 2018).

Air pollution

Since 2003, Quito counts on an Air Quality Monitoring Network, which has been updated and upgraded in recent years with the incorporation of state-of-the-art equipment and the installation of new automatic air quality stations. The main source of air pollution in Quito is transport, mainly vehicles running on diesel fuel (buses and trucks), aggravated by vehicle congestion caused by private vehicles followed by the impact, in specific areas, of thermoelectric plants and other industries use bunker fuels and fuel oil (Díaz Suárez 2017).

Over the past 5 years Air quality has remained relatively constant at a moderate level, with some minor fluctuations from year to year. Nevertheless, when it comes to Particulate Matter (PM) concentrations for 2017 continue to exceed the limits of the Ecuadorian Air Quality Standard (NECA). For the contaminant PM_{2.5}, the maximum monitored in the DMQ was 21.7 µg/m³, 6% higher than the maximum reported in 2016. With respect to the quality objectives proposed by the World Health Organization (WHO), the pollution levels of Quito are associated with a long-term mortality risk that is about 9% higher than if the provisions of the World Health Organization's Air Quality Guidelines (AQG) were met (Díaz Suárez 2017).

It is worth noting that with the vehicular interdiction in some arterial streets of the HCQ, not only reduced the vehicular circulation in 42%, but it also reduced the PM_{2.5} in 27% and the CO emissions in 60% in the whole area (Carvajal 2019b).

1.2 E-mobility overview

1.2.1 Policy environment

Existing regulations

National level

Ecuador has three important advantages to introduce electromobility: relatively short geographical distances, an energy matrix with predominance of renewable energy sources and an overall national electricity coverage of 98.8%. Over the last years, different public and private stakeholders in Ecuador started the debate on introducing electromobility as a realistic solution for a more efficient and sustainable transport. Some cities have pioneered electrical vehicles despite missing national framework (GIZ, 2019). Currently, there are several initiatives to promote different modes of electromobility in the country like e-bikes sharing, electric taxis, electric busses etc. Furthermore, according to the Interamerican Development Bank (IDB), in 2018 Ecuador was the third Latin-American country, after Mexico and Brazil, with higher market penetration of hybrid cars (Electromovilidad en América Latina, 2019).

D4.1 Nine (9) Demonstration Implementation Plans

In 2015, the national government started a tax reduction program to promote the commercialization and purchase of electric cars. Since then electric cars under US\$40,000 are not subject to import duties and those under US\$35,000 are not subject to VAT or Tax on Special Items (ICE). Moreover, electric vehicles are eligible for a reduced electricity price. However, the number of electric vehicles in the country is still very low, due to the lack of infrastructure: only 337 vehicles were sold between 2016 and 2019, i.e. 1% of the total sales in the period (Pacheco 2019b). In the case of batteries, in June 2019 a Resolution that reduced the import tax rate from 25% to 0% in all cases and for car chargers and charging stations from 5% to 0% was approved (González 2019). Electric bicycles can as well be deducted fully from income tax as a health good (El Telégrafo 2019).

Additionally, in 2015 the Framework Agreement for the Promotion, Marketing, and Prospects of Manufacture of Batteries and Electric Vehicles in the Republic of Ecuador was enacted in order to encourage the introduction of electric vehicles in the country and the eventual production of them in the national territory. Furthermore, resolution ARCONEL-038-15 defines tariffs with differentiated hourly demand for recharging medium and high voltage electric vehicles (Arconel, 2015).

More recently, in order to cope with the challenges and benefit the specific advantages of the country, the Ecuadorian government started organizing different actors to develop an appropriate structure to facilitate the introduction of electromobility in the country. First advances are:

- Electromobility is spearheaded by the Vice-president of Ecuador through the “National Agreement of Ecuador 2030”, which is an initiative led by the Vice-presidency of the republic, that aims to bring together public and private sector with civil society and international organisms, to develop norms, policies and plans on relevant areas of national interest under the framework of the SDGs.
- Approved in March 2019 the National Law on Energy Efficiency which regulates the transport sector. According to it, electric propulsion technology must be prioritized for public and freight transport; progressive consumption and emissions’ limits will be enforced and according to Art. 14 starting in 2025 all new urban transport vehicles (buses) will have to be electric (Pacheco 2019a).
- Resolution N. 016/2019 offers an exemption from import tax for electric vehicles with a value of less than US \$ 40,000, as well as charging centers and batteries (Comité Comercio Exterior, 2019).
- The development of a low-emission National Urban Mobility Policy supported by the EUROCLIMA+ program. This national policy seeks to establish policies and strategies, including e-mobility, to reduce GHG emissions, maintaining levels of equity and accessibility,
- Develop a study financed with GIZ support to define the future demand of electricity on the local level for e-vehicles

Ecuador signed the Paris Agreement in 2016 and became member of the NDC Partnership in 2018. In March 2019 Ecuador issued its first Nationally Determined Contribution (NDC). In its mitigation chapter a reduction of 9% in GHG emissions from the Energy, Industry, Agriculture

D4.1 Nine (9) Demonstration Implementation Plans

and Waste sector is defined in the unconditional scenario, and a reduction of up to 20% is estimated in the conditional scenario. Moreover, strengthening energy efficiency; shifting its consumption behavior; and fostering urban sustainable mobility are enunciated as lines of action in the Energy sector (NDC, 2019).

Moreover, in December 2019, the national government through the Ecuadorian Development Bank (BEDE) and the municipality of Quito through the Municipal Enterprise of Mobility and Public Works (EPMOP) subscribed an agreement for USD 130 millions to implement sustainable urban mobility projects that include the purchase of 300 electric buses (Presidencia de la República del Ecuador 2019).

Due to the severe fiscal deficit the country is going through at the moment, the national government has decided to review the subsidies to fossil fuels. In August 2018, the national government decreed the withdrawal of the subsidies for high quality gasoline (92 octanes – Super). The demand for this product dropped 40% in the first 6 months of the measure (Primicias 2019). Moreover, in October 2019, the president decided to also withdraw the subsidies for all types of fossil fuels, including diesel. This caused a severe political unrest that forced him to pull out the decree. However, there is a negotiation process going on, by which the national government wants to push forward the elimination of the subsidy.

Overall, the public budget has been affected by an average of USD 2.3 billion per year over the past 10 years to finance the fossil fuel subsidy, almost 3% of the country's Gross Domestic Product (GDP) or the equivalent of 10% of oil export revenues. Between 2008 and 2014, Ecuador had the third highest fuel subsidy in relation to GDP in Latin America and the Caribbean, surpassed only by Bolivia and Venezuela (Alvaro 2019).

Local level

Under the initiative of the previous mayor, the Municipality of Quito has developed an Ordinance Proposal on the 'Gradual Decarbonization of Transportation and Promotion of Clean Transportation in the Metropolitan District of Quito'. One of the main points of the proposed ordinance is the progressive renewal of the bus fleets of all BRT lines starting with 10% of the fleet. All public transport operators should present fleet renewal plans. With the aim of creating a zero-emissions Historic Center of Quito (HCQ) by 2020, the public transport fleet that circulates through the HCQ will be the priority for renewal.

The updated draft of the Ordinance includes as basic principles the prevalence of public over private transport; the progressive restriction of fossil-fueled vehicles; the free-concurrency for sales of vehicles with zero emissions technology, with its corresponding service and technical, preventive and corrective support, and sale of spare parts and other related services.

The main body of the ordinance authorizes the establishment and operation of zero emission vehicle charging stations in public and private properties, prior to compliance with the requirements established by the architecture and urban planning regulations, and other legal regulations in force in the Metropolitan District of Quito.

D4.1 Nine (9) Demonstration Implementation Plans

It also includes a chapter on incentives for the use of zero emission vehicles, that include preferential attention and discount in yearly technical revision process and a 40% discount in parking fees in Municipally owned parking lots. In terms of public and commercial transport the ordinance indicates that public Transport Operators may opt for priority attention in the integration of routes, if they present a plan to incorporate at least 30% of their authorized fleet with zero emission vehicles. Similarly, Taxis companies who choose to apply for location and / or relocation of parking lots and / or parking lots in high-demand circulation areas, sensitive areas, special tourist areas of the city and of development, Metro areas and transfer stations of passengers must present a plan to incorporate at least 25% of their authorized fleet with zero emission vehicles. Finally, incentives for manufacture of vehicles with zero emissions technology are also included, in the form of land property tax reduction.

The Ordinance also includes a specific chapter for the Low-emission Zone. For its implementation it establishes the creation of a Technical Coordination Table in charge yearly of measure planning and entrance control, given that from the year 2021 onwards, exclusive access of zero emission vehicles or previously authorized units is expected. In parallel, it indicates that the public land transport routes of passengers that circulate through the declared area in the Historic Center will be relocated in accordance with the Plan of reorganization of routes and frequencies of the public transport service and that from 2021 only zero-emission taxi units will be able to circulate.

However, the approval of the mentioned ordinance, as well as the launch of the bidding process for the purchase of 20 e-BRT-buses and 50 fully electric trolleys for the BRT system, a fleet renewal plan for the Central North BRT Corridor, which is operated by a private company, are pending on the table of the new elected Mayor and Municipal Council. Another challenge is that these measures will have to be supported by a readjustment of the public transport fare, which for the past 16 years has been USD 0.25, in order to assure the financial sustainability of integrated public transport system (Havela Rodríguez 2019).

The new Mayor, Jorge Yunda, in office since May 2019, has made some first steps, showing his willingness to push forward projects related to e-mobility.

- In June 2019 he announced the installation of 10 charging stations in different areas of the city. These will complement the 2 existing ones, which have been installed in shopping malls by the automobile company KIA (Carvajal 2019a).
- Moreover, since September 2019, he enforced a new odd-even regulation, by which cars, depending on their car plates, are not allowed to circulate in the city during a period of 15 hours of one weekday every week. In order to avoid the growth of the car fleet with the purchase of a second car, restriction days will change every 2 months. Before, the restriction was only applied during peak hours (5 hours in total) on a specific day for each plate number. In the case of e-bikes and e-scooters, the regulation does not apply. Meanwhile, for Evs and e-motorcycles only the previous regulation applies (5-hour restriction). Despite the fact, that this regulation was introduced temporarily (for an estimated period of 9 months) to ease the resurfacing works that are planned in the whole city, it has triggered an increase in the purchase of e-bikes, e-scooters and Evs.

D4.1 Nine (9) Demonstration Implementation Plans

Also relevant for the demonstration action is the Integral Plan of Development of the Historic Center of Quito, launched by the previous municipal administration in 2018, which outlines four strategies to face the main problems identified in the area. These include the creation of a sustainable multimodal mobility and public space network and the promotion of local capacities and economic activities in the HCQ (IMP 2018).

The Integral Plan establishes a model for mobility based on the organization by super blocks („supermanzanas“), which foresees a rearrangement of vehicular traffic, based on a study of redistribution of public and private transport, as well as mechanisms of mitigation and adaptation to climate change, for a continuous improvement of environmental quality (IMP 2018). Furthermore, the Plan states that the regulatory framework to be developed should prioritize the use of electric transport in the HCQ to reduce the negative impacts produced by air and noise pollution. The proposed Plan for the Integral Development of the HCQ foresees the introduction of electric freight and passengers’ vehicles (IMP 2018).

Another relevant initiative in the local context, comes from the cooperation already in place from C40 to the City of Quito. The C40 Climate Action Planning Program in Latin America offers the opportunity to support and catalyze climate actions by the city through flagship project. In such context, Quito defined as flagship project *“Climate Neutrality for the Soil of Quito. Adaptation and mitigation criteria for resilient public space and sustainable land use planning”*. Two key outcomes are expected resulting from this study:

Product 1. Urban planning standards for the zero emissions area of the Historic Center of Quito, and for the personal and electric mobility project to be implemented (Solution Plus).

Product 2. Proposal for regulations on resilient urban standards for the use of land and public space against heat waves and floods.

Policy gaps

Regarding policy and regulation, Ecuador has less progress than other countries in the region. The following table unveils existing regulations, gaps and normative arrangements still in progress.

Table 1: Existing and missing regulations related to electric mobility in Ecuador

Public policy instruments / strategic framework targeting e-mobility	Existing	Partially / in Progress	Gap
National Electric Mobility Strategy (or National Mobility Policy with a strong focus on e-mobility)		x	
Local electric mobility strategies (or Sustainable Urban Mobility Plans with a strong focus on e-mobility)			x
E-mobility addressed in the country NDC			x
E-mobility NAMA			x
Plans to integrate e-mobility in the NDC update phase		x	
Incentives for the purchase of electric-vehicles or clean vehicles			
VAT rebate / exemption	x		

D4.1 Nine (9) Demonstration Implementation Plans

Import duty rebate / exemption	x		
Vehicle conversion premiums			x
Property tax rebate / exemption			x
Waiver on tolls and parking			x
Waiver on driving restrictions		x	
Differentiated electricity tariffs	x		
Environmental taxes rebate / exemption			x
Regulation			
Regulation of charging stations			x
Formulation of installation standards and permitting protocols for EV charging point installation			x
Integration of charging system requirements with the local building codes and regulations			x
Clarification and formulation of mechanisms and regulations on charging operation and setting rates			x
Introduction of industry requirements on the adoption of Evs			x
Development of a government procurement program on Evs			x
Restrictions / limitations of the use of internal combustion engines / polluting vehicles			
Vehicular norms with high environmental standards (like EURO V, VI, etc...)	x		
GHG emission / energy efficiency standards for vehicle:			
RTE INEN 017	x		
NTE INEN 2204	x		
Vehicle labelling regarding their environmental standard		x	
Mandatory vehicle inspection regarding emissions	x		
Driving restrictions for polluting vehicles			x
Incentives and/or instruments for scrapping			
Legal obligation to eliminate vehicles (buses, taxis, trucks) after certain age of operation	x		
Presence of official dismantling/recycling centers; accreditation to manage car wrecks	x		
Structured industrial sector for scrapping / dismantling / recycling vehicles		x	
Public programs for vehicle fleet substitution	x		
Financial mechanisms incentivizing scrapping / recycling (incl. scrapping premiums)	x		
Mechanism to recycle batteries of e-vehicles			x

Source: (GIZ-AFD, 2019)

D4.1 Nine (9) Demonstration Implementation Plans

Even though the country still doesn't have a National Strategy for e-mobility at the moment, there is a bill for the promotion of sustainable mobility and development of electromobility under discussion in the Ecuadorian Congress. Additionally, the Ministry of Transport and Public Works is developing a low-emission National Urban Mobility Policy which will include a roadmap for the transition towards e-mobility. Moreover, due to the recently issued NDC of Ecuador new articulation schemes between the Ministries of Transport, Environment and Energy have been set up in order to increase ambition of the transport sector in the upcoming NDC Implementation Strategy.

Specifically, the Interinstitutional Committee for Climate Change includes a technical group of work for the energy sector. This group shall be led by the Ministry of Transport and it is expected this coordination scheme will provide support for the National Urban Mobility Plan; the discussion of the bill for promoting sustainable urban mobility and e-mobility; and advance policy and initiatives in the sector. The group includes participation from the local level (GIZ-AFD, 2019).

Since the transition is just taking-off, restrictions and limitations of the use of internal combustion engines/ polluting vehicles have been the first area of focus, but further regulations on how e-mobility should operate once in place is still pending. That explains why in the table all regulations revolving around charging stations, operations standards and so on are marked as gaps. Despite of this, incentive and regulations on scrapping have been developed and battery recycling is the only missing piece in that regard.

1.1.2 Business environment

Local businesses and start-ups working on e-mobility solutions

Since the late 90's when urban cycling advocating organizations raised and managed to have incidence in the local policy for the creation of urban cycling paths, a lot of local retailers of bicycles emerged, but sold basically imported merchandise. Later, some of them started developing their own models, but quite incipiently. In 2015, the Ministry of Industry implemented a program to support local assembly of bicycles, which led to the creation of various start-ups, which later have dabbled into e-bikes and scooter prototyping.

Table 2: Local start-ups working on e-mobility solutions

Entity	Scope
Sidertech Motorparts	E-scooters, Parts of Motorcycles and Bikes
Metaltronic	Parts and Bicycles and e-bikes
ECOMOVE	E-bikes, e-scooters and golf carts
BKR Bikes	Bicycles and e-bikes
Ecuacyclo	Bicycles
Base Extreme	Bicycles
TS Bikes (Indima)	Bicycles
Electrobike	E-bikes

D4.1 Nine (9) Demonstration Implementation Plans

Sidertech

It is a company originally dedicated to the engineering and manufacturing of high-added-value metalworking components for the iron and steel industries, cement and manufacturing in general. In 2012, they started the line of motorcycle parts and metal parts, ranking as the first producer of this line in Ecuador in the period of 12 months. Since 2015, they started working in bicycle assembly. In 2018, they launched ERIDE, an e-scooter locally designed and assembled. They are currently working already a prototype of e-cargo quadricycle with technical specifications to make it suitable for the topography of the Historic Center.

Metaltronic

It is a company dedicated to the manufacture of parts, pieces and accessories of bodies for motor vehicles: seat belts, inflatable safety devices (airbags), doors, bumpers. They also have production lines for motor parts and bicycle parts; and bicycle manufacturing and assembly. They have already launched model of e-bike and are working on the design of other versions.

ECOMOVE

A local start-up that works on the design, distribution and direct sale of top-quality electric bicycles, scooter, golf carts and accessories facilitate. Their vehicles are 100% electric and have several designs full city oriented. Among their products they have golf carts for several passengers (up to 8), a lift-up and a cargo version. Moreover, they can work in customized designs.

BKR Bikes

The company is based in the city of Cuenca and operates as a bicycle assembler and workshop for bicycles. They had an accelerated growth boost in 2015 when a national program to promote local assembly of bicycles was implemented but has diminish its market share since import tariffs were lowered. Recently, they have resume impulse and are working on the design of their own electric bicycles.

Ecuacyclo

Supported by one of the biggest economic groups in the city of Cuenca, Ecuacyclo was created in 2015 as a bicycle manufacturing and assembly company.

TS Bikes (Indima)

Company originally founded as equipment supplier for the Automotive Industry. 5 years ago, they started manufacturing bicycle parts and are locally assembling several models of bicycles, including an urban model.

E-mobility financing options

Local financing options

In terms of financing, several entities offer financing lines for electric vehicles. For example, Banco del Pacífico (state) offers an electric vehicle line of credit through a rate of 12.5% over five years. Banco Pichincha also offers conditions specific for light vehicles (Banco Pacífico, 2020).

BanEcuador, a public financial development institution, offers microcredits for electric taxis with rates of 9.8% interest for two to five years (BanEcuador, 2020).

Since 2018, the National Financing Corporation (CFN) offers a credit line intended for the acquisition of electric passenger and cargo fleets for duly constituted transportation companies with 70% for new projects and up to 100% in expansion projects. Financing amounts range from USD 50,000 to USD 20 million, an interest rate of 7.5% and a payment period of up to 15 years (CFN 2018).

Latin-American Development Bank (CAF)

CAF is also working on a GCF climate funding for local private banks, but it is still an ongoing assessment at the GCF (AFD, 2020).

French Development Agency (AFD)

Under the GCF funded TFSC Program, AFD has approved credit lines to 2 public banks (CFN and Banco del Pacífico) that might cover the purchase of Evs (AFD, 2020).

Furthermore, AFD has recently submitted a Concept Note for the Latin American E-Mobility Program (E-Motion) to the GCF. The Program aims to enable a large-scale regional transition towards electro-mobility in Latin America and to provide public and private decision makers with the tools that will allow them to increase the scope and ambition of the mitigation strategies of the region from a transport-sector perspective involving a paradigm shift in the transportation system. The program total amount is 850 million EUR for 10 countries, included Ecuador, out of which 85% is for financing of the electric vehicles fleet, 9% for charging infrastructure and the rest for technical assistance.

1.2.3 Capacity building (CB)

Current state and initiatives

ANETA

It is the biggest driving school of Ecuador. Last year they released an e-karting driving school since they hold great interest in electric mobility. In fact, they have been strong advocates for sustainable urban mobility in general, and e-mobility more specifically. They contributed to the development of a draft law on e-mobility that was already formally present to the National Assembly for discussion.

National Financial Corporation (CFN)

This is a public development bank, and as such provides not only financing, but has also a technical assistance branch. In such context, after the release of their financing program for fleet renewal, they have also been providing permanently technical assistance for operating companies in creating business plans with fleet renewal.

National Polytechnic University (Escuela Politécnica Nacional EPN- CCICEV)

CCICEV is the technology transfer and capacity building center established by the National Polytechnic University. It is the first laboratory official accredited to assess performance of electric vehicles in Ecuador. Moreover, they are also accredited to inspect motorcycles, and three-wheeled motor vehicles for passenger transport and cargo transport. And they act not only as laboratory but are also a Training and Research Unit from the Polytechnic University of Ecuador.

University of Cuenca

The University of Cuenca is one of the three universities in the city working actively on urban sustainable mobility. They have an undergraduate career in Electrical Engineering so they could also be great allies for the creation of a permanent academic program on e-mobility.

Current needs and opportunities

According to the Training Needs Assessment and more so given the context of an early stage of a transition towards e-mobility the main existing training needs are about vehicles and infrastructure technologies, battery disposal, procurement and contractors, finance and fiscal schemes and mobility and integrated planning issues.

Regarding specific topics the city needs in terms of training in relation to e-mobility; the respondents pointed out the following:

- E-bus charging
- Technical specifications
- Financing options
- Integration of e-mobility to SUMPS
- Charging standards
- E-mobility solutions for hilly cities
- Business and operation models for private operators
- Communication and promotion strategies
- E-logistics and last mile delivery schemes and business models

Further insights around capacity building topics were unveiled during the regional kick-off, where the following topics were mentioned:

- charging options
- equipment and regulation
- standardization process were clear requests

D4.1 Nine (9) Demonstration Implementation Plans

- electric infrastructure behind charging was raised as a topic
- autonomy testing
- and how to ensure interoperability were exposed
- GHG emissions reduction estimations
- use of renewable sources, including photovoltaic energy

On the other side, after scouting the local context, several opportunities were found, both with local institutions and with international initiatives already working related topics in the country, which are described below:

National Polytechnic University (Escuela Politécnica Nacional EPN- CCICEV)

EPN-CCICEV has the flexibility to create customized continuous training programs for operators or other target groups. In fact, given the academic excellence of the university they could also be great candidates to promote a permanent undergrad program on e-mobility. Furthermore, contact has been established in order to formalize a cooperation process among the Universidad de la República in Montevideo and The Polytechnic University in Madrid, since the three of them work actively in e-mobility in general. One specific topic for collaboration that has already been identified is the standardization normative.

University of Cuenca

The University of Cuenca is one of the three universities in the city working actively on urban sustainable mobility. They have an undergraduate career in Electrical Engineering and a Research Group on Sustainable Cities, so they could also be great allies for the creation of a permanent academic program on e-mobility.

MOVE-UNEP

MOVE is a training platform created by UNEP in partnership with CMM, EUROCLIMA+, among others for the transition to electric mobility in Latin America. Its aim is to bring governments, municipalities, the private sector and technology centers up to date with technical innovations, policy, financing and management solutions to accelerate the transition to electric mobility in the region.

EUROCLIMA+/MobiliseYourCity Latin-American Community of Practice

The urban mobility component of this EU Program contributes to the development of mobility plans at the local and national level. Complementarily, the component includes a regional Community of Practice among all 18 projects in the region and all sorts of urban mobility stakeholders interested in contributing (academics, consultants, practitioners, authorities, firms, etc.) In such context, the program has a wide potential for promoting key topics through various activities: webinars, e-course, conferences, workshops, peer-to-peer collaboration, and others. Although the CoP doesn't have a particular training series on the e-mobility topics, there is space for collaboration with SOL+ in order to create one. At the moment the EC+ collaborates already with MOVE for specific activities.

However, for the implementation of the pilot project in Quito, the greatest opportunity could be a peer-to-peer exchange activity with one of the EC+ cities in which e-mobility is a relevant topic of their measures around urban mobility.

TUMI-VOLT

A new global marketplace for electric and digital mobility. As an integral part of the Transformative Urban Mobility Initiative (TUMI), Tumi Volt will build on the expertise, network, and resources of TUMI to advance e-mobility in cities. The project will investigate all aspects of e-mobility (renewal energy use, battery production and recycling, charging infrastructure, financing concepts, types of e-vehicles, etc.) to support the establishment of know-how in politics and administrations. The project has just started, and one of the cities for implementation is Cuenca, Ecuador. Therefore, there is great potential for peer-to-peer permanent exchange of experience regarding progress and barriers for implementation.

French Development Agency (AFD)

The French Development Agency started working in Ecuador just 6 years ago but has had a strong expanding strategy in the country and more specifically in the transport and mobility sector. Now, they are working with GIZ and the GCF in the creation of a regional financing program for advancing transition towards e-mobility. In the preparation phase they are currently working, they have selected the 5 countries this program would be for, and Ecuador got selected for considering it with high interest and good enabling conditions. This program is expected to start in October 2021 and includes a significant component for capacity building. For the implementation of this component, AFD could rely on international allies they normally work with (e.g. CODATU) in order to provide training for local target groups.

1.3 Key Stakeholders

1.3.1 Local government bodies

Mobility Secretariat (Secretaría de Movilidad – SecMov)

The Mobility Secretariat and its attached dependencies -Metropolitan Public Company of Mobility and Public Works, Metropolitan Public Company of Passenger Transport of Quito, Metropolitan Public Company Metro of Quito and Metropolitan Transit Agency-, undertake a wide and integral work, with the deployment of actions that contribute to the development and strengthening of the road transport system, promoting the harmonic coexistence between all road users (Secretaría de Movilidad n.d.).

Metropolitan Institute of Heritage (Instituto Metropolitano de Patrimonio – IMP)

The IMP was created due to Quito's categorization as a World Heritage Site by the UNESCO with the aim of being the executing body of the policies related to the conservation of Quito's cultural and architectural heritage. Among its competencies are to register, protect and promote the Cultural Heritage and the Historic Areas of Quito. To this end, it seeks to coordinate with the community and with the owners of heritage assets (IMP n.d.). In this context, the IMP is directly involved in all policies related to the Historic Center of Quito.

Electricity Company Quito (Empresa Eléctrica Quito – EEQ)

The Public Electricity Company of Quito (EEQ) provides the public service of generation, sub-transmission, distribution and commercialization of electricity to the city of Quito and its

D4.1 Nine (9) Demonstration Implementation Plans

surrounding areas. It is a public enterprise owned mainly by the Ministry of Electricity and Renewable Energy (68%) and the Municipality of Quito (24%) (EEQ n.d.).

Environment Secretariat (Secretaría de Ambiente – SecAmb)

The Environment Secretariat is the municipal authority in charge of developing policies, strategies, plans, and actions to ensure the conservation of the natural heritage, the sustainable use of natural resources, environmental quality, under a sustainable development approach of the Metropolitan District of Quito. It is responsible for the air quality monitoring system and oversaw drafting the Ordinance of Gradual Decarbonization of Public Transport that was mentioned above (Secretaría de Ambiente n.d.).

Environmental Fund of Quito (Fondo Ambiental de Quito-FAQ)

The Environmental Fund is a public institution that enjoys administrative and financial autonomy, attached to the Municipality of the Metropolitan District of Quito, created by municipal ordinance in 2005, whose objective is to finance plans, programs and projects of a non-reimbursable nature framed in the District Environmental Policy, prioritizing proposals of direct impact on environmental problems and that are sustainable over time. These proposals can be presented by various intra-municipal actors, civil society and academia. (Fondo Ambiental, 2020).

Administrative Municipal Zone for the Historic Center – Manuela Sáenz (Adm Zonal Centro)

The city and is administered through eleven Administrative Municipal Zones. Each zone, classified as either urban or suburban, has their own administrator and contain can both urban and rural parishes. The Administrative Zone Manuela Sáenz oversees the Historic Center and therefore has to guarantee citizens access to quality public services, plan comprehensive development and guarantee citizen participation.

Metropolitan Public Enterprise of Passenger Transport (Empresa Pública Metropolitana de Transporte de Pasajeros – EPMT)

The EPMT is responsible for the operation and management of the public transport service of the 4 (out of 5) municipal BRT corridors of the Metropolitan District of Quito (EPMT 2017).

Metro de Quito Public Enterprise (EPMMDQ)

The EPMMDQ is the entity in charge of planning and carrying out the studies for the construction of the first subways line, as well as of the management, operation and maintenance of it once it is inaugurated (MDMQ 2013).

1.3.2 National government bodies

Ministry of Transport and Public Works (Ministerio de Transporte y Obras Públicas – MTOP)

As the governing entity of the National Multimodal Transport System, it formulates, implements and evaluates policies, regulations, plans, programs and projects that guarantee a safe and competitive transport network, minimizing the environmental impact and contributing to the social and economic development of the country (MTOP n.d.).

D4.1 Nine (9) Demonstration Implementation Plans

National Transit Agency (Agencia Nacional de Transito-ANT)

It is an entity contingent to the Ministry of Transport and is in charge of planning, regulation and control of land transportation, traffic and road safety, promoting equitable accessibility, sustainable mobility and preserving the environment. It is responsible for EV harmonization (ANT, n.d)

Ministry of Electricity and Renewable Energy (Ministerio de Electricidad y Energía Renovable – MEER)

The governing and planning body for the electricity, renewable energy, atomic energy and energy efficiency sectors, is responsible for meeting the country’s electricity needs through the formulation of sectorial policies, relevant regulations and plans for the efficient and responsible use of resources; complying with quality standards, encouraging social participation, environmental care and the sustainable transformation of the energy matrix (MEER n.d.).

Ministry of Urban Development and Housing (Ministerio de Desarrollo Urbano y Vivienda – MIDUVI)

Entity that exercises the steering role and implementation of public policy in cities, guaranteeing citizens access to a safe and healthy habitat, decent and accessible housing and an inclusive public space (MIDUVI n.d.).

Ministry of production, foreign trade, investment and fisheries (Ministerio de producción, comercio exterior, inversiones y pesca- MIPRO)

Entity in charge of formulating and executing public policies for industrial specialization, regulating acts related to international trade relations, and is in charge of the foreign trade and investment policy (MIPRO, 2020).

Ecuadorian Development Bank (Banco de Desarrollo del Ecuador – BDE)

The BDE was created in 1992 with the objective of financing programs, projects, works and services of the public sector, such as Ministries, Municipalities, Provincial Councils, etc., related to national economic development goals (BDE n.d.).

National Financial Corporation (Corporación Financiera Nacional – CFN)

The CFN is a public financial institution, which has the mission to promote the development of Ecuador’s productive and strategic sectors through multiple financial and non-financial services aligned with the national government policies (CFN n.d.).

1.3.3 Public transport operators

The main public transport operator in Quito in the **Metropolitan Public Enterprise of Passenger Transport** (EPMTPQ – see above), which is responsible of operating 4 of the 5 BRT lines in Quito.

Moreover, several private operators have already shown their interest in purchasing electric buses. The public transport providers **TransLatinos**, **Trans Planeta**, **Juan Pablo II**, **Metrotrans** and **Zeta** presented a proposal for the purchase of 90 buses. Meanwhile, the Central North BRT

Corridor, which is concessioned to a private operator, has also shown its interest to purchase 60 e-BRT-buses (Carvajal 2019c).

1.3.4 SOLUTIONSplus consortium

The demonstration action in Montevideo will involve the following SOL+ industry and research players:

ABB: The Ecuadorian subsidiary of ABB provides technology and automation services for the electric, hydrocarbon and petrochemical sectors. Its main products are: wire and wire systems, high and medium-tension frequency electricity converters, power measurement equipment, breakers, fuses, condensers, gas isolated electrical substations, measurement transformers, generators, engines, system protection and automation products, among others. The subsidiary has two offices and a service station in Ecuador. ABB Ecuador is currently assessing the feasibility of installing ABB equipment in one of the transfer stations of Quito's BRT system.

IDIADA: a leading company specializing in providing design, engineering, testing and homologation services to the automotive industry worldwide. It will support the charging standardization in the demonstration activity.

Valeo: Valeo Group is a Tier1 supplier world leader in 4 different core businesses: Visibility Systems, Powertrain Systems, Comfort Driving Assistance Systems and Thermal Systems. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2 emissions and to the development of intuitive driving. Valeo's strategy is based on innovation and growth in regions where there is a market potential. Thus, the Group has been able to diversify its products and positioning in the various regions where the automotive sector is growing (Europe, Asia, and America). Valeo will provide the drivetrains for the e-3 and 4-wheelers that will integrate the e-logistic system of the HCQ.

Volvo: Until now, the main provider of diesel buses for the BRT system of Quito has been Volvo, who in SOL+ will contribute to the business models for e-BRT systems and related technology and operational solutions.

ZLC: Zaragoza Logistics Center (ZLC) is an international center of excellence for research and education in logistics and Supply Chain Management that actively engages with industry and the public sector to develop and disseminate knowledge. ZLC acts as a catalyst for innovation and research in the area of logistics and SCM. ZLC will be in charge of elaborating the e-logistics plan for the HCQ.

Table 3 presents the consortium partners with a major involvement in the demonstration activities in Quito as well as their concrete involvement based on the SOLUTIONSplus Kick-off Workshop that took place in January 2020 in Berlin as well as bilateral and multilateral discussions that were held in the past months. This table will be updated permanently with more detailed information of SOL+ consortium members contributions.

Table 3: Specific contributions of SOL+ consortium members to Quito's demo

Consortium Partner	Role/Contribution
COORDINATION	
WI	Regional coordinator
UEMI	Local implementation support
EQUIPMENT	
Valeo	<ul style="list-style-type: none"> Provide the drivetrains and control units for the e-3-wheelers to be implement in Quito's demo
Bosch	<ul style="list-style-type: none"> Provide the drivetrains for the e-cargo bicycles to be implement in Quito's demo
ABB	<ul style="list-style-type: none"> Provide support charging infrastructure in the most adequate BRT transfer station of Quito (tbc) Technical assistance in the charging strategy/plan Technical assistance in the standardisation process
TECHNICAL SUPPORT	
ZLC	<ul style="list-style-type: none"> E-logistics plan (incl. Distribution centre) in Quito
IDIADA	<ul style="list-style-type: none"> Technical support on e-logistics business models and fare integration for Quito Batteries and charging assessment for Quito's pilot
UITP	<ul style="list-style-type: none"> Technical assistance on the e-bus operation plan
Volvo	<ul style="list-style-type: none"> Technical assistance on the bus operation plan
CMM	<ul style="list-style-type: none"> Linkage to the GEF projects in Latin America Technical support in e-bus specifications and regulatory framework
BUSINESS MODELS & START-UP INCUBATOR	
FIER	<ul style="list-style-type: none"> Business models for e-3-wheelers and e-buses
ERTICO	<ul style="list-style-type: none"> Support on the business models of the SMEs participating in the pilots
CAPACITY BUILDING	
RC	<ul style="list-style-type: none"> Vision building: development of e-mobility strategies/ integrating e-mobility in SUMP processes Capacity building and peer-to-peer learning on hybrid-trolleybuses, smart trolley grids, e-buses, eco-driving and charging infrastructure planning Development of smart trolley grids/ multi-purpose charging infrastructure (using DC-grids for charging of electric road vehicles) Charging infrastructure planning
SIMUS	<ul style="list-style-type: none"> Capacity building Regional trainings

D4.1 Nine (9) Demonstration Implementation Plans

CODATU	<ul style="list-style-type: none"> Capacity building and integration
REPLICATION AND SCALE-UP	
UNEP	<ul style="list-style-type: none"> Coordination with other GEF projects in the region Linkage to financing sources
IMPACT ASSESSMENT	
VTT	<ul style="list-style-type: none"> Impact assessment Latin American cities KPIs

1.3.5 Other Industry players

European industry

POLINI: It is an Italian manufacturer of tuning parts for motorcycles, mopeds, and scooters. Among other products, they produce cylinders and variators for both racing and road use. They also produce pocket bikes. They have provided parts for ERIDE, the e-scooter designed and assembled by SIDERTECH.

