

MAtchUP

D2.7: Electrical Vehicles and charging stations roll-out in Valencia – First Version

WP 2, T 2.5

September 2019 (M24)

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Abstract

As part of the Valencia 2020 Strategy, focusing the creation of environmental awareness, enhancement the quality of life and supporting social participation in a context of climate change, the sustainable mobility is one of the main lines of action. Within it, several measures and programs are being implemented to encourage the use of more efficient and less polluting transport, and in line with European policies, to promote the responsible use of the private vehicle, fostering social change in the transport habits.

Valencia has also developed the Sustainable Urban Mobility Plan (SUMP) in September 2013 and nowadays the Sustainable Mobility Department is updating it and developing many activities in order to achieve a sustainable city for its citizenship and focusing in the interests of people. One of the most important aspects in the SUMP is the decarbonizing of the transport system, especially analysing possible scenarios and starting with municipal fleet.

MAtchUP project is implementing a specific intervention focusing on the deployment electric vehicles and charging stations in the city of Valencia. Five different actions are being carried out by several partners in the Valencia demo site, which are in charge of designing, developing and deploying the technical solutions that will have as a consequence an increase of electrical vehicles with the respective charging points. These actions are:

A15-101 local government e-Vehicles

A16- 10 fully e-Buses + 8 hybrid buses

A17-2 e-bikes for disabled mobility and 3 e-bikes last mile logistics

A18- 72 EV charging points (10 for e-Buses, 57 for public cars, 2 for last mile bikes and 3 for mobility e-bikes)

According to the project work plan, this intervention has been designed in Task 2.1 and documented in D2.1 (M12) and D2.14 (M24), "Valencia Lighthouse interventions detailed definition" reports. The large take-up of electromobility is effectively taking place in Task T2.5, Sustainable Mobility, led by ETRA.





1 Introduction

1.1 Objective

This report is aimed at delivering the main outcomes of Task T2.5.1 - Deployment of electrical vehicles and Charging Infrastructure in the city of Valencia in a first version which covers the implementation until September 2019 (project month M24). The final version of this report (i.e. D2.19) will be delivered in September 2020 (project month M36).

This document describes the municipal strategy to encourage the acquisition of EV and charging stations as well as the targets to be achieved in the city according to the current strategy, with a focus on how MAtchUP will influence in these city objectives.

Furthermore, the document provides a description of the intervention **Electric Vehicles and Charging stations**, which includes a technical definition and the implementation plan. Several actions are part of the intervention and are also related with the successful implementation of new services on sustainable mobility that will take place in the context of Task 2.5.2, therefore it becomes very relevant to show the detailed progress of this roll out as well as to identify possible blocking issues or barriers to overcome in this stage. The above-mentioned actions are the following:

A15- 101 local government e-Vehicles

A16- 10 fully e-Buses + 8 hybrid buses

A17-2 e-bikes for disabled mobility and 3 e-bikes last mile logistics

A18- 72 EV charging points (10 for e-Buses, 57 for public cars, 2 for last mile bikes and 3 for mobility e-bikes)

Acronym	Definition
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
GHE	Green House Effect
IoT	Internet of Things
SUMP	Sustainable Urban Mobility Plan
IGBT	Insulated Gate Bipolar Transistor
EMC	Electromagnetic compatibility
AC	Alternating Current
DC	Direct Current
DSP	Digital signal processing
ERDF	European Regional Development Fund
NGO	Non-Governmental Organization
VTC	Vehículo de Transporte con Conductor/Vehicle with Driver

1.2 Table of acronyms





Partner	Task	Contribution
ETRA	T2.5.1	Deliverable and Task leader, technical support, coordination and refinement of deliverable. ToC. Chapter 1 (Introduction), 3 (Technical definition of the interventions), and 6 (Conclusions). Support in Chapter 3. Review and adaptation of contributions from project partners.
VAL	T2.5.1	Actions A.15, A17, A18 in Chapter 4 and 5
LNV	T2.5.1	Chapter 3. Support in actions A.15, A17, A18 in Chapter 4 and 5
EMT	T2.5.1	A.16 in Chapter 4 and 5
WIT	T2.5.1	Technical support in A.16 in Chapter 4 and 5

1.3 Contribution from partners

Table 1 – Contribution from partners to D2.7

1.4 Relation to other project activities

The tables below depict the main relationship of this deliverable to other activities (or deliverables) developed within MAtchUP. These dependences should be considered along with this document for further understanding of its content.

