Barcelona, a city committed to the environment

Ajuntament de Barcelona

Environmental report **2013**

Presentation

This report describes the situation of the environment in Barcelona and updates the dossier entitled Barcelona, a city committed to the environment, published in 2010.

The city was then going in for the European Green Capital award, a process which involved compiling and editing all the information required by the European Commission to assess the candidates for this award. The exhaustive questionnaire for the competition requests detailed information on specific environmental indicators, measures taken over the last few years in particular aspects and future objectives and projects. The report drawn up therefore provides a very comprehensive view of a city's environmental performance. On the one hand the dossier can be read as a catalogue, explaining how the city works in different aspects, but it can also serve as a report on activities and a statement of results. This document can also be compared with dozens of other cities reporting on the same aspects and using the same criteria and parameters.

These characteristics make the report highly valuable in its own right, quite apart from its application for the award, and it has been of great use over the last few years as a source of basic information, to explain the policies implemented by the city and even to certify the Council's environmental work before other organisations. It therefore seemed useful to update the dossier produced five years ago and make this into a regular five-yearly report on the state of the environment in Barcelona.

We present this report to allow access to the relevant information, with a keen interest in sharing the progress that has been made, with the commitment to call attention to any emerging challenges and in the hope that we are thereby fostering progress towards a better city.

Joan Puigdollers i Fargas
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Barcelona City Council

Introduction

This document covers the state of the environment in Barcelona, described in twelve chapters focusing on different aspects.

Each of these chapters defines the vision of the future for the city in its specific area, providing indicators and information on the present situation and listing the measures carried out in the last five years which have made it possible to get as far as we have. They also contain a statement of the measures already planned or envisaged for the near future which will help us to progress towards the vision of the future we aspire to.

The report does not provide an exhaustive compilation of the activities carried out but highlights the most relevant ones, either because they've brought about progress in environmental terms, because they enable us to understand how the city has developed or because they've made a great impact on citizens and good practices. It therefore contains some innovative, singular and emblematic measures which may also serve as inspiration for other cities. These are represented in the report in different ways depending on the type of measure in question.

The information provided is mainly on the work done by Barcelona City Council but, since many environmental aspects lie outside municipal competences, some of the data refer to other supralocal administrations as well as citizen involvement.

As far as possible, the content follows the guidelines laid down by the organisers of the European Green Capital initiative but it also provides details of other aspects that are considered to be priorities for the city, such as the vision for the future, work carried out with citizens, organisations and companies on a co-responsibility basis and the Smart City approach.

Compared with the previous report, this time we've attempted to bring in certain improvements by including graphics summarising each of the chapters, making it easier to read for those who only wish to leaf through, and by adding links to the most relevant sources of information throughout the document so that readers can read further on the topic. As in the previous edition, there is also an executive summary report.

Types of measures

- Planning and management
- Tools and actions in general
- Cooperation, international work, sharing experiences
- Improving knowledge, information, awareness and participation

Basic Data 2013

Region

02º 07’ 31’’ E longitude

41º 25’ 10’’ N latitude

412 m above sea level

10,216 hectares municipality

158 inhab/ha density

29.10 km² green areas

4,395 m beaches

Climate

15.8 ºC annual average

35.1 ºC maximum

-1.6 ºC minimum

2,776.4 hours of sunshine per year

967.0 hPa average

987.2 hPa maximum

932.6 hPa minimum

69 % relative humidity

580.0 mm total

40.2 mm maximum rainfall

112 days of rain

9 days of storms

Population

1,611,822 inhabitants

4,788,422 inhabitants in the metropolitan region

82.6 % population Spanish

17.4 % population foreign

83 years life expectancy (2012)

8.2 birth rate

9.2 death rate

7,571,766 tourists

16,485,074 overnight stays

Social indicators

€18,700/year
disposable household income per capita

18.3 %
at risk of poverty (2011)

89.40 %
secondary school graduation rate (2012-2013)

78.1 %
households with internet access

Economic indicators

€38.500
average GDP at market prices per inhabitant Base year 2000

17.2 %
unemployment

78.0 %
participation rate (4th quarter)

65.4 %
employment

Environ-mental indicators

18.1 m²/inhab
green areas

✔ *2003 - 17.39 m²/inhab*

16,782 GWh
total energy consumption (2012)