Other international industry players

BYD: the Chinese electric vehicle company, has expressed its interest in constructing an assembly plant in Ecuador that could respond to a demand of 300 buses per year (Villón Reyes 2018). In 2017 the national government and BYD signed an agreement for the construction of an assembly plant in the Special Economic Development Zone (ZEDE) of Guayaquil, which will produce 7, 12 and 18-metre-long e-buses, as well as electric trucks. BYD has already tested or introduced e-buses in the following Ecuadorian cities:

- Guayaquil: 20 e-buses were purchased by a private operator with a loan from the CFN. The buses arrived assembled 70%, the remaining 30% was completed by the national industry, who was in charge of installing the seats and configuring the wifi system (CFN 2019).
- Loja: 35 e-taxis were purchased in 2017 by the taxi cooperative “Ecotaxi” with loans granted by the CFN and the support of the local government (BYD 2017)
- Quito: 1 e-BRT-bus running since November 2017 and several 12m e-buses run tests in the main conventional bus routes in 2018

The **National Technical University (EPN)** signed an agreement with BYD in order to work on the technology transfer; to promote the development of skilled labor specialized in electric mobility and continuing education plans with technical profiles for mechanical assistance to electric vehicles.

1.3.6 Local vehicle industry

Between 2015 and 2018 the share of locally assembled cars in the total sales went from 53% to 25% due to an import tax of 15% to auto parts that was introduced by the previous government. In May 2019 the current government decided to impose a 0% import tax instead

D4.1 Nine (9) Demonstration Implementation Plans

with the aim of increasing the competitiveness of local assembly plants in comparison to Colombian cars. Some of the brands that are assembled locally are Chevrolet, Hyundai, KIA, Great Wall.

No electric cars are being produced now, but they could be partially assembled locally (see above, BYD). The main electric light duty vehicles that are for sale (on the primary market) in the country are:

- Hanteng X5 EV.-
 - Year: 2019,
 - Speed: 180 km/h,
 - Autonomy without charging: approximately 300 km
- CHOK G2.-
 - Year: 2019,
 - Speed: 50 km/h,
 - Autonomy without charging: 100 km
- CHOK Cross.-
 - Year: 2019,
 - Speed: 60 km/h,
 - Autonomy without charging: 120 km
- Renault Twizy Z.E. –
 - Year: 2019,
 - Speed: 80 km/h,
 - Autonomy without charging: 100 km
- Kia Soul EV.-
 - Year: 2019,
 - Speed: 145 km/h,
 - Autonomy without charging: 200 km

1.3.7 Civil society

Biciacción:

It is a non-profit citizen organization with almost 20 years of experience in environmental activism and bicycle promotion. With support of the Municipality of Quito they started organizing leisure cycling rides on Sundays – Ciclopaseos- which served as leverage for the creation of cycling pads in the city. In such context they constantly collect data on cycling, act as consultants and advocates and provide inputs for policy design. For instance, they design and collected data from 40 cities in Ecuador assessing the profile of cyclists (Biciacción, 2019).

Ciclópolis:

It is a non-profit citizen organization derived from Biciacción. Under concession from the Municipality they have managed officially the organization of Ciclopaseos in Quito and in other cities. Moreover, they have implemented other initiatives such as “Al Trabajo en bici”, cycling training programs for women and children, among others, to promote the use of bicycles for everyday commutes. (Ciclópolis, 2020).

Bypad:

BYPAD began in 1999 as a research project funded by the European Union, in order to carry out an audit of the bicycle transport policies of the local authorities. With this background they have also been hired as consultants to design action plans for promoting cycling as a mode of transport, through the determination of indicators baseline and measures participatively designed (Bypad, 2019).

1.3.8 International cooperation

C40 CFF: The C40 Cities Finance Facility, a joint project of the German International Cooperation Agency (GIZ) and the cities network C40, will help Quito electrify the Ecovía Bus Rapid Transit (BRT) corridor. The project will improve air quality and provide greener, healthier streets for the citizens of Quito (C40 CFF 2018).

EUROCLIMA+: Ecuador is one of the countries in Latin America being supported by EUROCLIMA+ to develop a Low-carbon National Urban Mobility Plan. The objective of this project, being implemented by the French Development Agency (AFD) in partnership with the National Ministry of Transport and Public Works, is to define a national strategy for low-carbon mobility that is applicable to all Decentralized Autonomous Governments of the country and that allows a considerable reduction of GHG emissions, while promoting equality and accessibility (EUROCLIMA+ n.d.).

2. Demonstration Action

Please list the solution(s) under development & test (e.g. e-2Ws sharing system, e-BRT, etc..) in this section and provide for each of them a full description (sub-sections below).

2.1 Situation analysis

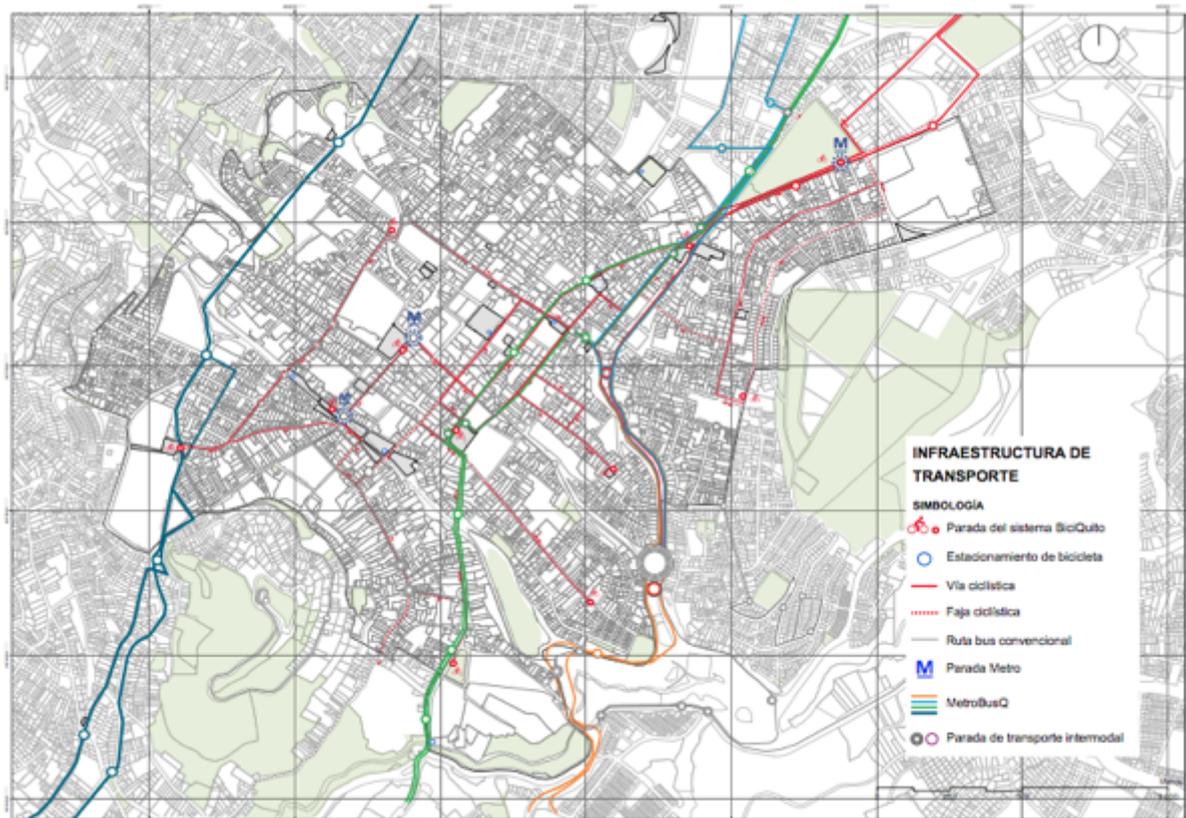
Main characteristics of the implementation area, the Historic Center of Quito (HCQ)

The Historic Center of Quito (HCQ) comprises an urban area of 376 hectares, with a (shrinking) population of approximately 40,000 inhabitants. Declared by the UNESCO as the first World Heritage Site in 1978, it is considered one of the most important historical sites of Latin America. Even though the HCQ has been losing residents for the past 3 decades, during daytime it still attracts important influxes of locals and foreigners because of its commercial and touristic importance.

Moreover, the HCQ is a mobility hub. Due to its location in the center of a long and narrow city as Quito, the HCQ is an obligatory crossing point for all the commuters from the southern area of the city that go to the Central Business District (CBD) to work and study. However, the colonial urban structure, which remains unchanged, has no capacity to assume the current flow of vehicles, generating high levels of congestion, as well as air and noise pollution. The polluting gases and the constant vibration threaten not only the health of the people that work and live in the area, but also the vulnerable structures of the old colonial buildings (MIDUVI 2013).

According to estimates by the Mobility Secretariat, in addition to the BRT corridors that pass through the HCQ, 76,038 vehicles, 1,233 buses, 65 conventional bus lines and 16 feeder lines circulate daily in the area. This situation has led to high levels of vehicle congestion, reducing traffic speed to 3 km/h at peak times, when the average in the city is 25 km/h. The most important means of mobilization in the Historic Center are public transport (72%) and pedestrian transport (19%). Due to the topography of the territory, there are areas of difficult pedestrian access, as there are slopes that exceed 30% (IMP 2019). Also, walkability is complex as well, since pedestrian had to share the road with heavy congestion and lack of safety and pedestrian routes are not well connected either. This is the situation that led to the pedestrianization of further streets in the core of the HCQ and the decision of turning the area into a LEZ. Figure 2 shows the existing transport network, including bike lanes.

Figure 2: Existing Transport Network in the HCQ



Source: (IMP 2018)

In this context, as it can be seen in bold grey in Figure 3, 9 streets in the main area of the HCQ have been turned into pedestrian streets, on which 280,000 people walk on weekdays and 315,000 on weekends (Carvajal 2019b). Despite the improved accessibility and road safety experienced by pedestrians, as well as the moderate increase in the economic activity in the area, this measure has made difficult the distribution of goods in the area (Diario La Hora 2019).

Figure 3: Pedestrian streets in the HCQ



Source: (Carvajal 2019b)

Additionally, intermodality is low since only in the La Marín station do different transport services come together and it is next to the BiciQuito stop and the Trolleybus at the HCQ. Nowadays, there is no infrastructure that allows connecting the different mobility alternatives in the area. On the other side, in private mobilization, 76% of the households with their own vehicle lack own parking (ICQ, 2016) which has led to the creation from private parking lots, which in some cases do not they have the necessary operating permits (IMP, 2019).

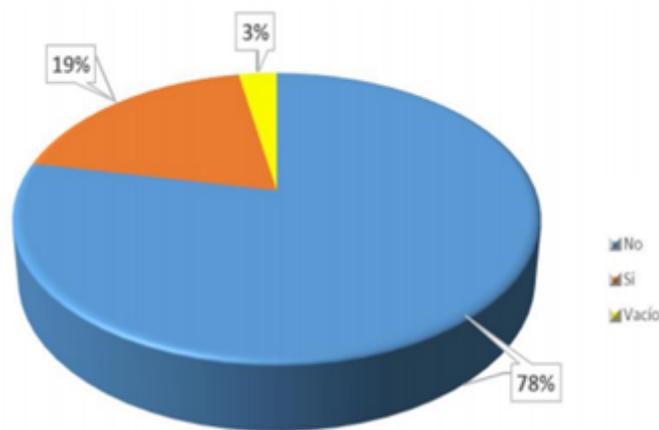
The Historic Center has great commercial importance for the city since it concentrates a high amount of business density (ICQ, 2017 b). Due to this dynamic, the Historic Center is the main generator of logistics flows in the city (ICQ, 2017 b). The supply activities are complex due to the population density, the existing infrastructure in the territory and the width of the streets (ICQ, 2017 b), which impairs the enjoyment of public space of pedestrians (AEUB, 2015). Despite the provisions of the ordinance No. 147, which regulates logistics in the Historic Center, night loading and unloading schedules are not compatible with the business dynamics of the territory, and the infrastructure to support the load demand and download of commercial establishments in the CHQ is deficient (IMP, 2019). The center has 22 formal sites assigned for loading and unloading, and shared uses such as tourism and embarkation and disembarkation of tourism, transportation school, among others (SecMov, 2018). This problematic gets ratified by the results of a survey applied to residents and business owners in the Historic Center in 2018, i.e. before the pedestrianization of García Moreno and Venezuela Streets, where 58% of respondents noted congestion and circulation problems as the main barrier for provisioning for

D4.1 Nine (9) Demonstration Implementation Plans

their businesses, a circumstance aggravated by the fact that 93% gets supplies at least once a week, and 28% in fact receives merchandise daily (SecMov, 2018a).

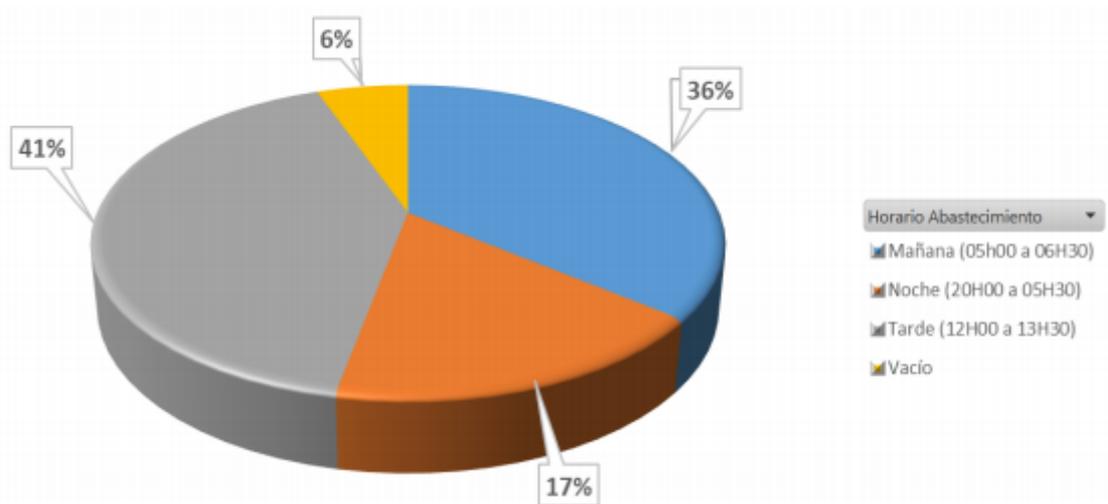
Regarding loading and unloading times, 78% of businesses don't know the official schedule (Figure 4) and 41% said they get merchandise between 12h00 and 13h30, i.e. at lunch time, therefore worsening congestion in the area (Figure 5).

Figure 4: Percentage of businesses in the HCQ aware of official loading time



Fuente: SecMov, 2018

Figure 5: Times of actual provisioning of merchandise in the CHQ



Fuente: SecMov, 2018

Only 17% declared to get provisions at night, and in fact even less businesses (13%) considered those hours as suitable for their provisioning needs. In fact, 80% of businesses considered morning and midday as the hours they need to get supplies (SecMov, 2018a).

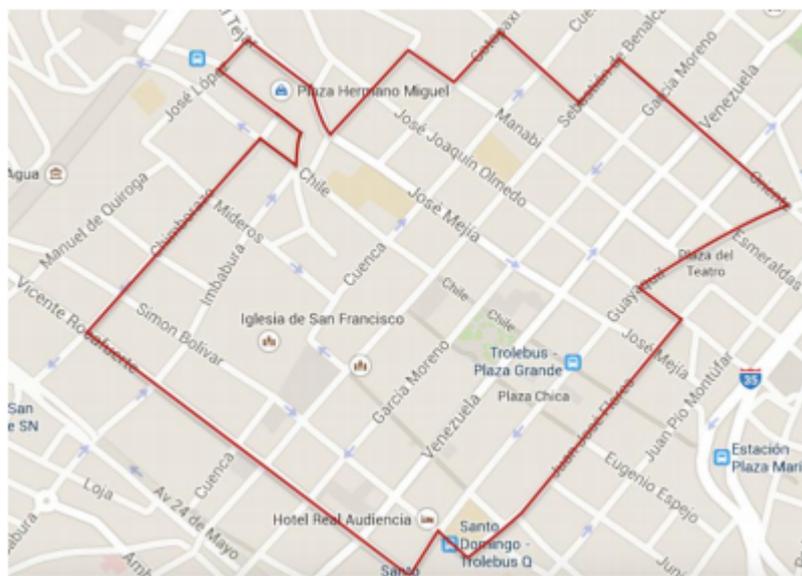
D4.1 Nine (9) Demonstration Implementation Plans

Most merchants (71%) declared they used vehicles for getting supplies, but 51% considered it as a difficult mode for provisioning, probably due to congestion and circulation since 88% of respondents said it takes them about an hour to get supplies (SecMov, 2018a). This result is consistent with the resistance merchants have shown to the pedestrianization of streets in the HCQ. Even though merchants acknowledge that after pedestrianization more people walk by, they complain about the lack of parking lots or nearby points where to leave the vehicles safely and about the appearance of informal sales (Diario La Hora, 2019).

Even though household statistics would characterize it as a lower-than-the-city average income zone, the area has a wide quantity and variety of businesses, reporting in the Economic Census (INEC, 2010 b) 188 different economic activities, in accordance with the Unified International Industrial Code (ISIC, fourth revision, a four digits). Retail business activities and wholesale constitute 35.6% of the existing businesses in the Historic Center (INEC, 2010 b).

According to a study made in 2015 to analyze and categorize urban logistics in the City Center, a shop inventory was created through Geo-referential collection of data from commercial establishments and commercial activity in the study area, including type of establishment, length of the front, geographical location, name of the location and availability of cargo area (Merchán, Blanco, & Bateman, 2015). For this, the first step is to select the most relevant commercial area based on different criteria such as population, population density, commercial activity, conflict between commerce and tourism, etc. The resulting area is the km² limited in the north by Oriente street, to the east by Juan José Flores street, to the south by calle Vicente Rocafuerte and to the west by Chimborazo street, as shown in figure 6.

Figure 6: Most relevant commercial zone in terms of urban logistics in the HCQ



Source: Cisneros Garzón, 2015

As shown in Figure 7, the shop inventory evidenced the existence of 3795 commercial establishments in the selected area:

Figure 7: Number and density of commercial establishments in the HCQ



Source: Cisneros Garzón, 2015

The number of establishments by type, is shown in the following table:

Table 4: Number and type of commercial establishments in CHQ

Type of commercial establishment	Number of stores	%
Grocery store	136	4%
Supermarket or convenience store	79	2%
Clothes and shoes	2207	62%
Food and beverages	254	7%
Drugstore	38	1%
Other	819	23%
TOTAL	3533	100%

Source: Cisneros Garzón, 2015

These results evidence an outlier in the category of clothes and shoes, which was geographically concentrated in the Ipiales sector. So, the study makes an adjustment in the results, taking off the outlier, and the results proved similar to the ones from Historic Centers in Latin- America. The corrected results are shown in the following table:

Table 5: Number and type of commercial establishments in CHQ without the Ipiales Sector

Type of commercial establishment	Number of stores	%
Grocery store	118	7%
Supermarket or convenience store	79	5%
Clothes and shoes	701	41%
Food and beverages	245	14%
Drugstore	37	2%
Other	545	32%
TOTAL	1725	100%

Source: Cisneros Garzón, 2015

2.2 Demonstration objectives and logical framework

The multimodal e-mobility hub to be implemented in Quito will be carried out in the Historic Center of Quito (HCQ), a UNESCO World Heritage Site, which aims to become a low- emission zone (LEZ), primarily accessed by clean public transport vehicles, pedestrians and bicycles. In order to improve passenger connectivity and last mile deliveries in the area, small electric vehicles (2-, 3-, and 4-wheelers) will be assembled locally with European components provided by SOL+ industry partners such as Valeo and Bosch. In this context, the multi-modal e-mobility hub will contribute to the consolidation of the planned LEZ in the HCQ and the integration of the existing mass transit lines (BRT and subway). The hub will take advantage of the existing electric infrastructure of the trolleybus and the subway systems in the area to create multimodal charging points / stations.

Table 6 shows the logical framework of the activities, subactivities and milestones that will have to be carried out for the successful implementation of the demonstration project.

Table 6: Logical framework of Quito’s demonstration project

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to the City)	MILESTONES (and other notes)
<p>OUTCOME 1. Availability high quality e-mobility innovations is increased.</p> <p><i>Baseline:</i> Several streets of the Historic Center of Quito (HCQ) have been pedestrianized with the aim of turning the area into a Low-Emission Zone (LEZ). In terms of vehicles, however, the current e-mobility solutions in the area to improve passenger connectivity and last mile logistics are inexistent. Charging solutions available to the public (as well as public transport operators) are still quite limited.</p> <p><i>Target:</i> High quality e-mobility solutions that improve passenger connectivity and last mile logistics in the LEZ developed by local industries are made readily available.</p>			
1. Locally produced vehicles (e-bikes, e-cargo-tricycles, e-delivery van) for urban logistics use is developed and tested	1. Call for local SMEs to design, develop, test prototypes, and produce the on-the-ground units for the demonstration.	1. Map and scout mature local SMEs 2. Conduct the call for local SMEs 3. Selection and awarding	1. Call for local SME conducted by October 2020.
	2. Tender for local SMEs to design, develop, test prototypes, and produce the e-bikes for the demonstration.	1. Map and scout mature local SMEs 2. Conduct the tender for local SMEs 3. Selection and awarding	1. Tender for local SME conducted by October 2020.
	3. Design, prototyping, testing phase	1. Design 2. Prototyping 3. Internal/ in-facility testing and validation	1. Designs available by Dec 2020 2. Final prototypes available by March 2021

D4.1 Nine (9) Demonstration Implementation Plans

	3. Production of units for demonstration		1. Demonstration units available by June 2021
2. On-the-ground demonstration of vehicles for urban logistics is conducted and assessed	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	1. Quito demo launched by June 2020 2. Detailed demonstration mechanics available by Dec 2020 3. Functional requirements to be available by October 2020 (c/o UITP)
		1. Market study on the logistics needs of businesses in the HCQ	1. Results of study available by December 2020
		2. Logistics plan conducted by ZLC with input of the market study	1. Results of study available by March 2021
		3. Functional and tariff integration of SOL+ demonstration activities to Quito's transport network by UITP	1. Results of study available by March 2021
	2. Implementation of on-the-ground demonstration activities	4. TU Berlin Design studio supporting study – data and participation from Quito	1. Results of study available by July 2020
		1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be submitted April 2023
3. Assessment	1. Determination of KPIs 2. Baseline activities 3. Monitoring 4. Analysis of data and evaluation	1. KPIs from SOL+ to be available by month 12	
3. Innovative charging facilities are demonstrated and assessed	1. Identification of charging needs		
	2. Planning for the installation and implementation		
	3. Installation and monitoring		
	4. Assessment		
4. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.
OUTCOME 2. Conditions for enabling accelerated e-mobility uptake are improved.			
<i>Baseline: The current enabling environments for e-mobility (relating to operations, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcome.</i>			
<i>Target: Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</i>			
1. Business models and business plans are developed and validated	1. Identification of locally-appropriate transformative business model concepts directly relating to the demonstration activity		
	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021

D4.1 Nine (9) Demonstration Implementation Plans

2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+
3. Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans are developed	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by January 2022.
4. Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institutions, and other relevant entities		
	2. Drafting and review of recommendations		
<p>OUTCOME 3. Local capacities relating to e-mobility are enhanced.</p> <p><i>Baseline: As e-mobility is still in its infancy stage in the country, capacities are still highly limited.</i></p> <p><i>Target: Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.</i></p>			
1. Peer-to-peer exchange program is conducted and documented	Visit of representative/s of partner cities to European expert city/cities	1. Matchmaking 2. Planning and development of itinerary 3. Visit	1. Visit to European expert city/cities within first 18 months
	2. Visit of European experts to the partner city	1. Identification of relevant experts 2. Planning and development of itinerary 3. Visit	1. Visit of European expert/s to the partner city between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner city and European experts to expert cities outside Europe	1. Matchmaking 2. Planning and development of itinerary 3. Visit	1. Joint visit between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
2. Toolkit for e-mobility is developed and shared with local stakeholders	1. Needs assessment		1. Technical Needs Assessment with local counterparts by May 2020
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

2.2.1 Demo Description

Multimodal e-mobility hub in the Low-emission Zone (LEZ) of the Historic Center of Quito (HCQ)

The demonstration activities in Quito will focus on creating connectivity between transport lines and stations with various e-mobility solutions in order to contribute to the consolidation of the LEZ in the HCQ. Moreover, the commercial and touristic character of the HCQ and the narrowness of its streets require the introduction of small e-cargo vehicles to transport goods within the area. As such, the introduction of forty (40) e-bikes (for the bike sharing system), three (3) e-buggies for passengers wanting to transfer quickly from one corridor to the other, and then (10) e-cargo bikes for last mile e-delivery services and one one(1) will be introduced and be tested in the area with the aim of scaling it up to a larger number of vehicles. In order to comply with the charging requirements of the Evs circulating in the area, the action will take advantage of the DC (Direct Current)-Grid to which the trolleybus catenaries and the subway

D4.1 Nine (9) Demonstration Implementation Plans

are connected. Cost-effective multi-standard DC charging points will be strategically positioned to provide on-street fast charging services for 2- and 3-wheelers. Moreover, the possibility of installing one fast charging point for e-(BRT) buses in the BRT terminal La Marín will be analyzed. Finally, the demonstration activities in Quito will be used to test solutions for hilly cities, which later could be replicated in cities like Bogotá and La Paz, to name a few. The Table 7 presents a summary of the vehicles, operations and integration that will be part of the demonstration activities in Quito.

Table 7: Summary of vehicles, operations and integration of Quito’s demonstration project

SOL	Modes	Vehicles	Operation	Integration
Passenger connectivity		26 E-bikes for the bike sharing system	Charging depot for e-bike sharing vehicles	Physical and tariff integration to the BRT and subway system SOL+ MaaS App
		3 E-buggy	Integrated ticketing, TSY charging system	
		30 E-BRT buses (Procured by the MDMQ)	ABB charging equipment for the BRT system (3 lines) (tbc)	
Last mile logistics		12 E-cargo bikes for the bike sharing system	Charging depot for e-bike sharing vehicles	Integration of passenger and freight transport in the bike sharing system
		10 E-cargo <u>quadricycles</u>	Distribution Centre and charging points for e-cargo vehicles	GPS and control centre Smart services (apps) Integration of last-mile services
		1 E-delivery van		

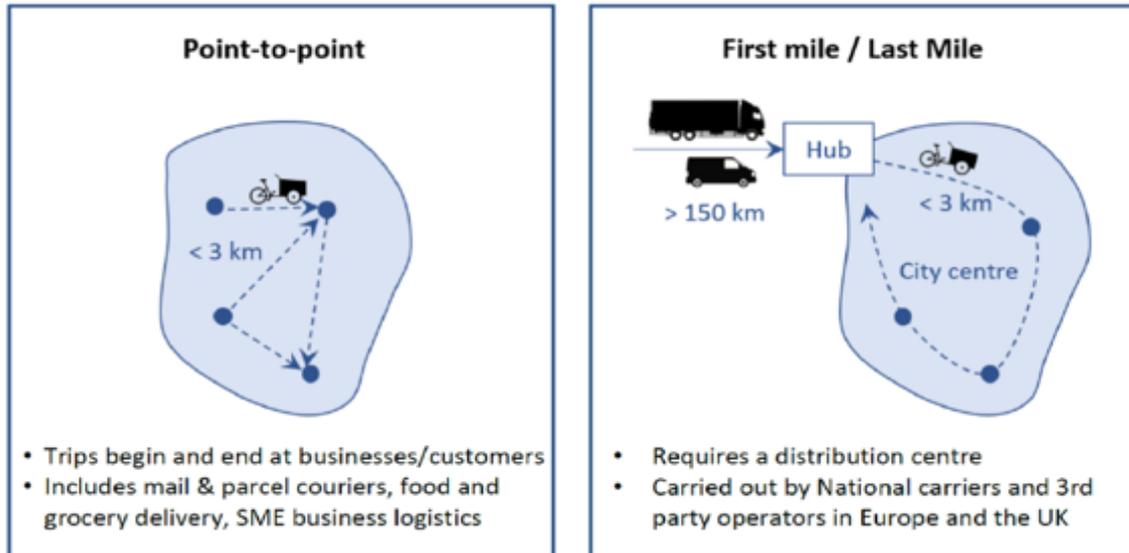
Last mile logistics

Given the complex situation of provisioning for businesses in the Historic Center, the aim of this demo in Quito’s urban freight system redesign is to establish a collaborative e-cargo distribution network by considering different interests, motives and barriers of the main stakeholders involved. A successfully established collaborative network will make the process of urban freight system redesign easier, more efficient and effective. In order to fulfil this aim, the demo pretends to develop a sustainable collaborative business and governance model.

Currently, distribution within the historical center of Quito is mainly conducted by diesel trucks, implying increased traffic congestion and air pollution. With the support of Zaragoza Logistic Center (ZLC), the demo will propose an optimization scheme for determining suitable micro hub locations and optimal routes conducted by cargo bikes for an average day. Sizing of micro hubs will depend on their number and the demand for delivery generated by commercial activities in the gravitating area as well as the delivery times.

A distribution center and a logistics plan that identifies the best routes for deliveries will also be one of the outcomes of the demonstration activities. The main cycle freight services can be seen in Figure 8, where the point-to-point deliveries are to be conducted by individuals using the available e-cargo bicycles in the bike-sharing system. Meanwhile, the last mile deliveries are to be conducted by a service provider.

Figure 8: Main cycle freight services



Source: ZLC, 2020

The distribution center, which will be located on a lot owned by the municipality, will be one of the core elements of the last mile logistics scheme that will be put in place to solve the needs of the businesses of the area. It will allow shop owners to bring their merchandise during daytime to the distribution center using regular medium and large freight vehicles. The current restrictions do not allow the entry of this type of vehicles to the core (pedestrianized) area during day time, increasing the costs for shop owners. The last mile will then be carried out using one of the cargo vehicles available in the distribution center. Figure 9 shows the example of the low-cost distribution center of the Komodo project in Berlin, Germany.

Figure 9: Komodo Distribution Center – Berlin, Germany



Source: www.komodo.berlin

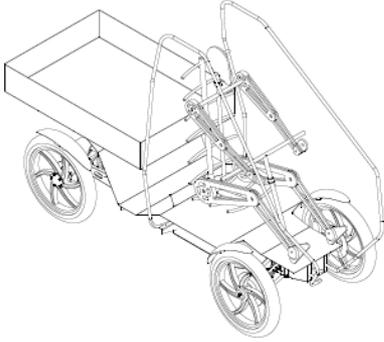
The logistic Plan will include the following components:

D4.1 Nine (9) Demonstration Implementation Plans

1. Assess opportunities for cycle freight logistics in Quito city center:
 - Market analysis, market segmentation, density of customers, understanding the customers base;
 - Analysis of local conditions for cycle logistics
 - Congestions, motor vehicle restrictions, narrower streets, parking spaces.
2. Engage with customers and SMEs in Quito city center:
 - In case of customers it is needed to understand their delivery needs
 - In case of SMEs it is needed to raise awareness of the use of e-cargo bikes.
2. Lead by example
 - Purchasing and using cargo bikes for all municipality activities where car/van can be replaced;
2. Location and sizing of logistics hubs
 - Optimal location of hubs or micro consolidation centers should be determined based on a set of alternative locations (underutilized space in city center or on the edge of city center). Sizing of hubs should be planned based on the density of demand. Space should be enough to provide parking for cargo bikes.
2. Cycle friendly infrastructure

For this demo and based on the logistics specifications, it is expected to determine technical requirements for the design of two types of vehicles:

Figure 10: Preliminary design for a e-cargo bike

E-quadracycle	Main characteristics
 <p>Preliminary design from SIDERTECH</p>	<ul style="list-style-type: none"> ● Drivetrain: Valeo eMused ● Max speed: 25-45 km/h ● Range: 100 km ● Power: 48V ● Slope: 30% ● Loading capacity: 100 -300 kg ● Length: 260 cm ● Width: 86 cm

By definition, E-cargo bikes fall into the category of light electric freight vehicles (LEFVs). LEFVs, in general, are bicycles or compact vehicles with electric pedal assistance or electric drive designed for distribution of goods on public roads with a limited speed (max 45 km/h) (ZLC, 2020). In the case of Quito, further adaptation will be needed specifically regarding breaks because of the hills in the Historic Center and their cobblestones and the aggravated situation when it rains.

Figure 11: Reference design for e-delivery van

E-delivery van	Main characteristics
 <p>Cargohopper from Alke (reference vehicle)</p>	<ul style="list-style-type: none"> ● Drivetrain: Valeo e-Access “Serial” ● Max speed: 33 km/h ● Range: 60-90 km ● Power: 48V ● Slope: 30% ● Loading capacity: 500 – 1,000 kg ● Length: 353 cm ● Width: 127 cm

Passenger connectivity

The HCQ is of great importance for the city, not only because of its historic value, but also because it is the area that connects the Central Business District (CBD) with the densely populated south of Quito. In October 2020, the subway will be operative with one of its fifteen stations located in the San Francisco Square, the heart of the HCQ, along with the new fleet of trolleybuses, running in the system that has been operative in the area since 1995. On the eastern side of the HCQ, in the area known as La Marín, there are two transfer stations, one where 3 BRT lines connect and a second one where approximately 60,000 passengers from the southeastern parishes arrive every day on their way to the CBD.

The other demo activity to be implemented in Quito aims to contribute to intermodality problems already described and the lack of support for active mobility. In that sense, and given Quito is about to start operating its first line of subway (Metro de Quito) the demo aims to contribute to both to the connectivity of passengers between the two metro stations in the HCQ and to complement the fleet of bikes from the new bike sharing system of the city. Moreover, once the Low-emission Zone is formally declared not only connectivity between these stops would be desired but also point-to-point mobilization among traffic attractors inside the Historic Center.

The bike sharing system in the city has been operating since 2012 but faced several financial and technical troubles that led to operational problems. At the beginning of 2020, the Mobility Secretariat announced the launch of a redesigned automated public bicycle system, that will operate in alliance with a private supplier (El Comercio, 2020). The idea is to count on state-of-the-art technology, automated controls and high-quality technological elements so that this system works as an ideal and safe means of mobility. It will use interactive Big Data, web service intertwined with the Municipality of Quito; liaison with the Mobility Orchestrator Strategic Alliance with the Metropolitan Public Company for Mobility and Public Works and integration with the new proposal for a bicycle network for the DMQ (EPMOP, 2020). Therefore, anchorage, disembarkation and loan system will be fully automated, and geofencing

D4.1 Nine (9) Demonstration Implementation Plans

would also be included. The new system will have 720 mechanical bicycles in the first phase and will cover most of the linear axis of the city from Quitumbe (South) to the Parque Bicentenario (North) (Diario LaHora, 2020).

The tendering process for the selection of a service provider was supposed to be released on March 22, and the expected time period until beginning of operation was 5 months. However, due to the COVID-19 emergency, the process is delayed.

In such context, the demo will contribute with the acquisition of 40 e-bikes locally assembled and specifically designed for the topography of the HCQ in order to complement the fleet of the new bike sharing system.

Figure 12: Existing bicycles in Quito’s bike sharing system

E-bicycle	Main characteristics
 <p>Existing e-bicycles in Quito (BiciQuito)</p>	<ul style="list-style-type: none"> ● Drivetrain: Bosch (model tbd) ● Max speed: 25 km/h ● Range: 30-60 km ● Power: 250 W ● Number of passengers: 1

Here, it is worth mentioning that the proposed bike sharing system will provide different types of bicycles that could respond to different user needs. Figure 13 shows some of the options that will be available.

