Project no. 691735

REPLICATE PROJECT

Renaissance of Places with Innovative Citizenship And Technology

This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

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REnaissance of PLaces with Innovative Citizenship And Technology

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H2020-SCC-2015 Smart Cities and Communities

Innovation Action (IA)

D 3.7 Report on the deployment of charging infrastructure in the city of San Sebastian

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1. EXECUTIVE SUMMARY

The aim of this document is to explain the process that the local administration of the city of San Sebastian has taken to prepare the city before the arrival of electromobility. This process has considered the infrastructure requirements, taking into account the energy needs and the sizing of the city in terms of recharging points.

During the research and design process, the City Council tried to identify and subsequently involve all the agents that must participate in those phases in which their contribution is necessary. Considering the size and type of deployment proposed the involvement of the city should not be limited only to the local administration but also to all the stakeholders involved in the entire value chain of electric mobility, from the energy supplier to the end user, private or public.

The effort and the work done have led to open several communication channels with stakeholders to involve them in the planning of the electromobility in the city and to take into account also the urban needs in their respective policies of their business exploitation.

The effort made by the city council to involve the different stakeholders of the city has had a considerable impact that has increased the awareness on the arrival of electromobility and has also led to increase the interest on offering their customers the possibility of recharging their vehicles in their facilities, as an added service, to the point that today the city has close of 70 charging points, both public and private.

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2. REPLICATE

The main objective of REPLICATE project is the development and validation in three lighthouse cities (**San Sebastián** – Spain, **Florence** – Italy and **Bristol** – UK) of a comprehensive and sustainable City Business Model to enhance the transition process to a smart city in the areas of the energy efficiency, sustainable mobility and ICT/Infrastructure. This will accelerate the deployment of innovative technologies, organizational and economic solutions to significantly increase resource and energy efficiency, improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas.

REPLICATE project aims to increase the quality of life for citizens across Europe by demonstrating the impact of innovative technologies used to co-create smart city services with citizens, and to prove the optimal process for replicating successes within cities and across cities.

The Business Models that are being tested through large scale demonstrators at the three cities are approached with an integrated planning through a co-productive vision, involving citizens and cities' stakeholders, providing integrated viable solutions to existing challenges in urban areas and to procure sustainable services. Sustainability of the solutions is fostered in three areas: economic and environmental and, finally, transparency in the public management.

In addition, the Model features the replicability of the solutions and their scale up in the entire city and in follower cities, particularly in three follower cities (**Essen** – Germany, **Laussane** – Switzerland and **Nilüfer**–Turkey) that are involved in the project and therefore, have access to know-how and results achieved on the project so they can apply the developed model. There are currently two observer cities, Guanzhou (China) and Bogota (Colombia).

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3. INTRODUCTION

3.1 Relation to Other Project Documents

The District Management Plan delivered in WP1 (D1.4) explains the organisational structure of the whole pilot actions in San Sebastian, covering the three main intervention lines of the project: energy, ICT and mobility, which is the one where this deliverable is framed.

Furthermore, considering mobility actions expected to be developed in San Sebastian, this deliverable is directly linked with the deliverable D3.6 Report on the deployment of EVs in the city of San Sebastian

3.2 Reference documents

This document is based in the following projects level documents:

Ref.	Title	Description
REPLICATE Grant Agreement signed 240713.pdf	Grant Agreement	Grant Agreement no. 691735
DoA REPLICATE (691735)	REPLICATE Annex 1 – DoA to the GA	Description of the Action
REPLICATE Consortium agreement signed December 2015 (7th December version)	Consortium Agreement	REPLICATE project – Consortium Agreement
REPLICATE Project Management Plan	D1.1 Project Management Plan (v.1) (29/04/2016)	REPLICATE Project Management Plan

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REPLICATE District Management Plans	D1.4 District Management Plan San Sebastian D1.5 District Management Plan Florence D1.6 District Management Plan Bristol	REPLICATE District Management Plans
REPLICATE Communication Plan	D11.1 Communication Plan	REPLICATE Communication Plan

Where there are contradictions, the documents listed above supersede this deliverable. The Grant Agreement is the contract with the European Commission so takes precedence over all other documents.

3.3 Abbrevations list

GA	Grant Agreement
CA	Consortium Agreement
DoA	Annex I–Description of the Action
EC	European Commission
H2020	Horizon 2020
PC	Project Coordinator
PL	Pilot Leader
PMP	Project Management Plan
TC	Technical Coordinator
WP	Work Package
WPL	Work Package Leader

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4. DELIVERABLE DESCRIPTION

The document describes the procedure that the city council has taken when it comes to addressing the design of an urban recharging infrastructure network.

To fulfil the description of the action, the document is structured in the following sections:

Section 5. State of the Art. Charging Infrastructure, provides general information about the electric recharging offer in the city when Replicate project started.

Section 6. Charging Point Typology. Summarizes the different types of recharging points that have been considered when evaluating what infrastructure should be provided to users.

Section 7. The Role of Municipalities in Electric Recharging, provides information about the types of recharge that should be contemplated in an urban environment, and which of them should be addressed by local administrations.

Section 8. Dimensioning and Location of Charging infrastructure, this section explains the factors that have been taken into account when sizing an electric recharging mesh in San Sebastian.

Section 9. Charging Infrastructure location research, provides information on the selected criteria to make a proposal for the location of charging points in the city, both from the point of view of street and underground parking situation.

Section 10. Installation, Configuration and Start-up of recharging points, explains the necessary phases from the design of the network to the installation and start-up of the recharging points.

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Section 11. Management and operation of Charging Infrastructure, provides information about the legal figure of charging manager in Spain.

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5. STATE OF THE ART. CHARGING INFRASTRUCTURE

The City Council of San Sebastián has a strategy of implementation, development and promote public and private electric mobility, which is part of a broad project context of city, which seeks to achieve a better quality of life for its inhabitants, and a friendly, safe and environmentally sustainable city.

The approach foreseen by the city for the deployment of electromobility is based mainly in two lines of action:

- Deployment of a recharging infrastructure network
- Promotion of the electric vehicle in the city

As the line of action dedicated to the promotion of the electric vehicle in the city has its own deliverable (D3.6 Report on the deployment of EVs in the city of San Sebastian), that line will not be treated on this section and even that being two well differentiated lines of action, their progress goes in parallel and they necessarily have to be linked, since any decision taken in one direction directly influences the other.

5.1 Background

Regarding the recharge infrastructure, and taking into consideration its location over time, at the beginning of the Replicate project, the city of San Sebastián had 11 charging points, public and private, for electric vehicles, with different uses and types:

- Public Road 1
- Petrol Stations 1
- Underground parking facilities 2
- Shopping centers 1
- Hotels 4
- Private 1
- Car dealership 1