Action	Relation to other Actions in the project
A15	A21
A16	A20, A24
A17	A22
A18	A20

Table 2 - Relation to other actions in the project

Deliverable	Relation to D2.7
D2.8	D2.8 reports the new services on sustainable mobility in Valencia which are developed on top on the infrastructures defined in D2.7
D2.14	The contents in this deliverable are directly linked to Valencia lighthouse interventions definitions which are reported in D2.14
D6.x	D2.7 includes preliminary information about financial plans and the accompanying business model structure of interventions. It is thus directly linked to WP6 (Exploitation and Market Deployment).
D2.19	D2.7 is the basis for all related Tasks and Deliverables. D2.19 will be the final version.

Table 3 - Relation to other activities in the project





2 Municipal strategy for the electromobility

The city of Valencia has approximately 800,000 inhabitants, with its population located mainly in the urban area, and due to economic growth and job creation, following a slightly upward trend.

Last mobility data available (2013) shows that almost half of trips that took place inside Valencia area were by foot, a small part (but visibly growing) was done by bike, another important part was using public transport, and only 1 out of 5 were made by car or motorcycle. However, in trips to or from the populations of the metropolitan area, the private vehicle (car and motorcycle) was the predominant mode: almost 3 out of 4 trips.



Figure 1 – Distribution of trips in Valencia, source: SUMP 2013

Based on this, the existing situation and its problems were analysed, and different mobility strategies were proposed in the Sustainable Urban Mobility Plan (SUMP), which are translated into the new guidelines to be followed in the development of transport policies, actions and infrastructure in the city. A set of new coherent and coordinated proposals have to guide a change in habits, and make more attractive the more sustainable forms of mobility. Among these new strategies, several objectives can be highlighted regarding electromobility:

- To promote a more rational use of motor vehicles, through the promotion of the technological renovation
 - o Incentives for the transition of cars and motorcycles to electric mobility.
 - Supporting the creation of an infrastructure for recharging of electric vehicles.
- To progress towards a smart mobility, through the advancements in the transport decarbonization:
 - Facilitating the replacement of fuel vehicles by others that use "clean" energy.
 - o Clearly supporting electric vehicles
 - Supporting the deployment of recharging stations for electric vehicles.
 - Renewing the fleet of municipal services and public transport, incorporating clean vehicles.
- Public transport: to adapt the EMT network to nowadays needs, including the renovation of the fleet with the inclusion of "clean" vehicles: hybrid and electric buses.





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Nowadays the Sustainable Mobility Department is being updated and developing many activities in order to achieve a sustainable city for its citizenship and focusing in the interests of people. Some initiatives in order to reduce the use of private vehicle and to promote alternative sustainable transport are being developed at the city, as these included in the MAtchUP project.

Valencia city has, since the end of June 2019, a new Urban Mobility Regulation. Replacing the previous one, of 2010, the new regulation highlights some points that the previous one did not include:

- Priority to pedestrians and public transport. This point is very interesting, since it promotes the use of less polluting transports that can decongest traffic at peak times.
- Limitation of bikes and electric scooters. Sidewalks are prohibited for these new vehicles. Even so, the city is expanding and improving the existing bike lane.
- Driver insurance to cover those who drive a personal mobility vehicle (bike or scooter).

Moreover, and focusing on electromobility, its Third Additional Provision is entirely dedicated to the infrastructures for electric vehicles, including:

1. The City Council will ensure that people with an electric vehicle have a complete and sufficient network of charging points to guarantee their use throughout the city.

2. The charging points will preferably be fast charging to be used by a larger number of vehicles.

3. The charging points will be indicated to make them visible, and the existing maps will be permanently updated to show locations in the different municipal information channels (websites, apps, open data, etc.).

4. Authorities shall ensure the maintenance and improvement of the infrastructure for electric vehicles in order to avoid their progressive deterioration.

In the Fourth Additional provision, the implementation of low or zero emission technologies is covered:

1. The Valencia City Council will focus its policy towards the objective of having a public collective transport in the city in accordance with the progressive implementation of technologies with low or zero emissions, adapting and evolving the public bus fleet towards this objective.

2. Likewise, it shall adopt the appropriate measures to favour the progressive implantation of those technologies in the taxi sector, as well as in the field of automobiles and motorcycles that circulate in the city.

The current status of electromobility infrastructures (charging stations) is as shown in Figure 2:







Figure 2 – Map of electromobility in Valencia (source: electromaps.com)

As it can be observed, most of the charging points are located in parkings and malls (commercial areas). There is a need of increasing the number of EV chargers on streets parking areas. Furthermore, the *Poblats Maritims* district, which is the target of MAtchUP, presents an evident lack of this infrastructure.





3 Technical definition of the intervention

The intervention in the scope of this deliverable is **Electric Vehicles and Charging stations.** There are four actions related, focusing the roll-out of new electric vehicles as well as infrastructure for recharging:

A15- 101 local government e-Vehicles

A16- 10 fully e-Buses + 8 hybrid buses

A17-2 e-bikes for disabled mobility and 3 e-bikes last mile logistics

A18- 72 EV charging points (10 for e-Buses, 57 for public cars, 2 for last mile bikes and 3 for mobility e-bikes)

The implementation of these actions is taking place as part of Subask 2.5.1 - Deployment of electrical vehicles and charging infrastructure.