Figure 13: Different uses of the bike sharing system

		
Individual	Family	Cargo

In addition, a prototype of e-buggy, using a similar design to the e-delivery van, is expected to be designed and implemented to connect several passengers at once. For this vehicle, the same

powertrain and platform as the e-delivery van described above would be used and adapted for this purpose. The aim is to provide different uses to the same type of vehicles and thus grant a larger market to the local producers.

Figure 14: Reference vehicle for e-buggy

E-buggy / golf cart	Main characteristics
 <p>Reference vehicle</p>	<ul style="list-style-type: none"> ● Drivetrain: Valeo e-Access “Serial” ● Max speed: 33 km/h ● Range: 60-90 km ● Power: 48V ● Slope: 30% ● Passenger: 8-10 ● Length: 400 cm ● Width: 127 cm

E-bus Charging infrastructure

The EPMTPO, the public transport company of the municipality in charge of operating 3 out of the 5 BRT lines, with the technical assistance of the C40 Cities Finance Facility (CFF) is in the process of determining the technical specifications and charging requirements for the procurement of the first 50 e-buses to be integrated to the Ecovía corridor. The final definitions will be available in July, but the following specifications have already been defined:

- 50 e-buses will be procured
 - 30 BRT buses (18 m)
 - 20 feeder buses (12 m)
- The charging standard chosen is the Combined Charging System, Type 2 (CCS2), which is the one recommended in the National Energy Efficiency Law and in the Decarbonisation Ordinance project.
- Automatic charging mode with communication protocols between the charger and the bus, with parameter control of how many times the bus is charged, energy efficiency control.
- The charging will be overnight and will take 150m per bus
- The autonomy of the buses will be 280 km

Regarding the distribution of the charging infrastructure within the BRT terminals for the charging of the first 50 e-buses, 2 options have been defined:

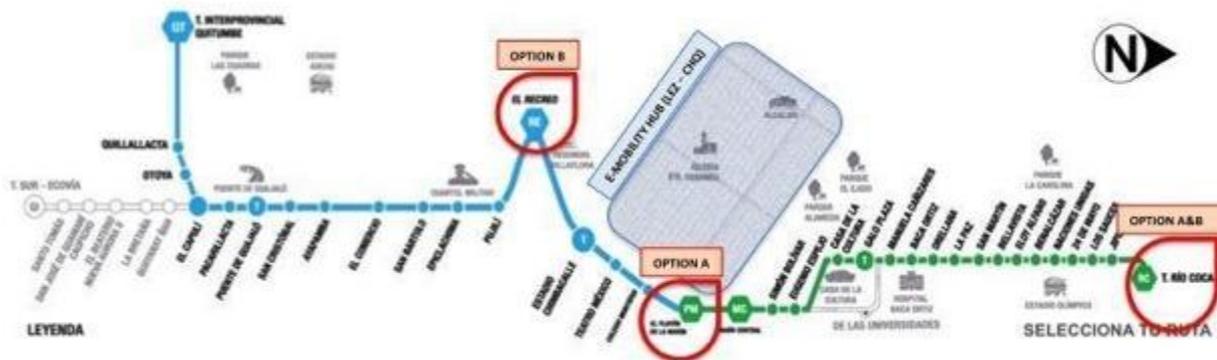
- Option A: 80% of e-BRT buses charge at the Rio Coca transfer station, 20% in La Marín transfer station

D4.1 Nine (9) Demonstration Implementation Plans

- Option B: 50% of e-BRT buses charge at the Rio Coca transfer station, 50% at the El Recreo transfer station
- All feeder buses charge at El Labrador terminal

Figure 15 shows the transfer stations that are being considered. It is worth mentioning that the La Marín transfer station is directly connected to the HCQ and thus to the e-mobility hub that SOL+ will promote in Quito as part of its demonstration activities. Accordingly, the installation of ABB charging equipment in the La Marín transfer station will enhance the passenger connectivity via e-mobility solutions in the area. Moreover, given that in La Marín 3 different BRT lines convey, this would allow different BRT operators to use the La Marín charging infrastructure to support their charging needs.

Figure 15: Options for the distribution of the charging equipment in the Ecovia BRT corridor



Source: Adapted from EPMT PQ 2020

Hence, conversations between the EPMT PQ and ABB Ecuador have been held in the context of SOL+ to define the technical specifications of charging solutions for each option. Once ABB provides the technical requirements for each option, consultations to the local electricity company, EEQ, will be made about the feasibility of installing in the different sites. Furthermore, the EPMT PQ is interested in the successful integration of ABB’s charging equipment in Chile. ABB will provide information and, if possible, coordinate a meeting with ABB Chile to make inquiries about the type of operation the buses have.

2.2.2 Test scenarios

A test scenario describes the environment in which the SOL+ demonstrations take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Table 8: Test scenario last mile logistics in the LEZ of the HCQ

Solution: last mile logistics in the LEZ of the HCQ		
Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i>	
Vehicles involved (type)	e-cargo quadricycles e-delivery van	
Vehicles involved (unit)	10 e-cargo quadricycles 1 e-delivery van	
Integration with PT system	n/a	
Lines/stops involved (units)	n/a	
Time span (testing activities)	From/to March – June 2021	
Time span (data collection)	Before From/to January – June 2021	After From/to June 2021 – December 2022

Table 9: Passenger connectivity in the LEZ of the HCQ

Solution: passenger connectivity in the LEZ of the HCQ		
Test category	<i>a) simulations</i> <i>b) tests in controlled environment,</i> <i>c) tests under real operational conditions</i> <i>d) feasibility study, assessment of technological concepts, code of practice and specifications</i>	
Vehicles involved (type)	e-bicycles e-buggy / golf cart	
Vehicles involved (unit)	40 e-bicycles 3 e-buggy / golf cart	
Integration with PT system	The purpose of these vehicles is to clean and fast mobility options to passengers transferring from the different mass transit options available in the area (BRT, subway, trolleybus, etc.). Thus, there will be physical and tariff integration.	
Lines/stops involved (units)	at least 5	
Time span (testing activities)	From/to March – June 2021	
Time span (data collection)	Before From/to January – June 2021	After From/to June 2021 – December 2022

Table 10: Test scenario support charging infrastructure for the e-BRT system

Solution: Support charging infrastructure for the e-BRT system (tbc)		
Test category	<i>c) tests under real operational conditions d) feasibility study, assessment of technological concepts, code of practice and specifications</i>	
Vehicles involved (type)	e-buses (18m)	
Vehicles involved (unit)	30 e-buses (18m)	
Integration with PT system	ABB charging equipment will be installed in La Marín BRT terminal, where 3 BRT lines are operative, becoming a support	
Lines/stops involved (units)	3 lines / 1 terminal	
Time span (testing activities)	From/to March – June 2021	
Time span (data collection)	Before From/to January – June 2021	After From/to June 2021 – December 2022

2.2.3 Business model plan

The detailing of the business model concepts, and the specific business plans relevant to the pilot will be conducted in 2021. The development of the business model concepts will explore potential emergent concepts relating to several dimensions such as: vehicle assembly/manufacturing; e-vehicle maintenance; ownership and management of shared e-cargo vehicles; provision of public charging facilities; and end-of-life resources management.

The project will also explore the possibility of establishing specific business opportunities that would involve local SMEs and EU-partner SMEs and industries, and mobility as a service model.

2.2.4 Vehicles/infrastructure/equipment provision

The table below shows the indicative (proposed) distribution of the funds for the development of the proposed vehicles. Essentially, the staff costs, components and other incidental costs for the prototyping of the 2-, 3- and 4-wheelers will be covered. Funds are also allocated for buying the final produced units.

Table 11: Indicative distribution of internal SOL+ funds for the Quito Demo

E-quadracycles		SME Call	City Equipment budget	Industry partner
Units	10	4	6	only components
Staff time & inhouse facility		9.600,00 €	14.400,00 €	- €
Components		12.000,00 €	18.000,00 €	6.000,00 €
Motor		- €	- €	6.000,00 €
Batteries		6.000,00 €	9.000,00 €	- €

D4.1 Nine (9) Demonstration Implementation Plans

All other components		6.000,00 €	9.000,00 €	- €
Distribution center infrastructure			14.600,00 €	
Other costs		- €	- €	3.000,00 €
Subtotal		21.600,00 €	47.000,00 €	9.000,00 €
E- bicycles		SME Call	City budget	Industry partner
Units	40	0	40	only components
Staff time & inhouse facility		- €	8.000,00 €	- €
Components		- €	20.000,00 €	20.000,00 €
Motor		- €	- €	20.000,00 €
Batteries		- €	12.000,00 €	- €
All other components		- €	8.000,00 €	- €
E-bike sharing infrastructure		- €	15.000,00 €	- €
Other costs		- €	- €	10.000,00 €
Subtotal		- €	43.000,00 €	30.000,00 €
E-delivery van		SME Call	City Equipment budget	Industry partner
Units	1	1	0	0
Staff time & inhouse facility		2.400,00 €	- €	- €
Components		4.400,00 €	- €	600,00 €
Motor		- €	- €	600,00 €
Batteries		1.800,00 €	- €	- €
All other components		2.600,00 €	- €	- €
Other costs		1.200,00 €	- €	300,00 €
Subtotal		8.000,00 €	- €	900,00 €
E-buggy / golf cart		SME Call	City Equipment budget	Industry partner
Units	3	2	1	0
Staff time & inhouse facility		6.000,00 €	3.000,00 €	- €
Components		11.600,00 €	5.800,00 €	1.800,00 €
Motor		- €	- €	1.800,00 €
Batteries		3.600,00 €	1.800,00 €	- €
All other components		8.000,00 €	4.000,00 €	- €
Other costs		2.400,00 €	1.200,00 €	900,00 €
Subtotal		20.000,00 €	10.000,00 €	2.700,00 €
GRAND TOTAL		49.600,00 €	100.000,00 €	42.600,00 €

2.4 Team involved

Table 13: Team members and contact details

Main Role	Company	Name	Contact
Demo leader	Municipality of the Metropolitan District of Quito (MDMQ)	(see below)	(see below)
Technical counterpart	Mobility Secretariat (SM) of the MDMQ	<u>Fernando de la Torre</u> Director of Sustainable Transport Modes (SM) <u>Henry Vilatuña</u> Director of Mobility Policy Planning (SM)	fernando.delatorre@quito.gob.ec henry.vilatunia@gmail.com
Technical and financial counterpart	Environment Secretariat (SA) Environmental Fund of the MDMQ	<u>Fernando Granizo</u> Director of Environmental Policies and Planning (SA)	fernando.granizo@quito.gob.ec
Coordination	Wuppertal Institute (WI) UEMI	<u>Maria Rosa Muñoz B.</u> WI Research Fellow Regional coordination <u>Lorena Saavedra</u> UEMI Research Fellow Local implementation	maria.munoz@wupperinst.org lorena.saavedra@uemi.net
Vehicles provider/s	Local assembler/s would ultimately be chosen through the SOL+ local SME call in Oct 2020. For a description of possible providers please go to the business environment section	tbc	tbc
Charging system provider	The charging system provider will be defined once the charging needs are identified	tbc	tbc
Service provider/s	Once the vehicles are operative, a public tender to lease the vehicles to a delivery company operating in Quito will be launched.	Tbc	Tbc
Regional support	CMM SIMUS	Sebastián Galarza Suárez Nidia Ibarra Serrano	sgalarza@cmmolina.cl desarrollo@redsimus.com

2.5 Risks Assessment

Table 14: Risks and Mitigation Strategies

Risk	Probability assessment	Consequences	Risk mitigation/comments
<i>Valeo components not delivered on time</i>	Medium	<p><i>Prototype developments would be delays</i></p> <p><i>Local assemblers might lose interest in the project</i></p>	<p><i>Incorporation of lead times for delivery, customs clearance;</i></p> <p><i>Clarification of regulations regarding importation</i></p> <p><i>Clarification of the process and progress to the assemblers</i></p>
<i>End products not suitable for topographic conditions of the Historic Center</i>	Low	<i>SOL E-vehicles are eventually not used</i>	<i>Context needs-based assessment at the core of the design phase</i>
<i>On-road crash or technical failure during actual demonstration</i>	Medium	<i>Injuries or worse; needs for redesign; stoppage of demonstration</i>	<p><i>Technical Performance and Safety testing incorporating operational scenarios to be done;</i></p> <p><i>Check if all insurance mechanisms are covered;</i></p> <p><i>Training for operators to be conducted</i></p>
<i>Vehicles will not be permitted on-the-road</i>	Low	<i>The e-vehicles will not be able to be utilized</i>	<i>Design and performance have to be assessed by CCICEV in order to ensure harmonization and therefore permit issuance</i>
<i>E-bikes for passenger interconnectivity get stolen or damaged</i>	Medium	<i>Stoppage of demonstration</i>	<p><i>City needs to make operational arrangements to the public bike system to ensure proper care, parking and storage of the bicycles.</i></p> <p><i>Proper parking equipment must be implemented in various key amenities in the Historic Center to</i></p>

D4.1 Nine (9) Demonstration Implementation Plans

			<i>diminish risk.</i>
<i>Ordinance for the Low-Emission Zone in the City Center gets delayed for discussion or does not get approved</i>	Low	<i>E-cargo vehicle utilization loses relevance and therefore demonstration gets at disabled</i>	<i>User needs-based logistic plan developed to increase attractiveness of demonstration regardless of formal declaration of the Low-Emission Zone.</i>
<i>Residents and local businesses opposition to the Declaration of the Low-Emission Zone and derived restriction of circulation restriction</i>	High	<i>Demonstration gets delayed or disabled due to political resistance of merchants</i>	<i>Timely involvement of merchants in the demo in order to ensure user needs-based approach for the logistic plan and vehicle design to increase attractiveness of demonstration regardless of formal declaration of the Low-Emission Zone.</i>
<i>Lack of interest of local assemblers for EV design using European components, given the context of lack of local industry protection measures against Chinese imports</i>	Medium	<i>SOL+ local SME call fails</i>	<i>City to issue special operating permits for the Low-Emission Zone, based on technical specifications.</i> <i>Coordination with the City to ensure procurement processes incorporate assessment of local components.</i> <i>Coordination with Ministry of Industry and other relevant authorities to promote local industry protection</i>
<i>Delays due to procurement processes</i>	Medium	<i>Delays in the whole prototyping/development and demo processes</i>	<i>Lead time to be accounted for in the planning of the procurement.</i>
<i>Political Instability and change in directive positions of counterparts</i>	Medium	<i>Delay in the whole implementation plan</i>	<i>Wide socialization of the project among various areas of the Municipality and citizens to ensure continuity.</i>
<i>COVID-19</i>	High	<i>On-site trainings, peer-to-peer exchange delayed</i> <i>Change of priorities in the local government</i>	<i>Provide online CB alternatives while the restrictions last</i> <i>Emphasize and focus on the aspects of the demo that could help mitigate COVID-19 transport-</i>

		<i>New procurement regulations (delays)</i>	<i>related risks</i> <i>Follow-up continuously with local counterparts to find suitable solutions on time</i>
--	--	---	--

2.6 Monitoring

A monitoring plan will be crafted based both on the “global” project key performance indicators (KPIs) to be developed within the Work Package 1 of SOLUTIONSplus and the main objectives to be co-identified with the local counterparts. Essentially, a set of highly relevant KPIs will be selected and methodologies (who, what, when, where, how) for collecting data for calculating the indicators will be included in the monitoring plan. To be able to properly assess the impacts of the demos, there would also be a need for baselining activities which would establish the benchmarks for the indicators. The baseline values would essentially capture “what would have happened in case the demonstration was not conducted.”

The KPIs would capture operational performance, and service quality-related perceptions. These KPIs would be selected based on a holistic framework that considers operational (reliability, range, etc...), environmental (and energy efficiency), social (e.g. safety, perceptions), and economic (e.g. total costs of ownership, operational costs and considerations, affordability) aspects of the demonstration activities.

3.Preliminary replication opportunities

Aside from the replication cities identified in general by SOLUTIONSplus worldwide, the local context provides two interesting opportunities, in the cities of Cuenca and Ambato, also in Ecuador.

Municipality of Cuenca

The city of Cuenca built an urban tram that will start commercial operation in the following months and whose route goes through the city center in order to avoid commutes done by private vehicles. In such context, the city is developing a project in order to convert the city center in a low-emission zone, where sustainable mobility is promoted through different initiatives: walking pathways, cycling routes, land use readjustment with superblock approach (“Supermanzanas”), among others. Furthermore, the city of Cuenca recently started working with GIZ Program TUMI-VOLT, which promotes e-mobility and one of the expected deliverables for the city is a Local Electric Mobility Strategy for the City.

In such context, it is an ideal candidate for peer-to peer exchange of experiences and for replication of the demonstration measures, particularly regarding passenger interconnectivity and the articulation of e-mobility solutions with a main massive transit project.

Municipality of Ambato

D4.1 Nine (9) Demonstration Implementation Plans

The city of Ambato is developing a Sustainable Urban Development Plan (SUMP) that would aim to lower emissions significantly over a 12-year time horizon. For that purpose, intense measures would be necessary in the city center, that is a major congestion area. In fact, a pilot project for spatial reconfiguration and pedestrianization in the city center is already under development. The purpose is to shift transportation patterns in an area of the city that enables active mobility due to its topography and extension. However, given the commercial character of the city and particularly of its center, pedestrianization and road reconfiguration will require alternative solutions for last mile freight. And given the SUMP goals of lowered emission, that would necessarily imply a shift to e-cargo vehicles. Therefore, replication of the demonstration solutions developed in Quito can be highly desirable.

4.Updates

Update June 2020

4.1 Progress towards implementation

Several activities that contribute to the implementation of the demo have been conducted in the past 6 months:

- Regional Kick-off Webinar took place on April 29. More than 40 city officials from Quito and Montevideo, as well as SOL+ partners such as ABB, Valeo, ZLC, IDIADA, Rupprecht Consult, Pluservice, POLIS, among others participated in the virtual kick-off, which had a focus on public transport electrification (further information [here](#)).
- Vehicles and equipment
 - Several local start-ups and SMEs with the capacity to assemble electric vehicles locally have been identified and approached.
 - Identified SMEs participated in the 1st Valeo workshop to get to know Valeo drivetrains.
 - Technical specifications of 1st e-quadricycle prototype (SIDERTECH) have been submitted to Valeo for feasibility assessment.
 - Discussions with the local representative from ABB and the EPMTQP are being held to define the possible charging solutions for Quito.
- Integration
 - 2nd version of the ZLC methodology for the logistics plan for the HCQ has been submitted based on the inputs and feedback received from the local counterparts on the 1st version.
 - The first proposal of an intermodal corridor for the HCQ by the TU Berlin Design Studio was presented to Quito for feedback on June 26, 2020.
- Capacity building
 - Several SOL+ consortium members conduct CB activities in the region. Thus, it has been decided to create a regional CB platform for Latin America.
 - The 1-week e-mobility course that is held annually by the UDELAR (local university) and the Polytechnic University of Madrid (UPM) has been identified as an opportunity for the Spanish speaking cities of SOL+ (Quito, Montevideo and Madrid). The possibility of integrating an Ecuadorian University, the National Polytechnic

D4.1 Nine (9) Demonstration Implementation Plans

University (EPN) in the network to promote exchange and CB on e-mobility has been discussed.

4.2 Next steps

- Local Innovators Call will be launched soon.
- Matchmaking process with European SMEs will start.
- Follow up with ABB and the EPMTPO to evaluate if they could provide a charging solution for Quito.
- Start data collection process that will serve as an input for the e-logistics plan of the ZLC.
- Regional CB platform for Latin America will be created.
- CB plan adapted to the local needs will be elaborated.
- Approach the EPN to discuss CB and cooperation possibilities in terms of e-mobility.

5. References

Agence Francaise du Developpement (AFD) 2020. GCF Concept Note for the Latin American E-Mobility Program (E-Motion).

Alvaro, Mercedes. 2019. 'Ecuador: Lenín Moreno, sus razones para el fin del subsidio al combustible y la oportunidad que vio Rafael Correa'. Infobae. 10 May 2019. <https://www.infobae.com/america/america-latina/2019/10/05/ecuador-lenin-moreno-sus-razones-para-el-fin-del-subsidio-al-combustible-y-la-oportunidad-que-vio-rafael-correa/>.

ARCONEL. 2019. 'Balance Nacional de Energía Eléctrica'. Quito: Agencia de Regulación y Control de la Electricidad (ARCONEL). <https://www.regulacioneolica.gob.ec/balance-nacional/>.

BCE. 2018. 'Cuadro Cuentas Cantonales 2018'. 1.17. Cuentas Cantonales VAB. Banco Central del Ecuador (BCE). <https://contenido.bce.fin.ec/docs.php?path=/documentos/Estadisticas/SectorReal/CuentasCantonales/Indice.htm>

BDE. N.d. 'Historia | Banco de Desarrollo del Ecuador'. Institutional. Banco de Desarrollo del Ecuador. Accessed 7 January 2020. <https://bde.fin.ec/historia/>.

Bravo, Esteban. 2017. 'Adjudicado el contrato para flota de 80 biarticulados para Quito'. Institutional. Transporte de Pasajeros. 4 July 2017. <https://www.trolebus.gob.ec/index.php/noticias/noticias-2/245-adjudicado-el-contrato-para-flota-de-80-biarticulados-para-quito>.

BYD. 2017. '35 taxis eléctricos en Loja, la capital ambiental del Ecuador'. BYD (blog). 21 April 2017. <https://bydelectrico.com/taxis-electricos-loja-ecuador/>.

Bypad. 2019. 'Estudio movilidad Ambato' pdf.

C40 CFF. 2020. 'Flagship Project Form_Quito'

C40 CFF. 2018. 'New Sustainable Infrastructure Coming To 9 Cities As C40 Cities Finance Facility Announces Support For Transformational Projects'. C40 Cities Finance Facility. 30 November 2018. <https://www.c40cff.org/news-and-events/new-sustainable-infrastructure-coming-to-9-cities-as-c40-cities-finance-facility-announces-support-for-transformational-projects>.

Carvajal, Ana María. 2019a. 'Escasa infraestructura para autos eléctricos en Quito'. Newspaper. El Comercio. 6 May 2019. <https://www.elcomercio.com/actualidad/escasa-infraestructura-autos-electricos-quito.html>.

———. 2019b. 'Peatonalización redujo la contaminación'. Newspaper. El Comercio. 5 August 2019. <https://www.elcomercio.com/actualidad/quito-centro-historico-peatonalizacion-contaminacion.html>.

———. 2019c. 'Transportistas de Quito planean comprar 150 buses eléctricos para mejorar la

D4.1 Nine (9) Demonstration Implementation Plans

movilidad'. Newspaper. El Comercio. 18 December 2019. <https://www.elcomercio.com/actualidad/transportistas-quito-compra-buses-electricos.html>.
CFN. 2018. 'Financiamiento de Movilidad Eléctrica'. Corporación Financiera Nacional (CFN). 18 October 2018. <https://www.cfn.fin.ec/financiamiento-de-movilidad-electrica/>.

———. 2019. 'LA MOVILIDAD ELÉCTRICA ARRANCA EN ECUADOR'. CFN. 6 May 2019. <https://www.cfn.fin.ec/la-movilidad-electrica-arranca-en-ecuador/>.

———. N.d. 'Quiénes Somos'. Corporación Financiera Nacional (CFN). Accessed 31 October 2019. <https://www.cfn.fin.ec/quienes-somos/>.

Ciclópolis. 2020. 'Ciclopaseo Quito' 26 June 2020. <https://ciclopolisecuador.wixsite.com/ciclopolis/ciclopaseo-quito>

Cisneros Garzón, P. A. (2015). Quito en el atlas urbano: categorización y análisis de la logística urbana en el centro histórico de Quito (Bachelor's thesis, Quito, 2015.).

Diario La Hora. 2020. 'En Quito la bicicleta pública vuelve a ser tarifada' 10 February 2020 <https://lahora.com.ec/quito/noticia/1102305219/en-quito-la-bicicleta-publica-vuelve-a-ser-tarifada->

Diario La Hora. 2019. 'Peatonalización desvela los problemas del Centro Histórico' 01 August 2019. <https://lahora.com.ec/quito/noticia/1102262326/peatonalizacion-desvela-los-problemas-del-centro-historico>

Diario La Hora. 2019. 'Centro Histórico de Quito, un lugar difícil para descargar mercadería – La Hora'. Newspaper. La Hora Noticias de Ecuador, sus provincias y el mundo. 13 March 2019. <https://www.lahora.com.ec/quito/noticia/1102228643/centro-historico-de-quito-un-lugar-dificil-para-descargar-mercaderia->.

Díaz Suárez, Valeria. 2017. 'Informe de la Calidad del Aire 2017'. ICA. Quito: Secretaría de Ambiente. <http://www.quitoambiente.gob.ec/ambiente/index.php/informes#informe-calidad-del-aire-2017>.

EEQ. N.d. 'Servicio Público de Energía Eléctrica Para Quito y Su Área de Concesión – Empresa Eléctrica Quito'. Empresa Eléctrica Quito (EEQ). Accessed 30 October 2019. <http://www.eeq.com.ec:8080/inicio>.

El Comercio.2020. 'Municipio anuncia que la bicicleta pública en Quito tendrá GPS y funcionará con una ,app' 16 January 2020. <https://www.elcomercio.com/actualidad/bicicleta-publica-quito-automatizacion-movilidad.html>.

El Comercio. 2017. 'Rodas Ofrece Cambiar Buses a Diésel Por Eléctricos Hasta El 2025'. El Comercio. 24 October 2017. <https://www.elcomercio.com/tendencias/quito-mauriciorodas-buses-dieses-energia.html>.

———. 2019. 'El 40% de buses públicos no cuenta con sistema GPS para control de flota'. El

D4.1 Nine (9) Demonstration Implementation Plans

MDMQ. 2013. 'Ordenanza Metropolitana No. 383'. Municipio del Distrito Metropolitano de Quito (MDMQ). <https://www.metrodequito.gob.ec/wp-content/uploads/2018/01/2-Ordenanza-0383-Reformatorio-Ordenanza-0237.pdf>.

MEER. N.d. 'Valores / Misión / Visión'. *Ministerio de Electricidad y Energía Renovable (MEER)* (blog). Accessed 30 October 2019. <http://historico.energia.gob.ec/valores-mision-vision/>.

Merchán, D., Blanco, E. E., & Bateman, A. (2015). Urban metrics for urban logistics: Building an atlas for urban freight policy makers. *Proceedings of Computers in Urban Planning and Urban Management CUPUM, Cambridge, MA*, 1-15.

Metro de Madrid. 2011. 'Encuesta de Movilidad 2011'. Municipio del Distrito Metropolitano de Quito.

Metro de Quito. 2020. 'El Metro Es Una Realidad'. Institutional. Metro de Quito. 1 June 2020. <https://www.metrodequito.gob.ec/>.

MIDUVI. 2013. 'Revitalización del Centro Histórico de Quito'. Quito: Ministerio de Desarrollo Urbano y Vivienda (MIDUVI) – Subsecretaría de Hábitat y Asentamientos Humanos. <https://www.habitatyvivienda.gob.ec/wp-content/uploads/downloads/2015/04/PROYECTO-CENTRO-HISTÓRICO-reformulación-dictamen-2015.pdf>.

———. N.d. 'Misión / Visión – Ministerio de Desarrollo Urbano y Vivienda'. Ministerio de Desarrollo Urbano y Vivienda (MIDUVI). Accessed 31 October 2019. <https://www.habitatyvivienda.gob.ec/valores-mision-vision/>.

MTOP. N.d. 'Valores / Misión / Visión – Ministerio de Transporte y Obras Públicas'. Ministerio de Transporte y Obras Públicas. Accessed 30 October 2019. <https://www.obraspublicas.gob.ec/valores-mision-vision/>.

MTOP, GIZ Ecuador, and b4future. 2018. '1er Foro Internacional de Electromovilidad – Cuenca 2018. Memorias del Foro & Propuesta de Hoja de Ruta para la Electromovilidad en Ecuador'. Cuenca: Ministerio de Transporte y Obras Públicas (MTOP). <http://b4future.com/downloads/B4Future-Memorias-1er-Foro-Electromovilidad-y-Hoja-de-Ruta-Electromovilidad-Ecuador.pdf>.

Pacheco, Mayra. 2019a. 'Los buses que se adquieran desde el 2025 deberán ser eléctricos'. *El Comercio*. 4 July 2019. <https://www.elcomercio.com/actualidad/buses-electricos-transporte-ley-combustible.html>.

———. 2019b. 'La matriz energética del Ecuador todavía depende del petróleo'. *El Comercio*. 5 September 2019. <https://www.elcomercio.com/actualidad/matriz-energetica-petroleo-ecuador-negocios.html>.

Presidencia de la República del Ecuador. 2019. 'Gobierno y Municipio comprometen 300 buses

D4.1 Nine (9) Demonstration Implementation Plans

eléctricos para Quito’. Institutional. Presidencia de la República del Ecuador. 12 June 2019. <https://www.presidencia.gob.ec/gobierno-y-municipio-comprometen-300-buses-electricos-para-quito/>.

Primicias. 2019. ‘Demanda de gasolina Súper cae 38,32% tras la eliminación del subsidio’. *Primicias* (blog). 2019. <https://www.primicias.ec/noticias/economia/demanda-gasolina-super-subsidio-petroecuador/>.

Secretaría de Ambiente. 2015. ‘Diagnóstico’. Secretaría de Ambiente – Alcaldía de Quito. 2015. <http://www.quitoambiente.gob.ec/ambiente/index.php/cambio-climatico/diagnostico>.
 ——. N.d. ‘Visión Conceptual’. Secretaría de Ambiente. Accessed 1 November 2019. <http://www.quitoambiente.gob.ec/ambiente/index.php/la-secretaria/vision-conceptual>.

Secretaría de Movilidad. N.d. ‘Secretaría de Movilidad – La Institución’. Secretaría de Movilidad. Accessed 30 October 2019. <https://secretariademovilidad.quito.gob.ec/index.php/la-institucion/presentacion>.

Villón Reyes, Jorge. 2018. ‘BYD traza plan para planta de ensamblaje de buses eléctricos en Ecuador | Ecuador | Noticias | El Universo’. EL UNIVERSO. 27 November 2018. <https://www.eluniverso.com/noticias/2018/11/27/nota/7071312/byd-traza-plan-planta-ensamblaje-buses-electricos-ecuador>.

D4.1 Demonstration Implementation Plan

City: Montevideo

1. Operating environment

1.1 Background

Montevideo, the capital city of Uruguay, has a population of 1.3 million, more than 30% of the country's population. Uruguay's GDP per capita is US\$16.245, which is the highest in the region. In 2014, its per capita CO₂ emissions were 1.98 tonnes. Uruguay has undergone a structural transformation of its electricity system, as such more than 90% of the electricity generated now comes from renewable sources. Transportation is the sector with the second highest energy consumption in Uruguay and is the main consumer of petroleum derivatives and the largest emitter of CO₂ (MIEM n.d). This can be explained by the fact that 82% of the motorised trips are completed in private vehicles with an average annual growth of the light-duty vehicle fleet of 7%. As for the public transport system, it is mainly busses operated by five private operators, and taxis. However, recently there are also micro-mobility providers pushing into the market. Montevideo is trying to advance the transition to an inclusive, adaptable, efficient and low carbon transport system. Therefore, within the MOVES project (for more details see below) , the Municipality of Montevideo, known as Intendencia, in cooperation with different national ministries aims at the integration of 100 e-buses, e-cargo-vehicles and e-taxis. It will begin in the metropolitan area of Montevideo and should serve as a model for replication in other cities of Uruguay. It is expected that this project will result in direct CO₂ emissions savings of at least 115,000t and indirect savings of at least 165,000t 10 years after the completion of the project.

1.1.1 Key facts and figures

Population (Uruguay): 3.5 million people

Population (Montevideo): 1.3 million people

GDP per capita: US\$16.245

CO₂ emissions: 6930000 / 1.98 tons (total and per capita)

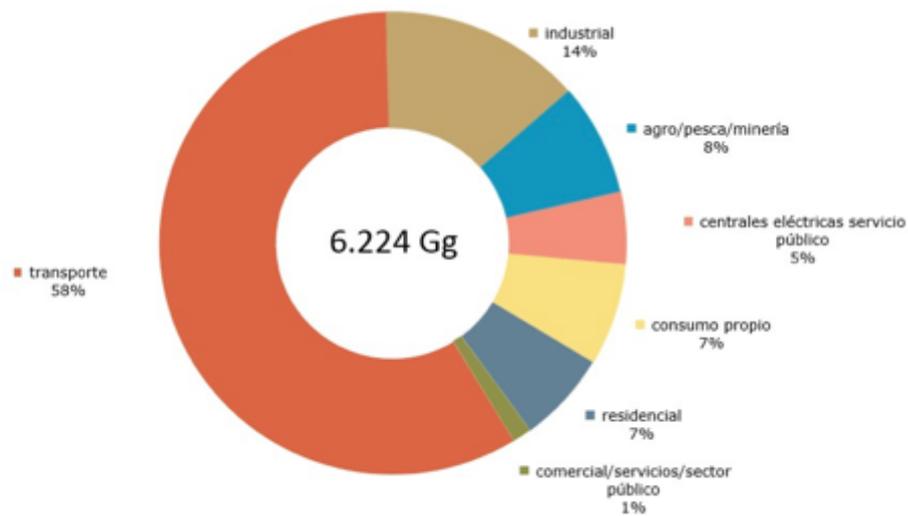
Modal shares: foot 34% / car 32% / bus 25% / motorbike 4% / bike 3% / taxi 1% / other 1%

1.1.2 Overarching issues

Mobility

As summarized above transportation is the sector with the second highest energy consumption in Uruguay, the main consumer of petroleum derivatives and the largest emitter of CO₂. The contribution of transport within the energy sector emissions has increased, at a small pace between 2006 (39%) and 2012 (40%), and more significantly afterwards, reaching a share of 58% in 2018 and with prospects to account for more than 60% of energy emissions in the next decade (BEN 2018a).

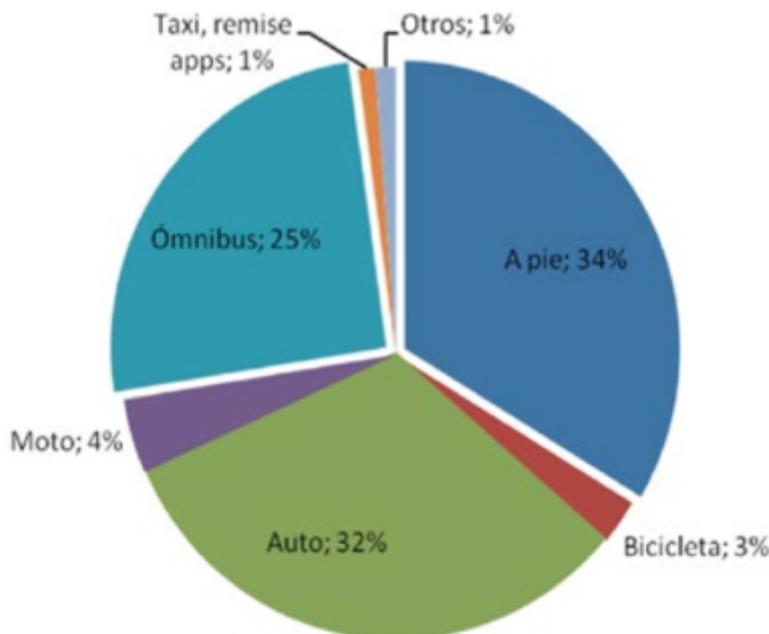
Figure 1: CO2-emissions by sector (2018)



Source: BEN 2018a

According to a survey from 2017, commissioned among others by the Municipality of Montevideo, the modal split in Montevideo is as follows: two thirds are motorized (car, motorcycle, bus, etc.) and one third are active mobility (walking and cycling), of which the vast majority is on foot (34%). 32% of the trips are made by car, 4% by motorcycle, 25% by bus, 34% on foot and only 3% by bicycle.