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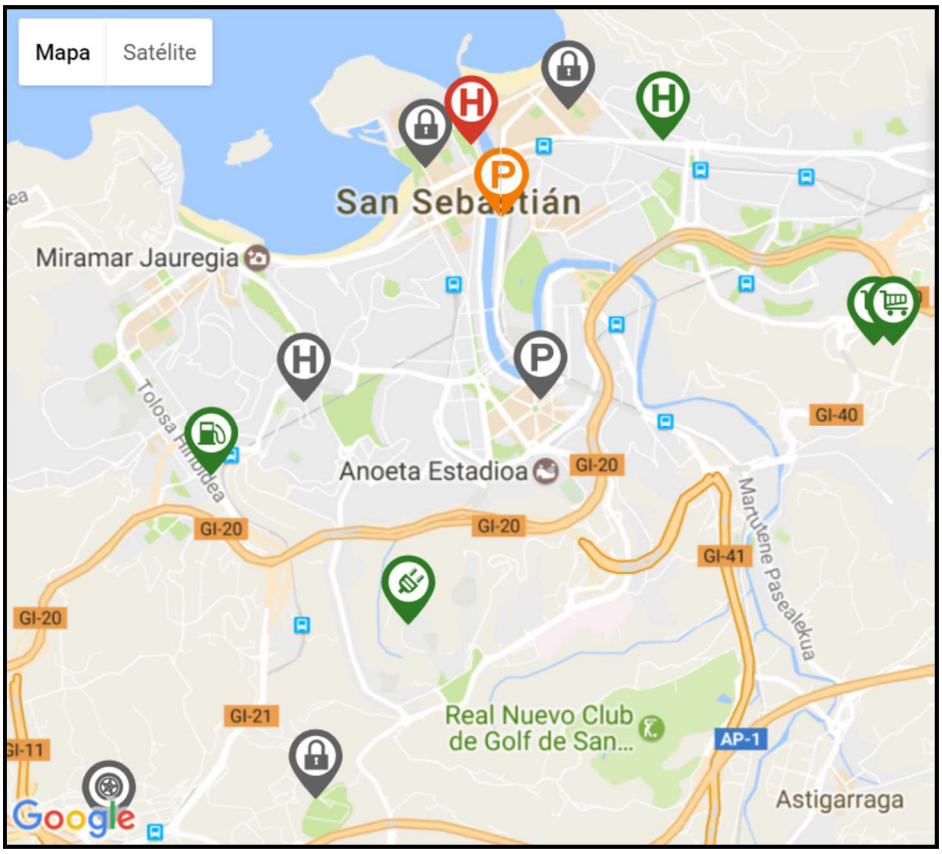

[Picture 1. Public/Private Charging points location in San Sebastian]

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6. CHARGING POINT TIPOLOGY

At the time of the recharging infrastructure approaching, it was necessary to start from the most basic point that was to identify the typology of recharging points that would have to serve both citizens and visitors to the city in order to guarantee recharge coverage for all types of electric vehicles on the market.

Starting from a theoretical point of view, the recharging point is the instrument that supplies energy to an electric vehicle, and as such, it must comply with the regulations and standards in force, both at European and Spanish level (in San Sebastian´s case).

They are mainly differentiated by the power, the amount of information exchanged with the vehicle that recharges and by the type of fixed connector that should fit in the electric vehicle. Based on these criteria, different charging modes and various types of connectors are known. The recharge time depends on all the mentioned factors, as well as the possible control that can be exercised on the car during the charge. Among the existing points, currently there are identified power points from 3.7 kW to 150 kW.

Type of Recharge	Recharge power (kW)	Recharge time*	Distance with 1h recharge (km)**
Super slow recharge	2,3	10-12h	20
Normal Recharge	3,7-7	6-8h	30-60
Semi-Fast recharge	22-25	1-1,5h	18-200
Fast Recharge	44-50	30 min	360-400
Super fast Recharge	90-120	20 min	>1000
Ultra fast Recharge	130-150	5-10 min	>1500

* *Approximate time in the full charge of a battery between 22 and 24 kWh capacity*

** *Approximate calculation taking into account an average consumption of 12 kWh / 100 km.*

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Today, the maximum values of autonomy reached by electric cars are about 600km in premium brands. However, the rest of manufacturers are working on increasing their autonomy and there are already models like the Opel Ampera with 400 km of real autonomy or the 300 km of the Renault Zoe. For this reason, the data of the reachable distance with 1h of charge would not apply in cases of super-fast and ultra-fast recharge, and would be restricted to Tesla models in the fast recharge.

6.1 Legislation and Regulation

Apart from the regulations applicable to any electrical installation and public works, there are specific National and European regulations for the electric recharging infrastructure. The most remarkable ones are summarized below.

National regulations

At the end of 2014, Royal Decree 1053/2014 came into force, in which the Complementary Technical Instruction (ITC) BT 52 was approved: "Facilities with special purposes. Infrastructure for recharging electric vehicles".

This approval meant an important push for the electric car recharging sector that depended on the legal installation schemes. One of the aspects that regulates is the mandatory installation of recharging points in new constructions or rehabilitations in addition to specifying the technical requirements of these facilities. The effects according to the scope of application are summarized below:

- Private fleet car parks (cooperatives, companies, workshops, concessionaires and similar): 1 recharge installation for every 40 places.
- Parking lots or permanent public parking lots: 1 recharge installation for every 40 places.
- On public roads: the installation that is needed to supply recharging stations thatare foreseen in the supra-municipal or municipal Sustainable Mobility Plans.

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- Single-family homes: in single-family homes that are equipped with the infrastructure for recharging electric vehicles, high level of electrification will be considered, thus modifying ITC BT 25, "Indoor installations in homes". When one or more parking spaces are provided for the parking of electric vehicles, an additional circuit must be installed for that purpose.
- Buildings of regime of horizontal property: at the time of installing recharging points in parking and collective car parks in buildings of regime of horizontal property of new construction, it will be necessary to carry out a conduction by common zones (by means of tubes, channels, etc.) so that referrals can be made to the recharging stations located in the parking spaces.

European regulations

Directive 2014/94 / EU of the European Parliament and of the Council of 22th October 2014, on the implementation of an infrastructure for alternative fuels, establishes a common framework of measures in order to minimize dependence on the means of transport with respect to oil and mitigate the environmental impact of them. Next, a series of definitions and regulations to be met in the field of electric vehicles.

Article 2: Definitions

3) "recharging point": means an interface that is capable of charging one electric vehicle at a time or exchanging a battery of one electric vehicle at a time;

4) "normal power recharging point": means a recharging point that allows for a transfer of electricity to an electric vehicle with a power less than or equal to 22 kW, excluding devices with a power less than or equal to 3,7 kW, which are installed in private households or the primary purpose of which is not recharging electric vehicles, and which are not accessible to the public;

5) "high-power recharging point" : means a recharging point that allows for a transfer of electricity to an electric vehicle with a power of more than 22 kW;

7) "recharging or refueling point accessible to the public" means a recharging or refuelling point to supply an alternative fuel which provides Union-wide non-discriminatory access to users. Non-discriminatory access may include different terms of authentication, use and payment;

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Article 4: Electricity supply for transport

1. *Member States shall ensure, by means of their national policy frameworks, that an appropriate number of recharging points accessible to the public are put in place by 31 December 2020, in order to ensure that electric vehicles can circulate at least in urban/suburban agglomerations and other densely populated areas…*
3. *In addition, Member States shall also take measures within their national policy frameworks to encourage and facilitate the deployment of recharging points not accessible to the public.*

6.2 Connector Types

The types of connectors that can be used in charging points are regulated by the international regulations IEC 62196-2 and IEC 62196-3. A description of them can be found below:

Schuko: domestic connector, which meets the CEE 7/4 Type F standard and is compatible with European power outlets. It supports currents up to 16 A and is only used for slow recharge and without integrated communication.	
SAE J1772 (Type 1, Yazaki): North American standard. It has five terminals, two of current, one of ground and two complementary proximity detection and control. It can work at AC voltages up to 250 V and under single-phase 32 A currents.	
Mennekes (Type 2): German industrial type connector. It has seven terminals, four for current, one for earth and two for communications. Can work with current: - Single-phase: voltage up to 250 V AC and currents of 32 A. - Three-phase: voltage 480 V AC and current 63 A (43 kW).	
Scame (Type 3): mainly supported by French manufacturers. It has five or seven terminals, either for single-phase or three-phase current,	

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grounding and communication with the network. It admits up to 32 A (for semi-rapid recharge).	
Combined single connector or CCS: it has been proposed by North Americans and Germans as a standard solution and with capacity to work both in DC and AC. It has five terminals, for current, protection to earth and communication with the network. Supports both slow and fast recharging - Single-phase: voltage up to 250 V AC and current up to 70 A. - Three-phase: voltage up to 500 V AC and current up to 63 A or 480 V DC and 200 A.	
CHAdeMO: standard of the Japanese manufacturers, specifically designed for fast recharge in direct current. It has ten terminals, grounding and communication with the network. It admits up to 200 A of current intensity (for ultra-fast recharges).	