In terms of mobility, the intervention affects the whole city, including the *Poblats Maritims* district. Electromobility infrastructures will be developed under the new standards in mobility and favouring the disabled mobility.



Figure 3 – Valencia city area and Poblats Maritims District





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A15, 101 local government e-Vehicles.

This action includes the involvement into the project of the e-Vehicles fleet belonging to the local government of Valencia and its service providers. The fleet consists of 12 e-Motorbikes, 13 e-Vans, 56 e-Cars and 20 e-Bikes. All these vehicles will be monitored along the project and their data will be integrated into the VLCi platform to be used for statistics and data-mining in order to determine the performance.

A.16, 10 fully e-Buses + 8 hybrid buses

This action was defined initially based on the acquisition of e-Buses for the EMT fleet as follows:

EMT Valencia will buy 10 e-Buses during the lifecycle of the project, being 2 e-Buses per year. The purchase of the e-Buses will follow a public procurement process keeping in mind some technical specifications, such as: dimensions (12 m x 3.2 m), energy storage and battery specifications (So-Nick type, 600-650V), capacity about 370 kWh, recharge in 6 hours, energy storage on demand and capacity to work with maximum slopes of 18%, among others. Within the fleet, 8 hybrid buses will be also included along the project. The performance of these vehicles will be monitored during the life of the project and the information will be provided into VLCi platform for data statistics and data mining studies to evaluate the performance of the service.

As defined in the action, EMT acquired 2 electric vehicles to start the electrification tests of the fleet. The performance of both buses was monitored in 2018 and 2019 and the analysis showed important irregularity in the performance of the service of electric vehicles compared to the new 35 hybrid units.

The difference between the reliability of the hybrids versus the electric models is clearly evident in the average of Km traveled by model. But also the great difference in the behavior between the two electrical marks is observed. The behavior of electric vehicles worsened over time and it is observed that in 2019 the number of km traveled is half that in 2018. Also mechanical problems arose during this testing phase. The complete description of this analysis can be found in section 4.2.5, as well as in D2.14 Valencia Lighthouse interventions detailed definition –

Thus, EMT has decided, by now, not to invest more resources in e-Buses and compensate the impact that the e-Buses would cause with higher number of hybrid buses.

So, in the 2nd Amendment of MAtchUP, it will be asked for a change according to the above-mentioned description

A.17, 2 e-bikes for disabled mobility and 3 e-bikes last mile logistics

Deployment of 2 e-Bikes for accessibility in order to provide people with reduced mobility with sustainable ways of mobility. Additionally, 3 e-Bikes will be bought for allowing sustainable mobility in the last mile. Pedelec bikes are selected for the integration into the urban sustainable mobility plan. Similar to previous actions, data will be monitored and integrated into VLCi platform.





A.18, 72 EV charging points (10 for e-Buses, 57 for public cars, 2 for last mile bikes and 3 for mobility e-bikes)

This action will deploy several charging points linked to the EVs detailed in A.15, A.16 and A.17. In particular, 10 e-Chargers for e-Buses following the EN61851-1/23/24, 30 kW-120kW with special attention to power factor > 0.95 and efficiency > 97%, 57 e-Chargers for public cars (15% fast charge 50 kW and the rest slow charge 20 kW), 3 e-Chargers for last mile bikes and 2 e-Chargers for disabled mobility e-bikes. Data from the EV chargers will be integrated into the VLCi platform through the demand management systems that are implemented under A.20 and A.21 (see D2.8, new services on sustainable mobility in Valencia (last mile, logistics, urban freight, ITS).

Furthermore, there is a strong link with tasks implemented in the context of the ICT platform, as it can be inferred form the description of the actions. In all cases, data will be monitored and integrated into VLCi platform as part of action A.30 - Open Data Management, which will implement the City Dashboard.





4 Executive project of the actions

4.1 A15 - 101 local government e-Vehicles

4.1.1 Management structure

The team in charge of the implementation is composed of VAL and WIT as main agents, furthermore LNV will assist VAL when it is required.

VAL will provide the e-Vehicles fleet and promote the purchase of new e-Vehicles by VAL and related companies.

WIT will monitor e-Vehicles using non-invasive devices and data will be integrated in the VLCi platform. The data will be used for statistics and data-mining purposes in order to determine performance and promote the use of alternative ways of transport.

4.1.2 Technical specifications of the city infrastructure

Currently, e-Vehicle fleet from Valencia City Council and related companies do not follow a standard. Therefore WIT, VAL and LNV are collecting technical information before the installation of tracking devices with different services of Valencia City Council.

