

# Barcelona metropolitan area



## Local context

### City size and context

Barcelona metropolitan area (AMB) counts 3,2 million people and is one of the largest metropolitan areas in Europe in terms of population. In Spain, the metropolitan area of Barcelona is second only to the metropolitan area of Madrid.

AMB is the global administration, and it comprises Barcelona city and 35 municipalities.

The metropolitan system of linked cities around the city of Barcelona -surrounded by open spaces- brings with it benefits for the environment, the economy and leisure, making it a liveable, efficient, and healthy city.

Barcelona is considered an attractive place to work, as well as a good place for investing and developing new business projects. The metropolitan city is perceived as an

innovative and creative metropolis, linked to the areas of culture, fashion, architecture, art, modernity, and sport.

### KEY FIGURES

**Population:** 3,239.337

**Area:** 636 km<sup>2</sup>

**Density:** 5,093.30 people/km<sup>2</sup>

**Average density in urban areas:**  
10,611.04 people/km<sup>2</sup>

**NUTS level:** NUTS-3

**TEN-T corridor(s):** Barcelona, and its metropolitan area, is an urban node of the Mediterranean corridor, with a first level port and airport also included in the TEN-T.

**USER-CHI role:** demonstrator city

The metropolitan area of Barcelona is one of southern Europe's chief economic engines, a hub for logistics and a magnet for talent, a place that is open to business.

### Geography

The metropolitan area of Barcelona is located at the northeast of the Iberian Peninsula. It is composed by a central plain fully urbanised (including big cities as Barcelona, l'Hospitalet de Llobregat, Badalona or Santa Coloma de Gramenet), one river in each side (Llobregat river and Besòs river), agricultural areas along the Llobregat river, and 25 km of Mediterranean beaches in front. The large green areas of Garraf, Collserola and the Marina mountains are placed in the middle, between the central plain and an interior plain called Vallès.

### Modal split

The modal split in Barcelona city and in the

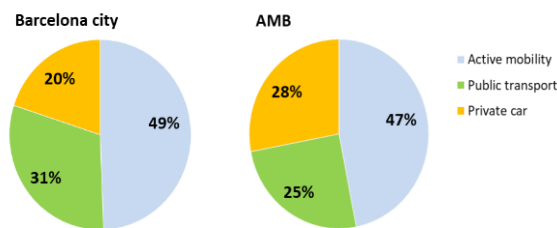


FIGURE 2: MODAL SPLIT IN BARCELONA AND AMB. SOURCE: ENQUESTA DE MOBILITAT EN DIA FEINER- EMEF 2018

Metropolitan area of Barcelona (labour day, 2018) is summarised in Figures 1 and 2.

Public transport includes bus, metro, tramway and taxis.

Shared mobility represents an important element in the AMB landscape. Taxi services

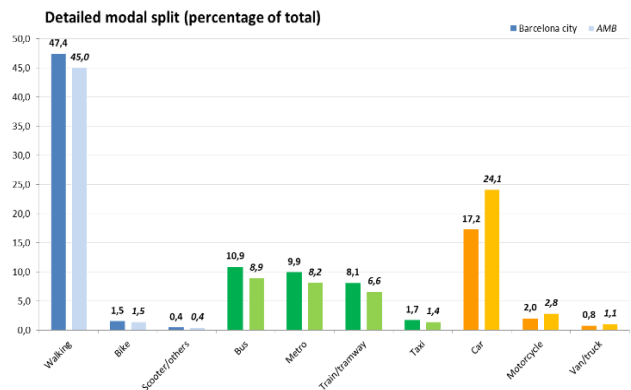


FIGURE 1: DETAILED MODAL SPLIT (% OF TOTAL). SOURCE: ENQUESTA DE MOBILITAT EN DEINER – EMEF 2018

as UBER or CABIFY are legally limited, however, they count for 6-7% of total taxi services (in green in Figures 1 and 2). Car sharing services count for 2% of total car trips. Moto sharing services (only available in Barcelona city) count for 2% of total motorcycle trips. Bicing -the public bike system of the city of Barcelona- counts for 18% of total bike trips in the city. As of today, the shared fleets are very concentrated in Barcelona city centre.