The vast majority of European vehicles are equipped with Type 2 and/or CCS connectors, while many Japanese vehicles incorporate Type 1 and/or CHAdeMO. As far as infrastructure is concerned, several combinations can be found, but from November 2017, according to Directive 2014/94 / EU, all new public recharging points should offer at least Type 2 (for CA) and CCS (for CC) connectors.

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6.3 Recharge modes

The four existing charging modes depend on the communication between the electric vehicle and the charging infrastructure, and the control of the charging process to carry out a series of actions (recharge planning, rationalization of recharge power…etc). These facts vary depending on the type of current available, the recharge speed and the necessary infrastructure.

Mode 1

[Picture 2. Picture showing charging mode 1]

Connection Type	Single-phase 230v	
Type of recharge	AC 10A (2,3kW)	AC 16A (3,7kW)
Recharge Time	12h	10h
Connector Type	Schuko connector (domestic socket) on the wall	
Security and control	No communication between charging infrastructure and electric vehicle	
Necessary infrastructure	Verification of the current outlet and the existing installation to comply with the regulations	

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Mode2

[Picture 3. Picture showing charging mode 2]

Connection Type	Single-phase 230v
Type of recharge	AC 16A (3,7kW)
Recharge Time	8h
Connector Type	Schuko connector (domestic socket) on the wall
Security and control	Cable with intermediate protection and control device that serves to verify the correct connection of the vehicle to the network. Communications between control box and vehicle.
Necessary infrastructure	Verification of the current outlet and the existing installation to comply with the regulations

Mode3

[Picture 4. Picture showing charging mode 3]

Connection Type	Single-phase 230v	Three-phase 400v

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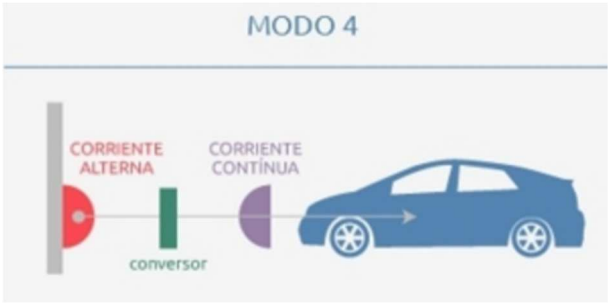
Type of recharge	AC 10A (2,3Kw)	AC 16A (11Kw)	AC 32A (22kW)	AC 63A (43kW)
Recharge Time	8h	2h	1h	30 min
Connector Type	Special connectors Type 1 (SAE J1772) or Type 2 (Mennekes)			
Security and control	The control devices and protections are located inside or outside the recharging point itself. The cable includes integrated communication with the network.			
Necessary infrastructure	Wall-box and Pylon type infrastructures			

Mode 4



[Picture 5. Picture showing charging mode 4]

Connection Type	Three-phase 400v
Type of recharge	DC 50-100kW
Recharge Time	20-30 min
Connector Type	Special connectors Type 4: CHAdeMO and CCS Combo for direct current
Security and control	The control devices and protections are located within the recharging point itself. The cable includes integrated communication with communication with the network.
Necessary infrastructure	Special infrastructures

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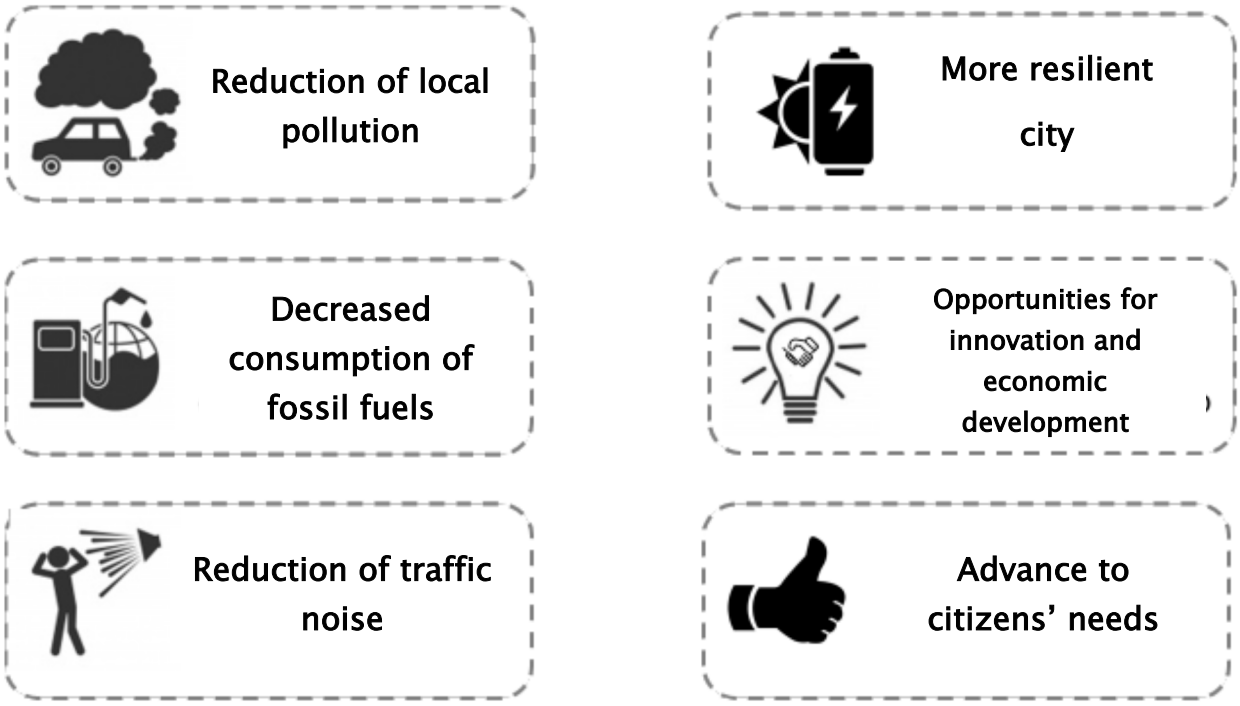
7. THE ROLE OF MUNICIPALITIES IN ELECTRIC RECHARGING INFRASTRUCTURE

Electric mobility has clear advantages over combustion vehicles when it comes to improving the following aspects of the city:



[Picture 6. Picture of the electric mobility advantages impacting the city]

According to those statements, it can be said that municipalities have a clear motivation for the promotion and implementation of the electric vehicle. On the other hand, the implementation of the electric vehicle is not proving simple and faces several barriers, mainly:

- User awareness: electric mobility technology is a disruptive innovation that changes the way vehicles are understood, but does not provide clear improvements in user experience, but rather restrictions on the autonomy of vehicles, and a higher vehicle price. In this context, it is considered that municipalities can influence their citizens very positively through training campaigns adapted to the profiles of users (citizens, professionals ...).

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- The initial investment of vehicles: electric vehicles still represent a significant extra cost (around 40%) on combustion vehicles and costs several years (depending on use) to amortize this overinvestment. The municipalities can implement incentives for the use of the electric vehicle that compensate this extra cost.
- The recharging network: the technology of electric vehicles changes the way in which energy is supplied and the charging network remains one of the main obstacles for the drivers of an electric vehicle.

Royal Decree 647/2011, which regulates the activity of the system's charge manager for the realization of energy recharge services, establishes that this service is offered by commercial companies, thus framing this service as a private service and not as a public one.

The context in which this legislation was made must be taken into account. At that time, a forecast was made of a large growth in the demand for electric vehicles in the following years, which implied an exponential and high growth in the demand for energy, and therefore it was understood that the service had great potential as a new model of business as well as a need for regulation of electricity demand.

However, these expectations turned out to be overly optimistic, and the reality has been that such growth has not occurred, and that the implementation of the electric vehicle and all the infrastructure and associated services, is having to face serious barriers of various kinds that make the profitability of them difficult to achieve.

There is a direct link between the existence of an electric recharging network and the implantation of the electric vehicle. Thus, private operators of infrastructure and recharge management will not be able to monetize and install more recharging points until there is a critical mass of electric vehicles.