Figure 2: Modal split



Source: Mauttone & Hernández 2017, p. 24

D4.1 Nine (9) Demonstration Implementation Plans

Though population growth is estimated to be rather low (0,4% annually), it will take place in areas outside the city center, thus leading to more potential travel trips. Also, the expected economic growth (annual growth rate of 1.6% in 2017, 2.5% in 2018, and 3.7% in 2019) is a further driver of motorization rates and thus higher CO₂ emissions from urban mobility in Montevideo. In 2007/08 the use of public transportation rose about 30%, when a policy of subsidies was introduced, keeping prices low. The Intendencia had set up an interesting financing mechanism: a transport trust, which functions as collective sector financing structure (in Spanish: *fideicomiso*), allowing companies to access much more beneficial conditions than if they did so individually (IM 2003; EV 2018). However, cheap ticket prices were unable to curb steady car-use growth and since 2014 ticket sales have even decreasing slightly. Not even the Sustainable Urban Mobility Plan (SUMP) of Montevideo, implementing a new pricing system and priority corridors has led to an increase in ridership.

Among significant stakeholders and large groups of the citizenry, the privileges of car users are not questioned, and also, implementation of new strategic concepts, such as for example the above mentioned corridors, are very controversial. Very few companies or public institutions encourage sustainable mobility solutions. In 2010, Uruguay started the active promotion of electric mobility. The installed renewable energy capacity for the generation of electricity is sufficient to satisfy the expected increase in demand according to the projections for the incorporation of electric vehicles (MIEM n.d).

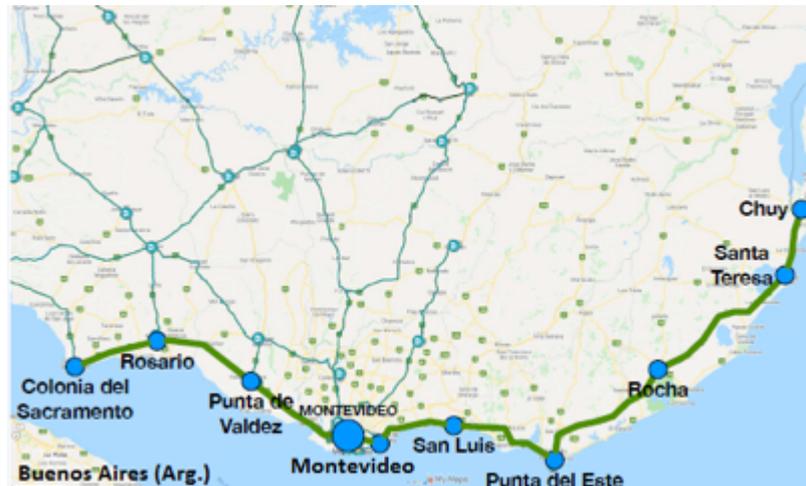
With this background, there have been attempts to help advance a transportation system that actively promotes e-vehicles (EV). In terms of incentives to Evs,

- the Internal Specific Tax (IMESI by its Spanish acronym), an excise tax that owners have to pay when purchasing a vehicle, was reduced more than 70% for hybrids and Evs (Decreto 246/012);
- electric utility vehicles were incorporated into the cleaner production indicator of the Investment Promotion Law¹⁵ (Decreto 02/12);
- and import duties for cars with exclusively electric propulsion were reduced from 23% to 0% (UTE n.d.).
- other tools described later.

Furthermore, the Uruguayan Government through its public companies UTE and ANCAP has built the 'Electric Route' that links the cities of Colonia del Sacramento ("in front" to Buenos Aires, Argentina) and El Chuy (on the Brazilian border) with charging points located every 60km. As it is shown below, that route connects important cities of Uruguay, including its capital Montevideo. This infrastructure was the first "electric route" in Latin America, inaugurated on December 2017.

¹⁵ In addition, until 30 April 2021, the purchase of passenger vehicles with exclusively electric motorization, which are used directly for the activity of the company, will be considered an eligible investment; art. 33, dec. 143/2018),

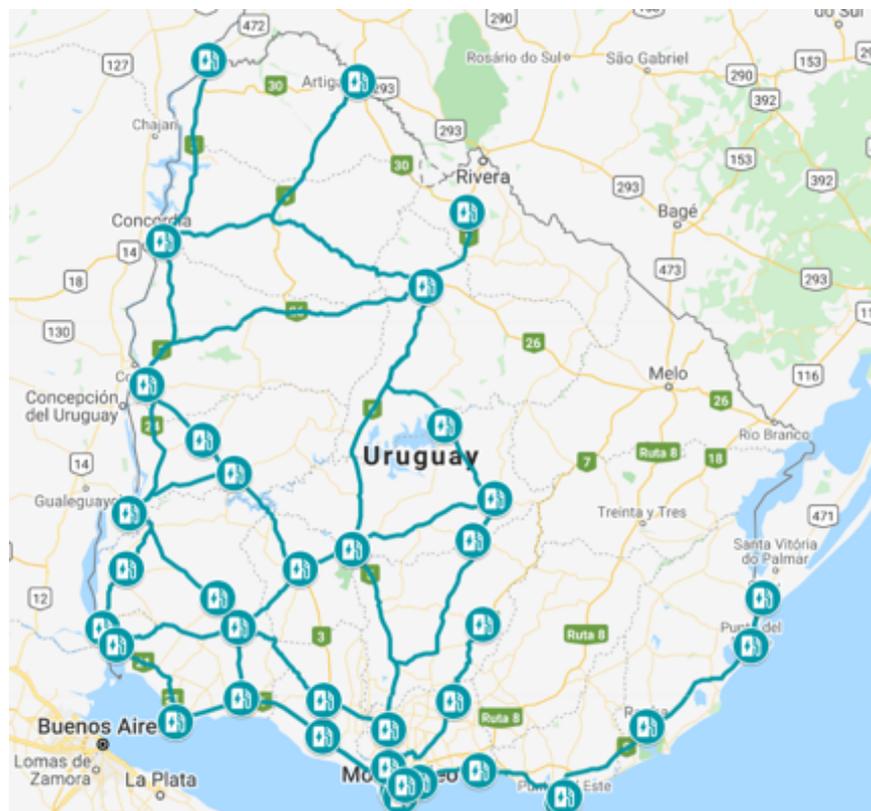
Figure 3: Electric Route



Source: Riso, Vignolo, Arismendi & Carriquiry, Faculty of Engineering 2020, p. 2

After the construction of the electric route, a subsequent expansion of the recharging network was carried out by the aforementioned companies, currently reaching a network that covers almost the entire country, including all departmental capitals in the near future. A complete map of Uruguay’s electric vehicle charging network is shown in the figure below.

Figure 4: EV Charging Network of Uruguay



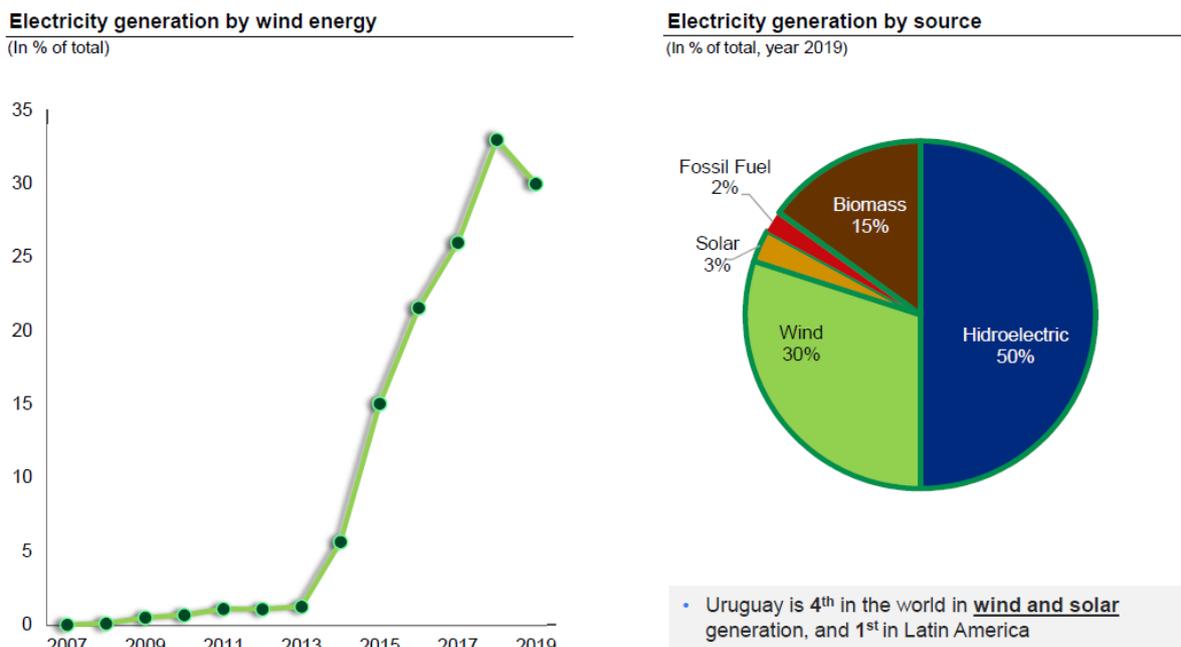
Source: UTE webpage¹⁶

¹⁶ <https://movilidad.ute.com.uy/carga.html?tab=evolucion-de-la-red>

Energy and GHG Emissions

Regarding the electricity system, Uruguay has since 2010 undergone a structural transformation within the framework of the “National Energy Policy 2005 – 2030”, so that more than 90% of the electricity generated now comes from renewable sources as it is shown in the next figure. The share of renewables in the energy matrix keeps growing which provides to Uruguay the capacity to upfront an important growing of the electric vehicle market in the coming years. The existing energy plans (e.g. *Política Energética Uruguay 2030*, established in 2008), favor further development of renewables, as a consequence of the strong national consensus of all major political parties (*Comisión Multipartidaria de Energía, 2010*) and stakeholders.

Figure 5: Renewable energy generation in Uruguay



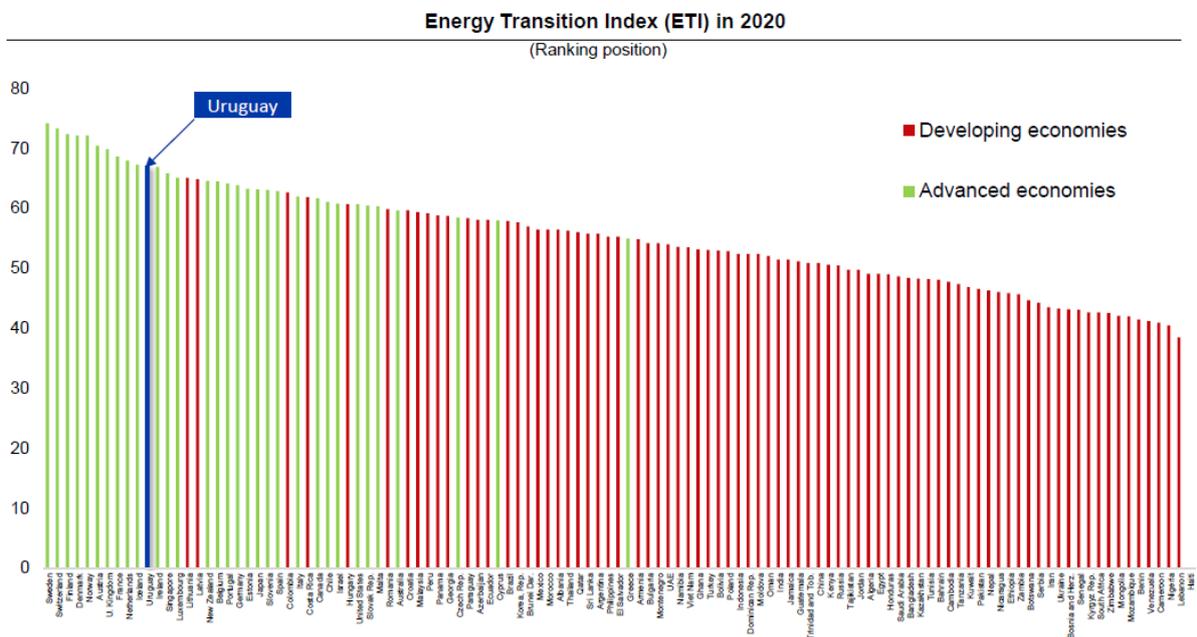
Source: National Energetic Preliminary Balance 2019, Ministry of Industry, Energy and Mining

Uruguay has been widely recognized for the transformation of its energy matrix over the past decade away from fossil fuels, and is often referred to as a global “Green Energy Leader”. It is the 4th country in the world in wind and solar power generation and it is the 1st country in Latin America with this portion of renewables (conventional and non conventional) in its electricity matrix.

Air Quality

Although air quality does not currently represent a problem in Uruguay, some established guide levels are exceeded showing a trend of steady increases in particulate material (CCAC 2016). Beyond that, Uruguay is the top performer amongst developing economies in the Energy Transition Index (ETI) and one of the best positioned in the world. The Energy Transition Index (ETI) is a fact-based ranking intended to enable policy-makers and businesses to plot the course for a successful energy transition. The ETI (elaborated by the WEF) does not only benchmark countries on their current energy system performance, but also provides a forward-looking lens as it measures their readiness for the energy transition, air pollution and carbon footprint.

Figure 6: Energy transition Index



Source: World Economic Forum

1.2 E-mobility overview

1.2.1 Policy environment

Existing e-mobility projects / programmes

In September 2017 the Global Environment Facility (GEF) approved the so called “**MOVÉS**” project, which aims at establishing an effective transition to an inclusive, adaptable, efficient and low carbon transport system. It was then launched in May 2018. The project facilitates the reform of the current framework of urban transport regulations and incentives, with a focus on public transport quality and promotion of non-motorized modes, the adoption of electric vehicles in the public transport and urban delivery sectors, closer cooperation among authorities and relevant agents and appropriate monitoring systems of transport GHG-emissions. Measures taken include the **labelling of energy efficiency in light combustion vehicles and the introduction of electric vehicles in public and utilitarian transport**. The latter

D4.1 Nine (9) Demonstration Implementation Plans

is done by promoting free testing of electric utility vehicles for companies with urban delivery operations. The free trial lasts for one month and will be implemented through rental companies. The implementation will begin in the metropolitan area of Montevideo and will be replicated in other cities of the country. The project aims to incorporate 100 e-buses in a period of 3-5 years, 70 of which will be allocated to Montevideo. To achieve this goal, **the national government will subsidise 60% of the total price of the 100 planned e-buses** (Ley N° 19670) (Presidencia 2019a). In the framework of MOVES project, the Ministry for Industry, Energy and Mining (MIEM) and the transport operators signed an agreement of purchasing 30 e-buses (100.000 USD for each company as subsidy) (Presidencia 2019b). As a consequence of the agreement, 30 electric buses were purchased in 2019, which started operations in May 2020. Among those 30 buses, 20 were supplied by the Chinese company BYD and 10 were supplied by the Chinese company Yutong. At present, there are also 55 electric taxis active in Montevideo. It is planned to reach 10% of the current fleet in 2020 (approx. 300), and also to continue including electric vehicles in the plans to renew the public utility fleet (IM 2019). The MIEM is executing the project, together with the Ministry of Housing, Planning and Environment (MVOTMA) and the International Cooperation Agency of Uruguay (AUCI).

One of the recent calls of the project MOVES (February 2019) aimed at suppliers interested in renting **electric tricycles and pedal-assisted electric bicycles for distribution**. Subsequently, delivery companies will be able to test the vehicles free of charge for one month, through the rental subsidy provided by MOVES. Moreover, it will be mandatory to have the course of the National Institute of Employment and Vocational Training (Inefop) as part of the training program for distribution workers on motorcycles, in order to also ensure workers' safety and reduction of accidents (UNDP 2019).

1.2.2 Existing regulations

Charging regulation:

UNIT IEC 61851-1: 2017 standard, year 2017. "Conductive charging system for electric vehicles – Part 1: General requirements". This standard is the first part of the IEC 61851-1 series that specifies the general requirements for the supply¹ of electrical energy for electric road vehicles. It should be noted that the vehicle and the electric vehicle power system are a complete system that is covered by a series of IEC and ISO standards. IEC 61851 covers the mechanical, electrical, communication, EMC, and performance requirements for the VE power system used to charge electric vehicles, including light electric vehicles.

UNIT 1234:2016 Standard, year 2016. "Conductive Charging System for Electric Vehicles – Vehicle Tabs, Sockets, Vehicle Connectors and Vehicle Input Connections – Standard Formats". This standard establishes a system of standardized formats for tokens, outlets, vehicle connectors and vehicle entrances for conductive vehicle charging.
Electrical.

Regulation on batteries

There is not currently a regulations for lithium ion batteries or batteries for electric vehicle in general. The decree 373/003 (year 2003) regulates the handling and disposal of electric lead-

D4.1 Nine (9) Demonstration Implementation Plans

acid batteries or accumulators for starting engines. That decree is being updated to adapt it to the new battery technologies that electric vehicles incorporate.

Regulation on energy efficiency labeling

UNIT 1130: 2013 Standard Energy Efficiency – Light Automotive Vehicles – Labeling, establishes the criteria for defining the performance of light vehicles and the characteristics of the energy efficiency label. A UNIT technical committee is currently active to update the standard, which will include vehicle efficiency labeling for electric and hybrid vehicles.

Subsidies for e-buses

The law No. 19670, article 349 (October 2018) gave to the government the power to implement equitably between Montevideo and the rest of the departments of Uruguay a subsidy destined to support the initial transition towards more efficient and sustainable technologies in the collective public transport of passengers by replacing up to 4% (four percent) of its fleet of diesel-powered buses with electrically powered buses. The subsidy is aimed at public passenger transport operators across the country who are interested in replacing a diesel bus with an electric motorized bus, according to the criteria defined in the regulation of the law. The law establishes that the subsidy cannot exceed the gap between the cost of acquiring a bus with an electric motor and the cost of acquiring a bus with a diesel engine.

Departmental Digest / Food Delivery Services

The Departmental Digest for food delivery services, Articles D.902.2 and D.902.3 published the present year by the Municipality of Montevideo regulate food delivery services through the use of mobile phone applications. Within the regulations, criteria are established that companies must adopt as well as the sanctions established in case of non-compliance.

1.2.3 Policy gaps

The following points below gather the policy gaps that have been found in relation to supporting and expanding e-mobility in Uruguay. The first part refers to public policy instruments and strategic framework targeting on e-mobility, the second one refers to incentives for the purchase of electric vehicles or clean vehicles. After that, some topics referred to restrictions or limitations of the use of internal combustion engines and polluting vehicles are examined, to finish in the analysis of incentives and/or instruments for scrapping.

Table 1: Existing and missing regulations related to electric mobility in Uruguay

<i>Public policy instruments / strategic framework targeting e-mobility</i>	<i>Existing</i>	<i>Partially / in Progress</i>	<i>Gap</i>
National Electric Mobility Strategy (or National Mobility Policy with a strong focus on e-mobility)	x		
Local electric mobility strategies (or Sustainable Urban Mobility Plans with a strong focus on e-mobility)	x		
E-mobility addressed in the country NDC			x
E-mobility NAMA			x

D4.1 Nine (9) Demonstration Implementation Plans

Plans to integrate e-mobility in the NDC update phase		x	
Incentives for the purchase of electric-vehicles or clean vehicles			
VAT rebate / exemption	x		
Import duty rebate / exemption	x		
Vehicle conversion premiums			x
Property tax rebate / exemption			x
Waiver on tolls and parking			x
Waiver on driving restrictions			x
Differentiated electricity tariffs	x		
Environmental taxes rebate / exemption			x
Regulation			
Regulation of charging stations			x
Formulation of installation standards and permitting protocols for EV charging point installation			x
Integration of charging system requirements with the local building codes and regulations			x
Clarification and formulation of mechanisms and regulations on charging operation and setting rates			x
Introduction of industry requirements on the adoption of Evs			x
Development of a government procurement program on Evs			x
Restrictions / limitations of the use of internal combustion engines / polluting vehicles			
Vehicular norms with high environmental standards (like EURO V, VI, etc...)		x	
GHG emission / energy efficiency standards for vehicles			
RTE INEN 017			x
NTE INEN 2204			x
Vehicle labelling regarding their environmental standard	x		
Mandatory vehicle inspection regarding emissions		x	
Driving restrictions for polluting vehicles			x
Incentives and/or instruments for scrapping			
Legal obligation to eliminate vehicles (buses, taxis, trucks) after certain age of operation			x
Presence of official dismantling/recycling centers; accreditation to manage car wrecks			x
Structured industrial sector for scrapping / dismantling / recycling vehicles			x

D4.1 Nine (9) Demonstration Implementation Plans

Public programs for vehicle fleet substitution		x	
Financial mechanisms incentivizing scrapping / recycling (incl. scrapping premiums)			x
Mechanism to recycle batteries of e-vehicles		x	

1.2.4 Business environment

Local businesses and start-ups working on e-mobility solutions

This section shows the findings on startups from the local environment related to electric mobility. It was found that there are several initiatives related to the academy or initiatives that come in some way from the academy (research projects, final year project and other kind of initiatives). In the academic environment it was found that not only in the public university there are initiatives related to electric mobility but also in private universities exist an important number of initiatives (private universities Universidad ORT and Universidad Católica del Uruguay). That happens also in the technological universities of Uruguay (UTEC and UTU).

In addition to these types of initiatives, there are small SMEs and entrepreneurs who are carrying out initiatives related to electric mobility, electric cars and batteries for electric cars. Some of the startups considered are seen as very promising in terms of their future development possibilities and several of them already have installed capacity to manufacture products or provide services on electric mobility.

It is important to mention that the SMEs that were found are working in a wide range of activities, from the production of different types of electric vehicles, production of software, maintenance services, charging solutions and final disposal of batteries for electric vehicles.

The table below contains the information on selected companies that are currently involved in e-mobility projects in Uruguay.

Table 2: Local start-ups working on e-mobility solutions

<i>SME Name</i>	<i>Type of activity</i>
BiciMon	e-Bike Sharing in Montevideo, Uruguay
GTVE	Development of a regulatory framework for the homologation of converted EV's
IIE Battery Services	EV battery testing & services
Werba	Battery waste treatment – Assembly of a battery waste processing chain
Mecatron	Electric vehicle battery upgrading
eMobility Solutions	Private electric vehicle charging network
moVERde App	App for EV city trips
Effiza	Battery chargers development
Ecomoving	Development 2 & 3 wheelers bikes
Green Star SRL	Development of 3-wheelers

It is convenient to mention that Uruguay has no domestic production of electric vehicles for the moment. However, there is a conventional vehicle manufacturer that is planning in the near future to incorporate in his factory a line production of an utility electric vehicle. The fact that Uruguay doesn't have domestic production of electric vehicles explains why it was promoted the import of electric vehicles with a reduction to 0 % of import tariffs.

Finally, regarding e-scooters implementations, there were different e-scooter companies in Montevideo since 2018 (like LIME, Grin (Mexican company merged with local firm Mono), MOVO (Spanish company) and Scoot) that were operating in Montevideo until May 2020 but they are not anymore operating in the city. There are other kind of startups that are now working on e-mobility projects as it was shown in the table before .

E-mobility financing options

Regarding electric mobility financing options implemented in Uruguay, the Specific Internal Tax (IMESI) applicable to hybrid and electric vehicles was reduced, electric utility vehicles were incorporated into the cleaner production indicator of the Investment Promotion Law, their requirement to property maintenance for 10 to 4 years, and the Global Tariff Rate for cars with exclusively electric propulsion engines was set at 0%.

The MOVÉS Project promotes testing mechanisms for electric utility vehicles and light last-mile delivery vehicles (electric pedal-assisted bicycles and electric tricycles) among urban delivery and transport companies, with the aim of making known the benefits of these new technologies. MOVÉS also promotes sustainable mobility plans in companies, and promote active transportation seeking out a cultural change in people's preferences and transportation decisions, looking for more sustainable and efficient options. Among that options are several mechanisms such as free renting and testing of electric vehicles for a period of time. During 2019, the MOVÉS Project began with free trials of electric utility vehicles as well as electric tricycles and electric pedal-assisted bicycles to last mile logistics. The implementation of institutional plans for sustainable mobility also began, where through a methodology developed by the MOVÉS project, companies carry out a process to improve the sustainability of routine trips.

Regarding the annual tax, during 2018 the electric vehicle patent (annual tax) was reduced to zero (0) and later, in 2019, it was decided to leave it in a half of combustion vehicles one.

The Investment Law (Ley Nº 16.906) is a law that protect and promote the investments in Uruguay, where it was established that a commision of application (COMAP) is the designated organism that sets the criteria for investment benefits. That law was amended in 2017 in order to include electric passenger vehicles within the investment eligible to obtain benefits. Rental companies were allowed to access the benefits of the investment law with the purchase of electric utility vehicles. In such amend, it was reduced from 10 to 4 years the requirement to

D4.1 Nine (9) Demonstration Implementation Plans

maintain ownership of these vehicles within the scope of the investment law and a call was launched for the replacement of taxis to electric vehicles.

As it was mentioned before, a great milestone in 2018 was the approval of Article 349 of Law 19.670, which generates a subsidy to cover the difference in costs in the purchase of an electric bus compared to a diesel bus, for approximately 100 units for the entire country. This law is regulated by decree 165/019 and the first call for subsidies for the purchase of electric buses was carried out during October, with the hope of subsidizing the purchase of more than 30 buses.

Another very important milestone in 2019 was the launch of the first call for subsidies for the purchase of electric buses for the regular transport of passengers. This subsidy covers the price gap between a diesel and an electric bus, eliminating emissions and improving service performance. For this, the mentioned regulatory decree of the law 19.670 was published, the Technical Commission composed by the MEF, MIEM, MVOTMA and MTOP was appointed, the technical requirements of the call were established and operating mechanisms and informative workshops for operators and municipalities were established. Requests were received for 33 electric buses, 30 of which were approved and are currently in operation.

Finally, during 2019 the regulations of the Investment Law were modified to allow car rental companies to present the purchase of electric utility vehicles as an eligible investment, taking into account that these companies are currently very relevant in the management of company fleets. It is necessary to mention that recently the COMAP (motivated by the pandemic) has decided to add additional benefits for investments that incorporate electric vehicles for a period of time.

Recently, in these days, a new plan is being developed by MOVÉS. That is the “Green Fleet” plan. The Green Fleet Plan (PFV) seeks to support companies with fleets dedicated to last mile delivery, urban transport and logistics operations in the process of changing their fleet towards a more efficient and sustainable solution. Its purpose is to support the analysis by the company of its operation and fleet with the replacement options of its vehicles for more efficient and sustainable options, and the incentives for this, provided by public and private institutions (already available in Uruguay) that MOVÉS brings together in the so-called Ecosystem for the Promotion of Sustainable Mobility.

The elements that can be supported to promote the transformation are:

- Tax benefits from the investment law (COMAP), which during 2020 also has added transitory benefits
- Green credits from financial institutions (in participating banks)
- Subsidies and supports for MSMEs on these credits (ANDE)
- Full liability insurance with promotional rates (BSE)
- Bonded patent
- Possibility of requesting non-reimbursable financing for technical evaluation studies of the MIEM in its DINAPYME and DNE / DAEE Directorates
- Possible funds from the Energy Efficiency Certificates of the MIEM / DNE, which allow a monetary income for energy efficiency measures implemented

D4.1 Nine (9) Demonstration Implementation Plans

- One-month free electric utility vehicle testing provided by MOVÉS (this is not new)

In addition to these incentives, new tools are being developed and will be incorporated into the ecosystem and informed when they become available. In general terms, Sustainable Vehicles (VS) will be understood as those that when replacing a traditional Vehicle with a Combustion engine (VC), imply a reduction, ideally elimination of emissions during their operation.

The PFV then proposes a methodology to analyze and diagnose the company's fleet and its operations, in order to identify opportunities to replace vehicles with sustainable alternatives or changes in operations that generate savings in fuel consumption, with consequent savings of costs and a reduction in emissions associated with the operation of the fleet. In this way, in addition to the positive effects associated with the reduction of emissions and congestion, among others, efficiencies are sought that result in a reduction in their costs, with a positive result in the business both from the economic point of view and improvements in the reputation of the company.

1.2.5 Capacity building (CB) **Current state and initiatives**

The public university of Uruguay (Universidad de la República – UDELAR) carry out an annual 1-week e-mobility course since 2017, with the participation of foreign professors. In 2019 the course was implemented with the partnership of the Polytechnic University of Madrid (UPM). More specifically, two professors from the Automobile Research Institute (INSIA) and two professors from UDELAR taught the course which will be replicated in 2020. UTE (Electric Power Company of the Uruguayan State) and FEIBIM (Iberoamerican Federation of Mechanical Engineering) are both the sponsors of this activity.

Current needs and opportunities

According to the Training Needs Assessment (TNA) and given the context of the transition towards electric mobility in Uruguay, the main existing training needs are in infrastructure technologies, battery disposal, business, finance and fiscal schemes and mobility and integrated planning issues.

In terms of technology, infrastructure and network planning, much of the training needs of the local government are related to the EV technology, the use of the EV, spare parts and maintenance of Evs. As the technology is relatively new, there are basic questions regarding its operation under certain driving conditions and the range of an EV that are not responded. It is also needed more information on electricity cost and maintenance of the units as well as the battery replacement and final disposal. There are also some questions of users regarding the policies of the Authorities such as the price of the electricity in the near future.

D4.1 Nine (9) Demonstration Implementation Plans

In terms of business model development, the TNAs identified that there are very important needs in that regard. It appears that users and entrepreneurs need to know more about EV business, related costs and how to do to take advantage of the benefits (fiscal and non fiscal) of the electric mobility.

The TNA showed that the main obstacles in Montevideo that could slow down a transition of e-mobility are:

In the public sector:

- Insufficient enabling policy and regulatory framework
- Limited financial means and high upfront investment cost for public actors
- Insufficient personnel in some key areas of the government
- Limited knowledge and skills on e-mobility projects
- Public authorities reluctant to decrease fuel tax revenues

In the private sector:

- Limited maturity of technology / Lack of suitable technologies / Difficult supply of batteries and maintenance for batteries.
- Reluctance of transport operators due to fear of job loss and lack of knowledge on e-mobility benefits
- Cumbersome maintenance (spare part availability or lack in after sales response)
- Reticence from local commerce and/or delivery companies
- Limited financial means in the private sector and/or high upfront investment cost for these actors
- Lack of private actors initiating e-mobility projects
- Lack of demand and limited knowledge and skills on e-mobility projects or business cases

It was also identified that the biggest risks and negative impacts of a transition to e-mobility in Montevideo could be:

- Management of e-waste and battery recycling
- Risks of new technology / new brands (lack of maintenance facilities, guarantee, not adaptable to the context and not equivalent to pre existing technology, short life of the battery or problems with charging standards)
- Increased demand for individual mobility if not combined with shared options and an appropriate policies
- Increased cost for local commerce and deliveries (in terms of electric tariff, battery maintenance or initial investment)

It should be noted that there is an initiative in Montevideo for Management of e-waste and battery recycling. This initiative is carried out for a company called Werba¹⁷. They are currently looking for economical support to face the required investment.

¹⁷ <https://www.werbasa.com/>

Apart from that, the highest needs for trainings were identified as:

- Infrastructure technologies (including charging technologies)
- Operation of electric vehicles
- Examples of successful project implementation and business modelling
- Logistics plan and delivery design systems
- Integration in policies and plans
- Finance and fiscal schemes

New ideas on capacity development issues were unveiled during the regional kick-off, where the following topics were mentioned:

- charging solutions and charging standardization
- regulation and standardization process
- electric infrastructure (grid infrastructure)
- range testing
- interoperability of charging stations
- GHG emissions reduction estimations
- use of renewable sources, including photovoltaic energy

An specific topic where Montevideo city has a need for training is the e-buses and e-taxis operations and logistics. For example: charging times and schedules, management of fleet, charging levels of batteries for e-buses and charge management from the point of view of the electric power distributor.

Finally, there are some local and international organisations and/or educational institutions that provide permanent training on e-mobility topics in Montevideo. That organizations are:

- CIER (trainings in e-mobility from the point of view of the electric grid)
- UITP (e-mobility trainings for members)
- GTVE (Faculty of Engineering / University of the Republic – one annual course)

Locally, the Working Group on Electric Vehicles (GTVE) of the public Faculty of Engineering of Uruguay and a counterpart group from the Pontificia Universidad Católica de Chile have agreed to explore a proposal that consists in the development of a regulatory framework for the homologation of converted vehicles (conventional vehicles converted to electric vehicles). This is a key issue for both university groups since it is understood that it is an activity that must be carried out under compliance with adequate regulations (non-existent at the moment), and it is also understood that the existence of such regulations can give sustenance for the activity to be consolidated, which would be very positive from several points of view. It is believed that there may be synergy with the National Polytechnic University of Ecuador as well as, eventually, with the Polytechnic University of Madrid, who already have a experience in converting vehicles.

As it was said before, an important opportunity in capacity building will take place in Montevideo from October 5th to October 9th, 2020 in the Faculty of Engineering of the

D4.1 Nine (9) Demonstration Implementation Plans

University of the Republic, Montevideo – Uruguay. The target audience for this course are technicians and professionals that work on e-mobility projects as well as personnel of the public administration with influence in transport and e-mobility policies. The objective of this course is to introduce the student to the design of electric and hybrid propulsion systems for electric vehicles in their different configurations such as series, parallel and mixed, as well as fuel cell vehicles. The sizing of different components and energy management strategies will be developed. Tariff topics and public policy aspects will be also included. New features this year are: safety aspects of electric vehicles, a more complete overview of hydrogen and safety aspects of fuel cell vehicles. Charging infrastructure will be also included.

1.3 Key Stakeholders

1.3.1 Local government departments

Public Transport Division, Intendencia de Montevideo (IM)

Intendencia de Montevideo (IM) is the local government of the capital city. It is the regulator of the public transport, and oversees sanitation and cleaning of the city and many more areas. Montevideo has public land available for electric buses charging stations. As the project activities will take place in the Department of Montevideo, the IM is the only local authority participating, closely cooperating with the national government. Nevertheless, the other two metropolitan departments (Canelones and San José) and their main municipalities could get involved in future, at least for replication activities. It is worth noting that IM is deploying a Traffic Control Center (Spanish: *Centro de Gestión de Movilidad; IM n.d.*), an Intelligent Transport Systems helping with the real-time management and control of transport in the city, and is engaged in the revision of its Urban Mobility Plan. The Mobility Plan is to be transformed into a Sustainable Urban Mobility Plan (SUMP), integrating the energy perspective in transport policies in order to promote changes in modes and means. A solid institutional partnership is crucial for the project approach, in order to empower IM in its leading role as public transport authority.

Consultative Council for Urban Transport (Consejo Consultivo del Transporte Colectivo Urbano de Montevideo)

This Council was established in December 2016 with the objective of improving the quality of the transport service in Montevideo. It is integrated by IM, the *Junta Departamental* (Municipal legislative body; Junta MVD), the *Defensoría de Vecinas y Vecinos de Montevideo* (neighbourhood advocacy body), the National Union of Transport Workers (*Unión Nacional de Obreros y Trabajadores del Transporte*) and the public transport companies (see below).