Existing e-Vehicles before the project:

- Supply:
 - o 23 e-Vehicles, 9 of them are e-Vans
- Gardening and Parks:
 - 11 Renault kangoo express ze 5p EV
 - o 2 Renault twizy cargo 45 EV
 - 8 Bereco moto cargo gel EV
 - 4 Renault zoe EV
 - 2 Toyota auris hybrids
- Mobility:
 - \circ 10 e-bikes and 1 e-car.
- Municipal Sports Foundation, FDM:
 - 4 (1 e-van, 1 e-motorbike, 2 e-car)
- Regional fleet:
 - o La Marina, 20 electric vehicles
- EMT: 2 e-Buses

Expected e-Vehicles after the project

As Valencia is promoting sustainable mobility some new acquisitions are foreseen in the project: cargo bikes and e-bikes for disabled mobility. Nevertheless new public procurement and new services will include e-Vehicles clause in order to promote sustainable mobility and reduce GHE.

Therefore, the expected e-Vehicle fleet is 101 Vehicles or more.





The monitoring system will use collected data from:

- Electric system status: battery load level, working hours, engine power.
- Driving: GPS, speed, acceleration, stops, distance since last charge of the battery

These data, which will be integrated with FIWARE VLCi platform (Valencia Smart City platform), will be treated and analysed thanks to Open Data / Source technologies and FIWARE (Orion Context Broker GE, Complex Event Processing GE, Hadoop for big data analysis, IoT Agents for sensors and trackers connectivity).

4.1.3 Planning of the tasks

2018		20	19			20	20		2021	2022
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
(1)	(1)	(1)								
(2)	(2)	(2)	(2)							
(3)	(3)	(3)	(3)	(3)	(3)					
	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)		
			(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
		M1	M2	M3						

(1) Design and specifications

(2) Selection of equipment and installers

(3) Installation of hard/software

(4) Start of operation

(5) Monitoring

Milestones:

M1: Design completed

M2: Equipment (sensors) installed

M3: Hardware and software tested

4.1.4 Health, safety and waste management requirements

Health issues as the promotion of EV will reduce GHE, so CO2 and NOx reduction.

Safety issues, not foreseen.

Waste issues, not foreseen.

4.1.5 Risks and proposed risk-mitigation measures

City Council plans need to be checked in order to get an estimation of new e-Vehicles for next year and confirm if e-Vehicle clause for new contract applies to every service and department in the City Council including companies providing the service.





4.2 A16- 10 fully e-Buses + 8 hybrid buses

4.2.1 Management structure

EMT is in charge of the vehicles acquisition, focusing on e-Buses and hybrid buses.

WIT will monitor e-Vehicles using non-invasive devices and data will be integrated in the VLCi platform.

4.2.2 Technical specifications of the city infrastructure

This actions will be included in the 2nd Amendment of the project so as to adapt to the new situation.

The material that EMT of València provides for the project consists of two electric buses, a 12m Irizar bus and another 12m BYD, and 16 hybrid buses. Table 4 and Table 5 show general characteristics.

Hybrid bus	
CO2 emissions (t)	52,16
Travel trip (Km)	6,91
Nr. Trips	7.171
Maximum capacity (travellers)	100
Average occupation (%)	57,42
Average Km/year	49.556
Gas	Diesel oil
Registered consumption factor	383,8672559
Vehicle regulations	EURO II - 91/542/EEC
Maximum authorized weight	19,5

Table 4 - Main sheet of the hybrid buses

<u>eBus</u>	
CO2 emissions (t)	0
Travel trip (Km)	6,91
Nr. Trips	4.342
Maximum capacity (travellers)	100
Average occupation (%)	57,42
Average Km/year	30.004
Gas	Electric
Vehicle regulations	Conventional
Maximum authorized weight	19,5

Table 5 - Main sheet of the e-Buses





Each e-Bus has assigned its own electric charger.

The Irizar bus is recharged in a Jema – belongs to Irizar group – 80kW charger. This equipment uses intelligent power modules, which are responsible for converting the three-phase AC power of the public electricity grid into the DC power of the batteries of the electric buses.

The energy conversion system consists of a three-phase charger, devices for the isolation and protection of connected systems in both DC and AC, and a control for the correct operation and maximum performance of the system.

The team has local monitoring as well as various possibilities at the level of local and remote communications that allow the management and remote viewing of the equipment through different supports and protocols.

The converter is composed basically of the following subsystems:

AC connection stage

It is the stage through which the equipment is connected to the Low Voltage network. It's formed basically by the following components:

- A thermal magneto circuit breaker for protection of the output and connection to network in BT (IT System).
- Power transformer for galvanic isolation of the electric network
- Differential relay for protection against earth leakage currents.
- Surge protection.
- An EMC filter for filtering possible noise introduced from the electrical network.
- Power connector for battery heating.
- Voltage and current transducers to measure the voltages and currents of the three phases.
- Power supplies for auxiliaries.
- Protections of auxiliary elements such as ventilation and heating.