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Taking into account all the above, it can be understood that the Public Administration has a clear motivation for the promotion and implementation of the electric vehicle in its entirety, which would justify its intervention until, at least, make it a profitable business and that, consequently, it works by itself within the laws of the market.

The role of municipalities:

a) Implantation of recharging points

It is analysed below which is the role of municipalities in the implementation of recharge points depending on the type of following points:

Linked recharge: is the recharge associated with a specific vehicle that normally charges for more than 6 hours in a row. Experts say that with good development, this type of charge can cover 95% of the user's needs. The installation of these charging points generally corresponds to the private sphere; it does not suppose a high cost, but it can get to be complex according to the ownership of the car parks. However, given that it is key to have a linked recharging point before the purchase of an electric vehicle, it would be beneficial for the municipalities to take measures to facilitate it:

- Install recharging points or pre-installations in the car parks of subscribers
- Control and encourage compliance with the regulations for the installation of charging points (ITC BT52) in new buildings and car parks.
- Give technical support and incentives to the installation of these points.

Opportunity Recharge: corresponds to the charge that takes place taking advantage of other tasks, such as leisure activities, shopping, restaurants, hotels, car dealers, etc. That is why this type of charge is usually located, mostly, in underground parking of large areas or rotating car parks. In this case, the installation of slow or semi-rapid recharging points corresponds to the space manager, and can be used as an element of

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marketing or corporate social responsibility. The role of the municipality may simply be to encourage, advise, facilitate agreements in case the points affect the public road and promote points.

Recharge in route: this is a charge that takes place in service areas and gas stations (or petrol stations) located on highways or motorways, and as a planned stop while a medium/long distance trip is made. The territorial competences of these points do not fall within the responsibilities of the City Council in this case.

Emergency recharge: fast recharging, only for short and limited periods of time. It is considered a key service for the purchase of an electric vehicle in two scenarios:

- Professionals who perform more than 100 km daily
- Individuals in sporadic situations and as emergency elements.

Currently, the operation and maintenance costs of recharging points do not compensate for the private exploitation of charging points, which infers the need to consider emergency recharge as a public service provided by the city council to the public.

b) Price of energy

The commercial nature of the recharge service implies, among other things, the obligation to apply to consumers the rates that, in accordance with the provisions of the General State Administration, corresponds to it.

However, and following the same line of argument that understands the recharge as a public service while the commercial service is not profitable, in various municipalities a public intervention is carried out on the prices, to encourage the use of the electric vehicle. It is always about temporary and specific measures that aim to encourage the

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use of electric vehicles, with the ultimate goal of promoting savings and energy efficiency.

This argument could find its legal basis in the Royal Decree Law 6/2010 of Measures for the promotion of economic recovery and employment, in Article 24.4, relating to Energy Recharge Services, which provides that:

The Administration will adopt specific programs to boost the efficiency in the demand for electricity for electric vehicles, with the aim of promoting savings and energy efficiency, optimizing the use of the electrical system, under the provisions of Article 46.2 of the Law 54/1997, of November 27, of the Electricity Sector.

However, it is worth mentioning that this topic is a source of discussions that are still not solved today or on which there is no consensus.

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8. DIMENSIONING AND LOCATION OF CHARGING INFRASTRUCTURE

For the location and dimensioning strategies of charging points for electric vehicles, it is necessary to differentiate between the different types of charging situations. In the case of San Sebastián, the main cases that take place are dealt with: the emergency recharge (both on-street and underground facilities) and the linked recharge.

8.1 Emergency recharge

In the emergency recharge, the installation of fast or semi-rapid recharging points is considered. For this, there are three main strategies, which can be combined to benefit from the advantages that each can bring to San Sebastian.

Territory coverage

This strategy aims to facilitate access to recharge to any citizen, placing a recharging point at a distance that does not involve a minor displacement at a distance/time from the residence or from the usual paths of citizenship.

In this case, criteria that are decisive when choosing between locations are the population density, the mobility data and the main routes of displacement in the city. It is especially interesting to take into account those trips that exceed 30-40 km. (that they would not need emergency recharge).

Other criteria to take into account when defining the location of the points are accessibility, surveillance, visibility, operating hours and the proximity of leisure areas to take advantage of the recharge time, for example. Additionally, the number of recharging points for each recharge station is defined depending on the actual demand of it.

In the following graph an indicator to validate the distribution of the points in a useful and interesting way can be seen, which relates the flow of drivers (%) that passes through the recharge points with the average deviation of them (minutes) according to several defined scenarios.

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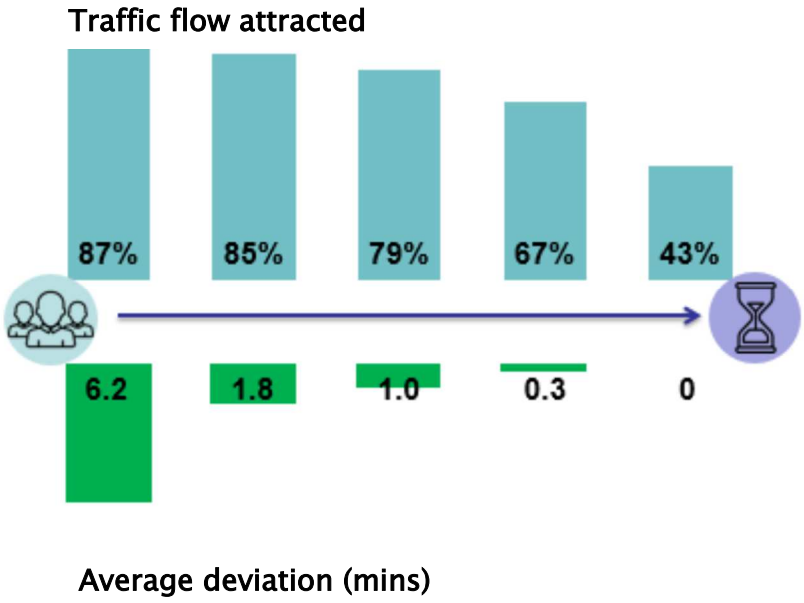

[Picture 7. flow of drivers (%) that passes through the recharge points with the average deviation of them (minutes).]

Mobility Criteria

In this second strategy, more emphasis is placed on welcoming the implementation of the electric vehicle as it is, a new agent of the urban mobility ecosystem.

The methodology to be followed consists of adapting the electric vehicle to the premises established in the Urban Mobility Plans (SUMP) of the affected municipalities or regions, finding the best actions to adapt the presence of the electric vehicle and the consequent recharging infrastructure, respecting and enhancing the objectives in terms of sustainability and mobility of the city.

In the case of San Sebastian, there is a clear decongestion strategy in the city center, which should prevent the installation of recharging points in certain areas where this could generate an increase in agitation traffic. On the other hand, agitation traffic should be avoided in future areas of limited traffic (LENZ-ZTL) or in any case install recharging points for groups that do need to access these areas (taxis and last mile distribution).

In short, complement the commitment to sustainable, safe, healthy and friendly mobility in the city. In this way, the trips on foot, bicycle and public transport will always be

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prioritized. Leaving the private vehicle for those uses that by type of use (taxi, distribution, services, etc.) or lack of infrastructure (long distance and poor connection with public transport).

For these reasons, this strategy should be based on adapting the size and location of the electric vehicle charging infrastructure so that it does not generate more traffic in the city and is mainly concentrated in the dissuasive car parks or work centers in the surroundings.

Study of the demand

The third major strategy is to identify all agents of motorized mobility, both individuals and professionals, and see which of them can be or are interested in being potential users of electric vehicles in the near future, and what patterns of behaviour they have to adapt the sizing and location of the recharging infrastructure to their needs.

This strategy may result in points in locations that by location criteria might not be considered and it would be possible to detect particular needs of certain user groups, such as the creation of exclusive charging points for taxi drivers.

The best methodology to implement this strategy must be preceded by a thorough analysis of the daily movements of each of the detected agents, taking into account distance traveled, travel frequencies, type of travel, vehicle inactivity, etc. And then draw the conclusions of location and dimensioning based on the territorial distribution of these agents in the city.