### Electric vehicles

The number and type of electric vehicles in AMB are shown in table 1. The data below refers to the AMB territory in 2018 and it is approximated.

TABLE 1: SOURCE: ESTIMATED FIGURES FOR 2018 BASED ON DGT, ICAEN AND AMB DATA

2018	TOTAL	EVs	Light Electric Vehicles (LEVs)				Light duty vehicles (LDV)		Heavy duty vehicles (HDVs)	
		Private cars	e-bikes	scooters	Motorcycles	Four-wheeler	Vans	Trucks (light)	Trucks (heavy)	Buses
BEVs	8,205	2,350	11,600	no data	5,400	20	220	200	-	15
PHEVs	12,600	1,000	-	-	-	-	-	-	-	-
HEVs	19,950	19,600	-	-	-	-	-	-	-	350
<b>TOTAL</b>	<b>40,755</b>	<b>22,950</b>	<b>11,600</b>	<b>no data</b>	<b>5,400</b>	<b>20</b>	<b>220</b>	<b>200</b>	<b>-</b>	<b>365</b>

## Charge point characteristics

### Payment options

At present, the on street public charging points are free of charge -after registration via web or app-, to promote electromobility. The next step will be to charge the users for the energy consumption via payment via credit card registered and validated when the user signs up in the database of the service.

Charging points in car parks apply an additional rate (according to the energy consumption or a fixed amount by service) to the hourly rate. The payment is done at the cash desk by cash or credit card. Often, users need to ask previously the cash desk to switch on the charging point.

When it comes to charging points in shopping centres, it is not unusual to find free charging in their car park.

Finally, for charging points in gas stations an energy consumption rate or a fixed amount by service is applied. The payment is done at the cash desk by cash or credit card. Some gas station networks have an app to register the users and provide them with pre and post payment via credit card.

### Total RES supplied

At present, the renewable energy supplied in the public charging points (quick chargers) located in AMB territory is not significant, but it is foreseen to switch to renewable sources in the very near future. Nevertheless, a limited number of public charging points (normal chargers) are connected to solar panels, although the renewable energy sources share supplied to the electric vehicles is limited.

## Electromobility strategies and initiative

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### State of play

Modern electromobility was introduced in Barcelona by the former MOVELE project (2011-2012), a partnership between the Barcelona City Council, the IDAE (Instituto para la Diversificación y Ahorro de Energía, linked to the Spanish central government) and ENDESA (the main electric power supplier in the metropolitan area of Barcelona). The project foresaw the instalment of more than 70 normal charging points in the streets (the first ones in the city) for electric motorcycles and cars.

The MOVELE project aimed to reduce pollution, however, did not reach its scope due to the lack of electric vehicles and users, the lack of technical maintenance and as an effect of vandalism.

The next step was then the creation of the LIVE Consortium in 2011, a public-private partnership open to all the bodies and organizations in the area of Barcelona and Catalonia region related to electromobility promotion. In the last years, LIVE has clearly worked as a network for knowledge sharing, dissemination and information related to electric cars.

Thanks to the relationship established in the LIVE consortium between the Barcelona City Council, AMB and the electric car makers NISSAN, RENAULT and BMW, a new project was launched to introduce public quick charging points in the whole metropolitan area.

More than 20 quick charging points were introduced in the streets of the city of Barcelona since then. This public-private funded project coincided in time with the launch of the NISSAN LEAF car, the NISSAN

e-NV200 van (made in Barcelona in the NISSAN factory), the RENAULT KANGOO van and the BMW i3 car.

After the completion of the quick charging network, the local administrations (including AMB and the city of Barcelona) implemented several initiatives to promote electric cars, such as car purchase subsidies, reduced car taxes, reduced parking hourly rates, reduced fares in toll roads, etc... As a result, electromobility began to take-up in Barcelona.

In 2020, before the COVID-19 crisis, even though the public administration continues to expand the public charging network and to ban the petrol or diesel cars in city centres as a manner to reduce pollution, there is the need to transfer leadership to the private sector (car makers, energy suppliers, charging point operators, investors, etc....) to scale-up electromobility.