Power stage

It is an AC / DC converter formed basically by the following components:

- Power unit formed by IGBT bridge with snubber protections and a filter DC of capacitors connected in parallel.
- An LCL filter of AC input.

DC connection stage

It is the stage through which the equipment is connected to the batteries. It is basically formed by the following components:

- Contactors to connect / disconnect the batteries.
- Current and voltage transducers to measure the current and voltage of the converter and batteries.
- A preload device from DC.
- An EMC filter to eliminate conducted noises.
- Surge protection.





Stage of control and regulation

It is the stage through which the regulation of the equipment is made and additionally constitutes general control and monitoring. It consists of the following components:

- A control system for regulation formed by a set of circuits between the ones that stand out:
 - Backpanel: Receive the signals and measurements of the different devices.
 - DSP Circuit: is responsible for regulation.
 - Auxiliary circuits: they are in charge of other control functions such as relays auxiliary output.
- Screen for local monitoring, measurements and alarms.
- Ethernet hub for external communication.
- Emergency mushroom to stop the loader.

The BYD vehicle is recharged in a BYD 80Kw charger of a similar structure.

On the other hand, and for performance monitoring of the vehicles, WiTraC proposes a solution for monitoring the real-time comfort variables of the bus fleet at important bus points. In summary, the solution would contain a series of sensors (temperature, humidity, noise and particles), as well as an information concentrator, existing the option of being able to send the data to the cloud for its visualization, or once the bus arrives to garages (that is, with or without data SIM). All this information could also be integrated with the company's systems, in order to be able to visualize themselves on the screens of the buses or to be able to put on displays.

As a result of the comfort monitoring system inside the bus, the data would be measured in real time and integrated with the client's systems, or a mobile application (adaptive and user-friendly) could be available so that users and travellers could use it and even generate information on the level of satisfaction or incidents during the journey.

2018		20	19			20	20		2021	2022
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
(1)	(1)	(1)								
	(2)	(2)	(2)							
			(3)	(3)	(3)					
			(4)	(4)	(4)	(4)	(4)	(4)		
					(5)	(5)	(5)	(5)	(5)	(5)
		M1	M2		M3					

4.2.3 Planning of the tasks

(1) Design and specifications

- (2) Selection of equipment and installers
- (3) Installation of hard/software
- (4) Start of operation
- (5) Monitoring





Milestones:

M1: Design completed

M2: Equipment (sensors) installed

M3: Hardware and software tested

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4.2.4 Health, safety and waste management requirements

Nothing to report

4.2.5 Risks and proposed risk-mitigation measures

The main risk, which finally became a reality, was the inherent risk due to the use of a still new technology for public transportation. As noted, the e-Buses technology was not mature enough to perform a public service in terms of the needed quality and amount of failure:

The EMT of Valencia acquired in 2016 2 electric vehicles to start the electrification tests of the fleet, in particular a 12m Irízar bus and another 12m BYD. The Irízar vehicle was received at the end of 2017 while the BYD was delayed 8 months (August 2018) to wait for an evolved version of the purchased vehicle.

The first thing we can highlight in this car is the irregularity in the performance of the service of electric vehicles compared to the new 35 hybrid units distributed between the MAN and Heuliez brands, also incorporated in 2018. In the weekly trend, we notice the great irregularity caused by the large number of breakdowns



Figure 4 - Performance of e-Buses

The difference between the reliability of the hybrids versus the electric models is clearly evident in the average of Km traveled by model. But also, the great difference in the





behavior between the two electrical marks with positive differential for the Irizar is observed. The behavior of electric vehicles has worsened over time and it is observed that in 2019 the number of km traveled is half that in 2018. That is to say that in 2019 we would require 2.4 Irizar vehicles to replace a hybrid diesel and 3.8 vehicles BYD.



Figure 5 – Number of kms, comparison between e-Buses and hybrid buses

From the mechanical point of view / SAFETY it presents a serious problem in the system of recharging and braking, and we still have not identified the cause. By default, the vehicle does not regenerate below 1.200 or 1.300 revolutions which gives sensation of loss of control for the driver. But it has also been detected that depending on the charge level of the batteries, the retardant does not act, having to work with the brakes exclusively. This behavior represents a serious security problem since the driver brakes abruptly in many occurrences although the position of the brake pedal is exactly the same. In contrast, the Irizar vehicle does not present any mechanics or driving problems, and the finishes and the reception have been the expected one. By contrast, the BYD has had many problems in receiving the vehicle since the definition did not conform to the contract.

Main deficiencies:

- Excessive vibration in the steering column.
- Battery cover makes rafts and stores rainwater.
- Braking failure, sudden braking.
- High voltage cables painted in black.
- Vehicle without manual ramp.
- Software problems: download 48v batteries.