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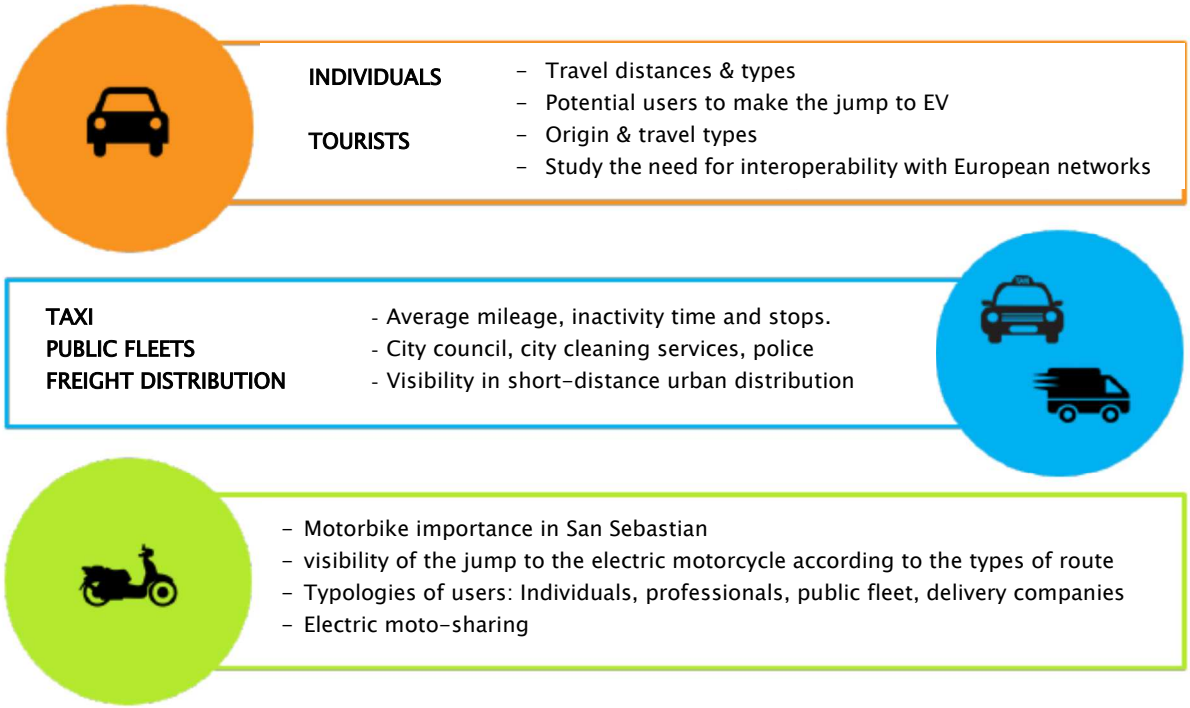
In the following scheme, a graphic classification of the main criteria to be studied according to the main user groups is shown.



[Picture 8. Picture about the criteria to be studied according to the main user groups]

Visibility criteria

On the other hand, the promotion of electric mobility also requires a promotion and communication strategy, and the reassuring effect that the fact of having emergency recharging points has on future users has been studied. Thus, it is also interesting to include a recharging point in a high visibility area that can be iconic in the city.

This strategy is also useful when it comes to publicizing both citizens and visitors the commitment of the City of San Sebastian for innovation and sustainable mobility in the city.

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8.2 Linked recharge

In order to satisfy the successful functioning of the electric mobility ecosystem, a correct approach to the linked charge is essential, complying with the following unwritten rule:

"The electric vehicle must charge where it parks, not the other way around"

In any case it is not advisable to increase the number of vehicles parked on public roads (and occupying public space) while charging for 6 or 8 hours.

In the case of the linked recharge, two main scenarios are differentiated, one of which is more important than the other in the case of San Sebastián as a city.

Linked recharge at home or private parking

As its name suggests, this case study contemplates the location of the recharging point linked to a vehicle or to a small number of vehicles at home or in private community-owned horizontal car parks.

This casuistry is strictly restricted to its management and installation by the user; therefore it does not apply in the case of the municipality.

Linked recharge in public parking

On the other hand, there is the linked charge located in public car parks with exclusivity strategies of the place or sharing, through a rental.

In both cases, the user would pay a periodic fee both for parking and for the place, being able to establish the time or use restrictions that are considered necessary to promote the possibility of giving a certain rotation to the places enabled with this service.

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9. CHARGING INFRASTRUCTURE LOCATION RESEARCH

In the background section, existing recharge points in the city of San Sebastian are listed, some of which are out of service and others are private for the exclusive use of certain companies or groups.

Today, for this first large deployment of electric mobility, two types of main locations are considered: underground parking for slow or semi-rapid charging and gas stations for fast charging. Additionally, the installation of specific charging points for taxi drivers and last mile distribution in certain strategic points of the public road is considered.

With the exception of these exceptional cases, the installation of charging points on public roads should be avoided due to the repercussions of this fact: occupation of the public road, more likely to be immersed in acts of vandalism, possible effects on the mobility of the area , etc.

For each of the cases, it is possible to analyze all the possible locations to be able to choose based on solid criteria. In the case of the semi-rapid emergency recharge, the city's underground car parks should be considered. In the next picture, the study locations in the case of the underground charge is shown in a map, both rotation (blue color) and connection car parks (black color).

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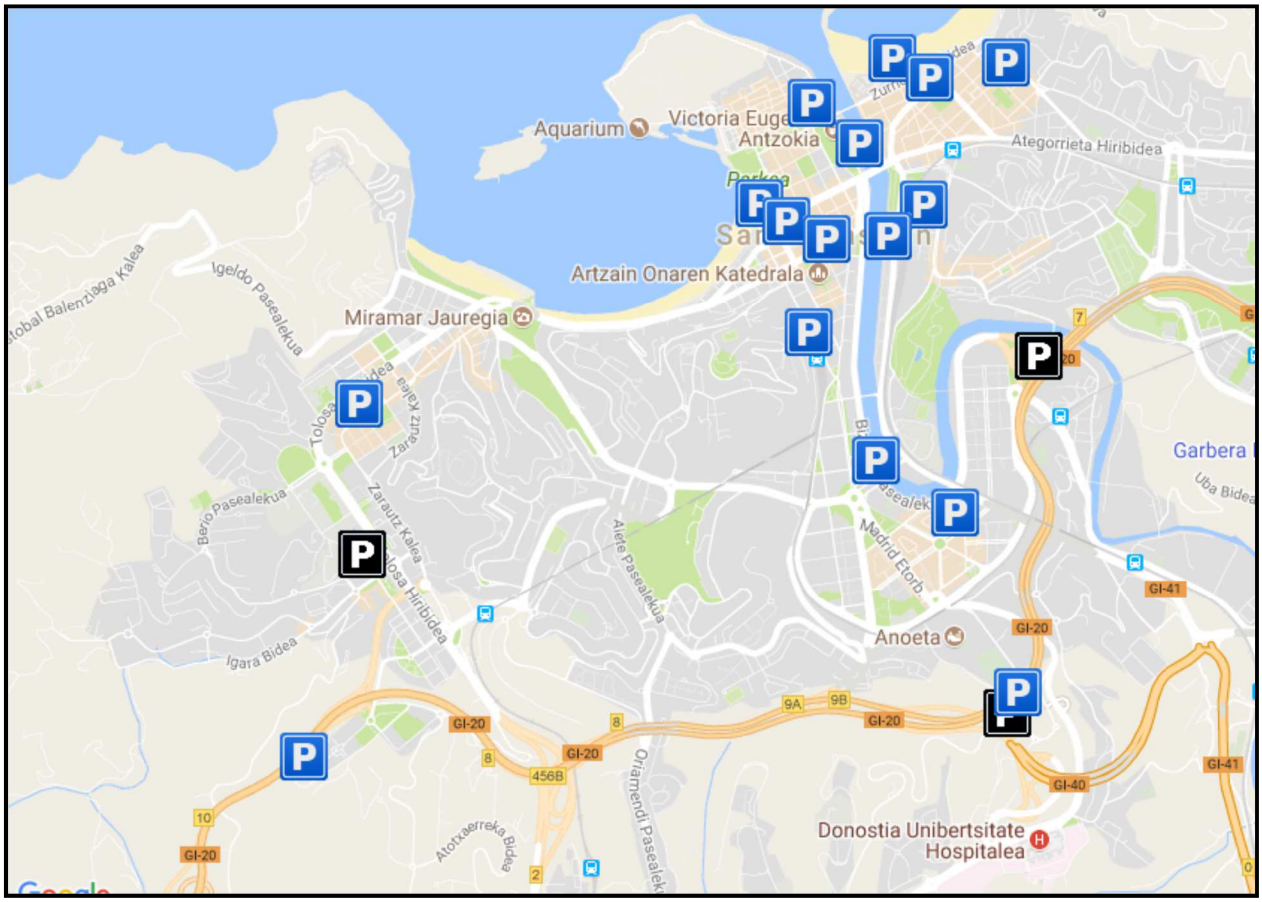