Congress of Mayors (Congreso de Intendentes)

Its institutional objective is about the coordination of the policies of the regional governments. Another area that began to develop in the Congress of Mayors more recently has been referred to as International Relations and Cooperation (URRIICI). Its purpose is to allow a better exchange of experiences in areas such as urban planning, etc. It also links with associations, municipalities, mayors, and provincial governments in Latin America and the rest of the world. This could be relevant for replicating the demonstration action.

1.3.2 National government departments

For the demonstration action the following institutions on national level are of relevance:

Energy Department, Ministry of Industry, Energy and Mining (MIEM)

Within the ministry, it is the energy department (Dirección Nacional de Energía) that is responsible for e-mobility (and also for the MOVES project).

Ministry of Housing, Planning and Environment (MVOTMA)

MVOTMA is in charge of both, climate change and spatial planning issues. The sustainable public transport system will be a structural component of the Land Use Plans, given its impacts at the local and global levels. It executes – together with MIEM – the above-mentioned MOVES project.

Ministry of Transport and Public Works (Ministerio de Transportes y Obras Públicas, MTOP)

It is responsible for the development and planning of public infrastructure works in order to promote national development.

Ministry of Finance (Ministerio de Economía y Finanzas, MEF)

With respect to e-mobility the Ministry has an important role to play as it is the one that formulates the decrees, stipulating financial incentives for e-mobility.

Interinstitutional group of energy efficiency for the transport sector

The interinstitutional group of energy efficiency for the transport sector (*Grupo Interinstitucional de Eficiencia Energética en el Transporte*) was created in 2014 (Decreto N° 325/017). From the national level it includes: MIEM (chair), MVOTMA, MTOP and MEF; from the local level: the Intendencia of Montevideo; and from the private sector: the Public Electricity Company (UTE). The main goal is to avoid duplicating efforts, share information, formulate a shared vision for the transport sector and generate synergies. As the Intendencia is the main partner for the demonstration action, coordination with the national level can be secured via this inter-institutional group.

The National Agency for Research and Innovation (ANII)

ANII is a government entity that promotes research and the application of new knowledge to the productive and social reality of the country. ANII makes available to the public funds for research projects, national and international postgraduate scholarships and incentive programs for innovative culture and entrepreneurship, both in the private and public sectors. ANII developed the National System of Researchers, a program of economic incentives for national researchers categorized based on a strict evaluation system. It also created the Timbó Portal, which allows free access to all kinds of scientific publications from all over the world for all Uruguayans. The ANII works as an articulation and coordination mechanism between the actors involved in the development of knowledge, research and innovation.

National Development Agency (ANDE)

The National Development Agency (ANDE) is an institution that promotes the development of the country through programs that seek to improve business and territorial competitiveness, with an emphasis on MSMEs. We integrate the National System of Productive Transformation and Competitiveness, which allows us to coordinate actions with other institutions to achieve

D4.1 Nine (9) Demonstration Implementation Plans

development among all. ANDE's purpose is to contribute to productive economic development, in a sustainable way, with social equity and environmental and territorial balance. We design effective, efficient and transparent programs and instruments, with special emphasis on the promotion of micro, small and medium-sized companies.

UTE (Public electricity company)

The National Administration of Power Plants and Electric Transmissions (UTE) is a public company of the Energy Sector that, through the development of the activities of generation, transmission, distribution and commercialization of electric energy, as well as providing advisory services and technical assistance in areas of its specialty and annexes, works to make electric energy affordable in the country. At the end of 2018, UTE was the public electric company with the largest fleet of electric utility vehicles in Latin America with 60 electric vans used for services and maintenance activities. UTE supported the purchasing of electric taxis with important grants and currently gives an important discount on energy charging for e-taxis. For private vehicles, a differentiated tariffs were created in 2019. Apart from that, UTE is the public company responsible for the development of the national charging electric vehicle infrastructure in collaboration with ANCAP.

National Administration of fuels, alcohols and Portland (ANCAP)

ANCAP is a state-owned integrated energy company, leader in the Uruguayan market for fuels and lubricants, for Portland cement and for the development of biofuels; with a regional vocation, with a focus on the client / user and the generation of value, environmentally and socially responsible and that contributes to the productive and social development of the country. Its mission is to ensure the supply of energy products and Portland cement and alcohols, all in accordance with regional quality standards and the needs of customers / users. ANCAP is oriented to the continuous improvement of efficiency and competitiveness, we promote integral development and the participation of staff, we act with social and environmental responsibility and we are committed to the trust that our company generates. ANCAP is involved in the development of the national charging electric vehicle infrastructure in collaboration with UTE.

1.3.3 SOLUTIONSplus Consortium

The demonstration action in Montevideo will involve the following SOL+ industry and research players:

T-Systems

T-Systems is partnering its customers as they address the digital transformation. The company offers integrated solutions for business customers. The Deutsche Telekom subsidiary offers one-stop shopping: from the secure operation of legacy systems and classical ICT services, the transition to cloud-based services (including international networks, tailored infrastructure, platforms and software) as well as new business models and innovation projects in the Internet of Things. Its main task in the context of the demonstration action will be the supply of charging equipment to Montevideo.

Valeo

Valeo Group is a Tier1 supplier world leader in 4 different core businesses: Visibility Systems, Powertrain Systems, Comfort Driving Assistance Systems and Thermal Systems. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2emissions and to the development of intuitive driving. Valeo’s strategy is based on innovation and growth in regions where there is a market potential. Thus, the Group has been able to diversify its products and positioning in the various regions where the automotive sector is growing (Europe, Asia, and America). Valeo will provide the drivetrains for the e-3 and 4-wheelers that will integrate the urban logistics system of Montevideo.

The following presents the consortium partners with a major involvement in the demonstration activities in Montevideo as well as their concrete involvement based on the SOLUTIONSplus Kick-off Workshop that took place in January 2020 in Berlin as well as bilateral and multilateral discussions that were held in the past months. This table will be updated permanently with more detailed information of SOL+ consortium members contributions.

Table 3: Specific contributions of SOL+ consortium members to Montevideo’s demo

Consortium Partner	Role/Contribution
COORDINATION	
WI	Regional coordinator
UEMI	Local implementation support
EQUIPMENT	
ABB / T-SYSTEMS	<ul style="list-style-type: none"> • Provide charging infrastructure to be installed in the e-bus depot that will be constructed in Montevideo • Technical assistance in the charging strategy/plan • Technical assistance in the standardisation process
Valeo	<ul style="list-style-type: none"> • Provide the drivetrains and control units for the e-3-wheelers to be implement in Montevideo’s demo
Bosch	<ul style="list-style-type: none"> • Provide the drivetrains for the e-cargo bicycles to be implement in Montevideo’s demo
TECHNICAL SUPPORT	
UITP	<ul style="list-style-type: none"> • Technical assistance on the e-bus operation plan
Volvo	<ul style="list-style-type: none"> • Technical assistance on the bus operation plan
CMM	<ul style="list-style-type: none"> • Linkage to the GEF projects in Latin America • Technical support in e-bus specifications and regulatory framework • Root-level analysis
BUSINESS MODELS & START-UP INCUBATOR	
FIER	<ul style="list-style-type: none"> • Business models for e-3-wheelers and e-buses

D4.1 Nine (9) Demonstration Implementation Plans

ERTICO	<ul style="list-style-type: none"> Support on the business models of the SMEs participating in the pilots
CAPACITY BUILDING	
RC	<ol style="list-style-type: none"> Vision building: development of e-mobility strategies/ integrating e-mobility in SUMP processes Capacity building and peer-to-peer learning on e-buses, eco-driving and charging infrastructure planning Charging infrastructure planning
SIMUS	<ul style="list-style-type: none"> Capacity building Regional trainings
CODATU	<ul style="list-style-type: none"> Capacity building and integration
REPLICATION AND SCALE-UP	
UNEP	<ul style="list-style-type: none"> Coordination with other GEF projects in the region Linkage to financing sources
IMPACT ASSESSMENT	
VTT	<ul style="list-style-type: none"> Impact assessment Latin American cities KPIs

1.3.4 Other international industry players

Other relevant industry players that are not consortium partners but involved in e-mobility market in Montevideo, are:

Yutong

Yutong (officially Zhengzhou Yutong Group Co., Ltd.) is a Chinese manufacturer of commercial vehicles, especially electric buses. It's 10 ZK 6108 models are currently (Oct. 2019) tested in a pilot phase in Montevideo. Buses del Sur (PIMATUR S.A.) is the representative in Uruguay of the bus manufacturer ZHENGZHOU YUTONG BUS CO LTD. (YUTONG) and truck manufacturer ANHUI HUALING AUTOMOBILE CO. LTD. (CAMC).

BYD

BYD also is a Chinese electric vehicle giant, providing K9-model electric bus and electric taxis to Montevideo. The first 50 e6 taxis were delivered already in 2015 to Uruguay. BYD has in Uruguay two representatives: the first one is SADAR, who is the responsible for a wide range of products, excluding the e-buses. The second one is CTS AUTO, a company that is responsible for the e-buses and some models of e-taxis.

1.3.5 Public transport operators

As public transport in Montevideo is run entirely by private operators, their involvement and participation in the process is crucial. Unlike in other Latin American cities, public transport in Montevideo is formalized and highly concentrated. There are only five private operators:

Compañía de ómnibus Pando S.A. (Copsa)

D4.1 Nine (9) Demonstration Implementation Plans

Copsa was founded in 1930, and has a 65% share of the market with 3 million tickets a month for routes that connect Montevideo with other important destinations (e.g. Canelones, Uruguay's second most populated department, or the beach resort of Punta del Este). It has recently renovated its fleet and is considering (October 2019) incorporating Yutong's (see above) hybrid busses.

Compañía Uruguaya de Transportes Colectivos SA (Cutcsa)

Montevideo's transport firm Compañía Uruguaya de Transportes Colectivos SA has put in 2016 one e-bus (a K9-model) by Chinese electric vehicle giant BYD in circulation. Recently, in May 2020, 30 BYD electric buses were additionally incorporated on its fleet.

Cooperativa de Obreros y Empleados del Transporte Colectivo (COETC)

The Montevideo-based urban transit firm launched a pilot project in August 2018 to try out Yutong's ZK 6125 CHEVG diesel-electric hybrid model, the first of its kind in Uruguay. Recently, in May 2020, 30 Yutong electric buses were additionally incorporated on its fleet.

Unión Cooperativa Obrera de Transporte (U.C.O.T.)

It is a Cooperative company that entered the transport system of Montevideo on February 26, 1963. Its initial integration was of two hundred cooperative members and a few employees, who began to operate with a fleet of 50 buses ACLO brand, to serve four urban lines. Recently, in May 2020, 30 Yutong electric buses were additionally incorporated on its fleet. Before that, a Diesel-supercapacitors hybrid bus was incorporated on its fleet obtaining quite good results in operation.

Corporación Ómnibus Micro Este1 (COME S.A.)

COMESA is a public transport company and has been operating since 1963 and has a fleet of 240 buses. As of October 2019 there are no e-vehicles integrated in the fleet. Recently, in May 2020, 30 Yutong electric buses were additionally incorporated on its fleet.

1.3.6 Academia

The Faculty of Engineering (Facultad de Ingeniería) of the University of the Republic is the only public institution of higher education in engineering in Uruguay. It states its objective as to train professionals to meet the needs and demands of the productive sector, as well as to contribute to the development of society. It has a research group on e-mobility called GTVE (Electric Vehicle Work Group) and gives a postgraduate course on the topic every year. The GTVE of the Faculty of Engineering is currently working in the context of an agreement with the Municipality of Montevideo and it is also working in the context of an agreement with UTE, the public power electric company of Uruguay.

INSIA is the Automobile Research Institute that belongs to the Polytechnic University of Madrid (UPM). Professors and specialists in hybrid and electric vehicles that belong to the INSIA, participates in different courses and projects in cooperation with the GTVE.

National Polytechnic University (Escuela Politécnica Nacional EPN- CCICEV): CCICEV is the technology transfer and capacity building center established by the National Polytechnic

D4.1 Nine (9) Demonstration Implementation Plans

University. It is the first laboratory official accredited to assess performance of electric vehicles in Ecuador. Moreover, they are also accredited to inspect motorcycles, and three-wheeled motor vehicles for passenger transport and cargo transport. And they act not only as laboratory but are also a Training and Research Unit from the Polytechnic University of Ecuador. It is expected to get to a kind of collaboration between the GTVE and the CCICEV.

University of Cuenca: The University of Cuenca is one of the three universities in the city working actively on urban sustainable mobility. They have an undergraduate career in Electrical Engineering so they could also be great allies for the creation of a permanent academic program on e-mobility. It is expected to get to a kind of collaboration between the GTVE and the University of Cuenca.

1.3.7 Civil society

The MOVES project intends to involve different NGOs at the local and national level, which can also be relevant for the demonstration action. The main Organizations are:

Red Uruguay de ONGs Ambientalistas (umbrella organization of environmental NGOs)

The umbrella organization of all environmental NGOs in Uruguay.

Centro Uruguayo de Tecnologías Apropriadas (CEUTA)

The Uruguayan Center for Appropriate Technologies is an independent, non-profit Foundation, created in 1985. Its mission is to disseminate, research and train in the use of appropriate technologies, generating alternatives that strengthen local communities by integrating social, economic and ecological aspects.

Taller Autogestionario de Ciclismo Urbano (TACU)

Cycling associations, that seeks to promote the use of the bicycle as an active means of transport, sharing experiences of own use and others to move safely and consciously in the city.

Asociación del Comercio Automotor del Uruguay – ACAU

The Association of Automotive Commerce of Uruguay (ACAU) is a non-profit Civil Association, duly constituted in accordance with current legislation and which brings together 22 companies representing and importing 50 brands of passenger cars, light utility vehicles, trucks and buses zero kilometer of different models, engines, values, designs and origins (MERCOSUR / Extra Zone).

UniBiCi

Unibici is an initiative that belongs to the University of the Republic (UdelaR) that promotes the use of bicycles among university students throughout the country for transportation to and between university premises, through the provision of specific infrastructure and services and the carrying out of information and awareness campaigns, also motivating the gradual inclusion of the active mobility in general and mobility with bicycle in particular. At the same time, UniBiCi seeks to contribute to public mobility policies in the country by developing ideas and

practices for promoting the bicycle, which transform public spaces in favor of healthy coexistence, in a framework of cooperation with Competent agencies and organizations.

1.3.8 International cooperation and finance

Development Bank of Latin America (CAF)

CAF is a development bank created in 1970, owned by 19 countries – 17 of Latin America and the Caribbean, Spain and Portugal- as well as 13 private banks in the region. It promotes a sustainable development model through credit operations, non-reimbursable resources, and support in the technical and financial structuring of projects in the public and private sectors of the shareholder countries of Latin America. CAF will support financing solutions for SOLUTIONSplus cities in Latin America and is thus relevant for potential replication activities.

Inter-American Development Bank (IDB)

The **Inter-American Development Bank (IADB or IDB or BID)** is the largest source of development financing for Latin America and the Caribbean.[1] Established in 1959, the IDB supports Latin American and Caribbean economic development, social development and regional integration by lending to governments and government agencies, including State corporations.

GEF

Financing for the MOVES project, which is closely interlinked with the planned demonstration action, comes from the Global Environment Facility (GEF).

Uruguayan Agency for International Cooperation (AUCI)

The *Agencia Uruguaya de Cooperación Internacional* (AUCI), is cooperating partner in the MOVES project and might thus be also relevant for the demonstration action.

2. Demonstration Action

As it follows, a list of the the solutions under development are shown. For each solution a full description is carried out.

2.1 Situation analysis

2.1.1 Public Transport

The Metropolitan Transportation System or STM is the public transportation system that covers the entire metropolitan area of Montevideo, the capital of Uruguay. It is aimed at improving mobility and travel times in the departments of Montevideo (white area in the image below), Canelones and San José. The system incorporates the use of new technology, which allows more efficient, rational and safe public transport, which enables effective controls and greater practicality for users through routes and costs according to their needs. The image below also shows the streets (the density can be see there), avenues and the connection with national routes in all directions. It is clear that the structure of the city is hardly centralized being the concentrations of the population and the activities in the Old City, in the city center and some neighborhoods located in the south and south-east of the city.

Figure 7: Metropolitan Transportation System of Montevideo (STM)



Source: Geographic information system of the Municipality of Montevideo¹⁸.

The Metropolitan Transportation System (STM) is aimed to improve the mobility of citizens throughout the department with plans for expansion for the metropolitan area and it involves the integration of all public transport in a common system. The system incorporates the use of

¹⁸ sig.montevideo.gub.uy/

D4.1 Nine (9) Demonstration Implementation Plans

new technology which allows more efficient, rational and safe public transport, enabling effective controls and practicality for users through routes and costs according to their needs.

The first changes made in the Metropolitan Transportation System (STM) were the incorporation of geolocalization for buses and a smart card (STM Card) to pay for trips. The users use the STM Card smart card for „multi-leg“ (1-hour or 2-hour) travel, as well as paying a cheaper fare, including free travel for retirees and students, such as subsidized tickets or normal fares to lower price. This card has stores in which money is recharged to be debited for tickets, and the service can also be associated with an account in the public bank (Banco República) for the postpaid debit of the ticket (without the need for prior recharge). This card, in addition to subsidized tickets, has a benefit for sellers and artists who carry out activities in the collective passenger transport service. Currently using this card, it is possible to pay for the taxi ride as well as access the movete system of public bicycles in Montevideo.

On the other hand, every bus is equipped with a GPS satellite control system that allows tracking the route and location of all units, adjusting routes and schedules. This technological incorporation makes it possible to have information on the number of users who use the different lines at all times in order to optimize the system.

The STM has several corridors, exchangers and terminals. Some relevant information regarding that infrastructure of the STM are:

BRT racers (it is an avenue with an exclusive line for buses):

- Garzón Corridor on Agraciada and Garzón Avenues
- General Flores Corridor on Av. Gral. Flores

Multimodal Terminals:

- Colón Multimodal Terminal

Exchangers (intercambiadores):

- Belloni exchanger

Terminals:

- Ciudadela Terminal
- Plaza España Terminal
- Pocitos Terminal
- Cerro Terminal
- Portones Terminal
- Paso de la Arena Terminal
- Colón Terminal
- Plaza Independencia Terminal
- Palacio de la Luz Terminal

The benefits of this system are the decrease of the money on board of buses, the increase of the system security and more control of the Municipality over subsidized tickets. Also, it simplifies the types of existing trips allowing the creation of new types of trips, having real

D4.1 Nine (9) Demonstration Implementation Plans

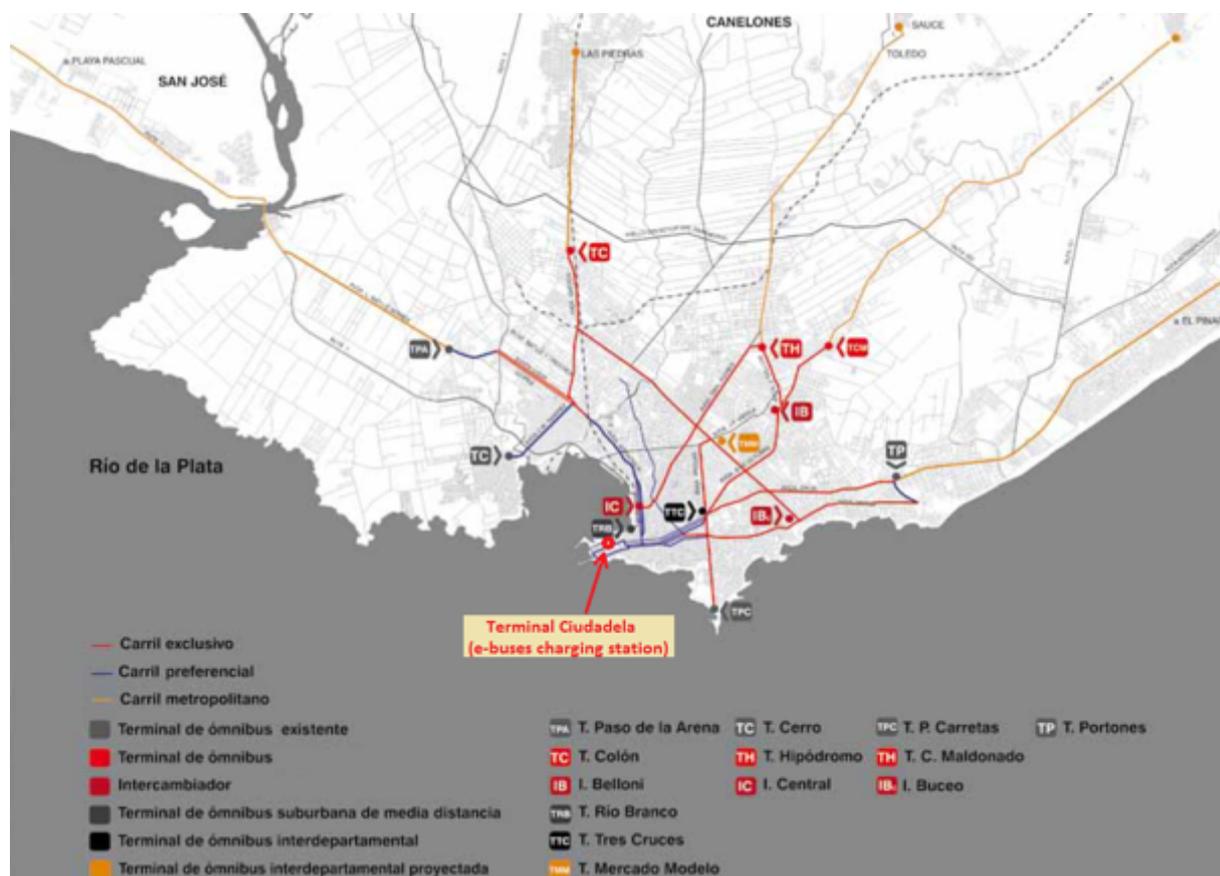
system data to optimize lines, routes and frequencies what allows the improvement of the control of compliance with schedules. Additionally, it is possible to offer more information to the user.

The following companies provide urban and inter-urban services:

- Compañía Uruguaya del Transporte Colectivo S.A (CUTCSA)
- Corporación de Microbuses del Este (COME)
- Unión Cooperativa Obrera del Transporte (UCOT)
- Cooperativa de Obreros y Empleados del Transporte Colectivo (COETC)
- Tala-Pando-Montevideo
- Casanova
- CITA

That information means that there are 4 companies that provide urban and inter-urban services and 3 additional companies that participate in the inter-urban services of the metropolitan transport system. Only in Montevideo city there are 140 bus lines that have 107 destinations (among there, are the listed terminals) and 4721 stops covered by 1528 buses. For the moment just 31 buses of those are electric buses. In the image below, it is possible to see the main corridors, terminals and the main structure of the STM. It was there identified the localization of the Ciudadela terminal where the e- buses charging station will be installed.

Figure 8: Public transport routes and terminals in Montevideo



Source: mobility plan report „towards an accessible, democratic and efficient mobility system 2010-2020“, Municipality of Montevideo.

As it was said before, only 31 buses of the total are electric buses. However, the law No. 19670 implements a subsidy destined to support the initial transition towards more efficient and sustainable technologies in the public transport of passengers by replacing up to 4% (four percent) of its fleet from diesel-powered to electrically powered buses. The subsidy is aimed at public passenger transport operators who are interested in replacing a diesel bus with an electric motorized bus, according to the criteria defined in the regulation of the law. Thanks to this subsidy, 100 electric buses will be purchased this year and it is expected that the Ciudadela terminal could be referenced as “the e-buses public terminal” in the STM.

2.1.2 Urban logistics

“Delivery” options

In Montevideo, several companies operate that provide food delivery and non-food items that make their deliveries on bicycles, motorcycles or tricycles. Among these companies are the global firms UberEats, OrdenYa, Glovo and Rappi, among others. In addition to these companies, there are delivery services for small food businesses that are not associated with mobile phone application companies.

As the gastronomic sector is one of the hardest beaten by the COVID-19 crisis, delivery services have recently increased their market share. Faced with this situation, the Municipality of Montevideo approved a new regulation (Departmental Digest / Food Delivery Services / Arts. D.902.2 and D.902.3) that sets the commercialization and supply of food through mobile applications and web platforms.

Among other things, the regulation establishes that it will be the responsibility of the applications „that the offers that appear in their electronic medium correspond to food companies with authorization, not being able to keep them active in case of closure or lack of authorization.“ The legal text reaches the distribution, deposit, exhibition, promotion, advertising, sale and delivery to the consumer.

The municipal decree defines the types of companies involved in this field and requires, among other things, the corresponding records in the Food Regulation Service of the Municipality, the correct food labeling, and the relevant data clarification. It sets penalties for non-compliance, both for bars and restaurants and for electronic intermediation apps, establishing a scale of fines or the suspension of the company for several days or totally, depending on the case.

The regulations set that „electronic food intermediation companies“ are those technology firms that make available means for the commercialization of their products. These must be registered prior to the start of their activities. Food companies that develop platforms or applications for sale must declare this commercial modality before at the Food Regulation Service of the Municipality.

Apart from the ready-to-eat food delivery, the delivery of other kind of products (hardware store, bazaar, supermarkets, etc.) is also increasing its volume in this context. For that reason,

suitables electric 3-wheeler or e-cargo bikes are a good option in order to provide a clean, safety, carbon free and efficient service.

2.1.3 e-mobility innovations

The adoption of the e-mobility in Montevideo is primarily limited to the public transport such as e-taxis and e-buses. Some innovations in electric vehicles have been limited to the conversion of the vehicle powertrain. Also, the electric company of the state of Uruguay has made an important effort in order to promote e-mobility by developing the charging grid and by buying an importante fleet of electric vehicles (the biggest in Latin America at the time). E-mobility solutions are strategic actions in Uruguay and that kind of actions would benefit the local e-mobility industry, as it would lead towards better perception and increased demand for such type of solutions. The development of local capacities in relation to the e-mobility is quite important and transcends the different governments. This development includes capacities in relation to industries, vehicle users, policymakers, and financing tools.

2.2 Demonstration objectives and logical framework

The planned demo action consists of assisting with the construction of a high-capacity bus depot to charge the existing and planned e-buses overnight, taking advantage of the electricity oversupply and a reduced electricity price at night. Since March 2020 there are 30 e-buses running in Montevideo and the bidding process for the next 40 will start in the following months. The high-capacity bus depot in the city centre bus terminal Ciudadela, where several bus operators start or finalise their journeys will integrate efficient and cost-effective smart charging solutions compliant with Combined Charging Standard (CCS) and Open Charge Point Protocol (OCPP)¹⁹. This will allow charging of up to 4 buses with 1 charger. Moreover, the strategic location of the terminal would allow the installation of charging points for e-car-sharing or e-taxi providers (still being explored).

Moreover, SOL+ will cooperate with the MOVÉS project for a joint program that will integrate: 1) local assembly of cargo e-2- and 3-wheelers, 2) a renting scheme for the produced vehicles that will ensure producers a renting fee for each vehicle during a year, and 3) identification of potential long term users of the produced vehicles.

The Table 4 presents a summary of the vehicles, operations and integration that will be part of the demonstration activities in Montevideo.

¹⁹ OCPP enables manufacturer-independent communication between electric car charging stations and various billing and management systems for charging infrastructures via an open application protocol.

Table 4: Summary of vehicles, operations and integration of Montevideo’s demo

Modes	Vehicles	Operation	Integration
	10 E-taxis (Procured by private operators)	Multi-standard 50 kw fast charging for E-taxi	Bus and taxi service integration
	30 E-BRT buses (Procured by the IM)	Charging infrastructure for PT integration (3 lines)	PT integration Interoperability
	15 E-cargo bikes	Charging points for e-cargo bikes	Integration to the MOVÉS renting scheme and green fleet program
	3 E-cargo tricycles	Charging points for E-3-wheelers	

The following table shows the logical framework of the activities, sub activities and milestones that will have to be carried out for the successful implementation of the demonstration project.

Table 5: Logical framework of Montevideo’s demonstration project

OUTPUTS	ACTIVITIES	MAJOR SUB-ACTIVITIES (relevant to the City)	MILESTONES (and other notes)
<p>OUTCOME 1. Availability high quality e-mobility innovations is increased.</p> <p>Baseline: In terms of vehicles, the current offer of locally produced electric urban logistics solutions is still quite limited. Interoperability of e-bus charging infrastructure is a challenge.</p> <p>Target: High quality last mile logistics e-mobility solutions developed by local industries are made readily available to the market.</p>			
1. Locally produced vehicles (e-cargo bikes and tricycles) for urban logistics use is developed and tested	1. Call for local SMEs to design, develop, test prototypes, and produce the on-the-ground units for the demonstration.	1. Map and scout mature local SMEs 2. Partnership with the national e-mobility promotion project MOVÉS 3. Conduct the (joint) call for local SMEs 4. Selection and awarding	1. Joint call for local SME conducted by October 2020.
	Design, prototyping, testing phase	1. Design 2. Prototyping 3. Internal/in-facility testing and validation	1. Design available by Dec 2020 2. Final prototypes available by March 2021
	3. Production of units for demonstration		1. Demonstration units available by June 2021

D4.1 Nine (9) Demonstration Implementation Plans

1. On-the-ground demonstration of vehicles for urban logistics is conducted and assessed	1. Detailed planning of on-the-ground demonstration	1. Planning and preliminary set-up (including stakeholder engagements)	1. Montevideo demo launched by June 2020 2. Detailed demonstration mechanics available by Dec 2020 3. Functional requirements to be available by October 2020 (c/o UITP)	
		2. Roll-out of locally assembled vehicles in partnership with the MOVÉS project	1. Vehicles will be tested by local companies for 1 year under the MOVÉS project renting scheme	
	2. Implementation of on-the-ground demonstration activities	1. Launching event 2. Data collection during implementation	1. SOL+ updates to be submitted every six months to the European Commission 2. Implementation summary to be submitted April 2023	
		3. Assessment	1. Determination of KPIs 2. Baseline activities 3. Monitoring 4. Analysis of data and evaluation	1. KPIs from SOL+ to be available by month 12
	3. Interoperable charging equipment is demonstrated and assessed	1. Identification of best possible charging equipment provider	1. Discussions with SOL+ industry partners 2. Discussions with local providers 3. Selection and awarding	1. Awarding conducted by October 2020.
		2. Planning for the installation and implementation	1. Infrastructure design	
3. Installation and monitoring				

D4.1 Nine (9) Demonstration Implementation Plans

	4. Assessment		
4. Concept/prefeasibility study for scale-up is developed*	1. Preparation of the pre-feasibility study		Note: The development of such will be dependent on the results of the assessment of the demonstration and the preferences of the targeted financial institution and mechanism.
<p>OUTCOME 2. Conditions for enabling accelerated e-mobility uptake are improved.</p> <p>Baseline: The current enabling environments for e-mobility (relating to operations, policy, and financing) is still evolving. Initiatives that provide support in improving these aspects are generally welcome.</p> <p>Target: Suggest locally appropriate business models and plans; Establish specific linkages between local and European businesses; provide recommendations for enabling policies; provide recommendations for a national programme focusing on funding and financing e-mobility</p>			
1. Business models and business plans are developed and validated	1. Identification of locally-appropriate transformative business model concepts directly relating to the demonstration activity		
	2. Business plan development and preparation of commercial operation		1. Business concepts to be submitted by UEMI to the European commission by December 2021
2. Interactions between EU industry and local businesses are established and documented	1. Initial stocktaking of SMEs		
	2. Start-up incubator set-up (c/o ERTICO)		
	3. Local hackathons and start-up events		1. Detailed timeline to be developed by SOL+

D4.1 Nine (9) Demonstration Implementation Plans

3. Recommendations for policy development, institutionalization and integration of e-mobility in local and national plans are developed	1. Consultations with local and national entities		
	2. Drafting and review of recommendations		1. Final recommendations by January 2022.
4. Funding, financing, and procurement for e-mobility program proposal is developed	1. Consultations with financing institution, and other relevant entities		
	2. Drafting and review of recommendations		
<p>OUTCOME 3. Local capacities relating to e-mobility are enhanced.</p> <p>Baseline: As e-mobility is still in its infancy stage in the country, capacities are still highly limited.</p> <p>Target: Local stakeholders' knowledge and capacities relating to different aspects of e-mobility are significantly enhanced.</p>			
Peer-to-peer exchange program is conducted and documented	Visit of representative/s of partner city to European expert city/cities	1. Matchmaking 2. Planning and development of itinerary 3. Visit	1. Visit to European expert city/cities within first 18 months
	2. Visit of European experts to the partner city	1. Identification of relevant experts 2. Planning and development of itinerary 3. Visit	1. Visit of European expert/s to the partner city between month 18 to the latter part of the SOL+ project (ideally up to June 2023)
	3. Joint visit of partner city and European experts to expert cities outside Europe	1. Matchmaking 2. Planning and development of itinerary 3. Visit	1. Joint visit between month 18 to the latter part of the SOL+ project (ideally up to June 2023)

D4.1 Nine (9) Demonstration Implementation Plans

2. Toolkit for e-mobility is developed and shared with local stakeholders	1. Needs assessment		
	2. Training on the toolkit		1. Trainings will be scheduled between 2021 – June 2023
3. Local training activities directly related to the demonstration action is developed and delivered	1. Training activities identification 2. Conduct of training activities		1. Training activities to be identified, prioritized, planned by November 2020

2.2.1 Demo Description

E-bus charging station in the Ciudadela Terminal

An e-bus charging station will be installed in Montevideo in the context of the SOL+ project. That e-bus charging station will be located inside a bus terminal in the Old City called “Ciudadela”. The bus terminal where that charging station will be installed is located on the border of the Old City of Montevideo, near to the Independence square where the main avenue of the city (18 de Julio) begins and where the city tour bus starts its trip. The terminal is also located near to another public transport terminal called „Río Branco” (interurban terminal).

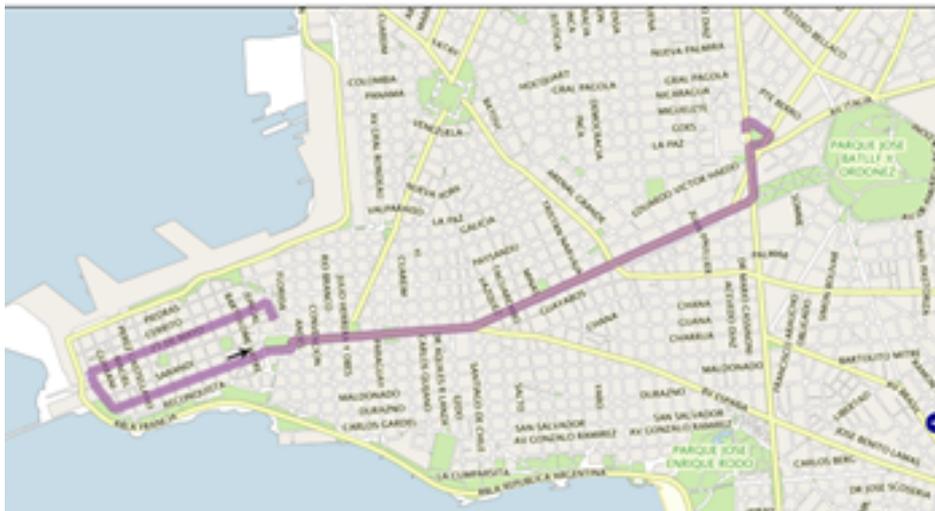
The Ciudadela terminal is a hub for public transport owned by the Municipality of Montevideo used mainly by the four operators of urban public transport in Montevideo. That operators are: COETC, COMESA, CUTCSA and UCOT. That terminal is also used by suburban public transport companies which are regulated by the Ministry of Transport and Public Works (MTO) . The terminal is used by these companies as a destination for the lines and for loading fuel (gasoil) for their buses. During the night, several buses are kept there.