- Repeat faults in batteries. Software problems and breakdowns that require replacement of the batteries.



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Proposed risk-mitigation measures:

By replacing 18 EURO2 buses with 10 e-buses and 8 hybrids, 883.58 t CO2 are saved. A similar saving of 888.61 t CO2 is achieved if 39 EURO2 buses are replaced by 2 ebuses and 37 hybrids. Two e-buses and 16 hybrids will be included in the project and results will be extrapolated. Below are the tables with the EURO2 sheet and finally, the detail of the calculations.

EURO2	
CO2 emissions (t)	72,27
Travel trip (Km)	6,91
Nr. Trips	7.171
Maximum capacity (travellers)	100
Average occupation (%)	57,42
Average Km/year	49.556
Gas	Diesel oil
Registered consumption factor	531,8809
Vehicle regulations	EURO II – 91/542/EEC S II
Maximum authorized weight	19,5
CO2 equivalence*	

<u>CO2 equivalence*</u>	
	tons CO2
10 e-buses + 8 hybrids	417,28
18 buses EURO2	1300,86
CO2 savings with respect to 18 EURO2 (t)	883,58
To save 883,58 t CO2:	
e-buses in stock	
2	
Hybrid buses	
37	
CO2 (t) savings with 2 e-buses y 37 hybrids	888,61

* CO2 savings assuming e-buses had same reliability as hybrid buses.

4.3 A17- 2 e-bikes for disabled mobility and 3 e-bikes last mile logistics

4.3.1 Management structure

The team: VAL, LNV and WIT as main agents.

VAL will provide the e-Bikes (disabled mobility and cargo)



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LNV will assist VAL, as this action is connected with A22 Last mile logistics based on e-Bikes.

WIT will monitor e-Vehicles using non-invasive devices and data will be integrated in the VLCi platform. The data will be used for statistics and data-mining purposes in order to determine performance and promote the use of alternative ways of transport.

4.3.2 Technical specifications of the city infrastructure

Currently, Valencia City Council does not have any service like this. At the end of the project the new service will be tested and evaluated.

The monitoring system will use collected data from:

- Electric system status: battery load level, working hours, engine power.
- Driving: GPS, speed, acceleration, stops, distance since last charge of the batter

These data, which will be integrated with FIWARE VLCi platform (Valencia Smart City platform), will be treated and analysed thanks to Open Data / Source technologies and FIWARE (Orion Context Broker GE, Complex Event Processing GE, Hadoop for big data analysis, IoT Agents for sensors and trackers connectivity).

4.3.3 Planning of the tasks

2018		20	19		2020				2021	2022
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
	(1)	(1)	(1)	(1)						
			(2)	(2)	(2)	(2)				
						(3)	(3)	(3)		
							(4)	(4)	(4)	
							(5)	(5)	(5)	(5)
				M1		M2		M3		

(1) Design and specifications

- (2) Selection of equipment and installers
- (3) Installation of hard/software
- (4) Start of operation
- (5) Monitoring

Milestones:

- M1: Design completed
- M2: Equipment (sensors) installed
- M3: Hardware and software tested





4.3.4 Health, safety and waste management requirements

Safety

The use of e-bikes for disabled mobility and cargo requires specific training in order to handle the bikes and avoid any safety and/or security issues

4.3.5 Risks and proposed risk-mitigation measures

<u>Risks</u>

As it occurs with any new service, a strategy to promote the use of both services will be required.

Involvement and cooperation of different agents, such as: Markets (Valencia City Council), Hospital and Social Welfare, NGO and private company to run the service.

Risk-mitigation measures

Involve in an active way Market, Social Welfare and Bike Agency (Agencia de la Bicicleta) as they are connected with potential target and have the experience.

This action might be integrated with A22 Last mile logistics based on e-Bikes as it will be possible to combine both actions in order to get better results with a limited budget and scarce resources.

4.4 A18-72 EV charging points

4.4.1 Management structure

The team is composed by: VAL, LNV and EMT as main agents.

VAL will provide the e-Charger points

LNV will assist VAL

EMT will manage some e-Charger points

4.4.2 Technical specifications of the city infrastructure

Before the project

Valencia City Council did not have a strategy regarding public e-Charger points, there were some e-Charger points, the majority of them from Supplier service and Gardening and Parks services.

After the project

Valencia City Council will have a strategy for the deployment of e-Charging points network (2019) and 72 e-Charger points will be deployed in the City.