[Picture 9. Rotation and connection underground car park facilities in San Sebastian.]

The low demand of some car parks is also an advantage because they will have no problem reserving places to electric vehicles so it would not be a problem and would be in line with the City Council's policy of keeping vehicles away from the center.

With regard to the emergency recharge located in gas stations around the city and its periphery, rapid recharging points will be deployed in various gas stations, with which the City is in a period of dialogue. The detected locations for this possible deployment are the following:

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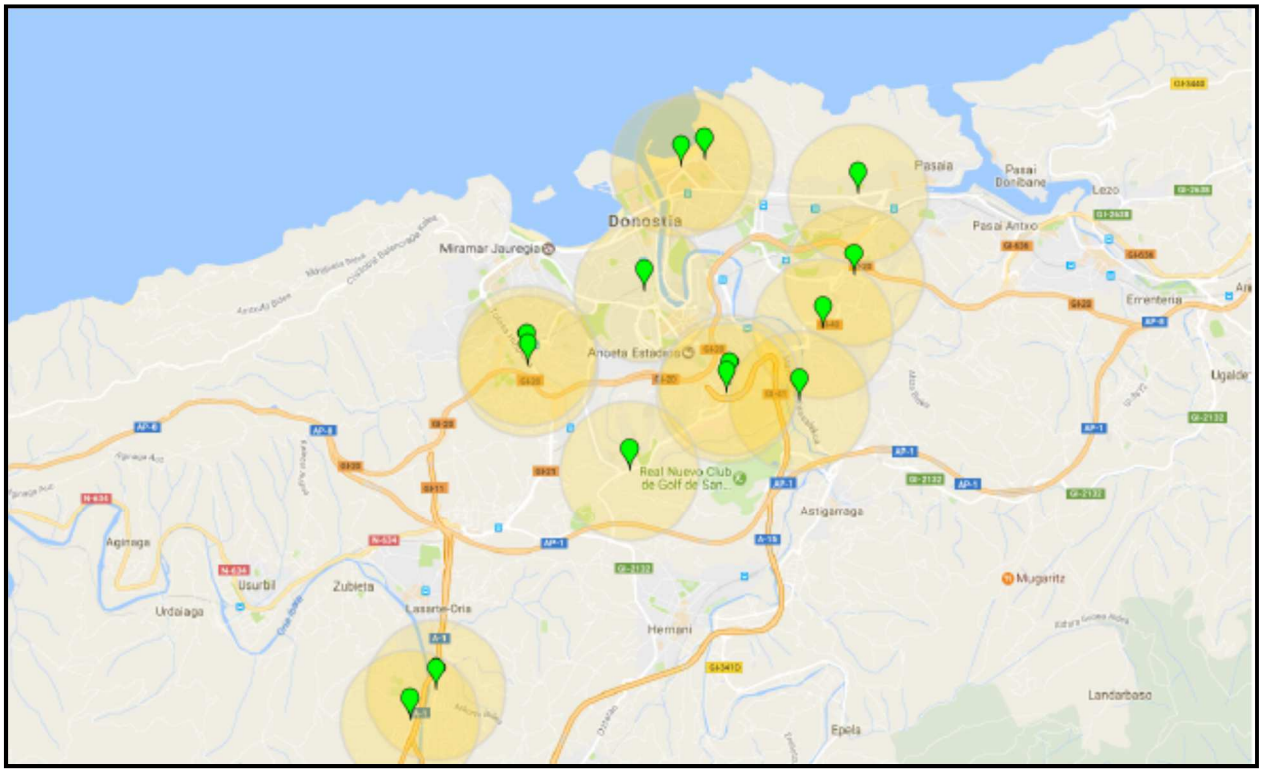

[Picture 10. Gas stations facilities in San Sebastian]

All this deployment of recharging points, both underground and on the surface, must be done in harmony with the environmental strategies of San Sebastian, among which the future pacification of an area of the city with limited traffic stands out, which makes it necessary to avoid creation of agitation traffic. In the plane below, this zone is observed, shaded in green.

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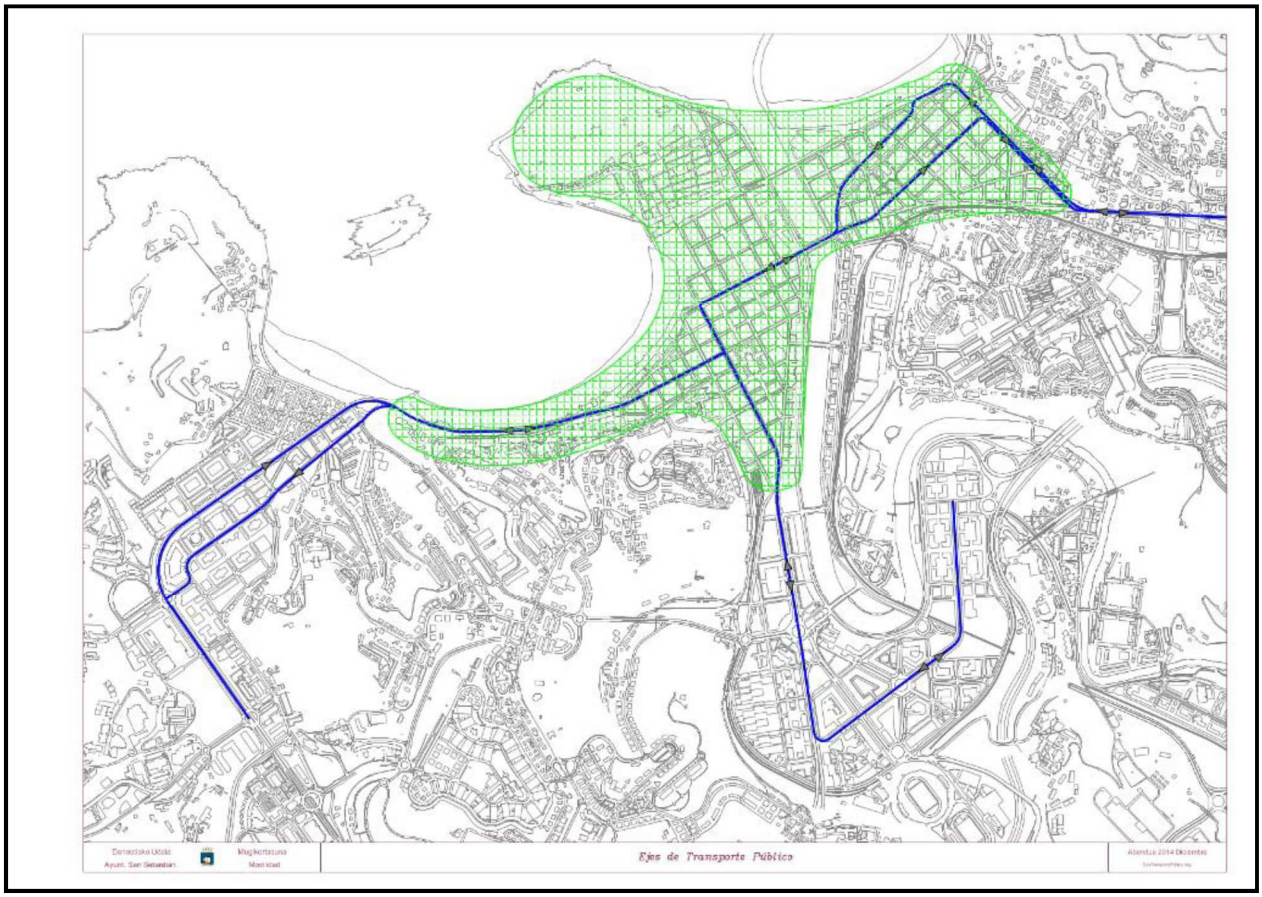