Thirty (30) electric buses were incorporated into Montevideo’s public transport system on June the 1st. These e-buses are distributed among the operators as it follows:

- CUTCSA: 20 units
- COETC: 4 units
- COMESA: 3 units
- UCOT: 3 units

The line CE1 (operated by CUTCSA, COETC and UCOT with their electric buses) is shown in the next picture. That line has a loop from terminal Tres Cruces (near to the end of 18 de Julio avenue) up to the Ciudadela terminal in the Old City.

Figure 9: Line CE1 route



Source: Geographic information system of the Municipality of Montevideo.

CUTCSA uses electric buses on three different routes, exclusives for e-buses. That lines are E14, CE1 and DE1 (the letter „E“ refers to electric).

The lines E14 and DE1 also arrive to the Old City through the main avenue, 18 de julio. Therefore there are 3 fully electric lines that get in the Ciudadela terminal.

COMESA rotates its electric buses on all its lines – the line 505 is destined for the Ciudadela terminal. They will continue with the same procedure in future incorporations of electric buses.

In consequence, there are 3 fully electric lines that enter to the Old City, creating the first electric corridor in the city on the „25 de mayo“ street. This route is very close to the „Ciudadela“ terminal, which makes it possible to coordinate the operation and recharge the e-buses during the operation or during the night as well. In the future, the lines that begin its routes in the Ciudadela terminal could incorporate electric buses increasing the number of e-buses that will be use that charging station.

In the next image it is shown in red the position of the projected e-buses charging station:

Figure 10: Bus terminal Ciudadela



Source: Google Maps 2020

The urban planning strategy for the Old City is likely to consider restricting vehicular traffic, promoting the use of active modes and low-emission public transport. Transforming part of the citadel terminal into an electric bus charging station would be key to continue on this path.

Charging requirements

Regarding the technical conditions for the e-bus charging station, it must comply the following conditions: for BYD buses there should be one charger 2 x 40 kW in AC, Type 2 connector and for Yutong buses the charger should be 150 kW in DC, GB/T standard connector.

Yutong original EVSE have two cables of 150 kW, being able to deliver 150 kW through one connector or 75 kW through each connector in order to charge 2 buses at the same time. On the other hand, BYD original EVSE have two cables of 40 kW each one, being able to deliver 80 kW in AC charging 2 buses at the same time.

It is expected that the charger that will be installed in Ciudadela terminal would be supplied by ABB or T-Systems as well, but they would be not able to deliver a charger that includes a GB/T standard connector (that was already confirmed by ABB).

On the side of SOL+, it was identified that it will be needed to charge three electric buses simultaneously: two of them will be BYD buses equipped with a Type 2 standard connector and one of them will be a Yutong bus equipped with a GB/T standard connector. In consequence the EVSE should comply the requirements for these buses or a solution for the different standards should be provided as well.

Locally, an startup called Effiza would be able to develop an adaptor in order to charge a Yutong e-bus with a charger with a CCS standard. Effiza is a startup that works with projects related to energy efficiency and electric mobility, focused on 3 areas: 1) projects on public lighting, 2) “on grid” and “off grid” solar photovoltaic projects and 3) e-mobility projects.

D4.1 Nine (9) Demonstration Implementation Plans

As regards e-mobility projects, the startup is dedicated to provide technical assistance to users or owners of electric vehicles, adapting charging solutions for different vehicles that have different kinds of connectors with different standards (Type 2, Mennekes, GB/T and so on). At the same time, Effiza is currently working on a project related to the construction of slow chargers, semi-fast chargers and fast chargers, with the aim to develop a Charger Management System that will indicate to the user the chargers availability, special reserves of chargers, among other centralized services. This development seeks to incorporate its own design. Every charger developed by Effiza will comply with the protocol OCPP for communication between the equipment and the energy provider.

It is expected that Effiza provides some kind of solutions in the charging center that will be installed in the Ciudadela terminal in order to match the different standards as it is shown in the picture below (it is just a prototype).

Figure 11: Effiza 40 kW GB/T to CCS adaptor testing



Source: Effiza

Urban logistics

In the described context, a couple of initiatives that include the development of 3-wheelers and e-cargo bikes are being carried out.

E-cargo tricycles

In collaboration with MOVÉS, a process is being carried out to determine the technical specifications that tricycles (3-wheelers) and electric cargo bicycles (e-cargo bikes) must have. Within the options managed, there is the possibility of building a tricycle with considerable load capacity and adequate performance for various types of goods, including heavy ones. For 3-

wheel prototypes, one of the possibilities is shown in figure 6, where a model can be seen that can be taken as a reference. From this model, variants may arise in successive instances.

Table 6: proposal for 3-wheelers development in Uruguay

Proposal for 3-wheelers	Main characteristics
	<ul style="list-style-type: none"> ● Drivetrain: Valeo e-Access serial ● Max speed: 65 km/h ● Range: 60-100 km ● Power: 6.5 kW (12 kW peak) ● Slope: 15% ● Loading capacity: 800 kg ● Length: 2200 mm ● Width: 1300 mm

One of the startups that would be able to go ahead with the manufacturing of 3-wheelers is Green Star SRL, an SME that is working on an e-mobility project in order to built a series of that kind of electric vehicles. They have experience in the manufacturing and exportation of 3-wheelers (the „Tango“ 3wheeler – initially powered with an internal combustion engine) and they built an electric prototype of this vehicle. They are currently working on the construction of new 3-wheelers, focused on a „deliverator“ model and a “ride” model. The “ride” model is shown in the following picture.

Figure 11: Tango “ride” and Tango “deliverator” from Green Star SRL



Source: Green Star SRL

D4.1 Nine (9) Demonstration Implementation Plans

Green Star is already able to go ahead with the next stage and receive VALEO motors to be mounted in a couple of prototypes (not the „deliverator“ model for the moment but yes in the near future). It is important to take into account that the last electric prototype was powered by a 72 Volts electric motor, so some technical topics should be discussed with Valeo such as the voltage of the motors and other relevant design parameters.

The “deliverator” model that is right now in development as it was shown in the picture before. This kind of 3-wheeler would be suitable for the delivery of some products that another startup located in Montevideo is producing. This is Compost Ciudadano (City Compost), a startup that collects organic waste in some specific areas of Montevideo in order to make organic compost with that. They are currently renting a pickup to do that, so it is their intention to buy an electric vehicle for that purpose. It is expected that a 3-wheeler fabricated by Green Star could be used by Compost Ciudadano in the context of the routed agreement with MOVES.

Apart from Green Star, it could be other SME interested in the open call for SMEs.

E-cargo bikes

Just as it was done for 3-wheeled vehicles, a process for determining technical specifications was also started for e-cargo bikes with the support of MOVÉS. For this case, two different types of e-cargo bikes were predefined to carry out a call. The first model has a conventional looked e-bike with a rear basket and eventually an additional basket in the front part (table 7). In any case with electrically assisted pedaling.

Table 7: proposal for an e-cargo bike development in Uruguay

Proposal for e-cargo bikes	Main characteristics
	<ul style="list-style-type: none"> ● Drivetrain: Bosch ● Max speed: 25 km/h ● Range: N/D ● Power: 250W ● Slope: 15% ● Loading capacity: 100 kg

A slightly more innovative proposal was also reached in which the cargo basket is located between the driver and the front wheel (table 8). Another possible design set up also the

D4.1 Nine (9) Demonstration Implementation Plans

basket between the driver and the front wheel, but instead of having a single wheel on the front axle it has a double wheel there. That kind of vehicle is also assisted by an electric motor, up to 250W of power.

Table 8: proposal for an e-cargo bike development in Uruguay

Proposal for e-cargo bikes	Main characteristics
	<ul style="list-style-type: none"> ● Drivetrain: Bosch ● Max speed: 25 km/h ● Range: N/D ● Power: 250W ● Slope: 15% ● Loading capacity: 150 kg

One of the startups that is developing e-cargo bikes is **ecoMoving**. They are currently developing a series of e-Cargo bikes that are being manufactured in Uruguay. The purpose of that startup is the construction and renting of e-bikes in order to replace bikes or motorbikes that are currently being used for delivery services in the city.

Figure 12: two types of e-cargo bikes in process of manufacturing by ecoMoving





Source: ecoMoving

There are other startups like ecoMoving that would be able to build e-cargo bikes here in Uruguay which could be supported by this plan.

2.2.2 Test scenarios

As it follows, a test scenario describes the environment in which the SOL+ demonstrations will take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Table 8: Test scenario e-bus charging equipment in the Ciudadela Terminal

Solution: charging station for e-buses and e-taxis(tbc) in the Old City (Ciudadela)	
Test category	d) feasibility study, assessment of technological concepts, code of practice and specifications
Vehicles involved (type)	e-buses
Vehicles involved (unit)	20 BYD e-buses (Type 2 connector) 10 Yutong e-buses (GB/T std. connector)
Integration with PT system	“Ciudadela” is a bus terminal where several PT lines start or finalise their trips. The purpose of this charging infrastructure is to provide an alternative charging point for PT operators
Lines/stops involved (units)	To be determined
Time span (testing activities)	From/to June 2021 – December 2021

Time span (data collection)	Before From/to January – June 2021	After From/to June 2021 – December 2022
-----------------------------	--	--

Table 9: Test scenario urban logistics

Solution: electric urban logistics solutions		
Test category	d) feasibility study, assessment of technological concepts, code of practice and specifications	
Vehicles involved (type)	electric 3-wheelers and e-cargo bikes	
Vehicles involved (unit)	2 electric 3-wheelers 15 e-cargo bikes	
Integration with PT system	without integration with the PT system	
Lines/stops involved (units)	N/A	
Time span (testing activities)	From/to June 2021 – December 2021	
Time span (data collection)	Before From/to January – June 2021	After From/to June 2021 – December 2022

2.2.3 Vehicles/infrastructure/equipment provision

The table below shows the indicative distribution of the funds for the development of the proposed projects. The staff costs, components and other costs for every project will be covered. For the e-3 wheelers and the e-cargo bikes, a SOL+ industry partner will provide the motors for the prototyping as the rest will be covered by the SME Call funding. The funds for the e-bus charging station will be covered by the city equipment budget.

Table 10: Indicative distribution of internal SOL+ funds for the

E-tricycles		SME Call	City Equipment budget	Industry partner
Units	3	3	0	only components
Staff time & inhouse facility		7.200,00 €	- €	- €
Components		13.200,00 €	- €	1.800,00 €
Motor		- €	- €	1.800,00 €
Batteries		5.400,00 €	- €	- €
All other components		7.800,00 €	- €	- €
Other costs		3.600,00 €	- €	900,00 €
Subtotal		24.000,00 €	- €	2.700,00 €

D4.1 Nine (9) Demonstration Implementation Plans

E-cargo bicycles		SME Call	City Equipment budget	Industry partner
Units	15	15	0	only components
Staff time & inhouse facility		5.250,00 €	- €	- €
Components		9.750,00 €	- €	7.500,00 €
Motor		- €	- €	7.500,00 €
Batteries		4.500,00 €	- €	- €
All other components		5.250,00 €	- €	- €
Other costs		- €	- €	3.750,00 €
Subtotal		24.750,00 €	- €	11.250,00 €
E-bus charging		SME Call	City Equipment budget	Industry partner
Units	1	0	1	0
Staff time		- €	10.000,00 €	- €
Infrastructure & equipment		- €	20.000,00 €	- €
Charging equipment		- €	- €	tbc
Infrastructure & installation		- €	20.000,00 €	- €
Other costs		- €	20.000,00 €	- €
Subtotal		- €	50.000,00 €	- €
EV Charging infrastructure network		- €	50.000,00 €	- €
GRAND TOTAL		48.750,00 €	100.000,00 €	13.950,00 €

D4.1 Nine (9) Demonstration Implementation Plans

OUTCOME 3. Local capacities relating to e-mobility are enhanced.												
1. Peer-to-peer exchange program is conducted and documented												
1. Visit of representative of partner city to European expert city/cities												
2. Visit of European experts to the partner city												
3. Joint visit of partner city and European experts to expert cities outside Europe												
2. Toolkit for e-mobility is developed and shared with local stakeholders												
1. Needs assessment												
2. Training on the toolkit												
3. Local training activities directly related to the demonstration action is developed and delivered												
1. Training activities identification and planning												
2. Conduct of training activities												

2.4 Business model plan

The proposed business model plan has as main actors the Municipality of Montevideo (IM) and the MOVÉS project. As for the charging solution for e-buses it will be the Municipality of Montevideo who provides the public space for the location of the charger. As for the electric vehicle manufacturing solution, it will be the MOVÉS project who receives the grant of 50 thousand euros (formally it will be the Ministry of Energy) to be later assigned to the SME winners of the call. Also, the MOVÉS will serves on rental mode the electric vehicles that are manufactured as a consequence of the call, assuring to the SME one year of renting for every vehicle. Apart from that, MOVÉS will add to the electric vehicles manufactured in the framework of the SOL + project all the aforementioned benefits that apply to the current plans as well as to the green fleet plan.

2.5 Team involved

Table 12: Team members and contact details

Main Role	Company	Name	Contact
Demo leader	Intendencia Montevideo	Gonzalo Márques Director Public Transport Division Carolina Romero Economic Analyst Public Transport Division	gonzalo.marquez@imm.gub.uy carolina.romero@imm.gub.uy
Coordination	Wuppertal Institute (WI) UEMI	Maria Rosa Muñoz B. WI Research Fellow Regional coordination Juan Pedro Carriquiry UEMI Research Fellow Local implementation	maria.munoz@wupperinst.org juan.carriquiry@uemi.net
Vehicles provider	Local assembler/s would ultimately be chosen through the SOL+ local SME call in Oct2020. For a description of possible providers please go to the business environment section	tbc	tbc
Charging system provider	Conversations with ABB and T-Systems have been held. Final decision pending	tbc	tbc
Promotion of SOL+ vehicles in the local market	MOVÉS Project Ministry of Industry, Mining and Energy (MIEM)	Ariel Álvarez Project coordinator	Ariel.Alvarez@miem.gub.uy

Regional support	CMM SIMUS	Sebastián Galarza Suárez Nidia Ibarra Serrano	sgalarza@cmmolina.cl desarrollo@redsimus.com
------------------	--------------	---	--

2.6 Risks Assessment

Table 13: Risks and Mitigation Strategies

<i>Risk</i>	<i>Probability assessment</i>	<i>Consequences</i>	<i>Risk mitigation/comments</i>
<i>Valeo components not delivered on time</i>	<i>High</i>	<i>Delay in prototype assembly</i>	<i>Set of lead times for delivery (key role on Valeo representative). Clarification of regulations regarding importation. Plan "B" instead of Valeo?</i>
<i>Bosch motors not delivered on time</i>	<i>Medium</i>	<i>Delay in prototype assembly</i>	<i>Set of lead times for delivery. Clarification of regulations regarding importation. Plan "B" instead of Bosch?</i>
<i>Final products not suitable for use</i>	<i>Low/Medium</i>	<i>e-vehicles are not used</i>	<i>User needs-based assessment at the core of the design phase. Local needs assessment (MOVES)</i>
<i>Final products are expensive in the context of the market</i>	<i>High</i>	<i>e-vehicles are not sold</i>	<i>Economic assessment at the design phase (simple design would be good in this sense)</i>
<i>Final products do not comply regulations for use</i>	<i>Low</i>	<i>e-vehicles are not used</i>	<i>Local regulation assessment (MOVES)</i>
<i>Hazards related to charging equipment</i>	<i>Medium</i>	<i>Problems with adaptors between CCS and GB/T standards. Equipment without</i>	<i>Ideally there would not be an adaptor and the supplier of the EVSE should supply the equipment with two</i>

D4.1 Nine (9) Demonstration Implementation Plans

		<i>warranty</i>	<i>types of connectors (GB/T and Type 2).</i>
<i>Hazards related to charging equipment</i>	<i>Low</i>	<i>Damage to the hardware or injury to users</i>	<i>The whole local regulations and standards must be complied. Best practices in terms of installation and subsequent checking are to be aimed for.</i>
<i>COVID-19</i>	<i>High</i>	<i>On-site trainings, peer-to-peer exchange delayed Change of priorities in the local government</i>	<i>Provide online CB alternatives while the restrictions last Emphasize and focus on the aspects of the demo that could help mitigate COVID-19 transport-related risks</i>

2.7 Monitoring

A monitoring plan will be crafted based both on the “global” project key performance indicators (KPIs) to be developed within the Work Package 1 of SOLUTIONSplus and the main objectives to be co-identified with the local counterparts. Essentially, a set of highly relevant KPIs will be selected and methodologies (who, what, when, where, how) for collecting data for calculating the indicators will be included in the monitoring plan. To be able to properly assess the impacts of the demos, there would also be a need for baselining activities which would establish the benchmarks for the indicators. The baseline values would essentially capture “what would have happened in case the demonstration was not conducted.”

The KPIs would capture operational performance, and service quality-related perceptions. These KPIs would be selected based on a holistic framework that considers operational (reliability, range, etc...), environmental (and energy efficiency), social (e.g. safety, perceptions), and economic (e.g. total costs of ownership, operational costs and considerations, affordability) aspects of the demonstration activities.

3.Preliminary replication opportunities

Opportunities for the production of similar vehicles can be explored in different developing countries in the world. In several cities in Uruguay and other countries of Latin America there are an important number of opportunities for the adoption of small and flexible urban delivery vehicles due to the increasing demand, and considering the existing alternatives. The success in the Demo can be a good example for further electrification in such cities, mainly in private urban delivery shops. This also applies in relation to the potential for replicating successful solutions for first and last mile solutions for logistics, as well as for urban waste collection.

The collaboration among different public organizations (Ministries, Academies, Federations) would be key in order to create replication opportunities. An inter-regional platform involving the different SMEs can also be established within the SOL+ Project to facilitate information and knowledge exchange. For example, Quito and Montevideo are conducting similar activities, and they are focusing on urban last mile freight, carrying out similar kind of projects and prototypes. Similar proposals in Kathmandu and Pasig are also being developed and it is known that there are important similarities among those projects and the ones in Latin America.

4. Updates

Update June 2020

4.1 Progress towards implementation

Several activities that contribute to the implementation of the demo have been conducted in the past 6 months:

- Regional Kick-off Webinar took place on April 29. More than 40 city officials from Quito and Montevideo, as well as SOL+ partners such as ABB, Valeo, ZLC, IDIADA, Rupprecht Consult, Pluservice, POLIS, among others participated in the virtual kick-off, which had a focus on public transport electrification (further information [here](#)).
- Vehicles and equipment
 - Several local start-ups and SMEs with the capacity to assemble electric vehicles locally have been identified and approached.
 - Identified SMEs participated in the 1st Valeo workshop to get to know Valeo drivetrains.
 - Technical specifications of 1st e-tricycle prototype (Deliverator) have been submitted to Valeo for feasibility assessment.
 - Terms of cooperation with the MOVÉS Project are being discussed, so that the produced vehicles could profit from their renting scheme.
 - Discussions with the local representative from ABB, T-Systems, Effiza, Yutong and the local counterparts (IM, UTE) are being held to define the best charging solution for the bus depot.
- Capacity building
 - Several SOL+ consortium members conduct CB activities in the region. Thus, it has been decided to create a regional CB platform for Latin America.
 - The 1-week e-mobility course that is held annually by the UDELAR (local university) and the Polytechnic University of Madrid (UPM) has been identified as an opportunity for the Spanish speaking cities of SOL+ (Quito, Montevideo and Madrid).

4.2 Next steps

- Local Innovators Call will be launched soon in partnership with the MOVÉS Project.
- Matchmaking process with European SMEs will start.
- A second meeting with T-Systems will be held to evaluate if they could provide a charging solution for Montevideo.
- Regional CB platform for Latin America will be created.
- CB plan adapted to the local needs will be elaborated.

5. References

- Balance Energetica Nacional Uruguay (BEN 2018a): Por sector – Matriz 2018 <http://www.ben.miem.gub.uy/caracteristicas3.html> [last accessed: 11. Nov. 2019]
- Balance Energetica Nacional Uruguay (BEN 2018b): Emisiones de CO₂ per cápita: <https://ben.miem.gub.uy/indicadores4.html> [last accessed: 11. Nov. 2019]
- Balance Energetica Nacional Uruguay (BEN 2018c): Generación de Electricidad – por fuente: <https://ben.miem.gub.uy/oferta5.html> [last accessed: 12. Dec. 2019]
- CCAC (2016): Uruguay: Rethinking practices for better air quality. Climate and Clean Air Coalition: <https://www.ccacoalition.org/en/news/uruguay-rethinking-practices-better-air-quality>
- EV (EV Asset Management) (2018): Fidecomiso Financiera. Fondo de Financiamiento del Transporte Colectivo Urbano de Montevideo III. Setiembre 2018. <https://www.bvm.com.uy/repo/arch/1275ba4f151d8537.pdf>
- GEF & UNDP (2017): MOVES project. Annotated Project Document template for nationally implemented projects financed by the GEF/LDCF/SCCF Trust Funds. https://www.miem.gub.uy/sites/default/files/pad_towards_a_sustainable_and_efficient_urban_mobility_system_in_uruguay.pdf
- IIA (n.d.): Plan de Movilidad Sostenible para Fing. <https://www.fing.edu.uy/noticias/area-de-comunicacion/plan-de-movilidad-sostenible-para-fing>
- IM (Intendencia de Montevideo) (2003): Acondicionamiento Urbano. Proyecto Decreto Junta Dptal., créase Fondo Financiamiento Transporte Colectivo Urbano Montevideo. Resolución N° 4920/03. <http://www.montevideo.gub.uy/asl/sistemas/Gestar/resoluci.nsf/0bfcab2a0d22bf960325678d00746391/3be76ce8bc1d464a03256e1c004d7358?OpenDocument> [last accessed: 11. Nov. 2019]
- IM (Intendencia de Montevideo) (2019): Más transporte eléctrico. <http://montevideo.gub.uy/noticias/movilidad-y-transporte/mas-transporte-electrico> [last accessed: 11. Nov. 2019]
- IM (Intendencia de Montevideo) (n.d.): Centro de Gestión de Movilidad – El tránsito en Montevideo. <http://montevideo.gub.uy/centro-de-gestion-de-movilidad-el-transito-en-montevideo> [last accessed: 11. Nov. 2019]
- JuntaMVD (Junta Departamental de Montevideo) (n.d.): La Junta <http://www.juntamvd.gub.uy/es.php/parlamento/index.html> [last accessed: 11. Nov. 2019]
- Mauttone, A. & Hernández, D. (2017): ENCUESTA DE MOVILIDAD DEL ÁREA METROPOLITANA DE MONTEVIDEO. PRINCIPALES RESULTADOS E INDICADORES. http://montevideo.gub.uy/sites/default/files/biblioteca/encuestademovilidadmvd-documentocompleto-final21_0.pdf [last accessed: 20. Dec 2019]
- MIEM (Ministerio de Industria, Energía y Minería) (n.d.): Movilidad Eléctrica. <https://www.miem.gub.uy/energia/movilidad-electrica> [last accessed: 11. Nov. 2019]
- Presidencia (2019a): Gobierno asiste a empresas de ómnibus urbanos con 400.000 dólares para transición a movilidad eléctrica. Publicado: 04.06.2019

D4.1 Nine (9) Demonstration Implementation Plans

<https://presidencia.gub.uy/comunicacion/comunicacionnoticias/proyecto-moves-subsidio-operadores-transporte-urbano> [last accessed: 11. Nov. 2019]

Presidencia (2019b): Con subsidio del Estado, Montevideo tendrá 30 buses eléctricos antes de fin de año. Publicado: 04.06.2019 <https://presidencia.gub.uy/sala-de-medios/audios/audios-breves/moncecchi-subsidio-buses-electricos> [last accessed: 11. Nov. 2019]

UNDP (United Nations Development Program) 2019: Movés lanza programa para incentivar el uso de triciclos y bicicletas eléctricas de reparto. https://www.uy.undp.org/content/uruguay/es/home/presscenter/articles/2019/02/moves_bicicletas_electricas.html [last accessed: 11. Nov. 2019]

UTE (n.d.): Vehículos eléctricos: <https://movilidad.ute.com.uy/vehiculos.html> [last accessed: 11. Nov. 2019]

Risso, Vignolo, Arismendi & Carriquiry: An evaluation of the actual electric vehicles charging infrastructure in Uruguay and possible designing approaches – Faculty of Engineering – University of the Republic, Montevideo, Uruguay.

UTE (n.d., 2): Carga de vehículos: <https://movilidad.ute.com.uy/carga.html?tab=red-de-carga> [last accessed: 11. Nov. 2019]

UNIT 1234:2016 “Conductive Charging System for Electric Vehicles – Vehicle Tabs, Sockets, Vehicle Connectors and Vehicle Input Connections – Standard Formats”. <https://www.unit.org.uy/normalizacion/norma/100000784/>

UNIT IEC 61851-1: 2017. Conductive charging system for electric vehicles – Part 1: General requirements. <https://www.unit.org.uy/normalizacion/norma/100000908/>

Decree 373/003: Regulation of the handling and disposal of lead and acid batteries used or to be disposed <https://www.impo.com.uy/bases/decretos/373-2003>

Law No. 19670 <https://www.impo.com.uy/bases/leyes/19670-2018>

FEIBIM: <https://feibim.org/wp-content/uploads/2019/06/CURSO-VEHÍCULOS-HÍBRIDOS-Y-ELÉCTRICOS-URUGUAY-V6-FEIBIM.pdf>

D4.1 Demonstration Implementation Plan

City: Madrid

1. Operating environment

1.1 Background

Madrid, the capital of Spain, has 3.2 million inhabitants. Madrid's energy consumption amounts to approximately 5.5% of Spain's total consumption, and the city's GHG emissions comprise 5% of national totals. Madrid's transport sector is responsible for 53% of direct emissions and 36% of total emissions. In the past 4 years, the Municipality of Madrid implemented a series of measures that aimed at reducing the intensity of private motor vehicle traffic by promoting public transport and encouraging pedestrian and bicycle transport. Madrid aimed to reduce the use of conventional cars by introducing tax incentives for clean-energy vehicles and by gradually restricting access and parking for highly-polluting vehicles, including the creation of a low emission zone (Madrid Central) in the city centre (launched in November 2018). These were some of the measures included in the former Air Quality and Climate Change Plan, known as Plan A, approved in 2017 with a scope up to 2020. The city has recently launched a new plan, so-called "Madrid 360", to replace Plan A, targeting even more ambitious goals in terms of air pollution reduction.

At regional level, more than 1,600 million people used the public transport network in 2019, which represents a 3.4% increase compared to 2018, according to data from the Regional Transport Authority (Consortio Regional de Transportes de Madrid).

1.1.1 Key facts and figures

City: Madrid

Population: 3,223,334 (2018)

GDP per capita: USD 40,907 (2018)

CO₂ emissions (total): Total (2016): 10,706 ktCO_{2-eq}

Modal shares (2018):

- At regional level: Public transport: 24%; Private cars: 39%; Walking: 34%; Others (including cycling): 3%
- At city level (city centre): Public transport: 34.8%; Private cars: 20.3%; Walking: 40%; Others (including cycling): 4.9%

1.1.2 Overarching issues

Mobility and Modal share

According to the partial Mobility Household Survey conducted in 2014, 13 million trips are carried out in 14.3 million stages every day in the Community of Madrid. From the latter, 73% were done by motorised vehicles and 27% by non-motorised modes. Between 2004 and 2014, the share of non-motorised transport increased by 2.5% (GFK, 2014). Despite the fact that the number of bike users has grown significantly in Madrid, reaching an estimate of 60,000 – 80,000 trips per day, its mode share is still negligible with 0.7% - 0.9% of total trips (gea21, 2016).

Regarding motorised transport, the public/private distribution (expressed in stages) showed a decrease of the public transport share from 53.2% in 2004 to 46.2% in 2014. However, these figures vary depending on the area being considered. Figure 1 shows the trips conducted within and between the different areas (city (turquoise) – metropolitan area (yellow) – community (pink) – beyond), divided by public (red) and private (blue) transport. It can be observed that the lion share of trips corresponds to the ones occurring within the city (3.8 million). Despite the fact that between 2004 and 2014 the share of inner city public transport slightly decreased from 62% to 60%, it is the only area where public transport dominates (GFK, 2014).

D4.1 Nine (9) Demonstration Implementation Plans

Moreover, in the decade from 2004 to 2014 the motorisation rate in the Community of Madrid increased by 45%, from 0.97 to 1.41 cars per household. Motorisation rate is lowest in the city centre, though it increased from 0.72 to 1.15 (GFK, 2014).

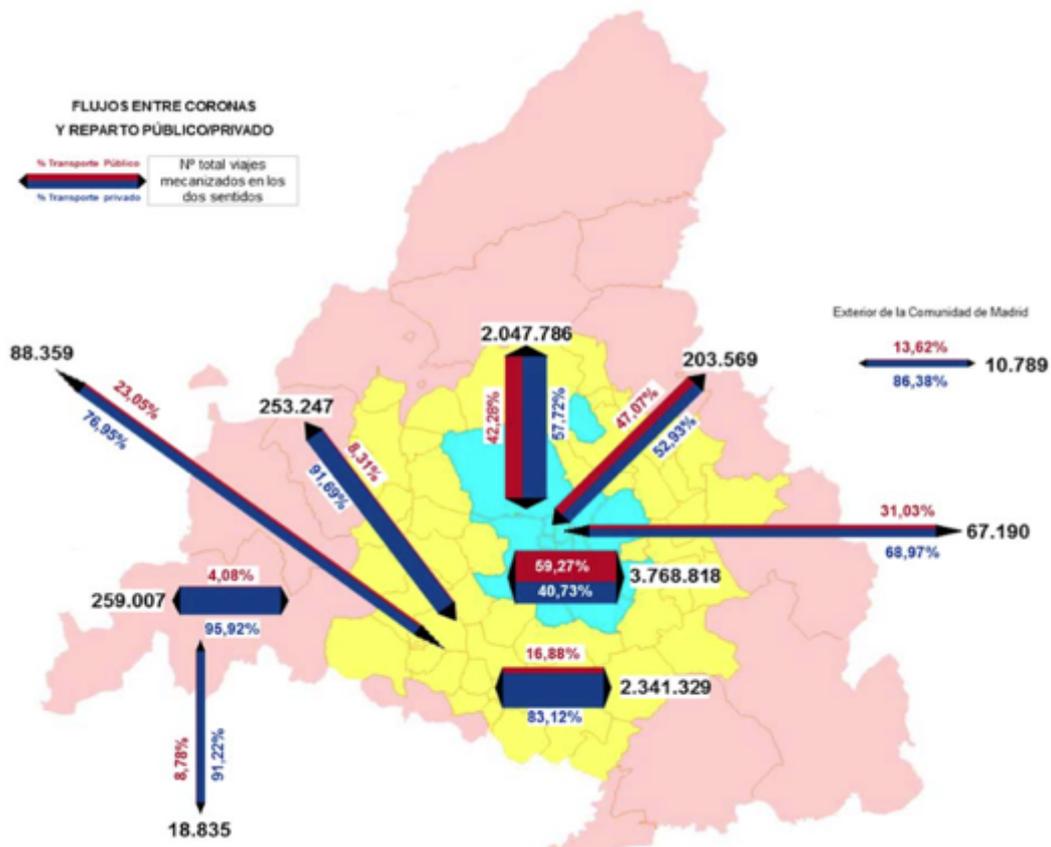


Figure 1 – Trips conducted within and between the different areas, Source: (GFK, 2014)

As shown in Figure 2, the Metro has the highest share of all public transport modes (ca. 40%), followed by EMT buses with ca. 30%. Suburban rail had a share of ca. 13% and intercity buses of ca. 17%. In comparison to 2004, the share of Metro and EMT remained mostly unchanged. There has been a slight increase in the share of suburban train (12.6% in 2004 and 14.1% in 2014) and a slight reduction for intercity buses, from 17.3% in 2004 to 15.3% in the ESM14 (GFK, 2014).

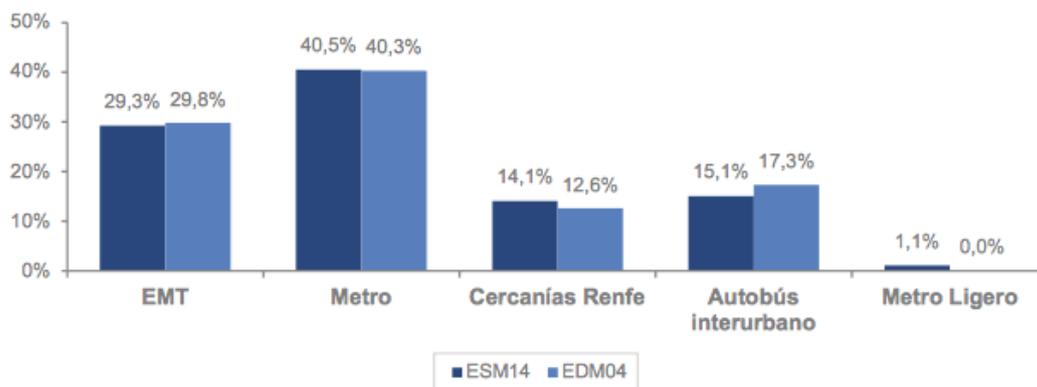


Figure 2 – Public transport modal share, Source: (GFK, 2014)

D4.1 Nine (9) Demonstration Implementation Plans

Madrid Regional Transport Authority has recently published the results of the new mobility household survey with data from 2018²⁰ which shows an increase in daily trips in the region (15.8 million vs 13 million in 2014). The results show also an overall increase in the use of private car vs public transport (depending on areas), as shown in Figure 3.

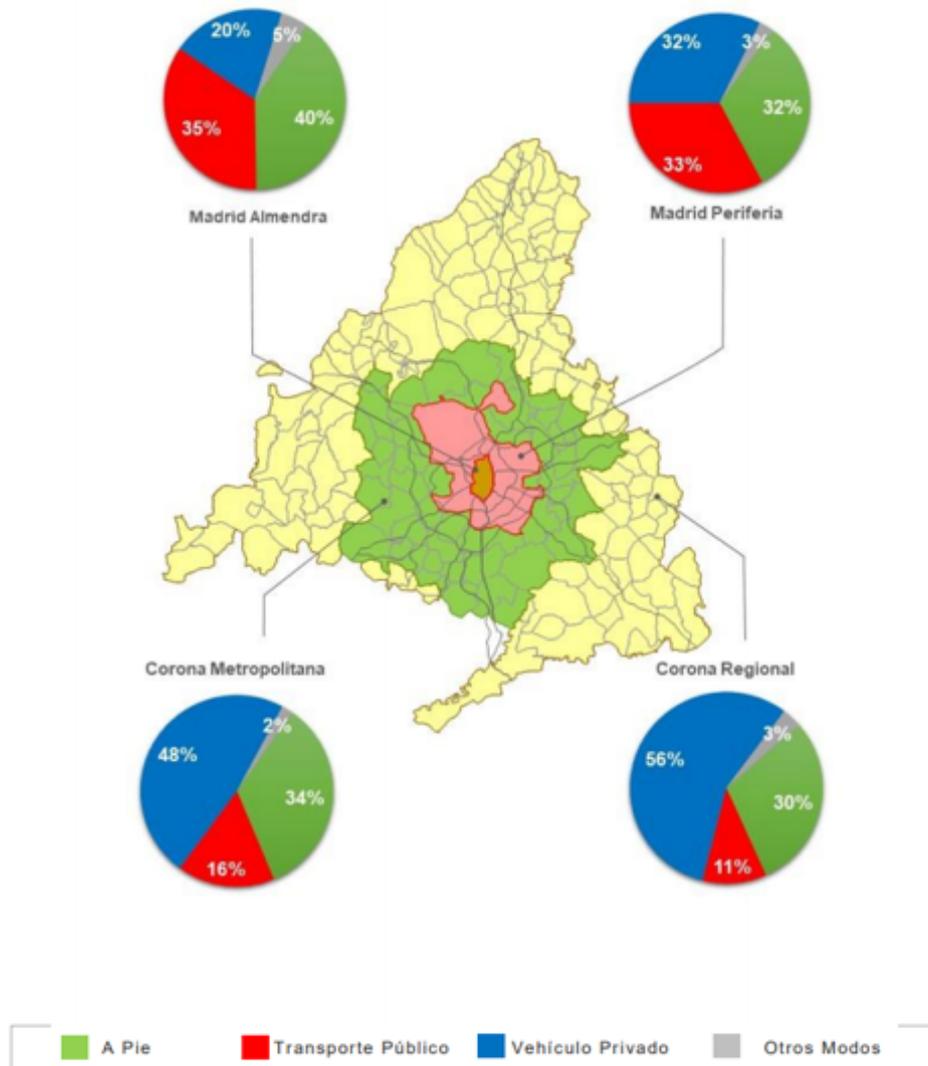


Figure 3 – Regional mobility survey, Source: EDM 2018, Consorcio Regional de Transportes de Madrid

Energy

In 2018, renewable energy sources accounted for about 40% of electricity generation, mainly through wind energy and hydropower. Nuclear energy is still the most important source of electricity. The share of coal was 13.5% (Red Eléctrica de España, 2019b).