4.4.3 Planning of the tasks

2018		20	19		2020				2021	2022
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
(1)	(1)	(1)								
	(2)	(2)	(2)	(2)						
	(3)	(3)	(3)	(3)	(3)	(3)				
	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)		
					(5)	(5)	(5)	(5)	(5)	(5)
		M1		M2		M3				

(1) Design and specifications

(2) Selection of equipment and installers

(3) Installation of hard/software

(4) Start of operation

(5) Monitoring

Milestones:

M1: Design completed

M2: Equipment (sensors) installed

M3: Hardware and software tested

4.4.4 Health, safety and waste management requirements

Health issues as the promotion of EV will reduce GHE, so CO2 and NOx reduction.

Safety issues, not foreseen.

Waste issues, not foreseen.

4.4.5 Risks and proposed risk-mitigation measures

<u>Risks</u>

As the network is not deployed at the same time and there are several users will be different e-Charger point with different providers and models.

There is not a real EV fleet in the city yet, therefore there is not enough demand yet and 72 e-Charge point could be difficult to reach.

Timing issue regarding public procurement from Valencia City Council as there are 12 e-Charger points to be ready during late 2019 or early 2020.

Risks mitigation measures

Involve private agent in order to achieve 72 e-Charger points combining private and public e-Charger points.





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5 Implementation

5.1 Status of the intervention

5.1.1 A15- 101 local government e-Vehicles

EV have been identified and initial phase to test some EV has started.

After local election process new communication with new councillors and managers will be required in order to involve more departments and deploy the devices.

5.1.2 A16- 10 fully e-buses + 8 hybrid buses

EMT acquired 2 electric vehicles to start the electrification tests of the fleet, in particular a 12m Irízar bus and another 12m BYD. The performance of both buses has been monitored in 2018 and 2019.



Figure 6 – BYD e-bus







Figure 7 – Irizar e-bus

As a result of the analysis performed (explained in section 4.2), at this moment e-Bus acquisition has changed original planning, and there will not be additional e-Bus in 2019 or 2020. EMT has decided to not invest more resources in e-Buses and compensate the impact that the e-Buses would cause with higher number of hybrid buses.

Therefore, two e-Buses and 16 hybrids will be included in the project and results will be extrapolated. At this stage, all the hybrid buses have been already acquired by EMT and are operative. Following actions include to allocate those vehicles to the correct lines, covering the *Poblats Maritims* district which is the target of this implementation.



Figure 8 – EMT Hybrid bus



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Sensors deployed in buses for monitoring purposes are the following:

- Temperature and humidity sensor DHT22
 - $_{\odot}$ Temperature between -40 to 125, with a precision of 0.5°C
 - Humidity between 0 to 100%, with a precision of 2-5%.
 - Sample frequency of 2 samples per second (0.5 Hz)



Figure 9 – Temperature and humidity sensor

- Noise and pollution sensor DFR0034
 - o DB detector
 - PM2.5 particle pollution sensor
 - Analog interface
- GPS sensor and CAN BUS
 - The CAN BUS will be connected as an indirect and non-intrusive way using hall effect sensors and OBD connector of the bus. An OBD splitter will be used so that the device won't need to be disconnected when a diagnosis of the bus is required.



Figure 10 – OBD splitter





5.1.3 A17- 2 e-bikes for disabled mobility and 3 e-bikes last mile logistics

Preliminary phase, several talks with Sustainable Mobility Department, Agencia de la Bici and Markets have taken place in order to design the action.

After local election process, new communication with new manager will be required in order to involve more departments and get the commitment to launch the tender process and service (A.22 Last mile logistics based on e-Bikes).

5.1.4 A18-72 EV charging points

Preliminary phase, several talks with Sustainable Mobility and EMT in order to know technical specifications and calendar.

After local election process communication with new manager will be required in order to involve more departments and get the commitment to deploy new e-Charger points including calendar and deadlines.

The main objectives of the recharging network of Valencia 2020 which is being designed, are the following:

- It will facilitate:
 - Frequent charging for professionals (taxi and VTC)
 - Emergency charge made by individuals
 - Night charging for the municipal electric fleet
- Procedures of operation and management of the points of recharge and the control platform must be proposed.
- In a first stage, 3 charging points will be installed in *Cabanyal-Canyamelar* neighbourhood (Maritime district)
- A bidding for the installation and operation of up to 9 fast recharge stations will be launched

The location of the first charging points (12) has been already decided, as shown in the following figure:







Figure 11 – Location of 12 fast-charging points in Valencia



Figure 12 – Charging station to be installed in Valencia

In the plan to design those locations, the following requirements have been considered:

1. Coverage of territory: zones will be covered in a way that every point in the city will have a charging station in less of 2 km.





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- 2. Mobility criteria: Aligned to the Sustainable Mobility Strategy from Valencia city council, foot-traffic areas are taken into account and location is prioritized in high traffic places.
- 3. Demand projection: in order to cover the demand and needs of different sectors (taxi, VTC) as well as potential users.
- 4. Visibility criteria: choice of visible or iconic places in the city as a tool for the dissemination and active promotion of electric mobility focusing citizens.