[Picture 11. Low Emissions and Noise zone (LENZ) proposal in San Sebastian]

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10. INSTALLATION, CONFIGURATION AND CHARGING POINTS START UP

10.1 Procedure with the electric energy supplier

The first step in carrying out the installation of the recharging points is the request to supply the necessary power through the electric distribution company (EDE), Iberdrola in the case of Basque Country.

Once the distribution company authorizes the installation to be carried out, the way to proceed with an estimation that may vary depending on the distribution company and the characteristics of the point and nearby distribution lines should follow the next steps:

1.- Municipal authorization

2.- communication facilities link

3.- verification facilities link

4.- municipal signage

5.- execution of works

6.- put in electric tension

The applicant, the City Council in this case, must perform the work and legalize the installation so that the distribution company can carry out the necessary work. This execution of work is around 45 business days, to which it is necessary to add the 45 days of administrative tasks and communications.

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10.2 Installation

Below is a list of requirements and tasks to be taken into account in the process of installing the recharging points:

- Supply of recharging equipment together with the communication modules corresponding to the chosen technology: it must be ensured that the equipment complies with the specifications and functionalities offered.
- Adaptation works of the distribution network to adapt it to the power needs required in the connection (in case the distribution company does not carry out the works). This is a critical point when planning the installation works as it depends on the agility of the response of the distribution company.
- Supply, installation and testing of the service box and control panel with the appropriate protections.
- Supply, installation, connections and tests of the connection line between the supply closet and the recharging points.
- Network of ground protection of the installation.
- Legalization of the installation
- Signaling work in the stations: painting of the reserved spaces, protection pylons and vertical signage for parking regulation according to the decisions taken by the City Council. It is recommended to make a graphic work in advance to define the pictograms, names, colors, etc. of generic electric mobility at the municipality or region level.
- Signposting works for the accesses: indications on the main access axes to each point / station. Design and location to be defined by the City Council.

From all the phases of the process of installing the recharge point on the surface, the one that can be most critical is obtaining the distribution network and registering the point of supply as they depend on the time and costs established with the distributor. When designing and installing electrical cabinets, it is recommended to work with companies accustomed to the standards of the distribution company.

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10.3 Configuration and start-up

After the correct installation of the entire recharging infrastructure, a test should be carried out to verify the perfect functioning of all the elements, especially:

- Verification of the correct functioning of the communications with the control center.
- Start-up and verification of the correct functioning of RFID readers or other devices for interaction with the user

One of the main tasks to verify together with the supplier (or suppliers) of the recharging points is to ensure a good adaptation of all electric vehicle models available in the market at the points to be installed, as there are cases in which connection fails. In the same way, as the electric vehicle market grows, the pertinent checks should be made to ensure a perfect harmony of the offered infrastructure with all possible users.

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11. MANAGEMENT AND OPERATION OF CHARGING INFRASTRUCTURE

As mentioned previously in section 7 "The Role of Municipalities in Electric Recharging", until year 2018 in Spain there was a legal entity called charge manager that was the only one authorized to resell electric power and therefore to operate recharging points.

Although the European Directive 2014/94 / EU of the European Parliament and the Council of 22th October 2014, already contemplated a similar figure of charge manager, the legal conditions that must be met to register as such in Spain, more than promoting development, what it has done has been to discourage it due to all the conditions that were required to register.

Recently the government has decided to back down and in the royal decree 15/2018 of October 8 of 2018, has reported on the elimination of that figure of the charge manager, since as the same royal decree declares, it has revealed itself as an excessively rigid figure and discouraging activity.

The royal decree adds that the measure of eliminating the figure of recharge will contribute to achieving the objectives set in the Strategy of Impulse of the vehicle with alternative energies in Spain.

Therefore, at present there is no definition of requirements that establishes how a recharging infrastructure can be operated, which is why those official bodies that intend to offer a public recharging service are waiting for it to be communicated. The elimination of the figure of the charging manager has also served to regularize the situation of those businesses that offered the recharge service to their customers in an illegal manner.

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12. INNOVATIONS, IMPACTS AND SCALABILITY

In this section, the recharging infrastructure analysis will be done from two points of view:

- On the one hand, the study and analysis carried out for the sizing of the city in terms of electric recharge demand.
- On the other hand, the municipal charging infrastructure installed to service the new electric vehicles purchased by the city council under the framework of the project, both cars and motorcycles.

12.1 Innovation solution

Obviously, the failure to install the recharging points in the planned underground locations of the city, does not allow conclusions to be drawn from the installation, but among the various meetings held with the operators, several possible business model solutions have been discussed to be implemented in the facilities.

Considering that there are 16 underground car parks in San Sebastian, of which 10 are mixed, that is, that they are to service rotation and residents demands, it is precisely in the latter that the installation of the recharging infrastructure has been planned, as it is logical to think, the location of mixed parking is where the population density is higher, which makes sense that part of the parking offer is reserved for residents.

In this sense, it is worth mentioning that the demand for these two groups (residents and rotation) is complementary since, as a general rule, occupancy of the parking for rotation is usually during the daytime and night residents demand is more related to night time. For this reason, and as a transitory measure until the demand for recharging points is high, a balance is sought in the facilities so that the demand of both groups can be met, offering the same service to both groups since their demand is complementary.

The establishment of rates in terms of electricity consumption is adjusted according to the peculiarities of each group, since for example the recharging point should be placed

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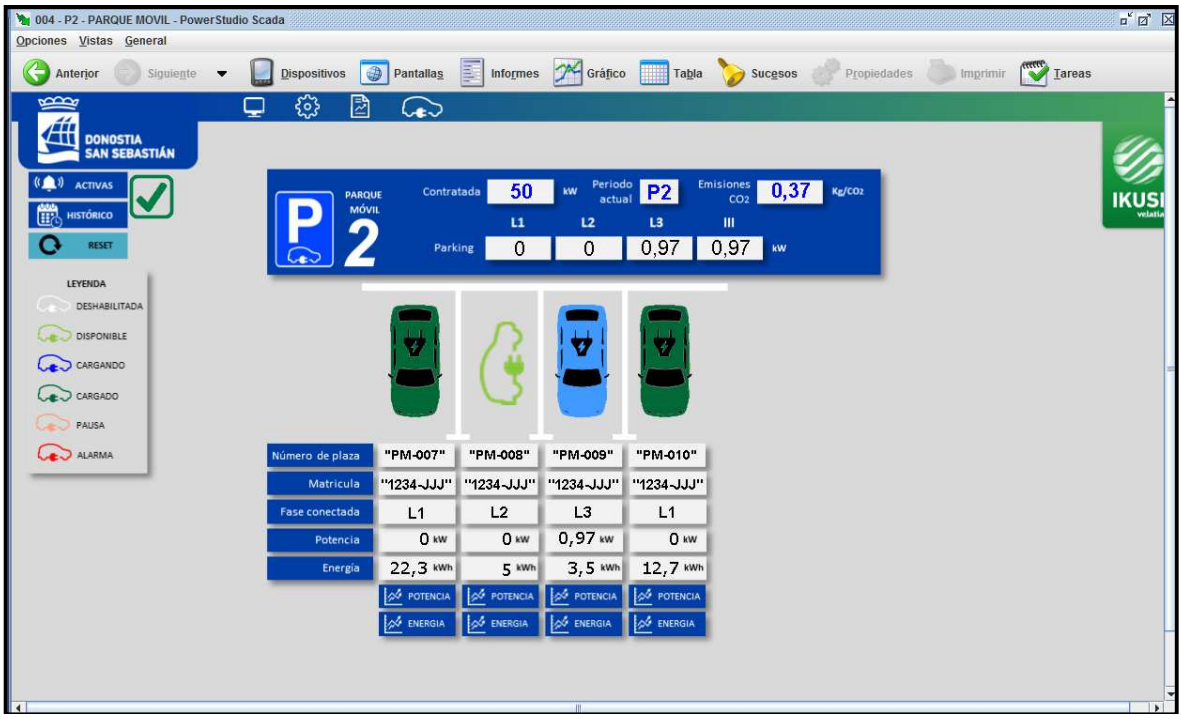
in a rotation location, which will force the resident to take their vehicle to recharge to a location that is not its usual one.