²⁰ <https://www.crtm.es/conocenos/planificacion-estudios-y-proyectos/encuesta-domiciliaria/edm2018.aspx>

Electricity demand coverage on the peninsula. 2018 [%]

■ Nuclear	20.6%	■ Wind	19.0%
■ Coal	13.5%	■ Hydro	13.2%
■ Combined cycle	10.2%	■ Solar photovoltaic	2.9%
■ Cogeneration	11.2%	■ Solar thermal	1.7%
■ Non-renewable waste	0.9%	■ Other renewables	1.4%
■ Pumped-storage ⁽²⁾	0.8%	■ Renewable waste	0.3%
		■ Import balance of international exchanges	4.3%

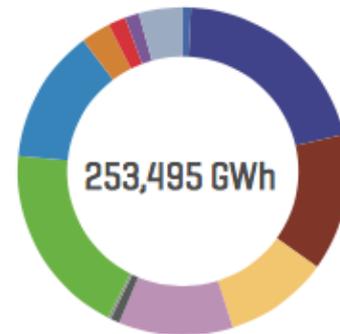


Figure 4 – Electricity generation in Spain. Source: (Red Eléctrica de España, 2019b)

The Autonomous Community of Madrid is highly dependent on the national electricity network as it has an installed power capacity of only 458 MW, one of the lowest in the country, and an electricity demand of 28,624 GWh. Madrid consumes 10% of the national electricity (Red Eléctrica de España, 2019b).

Air Quality

Madrid is among the European cities that exceed the EU-limit of NO₂ as it can be seen in : Figure 5 As a consequence, in 2015 the European Commission (EC) filed a case against Spain due to the high NO₂ levels in Madrid and Barcelona, which have been exceeding the permitted levels since 2010. In July 2019, the EC decided to lodge an official complaint with the European Court of Justice that could lead to sanctions for Spain (Miguel & Planelles, 2019).

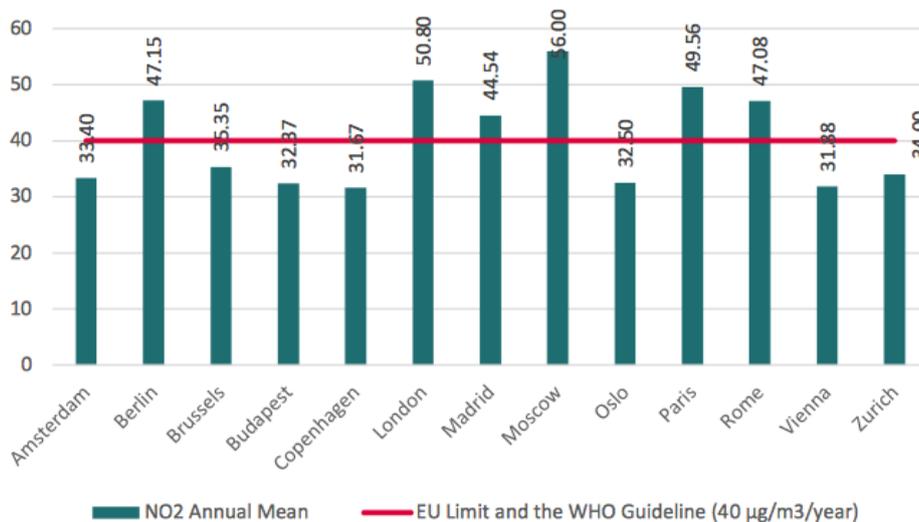


Figure 5 – NO₂ annual mean values in European Cities, Source: (Kodukula, Rudolph, Jansen, & Amon, 2018)

Moreover, despite being within the EU standards for PM₁₀ (40 µg/m³/year) and PM_{2.5} (25 µg/m³/year), Madrid does not comply with the WHO standards in these 2 pollutants (20 µg/m³/year and 10 µg/m³/year respectively) (Kodukula et al., 2018).

GHG emissions

The total direct and indirect GHG emissions of the city of Madrid in 2016 reached 10,706 kt CO₂eq, a figure that confirms the decrease that has occurred since 2005 (16,182 kt CO₂eq). In the period between 1990 (12,953 kt CO₂eq) and 2016, the reduction has been 17.35%. Per capita GHG emissions in the municipality of Madrid decreased by 36% and emissions per unit of GDP by 49% in the period 2000-2016.

The Residential, Commercial and Institutional (RCI) and Road Transport sectors contribute the most to the municipality's GHG emissions. In 2016, 49.1% and 22.9% of total GHG emissions stemmed from these sectors, although they show a downward trend in their total emissions. In the period 1999-2016, direct emissions from the RCI sector decreased by 14% and those from Road Transport by 29% (Ayuntamiento de Madrid, 2016).

However, in early 2020, European cities have seen a big drop in air pollution during the COVID19 virus outbreak. Data from the Copernicus Atmosphere Monitoring Service (Cams), which tracks pollution in 50 European cities, show that 42 of them measured below-average NO₂ levels in March, including Madrid, and so has happened with CO₂ emissions.

Pressures and Impacts

Despite the tensions generated in the last local elections in which controversy was generated on the low-emission zone and different mobility measures in the city by different political parties, electric mobility is currently considered a priority and it is at the top of the political agenda, as means to reduce air pollution in the city, and therefore it is explicitly reflected in the new sustainability strategy of the city "Madrid360".

1.2 E-mobility overview

Regarding public transport, since the early 2000s, Madrid, led by the Municipal Transport Company (EMT), has been testing different types of electric and hybrid buses. Thus, it has made great progress in improving the environmental performance of its fleet: 83% of its bus fleet is now clean or low-emitting, i.e., 65% GNC, 16% Diesel Euro V and hybrid, and 2% electric.

In 2007, Madrid launched the city's first entirely electric bus lines, the M1 and M2, using fully electric minibuses. These bus lines had very specific characteristics as they run in two areas of the city centre where streets are very narrow (cobblestone type).

Then, in 2018 the city launched the first fully electric bus line with "conventional" characteristics (typology of itinerary and bus size), bus line 76, which currently runs with 5 fully electric buses charged by induction on a 14km route with 42 stops. The 5 buses that run on this line were retrofitted from hybrid CNG-buses into fully electric.

More lately, EMT added fully electric 12 meter buses in several lines, and the most recent launch has been the so called "00" bus lines, which are two lines using fully electric buses that are also free of charge for passengers that allow getting to and cross the Low Emission Zone of the city.

At present, there are 55 e-buses 12 meters long and 30 mini e-buses running in the city with the goal of having 105 by the end of 2020. This is complemented by a fleet of over 2,400 pedelecs distributed across the 207 stations of BICIMAD, Madrid's bike sharing system operated by EMT.

1.2.1 Policy environment

Existing regulations

European and National level

The EU Commission has strengthened its air quality limits in 2016 and is pushing for low-carbon mobility. EU member states are required to develop national policy frameworks for the market development of alternative fuels & infrastructure (Directive on Alternative Fuel Infrastructure of 2016) and to consider energy consumption and environmental impacts when purchasing and leasing road vehicles (Directive on Promotion of Clean and Efficient road transport vehicles; 2009/33/EC). A revision of this Directive entered into force in August 2019 (Clean Vehicle Directive; 2019/1161/EU), setting out mandatory minimum procurement targets in each Member State for clean light-duty vehicles, trucks and buses for 2025 and 2030²¹.

At the national level, the Spanish Climate Change and Clean Energy Strategy (Estrategia Española de Cambio Climático y Energía Limpia, Horizonte 2007- 2012 -2020, EECCEL), is the instrument that was created to address GHG emissions reductions and boost sustainable development across Spain. To ensure emissions reductions, promote reductions in diffuse sectors, implement the National Plan for Adaptation to Climate Change and increase public awareness and responsible use of energy, the Strategy includes 198 measures and 75 indicators for monitoring. The measures are grouped into two areas: Climate Change (with eleven areas of action) and Clean Energy (with four areas of action). In relation to the chapter on Clean Energy and with the aim of gradually reducing energy intensity in Spain, the areas of action where measures are established are: energy efficiency, renewable energies, demand management, research, development and innovation in the development of low carbon dioxide emission technologies (CEPCO, 2019).

The Spanish Government has also recently drafted (May 2020) the first Climate Change and Energy Transition Law to achieve emissions neutrality by 2050, aligned with the EU Green Deal. The Law underlines the role of cities in achieving the Climate objectives, thereby favouring the creation of more liveable and healthy spaces, with improved air quality. In this sense, it establishes that the municipalities with more than 50,000 inhabitants and the island territories will introduce, in urban planning, mitigation measures that allow reducing emissions from mobility, including the implementation of low-emission zones no later than from 2023; it includes also the request of implementing actions to facilitate travel on foot, by bicycle or other means of active transport, and the improvement and promotion of the use of the public transport network. Shared electric mobility and the use of private electric means of transport should also be promoted.

Local level

At the local level, Madrid has introduced a series of incentives to encourage the acquisition of vehicles running on clean fuels. Since 2013, the Municipality of Madrid has granted between €2,000 and €10,000 per commercial vehicle replaced. This has enabled the replacement of over 2,000 taxis and over 650 commercial vehicles with electric equivalents. A new subsidy has been added in 2018 with the aim of promoting the purchase of private low-emission vehicles. It includes incentives of up to €5,500 for the purchase of an electric or fuel cell vehicle, and up to €2,500 in the case of biofuel. This plan also includes the installation of charging points for electric vehicles, in both public entities (municipalities) and private entities (companies,

²¹ On buses: 50% of the minimum target for the share of clean buses has to be fulfilled by procuring zero-emission buses – including fuel cell buses.

D4.1 Nine (9) Demonstration Implementation Plans

shopping centres and communities of owners), with an allocation of €1.5 million. Overall, since 2006, Madrid has allocated €124 million for this purpose, which has led to a joint investment of over €700 million, with more than 700,000 actions carried out, and has meant energy savings estimated at 240,000 tonnes of oil equivalent.

In November 2018, the previous city administration launched a ‘low-emission zone’ (Madrid Central) in the city centre, one of the main measures included in the city’s Air Quality and Climate Change Plan, known as Plan A, where, basically, only residents, people with reduced mobility and emergency vehicles could enter the low-emission area by car (some exemptions apply). The access restrictions for private vehicles were based on the Spanish environmental labels (Figure 6) which will be updated by 2021. Besides the air and noise pollution reduction in the area, the low-emissions zone aimed at promoting walking and cycling, as well as the use of public transport (Ayuntamiento de Madrid, 2019).

					
Label	Electric	Hybrid / battery	Gas	Gasoline	Diesel
	All	More than 40km autonomy	-	-	-
	-	Less than 40km autonomy	All	-	-
	-	-	-	Newer than 2006	Newer than 2014
	-	-	-	2000-2006	2006-2013
	-	-	-	Older than 2000	Older than 2006

Figure 6 – Spanish Environmental Labels for cars Source: (Rodríguez-Pina & León, 2019)

After the 2019 local elections, Madrid’s new Mayor launched a revised plan, so called “Madrid 360”, to replace the Plan A and address air pollution to the extent to reduce, according to the City Council’s calculations, NO₂ emissions by around 20% by 2023. The plan is scheduled to come into force in the first semester of 2020 and to be implemented progressively. The main measures proposed in Madrid 360 are the following (Delgado, 2019; Rodríguez-Pina & León, 2019, p. 360):

1. Puerta del Sol will be turned into a pedestrian area
2. Traffic restrictions
 - a. The circulation of private vehicles in the Central District of Madrid will continue to be restricted based on the environmental labels (see Figure 5). However, it is under study whether C-vehicles will be allowed to enter the LEZ as long as they transport 2 or more people (high-occupancy vehicles).
 - b. The new plan promotes the use of motorcycles in the area by increasing the number of parking spots and extending the schedule in which they can circulate the area (until midnight), depending on their environmental label.
 - c. Parking in the area will become cheaper, i.e., Evs will be able to park for free, ECO-vehicles will have a 50% discount and C-vehicles 10%.

D4.1 Nine (9) Demonstration Implementation Plans

- d. Business owners of the area will have the same treatment as residents, including the access to up to 20 guest passes.
 - e. The circulation restrictions for the most polluting vehicles (label A-Sin dist.) will increase gradually until 2025, when their circulation will be completely banned in the city.
3. Electric buses
- a. Zero Line – e-buses for free: the plan proposes the inclusion of several zero emissions bus lines for free that will provide access to the Central District of Madrid with two routes, one north-south and one east-west. These bus lines are already on duty (February and March respectively).
 - b. The electrification targets of the EMT fleet are quite ambitious, aiming at having 668 e-buses circulating in the city by 2027.
 - c. Economic incentives for low-emissions vehicles
 - d. 25M Euros per year will be allocated to car owners who decide to shift from an A-vehicle to an EV, ECO-V or C-V.
 - e. 10M Euros per year will be allocated to the renewal of the freight fleet
 - f. 5M Euros per year for the renewal of the taxis fleet

1.2.2 Policy gaps

At the moment Madrid City Council is working in reviewing the Sustainable Urban Mobility Plan of the city (which dates back from 2014) and at the same time is working on developing the detail of the measures of the new sustainability Strategy of the City “Madrid360”.

1.2.3 Business environment

Local businesses and start-ups working on e-mobility solutions

- *Business Association for the Development and Promotion of Electric Mobility (Asociación Empresarial para el Desarrollo e Impulso de la Movilidad Eléctrica – AEDIVE)*
Created in April 2010, AEDIVE is a Group of Innovative Companies that brings together the entire electric vehicle value chain. AEDIVE is a non-profit, independent association, whose trajectory and representation through its member companies – manufacturers and distributors of electric vehicles and charging points of various types, charge managers, marketing companies, auxiliary industry and components, renting and leasing companies, engineering, management and consulting firms, software and hardware companies, transport operators, technology centres, universities and professional end users (fleets) – has made it the valid interlocutor for the local and national governments when it comes to promoting the electric mobility (AEDIVE, 2019).
- *Association of Public Urban and Metropolitan Transport (Asociación de Transportes Públicos Urbanos y Metropolitanos – Atuc)*
The representation assigned by the Ministry of Development according to the park and the number of companies associated with the National Committee of Road Transport, section of urban public transport of passengers by bus, reaches 72.62%.
Atuc’s main goals are:
 - To promote the use of collective urban and peri-urban transport and to propose and study measures conducive to this end.
 - To defend the quality in the provision of services and to promote technological development that makes such improvements feasible.
 - To carry out and promote research studies on all aspects of transport in urban centres.
 - Promote seminars, workshops, work commissions, study surveys, etc.
 - Establish national contacts and exchanges with national and international bodies and associations (atuc, 2019).

D4.1 Nine (9) Demonstration Implementation Plans

Local mobility providers and start-ups

At the moment the mobility ecosystem is quite active in Madrid. Beyond the 41 public transport operators, there are around 16,000 taxi licenses, 8,500 ride hailing licenses (2 companies) and a wide number of shared mobility companies, with several car-sharing, motorbike-sharing and e-scooter-sharing companies with around 14,000 shared electric vehicles.

Regarding start-ups, it is also a hot topic with initiatives coming from both the private and public sector (i.e. Madrid in Motion program steered from Madrid City Council), which, for the local economy, brings more opportunities, both in terms of employment and innovation.

E-mobility financing options

At National level it is worth mentioning the MOVES Plan, where the funding amount for each type of electric vehicle is indicated (the Spanish region can allocate the budget). As a novelty, up to 70% of the total will be allowed to be assigned to vehicles.

More information is available at: <https://www.idae.es/noticias/el-gobierno-aprobate-un-nuevo-plan-de-ayudas-de-100-millones-para-fomentar-la-movilidad>

1.2.4 Capacity building

Madrid City Council is committed to extend electric mobility as an ally to reduce the negative impacts of urban mobility, being aware also about the potential coming from the strong position of Spain as a vehicle manufacturer in Europe. At National level, the Spanish Government has recently drafted (May 2020) the first Climate Change and Energy Transition Law to achieve emissions neutrality by 2050, aligned with the EU Green Deal, which may include the implementation of measures by city governments.

At Regional Level, Madrid Regional Government (Comunidad de Madrid) has the Air Quality and Climate Change Strategy, so-called “Plan Azul +”, in line with the Sustainable Development Goals set by the European Union, providing funding for fleet renewal, among others. The aim is to help the decarbonization of transport to achieve zero emissions, thus complying with the international agenda set by the Paris Agreements and the European Commission for 2050, including for this purpose also the setting of the Regional Board for the Promotion of Electric Mobility, which includes an active participation of many different stakeholders (industry, politics, media, institutions, etc.).

Last but not least, Madrid City Council launched its new Sustainability Strategy “Madrid360” last September 2019, which frames a favorable environment for electric mobility, setting ambitious goals for electrification (which includes public companies owned by the municipality, as it is the case of EMT). For example, reaching a network of 150 fast charging points by 2023 (today there are 45) or reaching a full electric bus fleet of 1/3rd (668 buses out of 2076) by 2027, among others (today there are 85 electric buses).

1.3 Key Stakeholders

1.3.1 Local government departments

Madrid City Council (Ayuntamiento de Madrid)

Madrid City Council is the public administration in charge of managing the municipality and defining public policies and strategies, acting as facilitator of any e-mobility initiative, and as a funding instrument.

Madrid Public Transport Company (Empresa Municipal de Transportes de Madrid – EMT)

D4.1 Nine (9) Demonstration Implementation Plans

The EMT is a public company owned by the Madrid City Council that was created in 1947. It operates and manages the whole network of public urban buses in the city of Madrid. It is also responsible for providing and managing the following mobility services: parking, tow trucks, public bike sharing system –BiciMAD–, cable car. The EMT will be the main counterpart in the project. Figure 6 shows the main figures of the company.

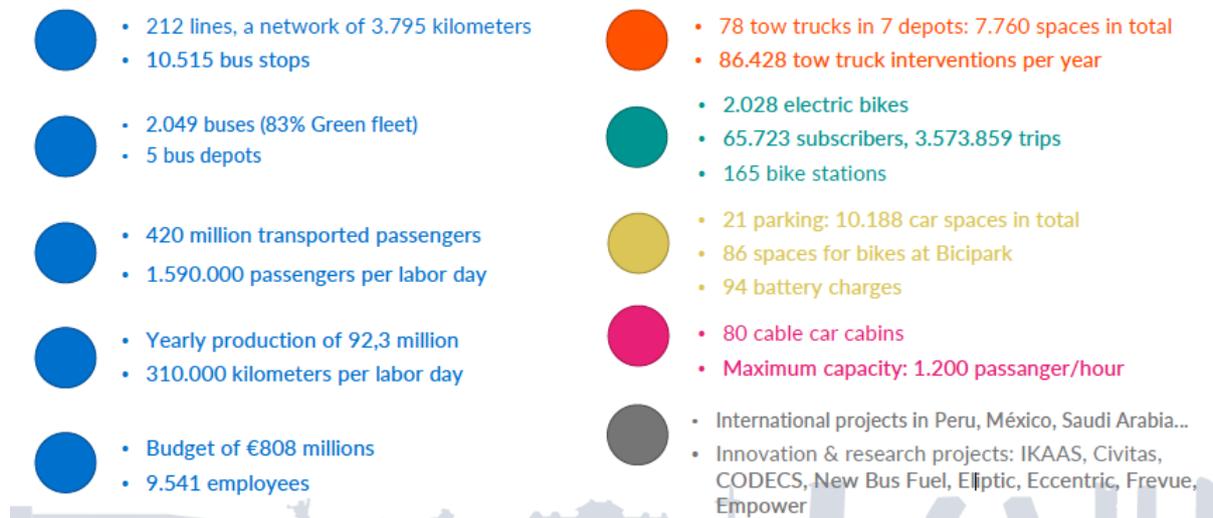


Figure 7 – EMT in figures, Source: (Fernández Balaguer, 2019)

i-DE, Smart Electric Networks

i-DE is one of the electricity provider in the Autonomous Community of Madrid. I-DE has more than 11 million customers and extends its electricity network through 10 autonomous communities and 25 provinces, covering an area of 190,000 km². In the context of electrification of transport and thermal energy, i-DE is focused on optimizing network planning and development.

i-DE is working on the development of new energy models that integrate distributed generation resources: electric vehicles, storage, photovoltaic panels, etc. Its objective is to allow an active management of the demand and to provide the services adjusting them to the current circumstances of the network. I-DE belongs to the Iberdrola Group, one of the world's largest electricity companies, the second largest electricity production group in Spain, Spain's largest energy group in terms of market capitalisation and fourth in the world and is at the forefront of the world's wind energy sector. (i-DE, 2019).

EMT has recently signed an agreement with i-DE to boost electrification in the municipal company, whose main objective is to promote the electrification of mobility and public transport for an optimal smart city model for Madrid. More information at this link: <https://www.emtmadrid.es/Noticias/EMT-e-i-DE-suscriben-un-acuerdo-para-impulsar-la-e.aspx>

Consorcio Regional de Transportes de Madrid

The Regional Transport Consortium exercises the functions of a single transport authority. It has a collegiate management structure, representing the Community of Madrid, the Madrid City Council, the other member municipalities, public transport users, trade unions, the Central Administration and the business sector. It assumes the following functions:

- The overall planning of regular passenger transport infrastructures.
- The definition of coordinated operating programmes for all modes.

D4.1 Nine (9) Demonstration Implementation Plans

- The establishment of an integrated fare system for the whole system, creating valid tickets for all companies.
- And, finally, the creation of a global image of the Transport System, being the interlocutor with the user (Comunidad de Madrid, 2019).

Environmental Council (Consejería de Medio Ambiente)

The Environment Council of the Community of Madrid is constituted as a consultative and advisory body, with the aim of promoting the participation of organisations interested in the defence of the environment and of people of recognised prestige in the preparation and monitoring of environmental policy (Comunidad de Madrid, 2018).

1.3.2 National government departments

Institute for Energy Saving and Diversification (Instituto para la Diversificación y Ahorro de la Energía – I)

As a public business entity with financial autonomy, it has the following competences:

- Improve energy efficiency and promote the implementation of renewable energies.
- Dynamise the market by providing technical and financial services for innovation projects with replication potential.
- Define the actions to implement the energy efficiency and renewable energies development policy of the Ministry of Industry, Energy and Tourism (I, 2019).

Electricity Network of Spain (Red Eléctrica de España)

Red Eléctrica was created in 1985. At that time it was the first company in the world exclusively dedicated to the distribution and operation of the electricity system.

Red Eléctrica was set up as a company with a majority of public capital, composed by the equity contributions of a group of public (Endesa and ENHER) and private electricity companies (Iberduero, Hidroeléctrica Española, FECSA and Unión Fenosa, among others). Red Eléctrica Group provides, manages and operates, the energy system and network infrastructure (Red Eléctrica de España, 2019a).

Centre for Industrial Technological Development (Centro para el Desarrollo Tecnológico Industrial – CDTI)

The CDTI is a Public Entity, dependent on the Ministry of Science, Innovation and Universities, which promotes innovation and the technological development of Spanish companies. It is the entity that channels requests for aid and support for R&D&I projects of Spanish companies at the national and international level. Therefore, CDTI's objective is to contribute to the improvement of the technological level of the Spanish companies by means of the following activities:

- Technical-economic evaluation and granting of public aid to innovation through subsidies or partially reimbursable aid to R&D projects developed by companies.
- Management and promotion of Spanish participation in international technology cooperation programmes.
- Promotion of the international transfer of business technology and support services for technological innovation.
- Support for the creation and consolidation of technology-based companies (CDTI, 2019).

1.3.3 Industry (European and international)

ABB

ABB b.v. is manufacturer of EV charging equipment, including interfaces to backend systems for remote status information, diagnosis, repair, over the air software updates, exchange of EV driver related authentication and payment services. ABB lays the foundations for a future of smarter, reliable, and emission free mobility, accessible by everyone, everywhere. ABB offers a total solution from compact, high quality AC wallboxes, reliable DC fast and high power charging stations with robust connectivity, to innovative on demand electric bus charging systems. ABB deploys infrastructure that meet the needs of the next generation of smarter mobility. ABB Ability™ connected chargers enable fast global service and proactive maintenance, as well as the interface to many (future) IoT services. ABB has years of experience in creating, installing and maintaining charging infrastructure, including several nationwide charger networks. ABB is a partner of SOLUTIONS+ project and will provide Madrid with 2 inverted pantographs and the electronic devices associated for fast charging.

Other European industry players

Irizar

Irizar is a business group with an international presence, whose activity is concentrated in the sectors of passenger transport, electromobility, electronics, electric motors and generators, connectivity and energy, being one of the main bus manufacturers in Spain. The Group is made up of seven brands that develop their productive activity in 13 plants, distributed in Spain, Morocco, Brazil, Mexico and South Africa (Irizar, 2019).

TECNOBUS S.p.A.

Tecnobus is an Italian company that has been operating in Frosinone in Via Mola dei Frati, 12, for more than 25 years, in a factory that occupies an area of 10,000 square meters and has obtained certifications on the design and production of electric buses and related parts. With the GULLIVER model, Tecnobus has been able to introduce low-floor buses in historic centres, which are absolutely non-invasive thanks to their extremely small size and capable of carrying up to 30 passengers in total comfort and, above all, which meet all the requirements dictated by the regulations governing European bus approvals for Class I public transport (Tecnobus, 2019).

Wolta Microbuses

Wolta is a new micro bus model (7m length) from a partnership between CARBUS (Body builder) and Rampini (bus provider) from 2018. They delivered to EMT 18 vehicles at the end of 2018.

The buses are fully electric, with a capacity of 30 passengers, A/C and electric heating, low floor and full accessibility. They are operating in the city center and provide service on one of the „00“ bus lines in Madrid.

Other international industry players:

BYD

Founded in 1995 as pioneer in battery technology, BYD's mission is to change the world by creating a complete, clean-energy ecosystem that reduces the world's reliance on fossil fuels. In Europe BYD focuses on making public transport emission free. Throughout its 24 years of growth, BYD has evolved from a small start-up with only 20 employees into a global

D4.1 Nine (9) Demonstration Implementation Plans

company with more than 220 thousand employees today. BYD has established over 30 industrial parks across six continents and has played a significant role in industries related to electronics, automobiles, new energy and rail transit (ByD company 2019).

Early 2020, BYD delivered 15 e-buses to EMT (k9 model). They are charging in a/c but have a bars pre-installation for using inverted pantographs and are available for fast charging.

1.3.4 Stakeholders

Civil society

Civil society is very much aware of the advantages of electric mobility. The main drawback is the excessive price of Evs compared to equivalent ICE vehicles and the generalized feeling of lack of charging infrastructure.

1.3.5 International cooperation and finance

CIVITAS ECCENTRIC (September 2016 – August 2020) is a European research project to test innovative measures to improve sustainable mobility on the periphery and in urban freight transport logistics. In both cases we are faced with great challenges. However, little attention has been paid to them in urban mobility policies so far. The project aims to change this situation by providing solutions in its five laboratory areas, located in the cities of Stockholm, Madrid, Munich, Ruse, Turku. Under the coordination of Madrid City Council, eleven measures have been applied in the city's laboratory area. In this way the project aims to contribute to the knowledge base and capacity building in terms of effective mobility solutions, with the aim of applying these solutions in other cities as well. Among the 11 measures, 4 refer to electric mobility. These are:

- Hybrid and electric buses in public transport in peripheral areas (measure 5.8)
- Incentives, campaigns and tests to implement electric vehicles (measure 6.2)
- Consolidation centre for cargo and incorporation of clean vehicles in the last mile logistics chain (measure 7.1)
- Prototype of low-emission cargo vehicle (measure 7.6) (Ayuntamiento de Madrid, 2019a)

In concrete terms 6 buses and 343 cars have been replaced by clean vehicles, and charging infrastructure has been installed in 19 municipal buildings of the city.

E-LOBSTER (June 2018 – November 2021) aims to develop an innovative, economically viable and easily replicable electric Transport-Grid Inter-Connection System that will be able to establish synergies between power distribution networks, electrified transport networks (metro, trams, light railways etc.) and charging stations for Evs. The proposed solution encompasses the integration of high power flow Electric Storage with smart Soft Open Points providing flexible control. The hardware and software control platform will be demonstrated at TRL 6 in one substation owned by Metro de Madrid. Business models and standardisation needs will be deeply analysed and measures to unlock existing barriers will be promoted and in parallel the knowledge generated from the project will be further exploited for the definition of the up-scale design of a full scale E-LOBSTER system, paving the ground towards replication across the EU (CORDIS, 2019).

Other projects

Other relevant projects EMT is involved in and can create synergies with the SOLUTIONSplus demonstration are:

- SHOW, which started in January 2020 and will run a pilot with autonomous micro e-buses. It will provide a shuttle between La Nave (Madrid Innovation Hub in

D4.1 Nine (9) Demonstration Implementation Plans

Villaverde district) and Villaverde Bajo Cruce Metro station (multimodal transport platform).

- Auto-bus (CDTI) is a project on automated e-minibuses but in this case is funded by a National organism (CDTI) and it will be carry out in Carabanchel bus depot with some characteristics like teleoperation, and will mainly focus on autonomous operations regarding cleaning, maintenance and charging

2. Demonstration Action

EMT e-fleet is growing yearly and it has been decided to implement a safe, secure and integrated solution for the management of its e-buses. The solution to be tested is by using an inverted pantograph solution.

2.1 Situation analysis

Today EMT has more than 80 e-buses of 5 different brands (Irizar, ByD, TecnoBus, Castrosua Tempus and Wolta). Each brand has its own charger and all of them can charge conductively by wire. These e-buses operate from two different depots, one in the north of the city and the second one in the south. At the moment charging is done by maintenance personnel that plug and unplug each bus. This action is monitored by the same amount of people during the charging period. This procedure is possible because EMT e-fleet is quite small (2% of the total).

The SOLUTIONSplus Madrid demonstration will help to improve the current situation by focusing on two main aspects: interoperability of charging and monitoring. The first one by using inverted pantographs instead of conventional conductive chargers with different plugs. The pilot will be carried out quite likely in Carabanchel bus depot (in the south of Madrid) where EMT has all the propulsion technologies available and sufficient energy supply. A virtual supervision and monitoring system will be installed (smart charging).

Also, EMT will adapt its e-buses with the roof bars and will implement or change their charging communication protocol to be able to charge by pantograph.

EMT will add a high power grid connection for the facilities.

2.2 Demo Description: Cutting-edge technology for smart charging

Given that by the end of 2020, Madrid will have 105 e-buses running in the city, measures to provide adequate and efficient charging will be needed. Five inductive charging points have already been implemented in the city and the buses to be purchased between 2019 and 2020 will have the capability of off-board opportunity charging. Thus, the demonstration will focus on the following measures:

- Testing a software to monitor and control the power network for charging stations and e-buses, maximizing bus availability and operational efficiency.
- Installation of 2 (two) inverted pantographs for opportunity charging with a modular design offering charging power of 90kW, 180kW, 270kW and 360kW, enabling charging times of 3-6 minutes using a low-cost and low-weight interface on the roof of the bus.
- These will be the first inverted pantographs installed in the city of Madrid. Besides increasing the power and thus the speed of each charge, the smart and wireless characteristics of this equipment, will increase the efficiency and safety of the charging process.

D4.1 Nine (9) Demonstration Implementation Plans

An additional component of the pilot will facilitate access to EMT charging infrastructure for taxis and car sharing providers, especially in the city centre by setting an electric mobility hub which will ease the development of business models. This element will be developed subsequently, upon its official presentation.

2.2.1 Demonstration objectives and logical framework

The main demonstration objectives can be summarised as follows:

- Testing inverted pantograph system
- Studying the new operational scheme
- Facilities adaptation
- Monitoring and smart charging
- Interoperability with existing e-bus fleet

Additionally, as indicated previously, some other initiatives will relate to the promotion of e-mobility in the taxi and car-sharing sector, especially by promoting easy access to charging infrastructure managed by EMT (e-mobility hubs).

2.2.2 Test scenarios

Cutting-edge technology for smart charging					
Test category	<p>a) tests in controlled environment,</p> <p>b) tests under real operational conditions</p> <p>c) feasibility study, assessment of technological concepts, code of practice and specifications</p>				
Vehicles involved (type)	e-taxi; e-bus; e-carsharing				
Vehicles involved (unit)	5 e-taxi; 10 e-bus;				
Integration with PT system	E-buses will be Integrated into the EMT operational control system and will operate in a full normal scheme as part of PT offer of the city. Regarding the other type of vehicles (e-taxis, e-char sharing) they will operate freely by using EMT e-mobility hubs				
Lines/stops involved (units)	Not defined yet				
Time span (testing activities)	From/to: 2021/2022				
Time span (data collection)	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Before</td> <td style="width: 50%;">After</td> </tr> <tr> <td>From/to: 2021-2022</td> <td>From/to: 2nd quarter of 2021/2nd quarter 2022</td> </tr> </table>	Before	After	From/to: 2021-2022	From/to: 2 nd quarter of 2021/2 nd quarter 2022
Before	After				
From/to: 2021-2022	From/to: 2 nd quarter of 2021/2 nd quarter 2022				

2.2.3 Vehicles/infrastructure/equipment provision

- Need of adapting buses for the operation by using inverted pantographs.
- Buses are already available (BYD brand)

D4.1 Nine (9) Demonstration Implementation Plans

- Additional equipment to be installed in the roof of buses (they have a preinstallation but some fine settings need to be done, as well as communication equipment). EMT has 100,000 € for this action. Further information on the equipment can be provided once the partner ABB provides the final solution proposal (ongoing process).

2.3 Detailed Time-plan

Phases	2020				2021				2022				2023			
Preparation phase																
Identification of test area																
Kick-off																
Charging equipment Install																
Test																
Data collection																
Local data analysis																
Scale-up																

2.4 Business model plan

EMT, as a public company, does not foresee the development of a business plan as such. The main aim is to test solutions that can optimize operations, improve energy efficiency, save operational costs and improve the environmental performance of buses together with the improvement of service to citizens.