5.2 Risks found and corrective actions performed

Risks are mainly related to the acquisition of electric vehicles. On the one hand, several issues related to the e-Buses fleet have been deeply described in section 4.2.5. After the analysis, a complete redesign of action A17 has been proposed, and therefore the implementation plan is now redefined based on the deployment of a new buses fleet. It will be included in the 2^{nd} Amendment of the project.

Some other risks are related to the rest of e-vehicles, which depend on different procurement processes. In this case, the active involvement of public authorities is being crucial for the progress of these cations (A16 and A17).

Finally, regarding the deployment of an EV charging infrastructure, also tendering processes affect the implementation plan. Both Valencia City Council, Las Naves and ETRA are working together to find some additional charging stations that can be integrated in the platform developed in A20, in order to minimize the possible impact of a delay on the charging points availability.

5.3 Business model and financial scheme applied

These mobility interventions cannot be independently carried out without an investment plan behind and, in this sense Valencia will support the economic development of the *Poblats Maritims* district area, increasing the support for entrepreneurship. As main funding initiatives, Valencia provides the Integrated and Sustainable Urban Development Strategy for this district (EDUSI) from 2017 to 2021 with 30M€ funded 50% by ERDF and 50% by the municipality. Besides, within the program RED.es, Valencia will invest 7.8M€ in the next years.

In the case of A18, for deployment of EV charging points, the following funding scheme is applied:

- EDUSI, in the case of the EV charging infrastructure at *Cabanyal-Canyamelar* neighbourhood (*Poblats Maritims* district)
- RED.es project for charging points aimed at public fleet.

Recent investigations (Naveal, 2019; Palencia, 2018) reveal that the change to an electric vehicles fleet could help public authorities to save money - in addition to avoiding the emission of hundreds of tons of CO2-. In the case of being able to avail of public aids offered (the subsidy of the MOVES Plan, Edusi or tax relief) to the purchase of electric vehicles, their price would be lower than that of those of combustion.





Operating costs (fuel and maintenance) would also be lower. Therefore, the total disbursements would justify the change.

In the case of the electrification of vans, a very prevalent segment among the fleets of public companies, this action could be competitive even without aid thanks to its lower operating costs, as well as the low starting price they represent with respect to electric vehicles. Studies also consider that the rental battery model is more advantageous than in ownership, although the total cost may be slightly higher.

On the other hand, the rental or renting / leasing formula is valued as the most appropriate for the convenience it provides in payments. If the need is to buy a vehicle, leasing is the best alternative. In those cases where the purpose is only to acquire a mobility service, renting would be the best solution.

5.4 Citizen engagement strategy implemented

There is no promotion campaign to populate and convince of the benefits for the implementation of the actions, since e-Vehicles are part of the public fleet to be deployed by Valencia city council. Nevertheless, the e-Mobility fleet will set an example for the Valencia City Council and it will help to spread the word about sustainable mobility and go green.

But, the deployment of charging point in the city is expected to act as a booster for the promotion of e-Mobility.

Direct savings in CO2, GHG and climate change will be a clear example of sustainable mobility, on the other hand promotion of alternative ways of transport will have an impact in society if public policies are developed in this line as the Mobility ordinance, SUMP and limited access to EV in the city will give a boost to the initiative and promote EV business.

5.5 Next steps

The roll-out of this intervention continues until M36 (September 2020), in which the final systems have to be completely deployed in the city of Valencia. This includes the final refinements, since in M30 (April 2020) the technical, social and economic evaluation will take place and this will contribute to get some valuable data related to the actions implemented. Therefore, there is still some room for improvement and refinement until the final version of this report, D2.19, is delivered.





6 Conclusions

Valencia city has identified several challenges to be addressed, focusing a sustainable mobility and also to support the transformation process of the city as a whole, but of the *Poblats Maritims* district in particular. This also means to address specific solutions of electromobility in a suitable combination of resources to finance them. Therefore, the city is committing several financing schemas that include ERDF, National and Municipality, but this process also requires to get adapted to procurement processes and to the (local and national) political conditions. During this first stage in the implementation of the actions, some problems arose related with the acquisition and purchase of the electric fleet, which have been analysed in order to get to an optimal solution, as it is in the case of the e-Buses as detailed in A.16.

The commitment of the city in terms of Sustainable Mobility and the development of strategies and regulations, which has as the most recent result the last Mobility Municipal Regulation in force since June 2019, contribute to unblock the roll-out of electromobility infrastructures. Therefore, it is expected that in the following months several activities will take place in the context of this intervention. Additional vehicles will be purchased as part of the municipal EVs fleet and they will be used to demonstrate the implementation of new mobility services, which are currently being developed in Subtask 2.5.2.