✘ *1999 - 15,664.78 GWh*

108.4 l/inhab per day
domestic water consumption

✔ *1999 - 137.5 l/inhab. per day*

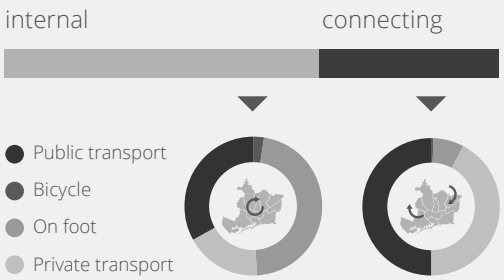
730,285 tonnes
urban solid waste

✔ *2003 - 860,338 tonnes*

36.2 %
separated waste collection

✔ *2003 - 23.95 %*

7.7 million
trips per day



40 micrograms/m³
average annual level of NO_2

✔ *2003 - 55 micrograms/m³*

24 micrograms/m³
average annual particle level (PM_{10})

✔ *2008 - 36 micrograms/m³*

Summary

Energy and climate change mitigation

Barcelona, a city committed to combating climate change

Energy and climate change mitigation

Vision of the future

Becoming a self-sufficient city with zero emissions

Current situation

Final energy consumption (2012)

16.782 GWh

10.35 MWh per capita

Self-sufficiency

1999 **0.33 %**

2012 **2.08 %**

CO_2 emissions (2012)

1999 **3.19** tonnes de CO_2 per capita

2012 **2.28** tonnes de CO_2 per capita

Lines of work

Committed to combating climate change 'Signing of the Covenant of Mayors'

Innovation 'Electrifying vehicle fleets' 'Smart street lighting'

Self-generation 'Solar on new and renovated buildings' 'Renewable energies in municipal buildings'

Efficiency 'DH&C networks taking advantage of residual cold and heat'

Self-sufficiency and reducing emissions 'Energy Self-Sufficiency Plan'

1.1 Vision, challenges and opportunities

Vision of the future

In the fight against climate change, Barcelona wishes to become a self-sufficient city with zero emissions. That's why we need a change in the energy model to ensure guaranteed sustainability. To achieve this, we need to make progress in three key aspects: significantly reducing demand and consumption (savings and efficiency), increasing the generation of energy by means of local resources (renewable and residual sources) and thereby reducing dependence on fossil fuels, and optimising the networks of infrastructures already in place.

On its way to self-sufficiency and zero emissions, Barcelona needs to take advantage of the opportunities provided by aspects intrinsic to the city such as its mild climate, at the same time as having to overcome the challenges and difficulties involved in being a major economic force and complex urban area.

- **Barcelona, a densely populated Mediterranean city.** The city's 'Mediterranean character and its mild climate make life easier in terms of energy consumed for heating and its density helps us to take advantage of each kWh used for more people, unlike other cities. For these two reasons, Barcelona has a moderate energy consumption in comparison with other conurbations.
- **The urban heat island effect makes temperatures rise.** Despite the city's benign weather thanks to its Mediterranean climate, Barcelona's temperatures are rising, mainly through the heat island effect. This effect (which consists of a rise in temperatures in urban zones because of the heat retained in the paving and buildings) leads to changes in energy habits of those living in Barcelona, with a lower use of heating in housing, offices and services during winter but an increase in the use of air conditioning throughout the summer.
- **Barcelona, one of the country's major economic and tourist centres, the hub of a great deal of activity.** Barcelona's strategic location in the centre of the Mediterranean corridor and with one of the most important ports in the Mediterranean makes the city a great economic centre and transit zone. In fact, Barcelona's area of influence is not only the metropolitan area or the metropolitan region but practically the whole of Catalonia. Producing this enormous amount of activity requires significant energy consumption and greenhouse gas emissions are further aggravated by mobility.
- **Barcelona, a city of great social and multicultural complexity.** Even though the migratory process has been interrupted by the present economic situation, Barcelona is a highly diverse and complex city and has become home to a mix of very different cultures. This is something to be taken into consideration when assessing the city's trends in energy consumption as social conduct in terms of energy use is very closely associated with a society's energy consumption and each culture often perceives the use of energy differently.
- **At present there is no law supporting the use of renewable energies** by means of incentives and/or tax rebates as a result of the enactment of Royal Decree 1/2012, which abolished economic incentives for new electricity production installations under the special regime (for cogeneration, renewable energy sources and waste treatment).

1.2 General context and current situation

For years Barcelona has been committed to combating climate change, which is why energy management ⊕ and the reduction of greenhouse gas emissions are priorities on the city's political agenda.

Even so, Barcelona has the same underlying problems as many other cities: its energy consumption may be relatively low but it's still high overall as a whole and the sources of the energy consumed could be improved, with only 1.87% of all primary energy consumed coming from a renewable source. Barcelona must therefore reduce its dependence on external energy sources and foster local, renewable energy on a network basis; i.e. increase its self-sufficiency.