### Supporting policies for zero emission vehicles

From 2011 to 2020, several supporting policies have been implemented in the metropolitan area of Barcelona to promote electric vehicles.

#### Private electric cars

Several incentives are provided to foster private electric cars, including: purchase subsidies (around 5,000 € per car, through a Spanish central government call); reduced annual local taxes (75%-100% for BEV cars); reduced fares in toll roads (only in toll motorways managed by the regional government); reduced parking hourly rates (100% free for BEV cars, only for regulated on street parking lots); subsidies for public

and private investors for the extension of the charging network (through a Spanish central government call and a regional government call); free energy in public charging points managed by the local administrations, such as AMB.

During 2020 a low emission zone - called ZBE<sup>1</sup> - will be created in the city of Barcelona. The ZBE bans the entrance to all the most pollutant cars and vans, encouraging the use of electric vehicles.

#### Light electric vehicles

Financial incentives for LEVs include for instance subsidies to the citizens for the purchase of an electric bike (250 € per e-bike). More than 4,000 e-bikes were subsidised during the last six years. There are also purchase subsidies for municipalities to buy electric motorcycles for officials (around 3,000 € per motorcycle, through an AMB call).

AMB has distributed almost 500 e-bikes to the metropolitan municipalities. These electric bikes have become part of the public fleet available for officials and local students.

Moreover, AMB has also distributed e-bikes to the workers in the metropolitan area, in a free temporary rental to encourage them to go to work by bike.

In 2019, AMB has open a call to assist small logistic companies to purchase electric cargo bikes (up to a maximum 50% of the purchase price).

#### Light duty electric vehicles

The majority of supporting policies to electric private cars also apply to light duty electric vehicles (vans), including purchase subsidies for municipalities to buy electric vans to be dedicated to public works

(around 10,000 € per van, through an AMB call).

In 2021, AMB expects to open a new call to assist small logistic and transport companies to renew old diesel vans with new electric, hybrid, or gas vans (2,000-4,000 € per van).

#### Heavy duty electric vehicles

AMB has worked very closely with public transport operators to renew progressively the traditional diesel buses with modern hybrid (petrol and electric) and fully electric buses.

#### Regional and national frameworks

Before the COVID-19 crisis, the Spanish central government was working on a new law called *Ley de Cambio Climático y Transición Energética*. This law (and some existing technical regulations) could be considered the first electromobility framework for Spanish cities.

In this law<sup>2</sup>, the responsibility to guarantee a charging network for electric vehicles in Spain is assigned mainly to the private sector, especially the one dedicated to fossils fuels distribution. For instance, the law fixes a minimum number of quick chargers in the new or in the busiest petrol stations.

At regional level, there is another strategic framework for electric mobility: the Catalan law about climate change (*Llei 16/2017, de l'1 d'agost*) and the new one called *Llei de Transició Energètica de Catalunya*, also under discussion. However, what is relevant at regional level is the PIRVEC programme: *Pla estratègic per al desplegament d'infraestructura de recàrrega per al vehicle*

<sup>1</sup> For more information: <https://zbe.barcelona>

<sup>2</sup> Not yet approved at the time of writing

elèctric a Catalunya 2016-2019 (an updated version is in progress).

The PIRVEC programme seeks the collaboration between public (regional and local administrations) and private agents with the aim to advance towards a sustainable mobility based on electric cars. Therefore, the main PIRVEC goal is to achieve a regional charging network with more than 100 quick chargers spread throughout the region (by 2019)<sup>3</sup>.

Despite the new legal frameworks, the effective initiative in electromobility remains as of today with the local administration (city councils of medium and big cities). This is especially true in the innovative metropolitan area of Barcelona. However, the economic resources are limited at local level, and the central and regional governments will keep the power to adjust the local investments in electromobility with the different specific subsidy calls.

This kind of collaboration arrangement between central and regional government (granting the economic resources) and the local administrations (deciding on the best initiatives in each territory) has been a good scenario for the development of electromobility in the metropolitan area of Barcelona. Electric car makers present in the area accepted this formula and joined their efforts with the administrations.