2.5 Team involved

Main Role	Company	Name	Contact
Demo leader	EMT	Sergio Fernández Balaguer Irene Blázquez Montserrat Luque César Omar Chacón Julian del Olmo Perandones	Sergio.fernandez@emtMadrid.es Irene.blazquez@emtMadrid.es Montserrat.luque@emtMadrid.es Cesar.chacon@emtMadrid.es Julian.delolmo@emtMadrid.es
Vehilces provider	BYD	Joaquín Bellido	Not a project partner
Charging system provider	ABB	Jeroen Heggelman Wil van Gils	jeroen.heggelman@nl.abb.com wil.van.gils@nl.abb.com
App/software provider	ABB	Jeroen Heggelman Wil van Gils	jeroen.heggelman@nl.abb.com wil.van.gils@nl.abb.com

D4.1 Nine (9) Demonstration Implementation Plans

City support	UITP WI, UEMI	Michele Tozzi Stefan Werland, Oliver Lah	
--------------	------------------	---	--

2.6 Risks Assessment

<i>Risk</i>	<i>Probability assessment</i>	<i>Consequences</i>	<i>Risk mitigation/comments</i>
<i>Delays in the preparation phase</i>	<i>Low</i>	<i>It affects the whole process</i>	<i>Close follow up with the different partners involved. Permanent communication</i>
<i>Delays in receiving and installing the charging equipment</i>	<i>Medium</i>	<i>The e-bus pilot itself can't start without the charging infrastructure</i>	<i>EMT can provide feedback to the project by using existing buses with conductive charging</i>
<i>Delays in adapting buses</i>	<i>Medium</i>	<i>EMT can't start the adaptation of buses until the charging equipment is fully defined</i>	<i>Permanent communication with the charging infrastructure provider (ABB)</i>
<i>Lack of interest from e-taxi and e-carsharing sectors</i>	<i>Low</i>	<i>Lack of electrification of their fleets and consequently of a business model</i>	<i>The momentum is favourable and funding incentives (beyond SolutionsPlus project) are foreseen by public administrations to help in this process</i>

3. Preliminary replication opportunities

If the solutions to be tested in the demonstration turn out to be successful, an extension to – potentially - the entire EMT e-bus fleet will be considered. Beyond Madrid, several cities members of the consortium or external to the consortium might be interested in the approach and technology used for smart charging. The Madrid demo team is willing to the support replication cities via the dedicated project schemes and tools.

4. Updates

4.1 Progress towards implementation

D4.1 Nine (9) Demonstration Implementation Plans

Since the beginning of the project, EMT has been working to identify the best location to test the smart charging solutions for e-buses. However, the COVID 19 crisis has slowed down the preparation phase and the final technical solution proposal for the bus charging has not been provided yet. This fact had clearly affected the adaptation of buses and the overall implementation of the demo. Nevertheless, the kick-off of the demonstration took place on 12th June 2020 and the demonstration leader is actively working to speed up the process in the coming months.

Regarding the e-taxi and e-carsharing demo, EMT has been dealing with Madrid City Council to set an e-mobility hub in a central location of the city, and it is now in the process of getting the political approval.

Finally, the activities performed for the set-up of the demonstration have also contributed to additional Work Packages, mainly WP3 and the task *e-mobility solutions catalogue*.

4.2 Next steps

The next forecasted step is to agree with ABB on the charging solution and set the chronogram for the delivery and installation. Once this step is clarified, the adaptation of the buses will start.

5. References

- AEDIVE. (2019). Misión [Business]. Retrieved 18 November 2019, from AEDIVE - Asociación Empresarial para el Desarrollo e Impulso de la Movilidad Eléctrica website: <https://aedive.es/mision/>
- atuc. (2019). Sus objetivos son: | Atuc [Business]. Retrieved 18 November 2019, from atuc - movilidad sostenible website: <https://www.atuc.es/asociacion/objetivos.html>
- Ayuntamiento de Madrid. (2016). Energía y cambio climático - Inventario de emisiones - Ayuntamiento de Madrid [Institutional]. Retrieved 19 November 2019, from Portal Web del Ayuntamiento de Madrid website: <https://www.madrid.es/portales/munimadrid/es/EspelInf/Energia-y-cambio-climatico?vgnextfmt=default&vgnextoid=0ca36936042fc310VgnVCM1000000b205a0aR CRD&vgnnextchannel=6f48a851c9cd2410VgnVCM1000000b205a0aR CRD&idCapitulo=6877178>
- Ayuntamiento de Madrid. (2019a). Las 11 Medidas - CIVITAS ECCENTRIC [Institutional]. Retrieved 19 November 2019, from Portal Web del Ayuntamiento de Madrid website: <https://www.madrid.es/portales/munimadrid/es/Inicio/Medio-ambiente/CIVITAS-ECCENTRIC/Las-11-medidas/Las-11-Medidas/?vgnextfmt=default&vgnextoid=16ca728de6540610VgnVCM1000001d4a900aR CRD&vgnnextchannel=a92192f14e69f510VgnVCM1000001d4a900aR CRD>
- Ayuntamiento de Madrid. (2019b). Madrid Central. Información General [Institutional]. Retrieved 14 November 2019, from Portal Web del Ayuntamiento de Madrid website: <https://www.madrid.es/portales/munimadrid/es/Inicio/Movilidad-y-transportes/Madrid-Central-Zona-de-Bajas-Emisiones/Madrid-Central-Informacion-General/?vgnextfmt=default&vgnextoid=a67cda4581f64610VgnVCM2000001f4a900aR CRD&vgnnextchannel=508d96d2742f6610VgnVCM1000001d4a900aR CRD#>
- CDTI. (2019). Qué es el CDTI / Funciones [Institutional]. Retrieved 19 November 2019, from Centro para el Desarrollo Tecnológico Industrial - CDTI website: <https://www.cdti.es/index.asp?MP=6&MS=5&MN=1>
- CEPCO. (2019). Estrategia Española de Cambio Climática y Energía Limpia, Horizonte 2007-2012-2020. Retrieved 19 November 2019, from Web corporativa de CEPCO website: http://www.cepco.es/noticia.asp?id_rep=2464&t=113
- Comunidad de Madrid. (2018, November). Decreto 103/1996, de 4 de julio por el que se crea el Consejo de Medio Ambiente de la Comunidad de Madrid. Retrieved 18 November 2019, from Legislación de la Comunidad de Madrid website: http://www.madrid.org/wleg_pub/secure/normativas/contenidoNormativa.jsf?opcion=VerHtml&nmnorma=1214&cdestado=P#no-back-button
- Comunidad de Madrid. (2019). Organismo autónomo Consorcio Regional de Transportes Públicos Regulares de Madrid. Retrieved 18 November 2019, from Portal de Transparencia website: <http://www.madrid.org/es/transparencia/consejeria/organismo-autonomo-consorcio-regional-transportes-publicos-regulares-madrid>
- CORDIS. (2019). Electric LOSses Balancing through integrated STorage and power Electronics towards increased synergy between Railways and electricity distribution networks | E-LOBSTER Project | H2020 | CORDIS | European Commission. Retrieved 19 November 2019, from CORDIS EU research results website: <https://cordis.europa.eu/project/rcn/216068/factsheet/en>
- Delgado, A. (2019, January 10). MADRID 360, un nuevo aire [Institutional]. Retrieved 19 November 2019, from Dirección General de Tránsito (DGT) - Tráfico y Seguridad Vial website: <http://revista.dgt.es/es/noticias/nacional/2019/10OCTUBRE/1001-Madrid-360.shtml#.XdQpUy2ZOIP>
- Fernández Balaguer, S. (2019, October). EMT Electric Buses. Presented at the Observer cities, Budapest.

D4.1 Nine (9) Demonstration Implementation Plans

- gea21. (2016). Plan Director de Movilidad Ciclista de Madrid - Revisión y Actualización (No. Expediente no: 711/2016/14306). Retrieved from Área de Gobierno de Desarrollo Urbano Sostenible - Ayuntamiento de Madrid website: https://www.madrid.es/UnidadesDescentralizadas/UDCMovilidadTransportes/BICI/OficinaBici/Plan_Director_Movilidad_Ciclista/PDMC2008_Revision_y_actualizacion_1.pdf
- GFK. (2014). Encuesta Sintética de Movilidad en la Comunidad de Madrid (ESM14). Retrieved from Consorcio Transportes Madrid website: https://www.crtm.es/media/519661/esm_2014.pdf
- IDAE. (2019). Nuestra Historia. Compromiso Público con la Eficiencia Energética y las Energías Renovables [Institutional]. Retrieved 18 November 2019, from Gobierno de España - IDAE website: <https://www.idae.es/conozcanos/quienes-somos/nuestra-historia>
- i-DE. (2019). Conócenos - i-DE, REDES ELÉCTRICAS INTELIGENTES. Retrieved 15 November 2019, from i-DE - Grupo Iberdrola website: <https://www.i-de.es/conocenos>
- Irizar. (2019). La marca [Business]. Retrieved 18 November 2019, from Irizar - lighting the road website: <https://www.irizar.com/irizar/la-marca/>
- Kodukula, S., Rudolph, F., Jansen, U., & Amon, E. (2018). Living Moving Breathing - Ranking of European Cities in Sustainable Transport (p. 106). Retrieved from Wuppertal Institute commissioned by Greenpeace website: https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/living_moving_breathing_-_greenpeace_city_ranking_report_-_final.pdf
- Miguel, B. de, & Planelles, M. (2019, July 24). Bruselas lleva a España ante la justicia por la contaminación en Madrid y Barcelona. El País. Retrieved from https://elpais.com/sociedad/2019/07/23/actualidad/1563894873_941133.html
- Red Eléctrica de España. (2019a). Misión y visión. Retrieved 17 November 2019, from Red Eléctrica de España website: <https://www.ree.es/es/conocenos/ree-en-2-minutos/mision-y-vision>
- Red Eléctrica de España. (2019b). The Spanish Electricity System. Preliminary Report 2018 (p. 36). Retrieved from Red Eléctrica de España website: https://www.ree.es/sites/default/files/11_PUBLICACIONES/Documentos/InformesSistemaElectrico/2019/Avance_ISE_2018_en.pdf
- Rodríguez-Pina, G., & León, P. (2019, September 30). Madrid 360: Almeida relaja las restricciones para acceder en coche al centro. El País. Retrieved from https://elpais.com/ccaa/2019/09/30/madrid/1569824646_593497.html
- Tecnobus. (2019). Quienes somos. Retrieved 18 November 2019, from TECNOBUS S.p.a. website: <https://www.tecnobus.it/index.php/es/quienes-somos>

D4.1 Demonstration Implementation Plans

City: Hamburg

1. Operating environment

1.1 Background

Hamburg, officially the Free and Hanseatic City of Hamburg, is one of Germany's 16 federal states and, with a population of over 1.8 Mio, the second-largest city in Germany and 8th largest in the European Union. The city's metropolitan region is home to more than five million people. Hamburg's transport sector is responsible for 27% of the cities direct emissions (BUE n.d.), and although the share of private motor vehicle trips is decreasing, the overall number of travelled passenger kilometres is expected to increase. In terms of air pollution Hamburg is ranked as one of the worst performing cities of Germany (Urbanista 2017). One major source for air pollution is the port of Hamburg, being one of the biggest in Europe and located in the city centre; around one third of nitrogen oxide pollution can be attributed to it (SZ 2019). Apart from measures targeting vessel and port management, Hamburg also implemented measures to reduce noise and air pollution by enhancing the general (road) traffic situation, e.g. using emission free vehicles in public transport, improving the cycling infrastructure, or set-up of intermodal sharing systems. It has set a goal to reduce overall CO₂-emissions by 40 per cent in 2020 and 55 per cent in 2030.

1.1.2 Key facts and figures

City: Hamburg

Population: 1,8 Mio. (metropolitan region: 5 Mio)

GDP per capita: 64.957 EUR

CO₂ emissions (total and per capita): 16.743 Tsd. tons / 9,3 tons per capita (BUE n.d.)

Modal shares: 36 % private, 22% public, 42% active (15 % cycling, 27% walking)

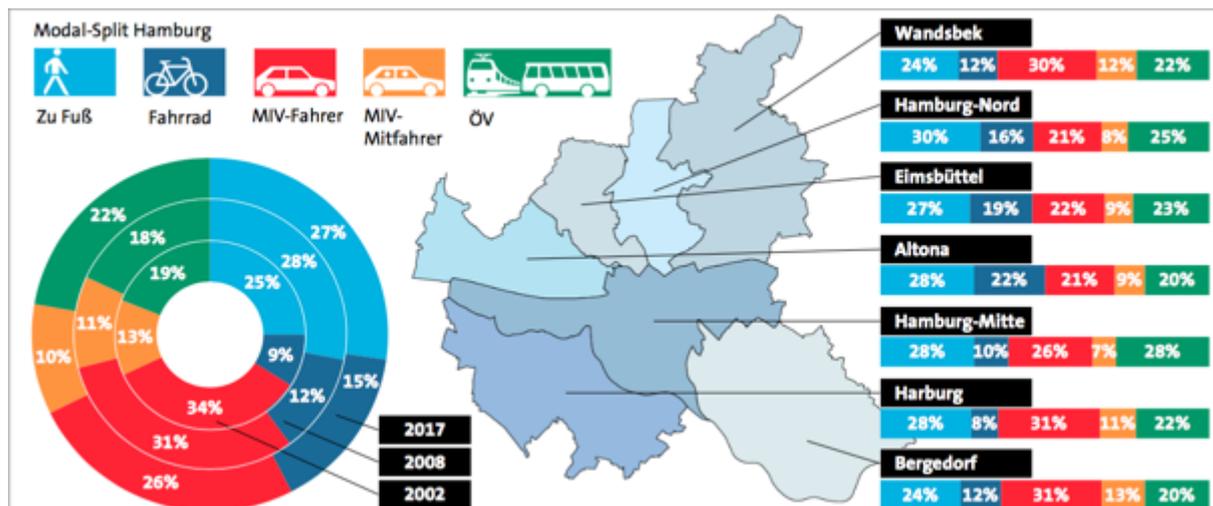
1.1.3 Overarching issues

Modal share

Between 2002 and 2017 the share of bicycle trips in Hamburg grew from just under 10 to 15 per cent. The share of public transport rose from just under 20 to 22 percent. Hamburg's hinterland also shows a slight increase in share of public transport (currently around 10 per cent). 27 per cent of all trips by Hamburg residents are on foot. In the surrounding area, it is only around 20 per cent in 2017 (infas 2019, 6). The public transport system receives high approval rates, with three out of four respondents grading it with good or very good (only walking scores better) (infas 2019, p. 20).

Motorised private transport had a share of 26 per cent in 2017. This means that the citizens of Hamburg covered a good third of their journeys by car, motorbike or truck. In 2002 and 2008, this share was still over 30 per cent. However, in the surrounding area, the decline in the use of private vehicles is small: from over 60 per cent in 2008 now falling just below this mark (infas 2019, p. 7). In general, the average length of the distances travelled by car increases, while the proportion of these distances decreases (ibid). In Hamburg, more than half of all passenger kilometres are currently travelled by car every day (40,000,000 out of 70,000,000 km).

D4.1 Nine (9) Demonstration Implementation Plans



Source: infas 2019, p. 9

Around 9,000 tons of CO₂ are emitted by road traffic in Hamburg every day (Urbanista 2017). Although an increasing number of households do not own a car (4 out of 10, compared to 2008, when only 3 out of 10 renounced a private vehicle), it is expected that the passenger kilometres will even increase, also due commuters from the periphery to the city centre (infas 2019).

Energy

The share of renewable electricity in total gross electricity consumption in Germany is 31,7 per cent (as of 2016) (BMWI 2020); the share of renewable energy in final energy consumption in the transport sector in Germany is 5,1 per cent (ibid.).

In Hamburg, the Moorburg coal plant, installed in 2015 against criticism from civil society, is one of the biggest coal-fired power plants in Europe. It provides not only energy for the city-state but also to other federal states of Germany.

Hamburg Energie, a company funded in 2009 and fully owned by the city, focuses on the supply of clean energy. It supplies gas and electricity to around 132,000 customers in Hamburg. It is also entrusted with the central supply of electricity (certified green electricity) for the publicly accessible charging infrastructure in Hamburg (Hamburg Energie n.d.).

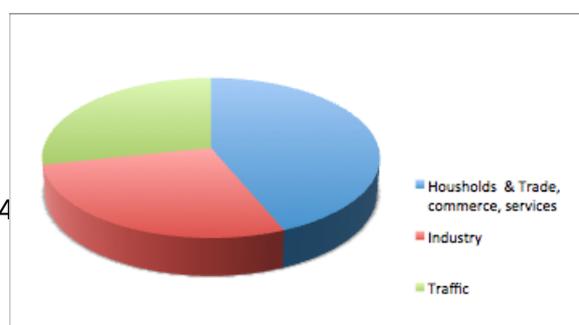
Air Quality

Although Hamburg's air quality has improved in recent decades, individual air pollutants exceed the specified limit values. For NO₂ the relevant emission limit values have not been complied with since the tightening of the limit values in 2010. The biggest share of NO₂ emissions comes from the port of Hamburg. For particulate matter (PM10), the measured values for the annual average since 1998 have always been below the limit value introduced by the legislator in 2005. But the number of 35 exceedances of the daily mean limit per calendar year was not met in 2005, 2006 and 2011 (Behörde für Umwelt und Energie n.d.).

GHG emissions

For 2016 Hamburg CO₂ emissions amounted to 16,844 thousand tonnes. They have been declining since 1990 but are still high with 9,3

304



D4.1 Nine (9) Demonstration Implementation Plans

t per capita. The largest share of Hamburg's CO₂-emissions is caused by the sector households and commerce, trade and services with 44 % (in blue), 27% are caused by traffic (green) and 29 % by industry (red).

Source: own graph, based on (BUE n.d.)

Pressures and Impacts

The transformation of the mobility system ("Verkehrswende") is high on the political agenda of the governing coalition of Socialdemocrats (*Sozialdemokratische Partei Deutschland, SPD*) and the Greens (Die Grünen). Air quality issues and the corresponding EU regulations are certainly one of the main pressures for further action²² (Amt für Immissionsschutz und Betriebe 2017). Another pressure comes from civil society: the so-called Fridays for Future movement is demanding further action on climate change. Hamburg's mayor (SPD) has announced a new climate protection plan to be adopted in December 2019, outlining further concrete measures and called this an important signal to the youth of the climate movement (Meyer and Meyer-Wellmann 2019). Moreover, a draft climate protection law was passed in December 2019 by the Senate and has to be adopted by the City Parliament (in German: Bürgerschaft). The plan inter alia foresees the extension of the public transport network, the implementation of express bus lines, and a better linkage of 'traditional' public transport with new mobility services (sharing models, on-demand services), and the construction of additional mobility hubs.

1..2 E-mobility overview

Regarding electric mobility Hamburg is quite advanced, compared to other German cities. With 750 publicly accessible charging stations Hamburg is the city with the most charging stations in the country. And a further 150 charging points will be set up at so called *switchh* locations (intermodal sharing hubs) for the use of e-carsharing vehicles. The number of electric vehicles used in Hamburg as of 2018 is 2,600 . In addition, there are around 1,000 electric vehicles from the metropolitan region, some of which are using the charging infrastructure daily (BUE n.d.). Goal is to have an emission-free bus fleet in 2030 (HOCHBAHN 2018).

From 2020, the two public bus transport providers, HOCHBAHN and VHH, will only purchase emission-free buses (BMVI 2018). Hamburger Hochbahn AG, the main public transport provider (see also below in more detail), has set the goal to have integrated 60 electric buses into the fleet in 2020 and by 2030, the entire HOCHBAHN fleet of around 1,000 buses is to be converted to emission-free drives (HOCHBAHN 2018). In November 2018 the first e-bus started operating in the city, and as of November 2019 there are now 30 e-buses running. A call for tender for 500 e-buses was published in August 2019. According to its own statements, HOCHBAHN is aiming for pro-rata federal funding for procurement of those buses (ibid.).

The city is also acting as a role model for sustainable procurement procedures. Since 2014 the requirements for procurement of vehicles for the municipal fleets (authorities, offices, state enterprises) foresee that fully or partially electrically driven cars must be chosen as a priority. There are also binding target values: for the so-called core administration this is 23%, for the municipal companies it is 19% of vehicles (BMVI 2018).

Another important project is the implementation of the mobility platform *switchh* (<https://www.switchh.de>). The platform is coordinated and managed by Hamburger Hochbahn AG (see below), private car-sharing providers Share Now and Cambio and the bike-sharing provider StadtRad. The platform provides an app with which all forms of mobility can be booked easily and from a single source. This makes it easier for users to switch from one mode to the

²² EU law requires, if values are exceeded, to draw up a clean air plan, setting out the necessary measures for the permanent reduction of air pollution.

D4.1 Nine (9) Demonstration Implementation Plans

other (BMVI 2018). Next to the app there are so-called *switchh*-stations, installed by HOCHBAHN, which are parking spaces integrating the different car-sharing operators acting as real intermodal connection points. 150 of these are to be equipped with e-charging stations for e-sharing vehicles.

In 2009 Hamburg introduced a bike-sharing system (StadtRad). It is very successful with over three million trips per year. It is the most used bicycle rental system in Germany (Fischer 2019). In 2018 there were 214 rental stations with 2,450 bicycles. Today there are already 224 stations, which will be gradually expanded in the coming years to 350 stations with 4,500 rental bikes (ibid). The Green Party wants to expand the StadtRad network also to Hamburg's peripheral areas and wants to simplify the combination of public transport ticket and use of those bikes (Grüne Hamburg 2019).

In 2015 the Senate (Hamburg's executive authority) declared Hamburg to become a "Fahrradstadt" (bicycle city) in 2025. Goal is to double the bicycle trips from 15 to 25 per cent. Moreover, it is enshrined that 50 km of new and protected bicycle lanes are to be built every year. To improve cycling, Hamburg is currently investing around EUR 20 million annually in infrastructure and services (BMVI 2018).

Of relevance for the demonstration action is the plan to better connect the peripheral areas - especially those with high new construction activity - and Hamburg's hinterland with local public transport. This applies both to the expansion of the high-speed rail network and to the increase in the frequency of services, as well as to a uniform Park+Ride (P&R) development. Since 2015 the Bike & Ride system has been improved, with over 3,000 pitches for bicycles at larger public transport stations ('Bike + Ride in Hamburg' n.d.) and it is planned to extend the network even more (the Greens want to build 25,000 parking spaces at all S-Bahn and U-Bahn stations to a high, uniform standard by 2025; (Grüne Hamburg 2019). For commuters this means that they can grab a city bike when they arrive in the city and travel close to their workplace.

Also, in order to encourage cycling from the periphery there are so called Veloroutes being built, which lead star-shaped from the surrounding area of Hamburg into the city. There are 14 routes with a total length of 280 kilometres, which are said to be completed in 2020 (Hamburg Marketing GmbH n.d.).

One recent trend is, like in many other cities, use of e-scooters for micro-mobility. E-scooters were introduced to Hamburg in summer 2019 and as of October 2019 there are almost 7.500 of these vehicles stationed from four different companies. They are mostly used in the inner city (hamburg.de n.d.).

1.2.1 Policy environment

Existing regulations

European and National level

The EU Commission has strengthened its air quality limits in 2016 and is pushing for low-carbon mobility. EU member states are required to develop national policy frameworks for the market development of alternative fuels & infrastructure (Directive on Alternative Fuel Infrastructure of 2016) and to consider energy consumption and environmental impacts when purchasing and leasing road vehicles (Directive on Promotion of Clean and Efficient road transport vehicles; 2009/33/EC). A revision of this Directive entered into force in August 2019 (Clean Vehicle Directive; 2019/1161/EU), setting out mandatory minimum procurement targets in each Member State for clean light-duty vehicles, trucks and buses for 2025 and 2030²³.

On the national level, Germany has different strategies and goals in regard to sustainable mobility. The federal Government has set the goal of decarbonizing the transport sector in its

²³ On buses: 50% of the minimum target for the share of clean buses has to be fulfilled by procuring zero-emission buses – including fuel cell buses.

D4.1 Nine (9) Demonstration Implementation Plans

Mobility and Fuels Strategy. The national climate protection plan 2050, adopted in 2018, outlines CO₂ reduction goals for each sector, including the mobility sector. According to the interim target for 2030, greenhouse gas emissions from transport must be reduced from approx. 160 million tonnes of CO₂ equivalents to between 95 and 98 million tonnes. Thus, the importance of e-mobility, alternative fuels, digitalization and all other climate friendly modes of transport, like cycling, rail, public transport, etc., are stressed. In order to reach the 2030 goals, measures programs are to be developed, along with Impact Assessments of the reduction potential of the respective measures. Moreover, there are specific strategies and funds for improving e-mobility infrastructure, like the German Government Program for e-Mobility, functioning as a compass and framework for promoting electro-mobility in Germany. There is also an abundance of calls for funding e-mobility; most of them belong to the aforementioned Government Program for e-mobility. There is e.g. an "environmental bonus" of 4,000 euros granted for vehicles with a net list price of max. 60,000 euros, which will be procured and registered until 31 December 2020; or exemption for pure e-vehicles from motor vehicle tax for 10 years until their first registration on 31 December 2020²⁴). The Federal Government also passed the Energy and Climate Funding Act to cover all program expenses of e-Mobility. Hamburg is intensively implementing the federal government's support programs (being one of the model regions for e-mobility funded by the national Government, it has e.g. installed an extra project platform for supporting leasing of e-vehicles for commuters) (hySOLUTIONS n.d.).

Local level

Hamburg's special situation as being a city-state (being both a city and a federal state) gives the city more competences, planning capacities and a different budget than there is usually on the local level (e.g. in Hamburg there is no distinction between the federal state budget and the city's budget). This might be one of the reasons why it has been quite successful in implementing activities to transform urban mobility towards a more sustainable one. The activities are embedded in different programs and plans, outlining respective measures (see BMVI 2018), e.g.:

- The Mobility Program of 2013 (Mobilitätsprogramm) in the context of continuous mobility planning,
- The Second Clean Air Plan (Fortschreibung Luftreinhalteplan, LRP) of 2017, containing different measure to comply with the NO_x emissions,
- The concept for further developing electro-mobility (Konzept zur Weiterentwicklung der Elektromobilität 2017) in 2017 and the Masterplan charging infrastructure (Masterplan Ladeinfrastruktur) of 2014 to accelerate the electrification of vehicles in commercial fleets and private use,
- ITS (Intelligent Transport Systems) Strategy for Hamburg of 2016 and its continuation in 2018 for the continuous digitization of the transport system,
- Hamburg Noise Action Plan of 2013 and its continuation (2018) to reduce the impact of noise on the population,
- Hamburg Climate Plan 2015 for the reduction of CO₂ emissions,
- the SmartPORT Initiative of the Hamburg Port Authority with the partial aspects "logistics" to improve the traffic and goods flows,
- The "Hamburg Green City Plan", focusing on electrification, digitalisation, urban mobility and logistics²⁵ (BMVI 2018).

²⁴ At present, the Federal Government is discussing extending the term and simultaneously increasing the premium.

²⁵ Under the National Government's initiative on Clean Air 2017 - 2020 Immediate Programme ("Sofortprogramm Saubere Luft") all cities with air quality standards not complying with EU limits, had to formulate such a plan as prerequisite for the use of federal funding.

D4.1 Nine (9) Demonstration Implementation Plans

- In December 2019 it adopted the continuation of Hamburg's Climate Plan, with a CO₂ emission reduction target of 55% by 2030 (and climate neutrality in 2050).
- climate protection law, creating a binding legal framework for reduction targets (December 2019).

1.2.2 Policy gaps

The further development of Hamburg as a model region for sustainable public transport requires the improvement of framework conditions, including the close cooperation between all parties and an integrated approach: Measures should not only focus on improving charging infrastructure and campaigns promoting the change to electric mobility; they also need to focus on intermodal concepts and enhanced connectivity of public transport. Innovative technological solutions are needed to foster and inspire the integration of 'traditional' public transport and new mobility services. The activities need to be supported by accompanying research, capacity building, international networking and communication.

1.2.3 Business environment

Hamburg encouraged the use of electric mobility very successfully for several years. Along with the project coordination unit hySOLUTIONS, Hamburg realizes an ambitious program for rapid conversion to alternative drive technologies. This includes rising numbers of e-vehicles and charging infrastructure. Considering the frequency of e-vehicles and charging stations in public spaces, Hamburg is one of the pioneers in Germany. There are several consortium projects, like "Hamburg – Wirtschaft am Strom" or "ePowered Fleets", in Hamburg subsidised by the federal government to foster the expansion of electric mobility²⁶.

Furthermore, Hamburg has an active local start-up scene in the field of electric mobility. According to "Deutschen Startup Monitor 2018" about 7% of all German start-ups are based in Hamburg, many of them working on mobility and logistics solutions.

1.2.4 Capacity building

Hamburg tries to further extend its pioneering role in the field of electric mobility with new concepts and a dedicated program. This is guided by the federal governments' plan to become a leading market for electric mobility solutions. One important aim is to improve the regulatory framework for the development of e-mobility as a sustainable and future-oriented mobility concept and to ensure equal opportunities converting to electric vehicles. In order to achieve these goals information must be bundled, and networks have to be formed to share knowledge and experiences. At national level the „Bundesverband eMobilität“ promotes the development of electric mobility. At regional level Hamburg brings together over 500 partners which are users of electric mobility, contributors of vehicles or components but also city representatives²⁷. An active participation and cooperative interaction of industry, politics, media, institutions and citizens is needed to ensure a sustainable development in the field of electric mobility.

1.3 Key Stakeholders

In order to ensure the best possible consideration of citizens' interests in accordance with sustainable urban development plans the most relevant stakeholders for the demo action in

²⁶ <https://www.hamburg.de/bwvi/elektromobilitaet/>

²⁷ <https://hysolutions-hamburg.de/strategie/partnernetzwerk/>

Hamburg are the city administration's department for transport and mobility transition (Behörde für Verkehr und Mobilitätswende), the relevant district authorities (Bezirksämter) and the new mobility affine target group as well as prospective customers. Moreover, a close collaboration between HOCHBAHN and the umbrella association for public transport in Hamburg (Hamburger Verkehrsverbund) is needed to optimally integrate the planned demo action into existing mobility offers.

2. Demonstration Action

2.1 Situation analysis

Currently four e-scooter providers are operating in Hamburg. Together they provide customers with 7500 e-scooters. Since the approval of e-scooter traffic in Hamburg in 2019, the providers have successively been expanding their business areas. However, there is still a clear focus on the inner-city. This is where the demonstration action comes in as a last mile solution to improve the inadequate public transport supply in the city periphery.

2.2 Demo Description: e-kick-back-scooter²⁸ sharing system

The demonstration action in Hamburg is about providing and implementing an e-scooter-sharing-service for last mile connectivity, especially in the outskirts area. The overall objective is to expand and enhance the attraction of public transport.



Approach:

In the morning the e-scooters are placed in residential areas, so that the customer can use the e-scooter to get to the nearest public transport station. On the way back, the e-scooters should be positioned at the public transport station (on specially provided park and ride areas), so that the customer can take the e-scooter for the last mile. To increase the added value for the customers, the e-scooter sharing system will be integrated into Hamburg's mobility as a service (MaaS) app.

2.2.1 Demonstration objectives and logical framework

The objectives of the demonstration action in Hamburg are to increase the attractiveness of public transport and to drive a stronger integration of e-scooters with the public transport system. The integration of e-scooter sharing with the public transport system should create an alternative to private car use and raise the potential for new customer acquisition. We assume that:

²⁸ E-Kick-back Scooter = hereafter referred to E-Scooter

D4.1 Nine (9) Demonstration Implementation Plans

- By using the e-scooter sharing system, the customers can do without their private car on the last mile.
- It cannot be excluded that in the short run cannibalisation effects between the different modes of transportation will occur but it is expected that in the long run positive effects for the total system can be generated.

2.2.2 Test scenarios

A test scenario describes the environment in which the SOL+ demonstrations take place. It includes the entire set of conditions under which the e-mobility solutions are developed and tested or, in other words, the detailed description of what is going to be tested, when, where and how.

Solution: e-scooter sharing system	
Test category	tests under real operational conditions
Vehicles involved (type)	E-scooters
Vehicles involved (unit)	~ 100 e-scooters
Integration with PT system	- Metro - Bus - Park and Ride-areas
Lines/stops involved (units)	~ 2 metro stations and 2 Park and Ride-areas
Time span (testing activities)	2021
Time span (data collection)	2021 (* data will be collected throughout the project)

2.2.3 Vehicles/infrastructure/equipment provision

What is needed with regard to equipment overall?

- E-scooter provider
- E-scooter
- Racks for e-scooters
- Park and Ride-areas

What is available already?

- Infrastructure
- Park and ride-areas

What needs to be purchased by the city (100,000 EUR budget)?

- E-scooter sharing service

What could be contributed to demo cities from a European start-up, SME.

- Connection opportunities existing tariff structure
- Brainstorming for potential incentive schemes

2.3 Detailed Time-plan

	2020			2021				2022			
Preparation phase											
Identification of test area											
Kick-off											
Equipment install											
Test											
Data collection											
Data analysis											

2.4 Business model plan

The business model behind this demonstration action is not primarily based on monetary objectives. It is not designed to earn as much money as possible with the e-scooter sharing system (at least not for the individual service; still, aggregated cost-revenue structures could be different if the entire system is regarded).

The chosen business area in the outskirts will not be profitable in the short run. Therefore, it will be necessary to pay potential service providers an operation fee to balance operating cost due to higher relocalisation activities in these areas. In the long run, there might be the opportunity of revenue enhancement by increasing the attractiveness of public transport, expanding existing mobility offers and attracting new customers to public transport.

2.5 Team involved

Main Role	Company	Name	Contact
Demo leader	HOCHBAHN	Dominik Radzuweit Karen van der Linde	dominik.radzuweit@hochbahn.de karen.van_der_linde@hochbahn.de
Vehicle provider	To be determined, tender procedure		
App/software provider	HOCHBAHN, Vehicle provider (to be determined)		
City support	UITP WI, UEMI	Michele Tozzi Stefan Werland, Oliver Lah	

--	--	--	--

2.6 Risk Assessment

<i>Risk</i>	<i>Probability assessment</i>	<i>Consequences</i>	<i>Risk mitigation/comments</i>
E-scooter sharing system will not be used as promised	low	high	Develop a sustainable concept which emphasizes the added value for the customer; marketing activities; incentive schemes
E-scooter sharing system leads to cannibalization effects between the different means of transport (esp. bus and e-scooter)	low	medium	Adjusting existing offers along actual needs and focusing on the target group and those people depending on basic public services
Integration into MaaS app is not that easy to realize, finalization and release of MaaS app may be delayed	medium	medium	Early coordination of app development resources; participation in prioritization process; access to experts for app development

3. Preliminary replication opportunities

If the demonstration action turns out to be successful, an extension to further locations in Hamburg is conceivable. Furthermore, the e-scooter fleet can be expanded (to more than ~ 100 e-scooters). If the approach in Hamburg prove itself in the long term and sustainably, it makes sense to transfer the concept to other cities as a last-mile solution.

Beyond Hamburg, a range of cities (incl. Hanoi) have voiced interest in following the demonstration action. Moreover, app development might profit from Hamburg's experiences.

4. Updates

4.1 Progress towards implementation

The initial phase was to set up the project concept including the scope and the arrangement in detail. This concept was the starting position for first internal discussions. Beside the general

D4.1 Nine (9) Demonstration Implementation Plans

project installation this includes discussion about the potential of integrating the planned sharing service into the existing HVV-Switch App. Here we identified a strong dependence on the current development activities and therefore an integration of a new provider will not be possible before the beginning of 2021. In addition to the digital integration, the connection to the existing tariff system is crucial for the success of the project. Preliminary thoughts about possible incentive schemes have been taken to create benefits related to money and time for the customer. A deeper analysis for potential locations was already made. Therefore, different criteria have been selected and potential locations for implementing the sharing service have been identified.

4.2 Next steps

The next most important step will be to start the call for tender. The procurement procedures of HOCHBAHN as a public undertaking requires a tendering process to allow equal opportunities to all potential service providers. The tendering process will be time consuming: tender documents must be defined, describing the desired performance and potential providers have to prepare and submit their offers. These offers must be verified and valued. Finally, discussions with suitable providers are needed to make a decision and to award the contract. After that, HOCHBAHN can finally define the location for the demo action and start working on adequate incentive schemes and MaaS App integration.