This type of situation is what has led to rethin the charging models in future underground parkings that will have an electric recharge infrastructure in their facilities and that for local operators has meant an innovation to their usual management model.

In the case of the municipal infrastructure, the placement of the recharging posts has led to a study of the electrical power contracted by the building where charging infrastructure is located, since in the sizing of the electrical needs of the buildings at the time of its construction, logically this contingence was not foreseen.

It is true that the demand for recharging municipal vehicles is mainly during the night time, which is the period in which there is usually no activity in buildings, so that practically all of the electrical energy provided for the building can be used for recharging of the vehicles. The monitoring software linked to the recharging infrastructure also makes it easier to know the true recharge demand and if there may be saturation peaks in the network.



[Picture 12. Municipal Charging Infrastructure Software Screenshot. Situation of charging slots]

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12.2 Social impacts

As mentioned in the previous section, the lack of physical implementation of the infrastructure has prevented having a social impact, although it is true that it has allowed reactive infrastructure that was in disuse. Specifically in San Sebastian, the car-sharing service that was operating between 2012 and 2014, left an infrastructure without use that thanks to the measures carried out within the Replicate project before the arrival of electric mobility in the city, they have served to retake that infrastructure and currently they are taking the corresponding steps to offer this recharging infrastructure as a public service.

The bureaucratic process is being longer than expected, since this infrastructure initially had a private use directed only to the customers of the car-sharing service and to be able to transform the service into a public service it was necessary to sign an agreement with an entity that it has to take charge of said infrastructure, and be able to restore it technically.

Anyway, from the city council it has been considered beneficial to re-establish the system in that way, since it is a need that was already demanded in a timely manner and that with the gradual increase of electric vehicles in the city, it is understood that it will be a recharge offer that will have a remarkable use, because it is also well located within the city.

12.3 Environmental impacts

In the case of municipal infrastructure, the environmental impact is more linked to the use of the vehicle fleet rather than the infrastructure itself. As reflected in the deliverable D3.6 (Report on the deployment of EVs in the city of San Sebastian), the incorporation of both vehicles and motorcycles in the municipal fleet has had a positive environmental impact, providing savings of 7,140 and 8,790 tonnes of CO2 respectively.

Logically, as the urban infrastructure extends the environmental impact will also be affected in a positive way since the proportion of electric vehicles with respect to the total number of vehicles circulating in the city will also increase.

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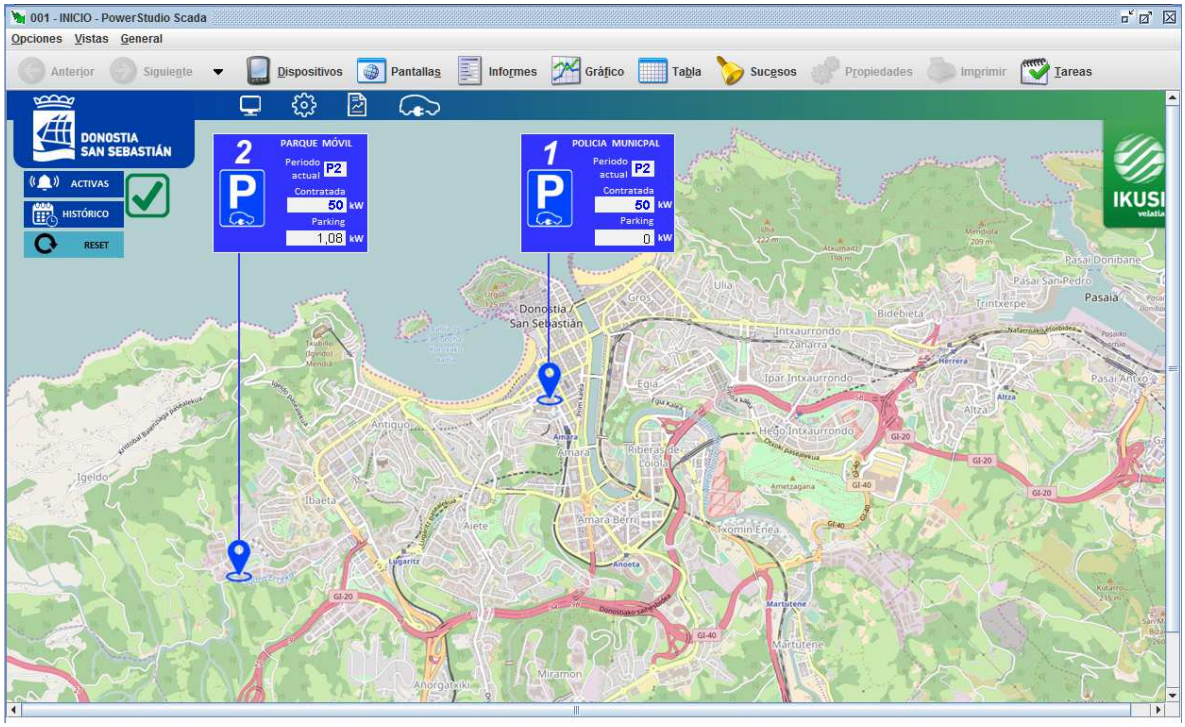
12.4 Replication and scalability potential

The consultations received by the surrounding municipalities on the incorporation of electric fleets to provide the corresponding public services has also led to consulting about the linked infrastructure.

The fact that the municipal infrastructure is "joined" by a common software generates a pull effect, since other municipal departments can benefit from having a "free" monitoring in addition to being part of an "electrical" community, which facilitates communicating with the supplier when doing so from a more global position than if he did it as an isolated client.



[Picture 13. Municipal Charging Infrastructure Software. Charging Points Location screenshot.]

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13. CONCLUSIONS

As it can be deduced throughout the content of this document, the deployment of a charging infrastructure for electric vehicles in a city is not something that only affects a mobility plan. Although, the arrival of the electric vehicle as an element that will interfere in daily traffic it can be considered a mobility matter, all the services derived from it have a direct effect on city configuration, both in terms of land planning as of the available energy resources.

An urban recharge network should be integrated into the urban plan of the city due to the impact it has on city's daily activity. From the city council point of view, not only the mobility department is affected, but other departments must also be involved in the design of the recharging network since the impact is not limited to traffic circulation but to the general layout of the city.

Today the placement of a network of recharging on the street has a visual component that shows the commitment of the city towards a more ecological model, but it is also true that this positive factor becomes negative when generating more obstacles and furniture in the public space. The search for a balance between positive and negative factors is what should prevail in the deployment of a recharging infrastructure balanced with the rest of the mobility of the city.

In the case of the city of San Sebastian, and in many other cities of the state, the elimination of the legal figure of the charging manager, will increase the freedom of action when it comes to defining the services destined for public recharge, whether it is an internal or external management and that it will involve a restructuring of policies aimed at promoting the model of electric mobility in urban environments.