## Deployment approaches

The deployment approach adopted in the AMB is centred around a basic network developed and managed by AMB and other

local administration in the metropolitan territory (the city of Barcelona and other big municipalities). In addition, private companies, in concertation with the main energy providers in the area, could complete the network in the future.

The public charging network in the streets of Barcelona, formed by more than twenty quick chargers, is owned by City of Barcelona, working as CPO and EMP.

The public charging network in the metropolitan area of Barcelona is a twin network to the Barcelona one. In other words, they use the same equipment, same conditions, and same instructions, but different apps. The AMB network is constituted by quick chargers (10) as well, and AMB acts as CPO and EMP. In 2019, this network delivered more than 380,000 kWh.

Both charging networks have ambitious expansion programs for the next years. For the AMB network, the expansion program is a measure approved in the *PMMU-Pla Metropolità de Mobilitat Urbana 2019-2024*.

Private charging points could be installed in the metropolitan area of Barcelona but, as of today, the electric fleet is not enough developed for a large charging points offer. Consequently, the public networks, with free energy, absorb all the demand and prevent business opportunities for the private sector.

## Good practices

The metropolitan area of Barcelona accumulated a few best practices and

there are 85 public quick chargers and 19 private quick chargers. All of them with public access.

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<sup>3</sup>According to the 2020 PIRVEC INDICATORS, at the end of 2019 second semester, the goal of 100 quick chargers at regional level has been achieved: today,

solutions related to the deployment of electromobility, especially in respect to dissemination, communication and user-friendliness.

### **A regional Memorandum of Understanding**

At regional level (Catalonia), it was created a Memorandum of Understanding (MoU) between municipalities acting as CPOs to make all the municipal RFID<sup>4</sup> cards interoperable in any charging point. The RFID cards are the most used means of service authorization in a charging point. This MoU avoids the users have to carry a set of cards when travelling around Catalonia with an electric car.

### **An app to get access to the charging services.**

The AMB and the Barcelona charging point networks are now available through an app (or with the aforementioned RFID card). Unfortunately, at this first stage, each network has a different app (AMB *Electrolineres* for the AMB, *SMOU* for Barcelona), but they will converge in the future. The apps give on-line information about the availability of chargers, allow user registration, facilitate user authentication for service at a charging point, allow starting and stopping the charging operations, and give the user information about invoicing, historical data, personal preferences, etc.

### **Communication strategy**

As EMP, AMB and Barcelona have put in place a big communication effort in the last years to promote electromobility to the public: conferences, participation processes, local exhibitions and publications have been carried out. Furthermore, a name and a

brand image have been designed for them: AMB *Electrolineres* in one case, and *Barcelona endolla't* in the other case, and when the charging networks have been fully implemented, the service instructions have been deeply communicated.

### **Free charging at public charging points.**

Finally, the impact of free charging in the public charging networks must be recognized. A lot of new electric cars (BEV and PHEV) have been purchased with the incentive of a low travel cost in comparison with diesel or petrol cars.

## **Challenges and barriers**

Despite the great progress, some barriers to electromobility remain however in the Barcelona metropolitan area. For example, socioeconomic conditions are still too low to expect a wide take-up of electric cars in the market. High prices and low range of battery electric vehicles make them still not enough attractive to users, who prefer hybrid cars. Similarly, the available electric vans on the market are expensive and have a low range, which make them less attractive than diesel and petrol vans to private companies.

Finally, having a parking place with a domestic charging point continues to be the most convenient option for recharging. However, in some metropolitan municipalities the use of on streets charging points remains the only possibility, but the number of normal on street charging points is today very low or zero and thus not ready to accommodate a demand increase.

The number of public charging points in the metropolitan area of Barcelona increases

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<sup>4</sup> Radio frequency identification uses electromagnetic fields to automatically identify and track tags attached to objects.

very slowly due to the current economic trends, but it is expected that the electric car sales will grow after the current car makers' promotion campaigns. That could cause a collapse of the public charging networks.

However, the area of Barcelona offers some opportunities for the further deployment of electromobility. For example, Barcelona can count on a significant segment of young people with high environmental awareness -due to the chronic pollution problems in the city centre- and thus very favourable to electromobility. In addition, Barcelona is home to a high share of tech passionate and high-income people open to innovation, sometimes organized in active clusters, associations, and platforms.

The presence of electric car, and van (NISSAN), as well as electric motorcycle (SCUTUM) makers in the area creates the conditions for fruitful partnerships and public-private collaborations. Furthermore, the presence of such industrial segments fosters periodic exhibitions and demonstrations of e-bikes, electric motorcycles, electric cars and vans, which help promoting electromobility to potential users.

Finally, the close cooperation between administrations has proven a success in the

past and continues to be an important asset for further development of electromobility.

### Learning needs

In line with the open issues in the metropolitan charging networks, there are some topics where further learning and knowledge sharing is needed:

- Payment methods and rates applied.
- Enforcement, or how to control the charging time, how to disincentivise electric cars parking in the charging point after the recharge operation is completed.
- Positive discrimination: in a charging point, how to give preference to BEV cars over PHEV cars.
- Ultrafast charging (up to 150 kW) technology and feasibility.
- Charging points for shared services with electric cars or motorcycles.

## USER-CHI solutions

In Barcelona, all the eight USER-CHI products will be demonstrated. The USER-CHI products are the following:

- **CLICK- Charging location and holistic planning kit:** An online tool for the location planning of new charging infrastructure in cities and TEN-T corridors.
- **Stations of the future handbook:** Guidelines and recommendations to design the perfect user-centric charging station of the future.
- **eMoBest – e-Mobility replication and best practice cluster:** A collaboration platform to facilitate the transfer of best practices among



the demonstration and replication cities.

- **INFRA – Interoperability framework:** A package of rules, guidelines and recommendations that will support highly interoperable processes among the electromobility stakeholders.
- **INCAR – Interoperability, charging and parking platform:** A platform providing roaming and barrier-free access to EV charging points and offering related innovative integrated services for the EV drivers.
- **SMAC – Smart Charging tool:** A tool providing smart grid integration and demand management services for slow, medium, fast and ultrafast charging.
- **INSOC – Integrated solar DC charging for Light Electric Vehicles (LEVs):** A solution combining charging, onsite production of renewable energy and theft-proof parking for Light Electric Vehicles.
- **INDUCAR – Inductive charging for e-cars:** A wireless and highly automated charging solution for e-cars.

At this stage, 3 main areas of intervention have been identified in Barcelona (or around Barcelona) as USER-CHI demonstration city:

### Demo site solution 1: solar DC charging for e-bikes

The solar DC charging for e-bikes solution foresees the installation of a DC charging equipment for e-bikes fed with solar energy in a theft-proof parking or dock. The e-bikes will be part of an existing public sharing service in selected municipalities around Barcelona.

#### Stakeholders involved

A local e-bike maker, Digital System Integrator (DSI) as RES specialist, and AMB as manager of the public sharing service e-Bicibox.

#### Objectives

To facilitate the recharging of empty e-bike batteries, without removing the bike or the battery, and using renewable energy.

#### Timing

The technical definition of the solution will be carried out in 2021, followed by implementation and testing in Barcelona in 2022.



### **Demo site solution 2: inductive charging for EV fleets**

This solution foresees the installation of inductive charging equipment for a corporate fleet to facilitate overnight charging.

#### **Stakeholders involved**

IPT technology as technical specialist, and AMB as manager of a corporate EV fleet.

#### **Objectives**

To show the advantages and the feasibility of inductive charging for EV fleets.

#### **Timing**

The definition of the technical solution will happen in 2021, while the implementation and testing will be carried out in 2022.

### **Demo site solution 3: ultrafast charging for EV long travellers**

This solution plans the installation of an ultrafast charging point (up to 150 kW) in the Barcelona area as a node of the TEN-T Mediterranean Corridor.

#### **Stakeholder involved**

Local electric works company, AMB as CPO and EMP of the public charging network with points on the TEN-T Mediterranean Corridor.

#### **Objectives**

To offer an ultrafast charging point to the EV long travellers and test some user centric products developed in the USER-CHI project.

#### **Timing**

The definition of the technical solution will happen in 2021, while the implementation and testing will be carried out in 2022.