1.2.1 Electricity and natural gas, the main sources of energy

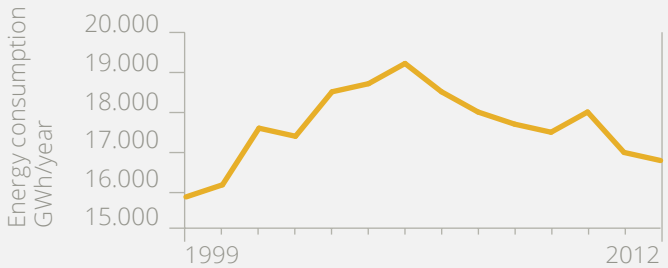
Over the last few years there has been an upward trend in energy consumption with consumption going from 15,664.78 GWh in 1999 to 18,036.88 GWh in 2010. This rise, however, has not been constant as the growth rate was in excess of 3% until 2005 whereas consumption gradually fell between 2005 and 2010, the year when it started to rise again. In 2012 total consumption stood at 16,782 GWh.

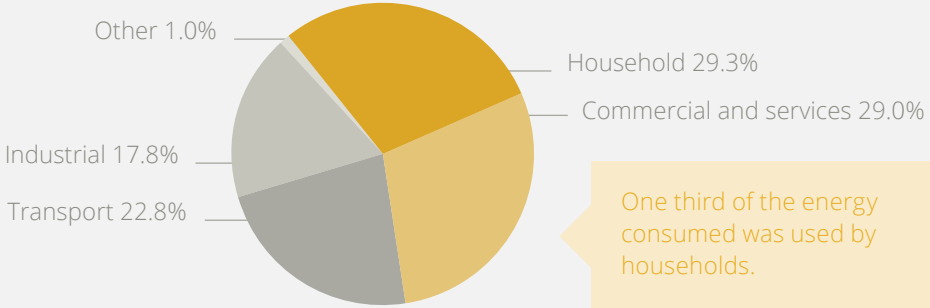
In 2012 the city of Barcelona's consumption per capita was 10.35 MWh/year

One third of all the energy consumed in 2012 was used by households: 29.3%, a further third being used by the commercial and services sector, with 29.0%. The remainder was used by industry (17.8%), transport (22.8%) and other sectors (1.0%).

As regards energy sources, 42.68% was electricity, 35.51% natural gas, 20.69% automobile petroleum and 1.12% Liquefied Petroleum Gases (LPG).

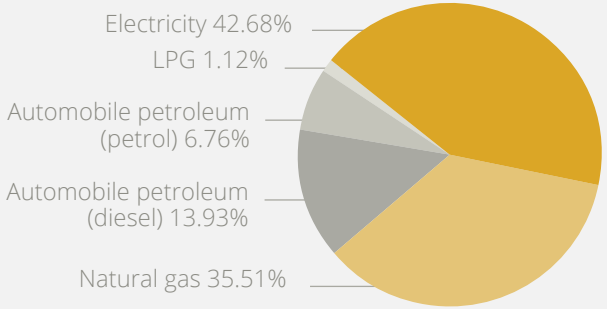
From 1999 energy consumption gradually increased until 2006, at which time it started to drop, except for 2010, when it rose once more





One third of the energy consumed was used by households.

In 2012, most of the energy consumed came from electricity and natural gas.



According to Catalonia's electrical mix for 2012 the energy source with greatest share of electricity generation is nuclear energy (55.42%). This is followed by generation in the form of natural gas at combined cycle power plants (16.17%), cogeneration (12.02%), hydroelectric generation (8.96%), wind power (5.15%) and other methods (2.28%).

In Barcelona's final energy consumption in 2012 this electricity consumption accounted for 42.7% of the total consumption. In terms of the source of the final energy consumed in Barcelona, 42.4% of the total final energy was produced by natural gas, 23.7% nuclear, 20.7% came from fossil fuels, 3.9% from hydraulic power, 5.1% from gas cogeneration, 2% from wind power and 0.3% from solar energy. It should be noted that, in 2008, solar energy represented 0.1% and wind power 0.6%.

Considering Spain as a whole, electricity was mainly generated by nuclear energy (22%), coal (20%) and wind power (18%). Other sources of energy are combined cycle power plants (14%), cogeneration (12%), and hydraulic power (9%).

In Barcelona and the Besòs area in 2012, 5,612 GWh of electricity was generated by large Ordinary Regime power plants, accounting for 78.3% of the electricity used in the city's final consumption. This highlights the continuing great dependence on fossil fuels. Even though there has been an improvement in electricity production facilities, emissions from electricity consumption have continued to grow due to the rise in consumption since 1999.

However, we should also note the progress made by the city of Barcelona in increasing the existing photovoltaic power, for example. This has gone from 2.5 kWp installed capacity in 1999 to 12,388 kWp in 2012.

1.2.2 The city's renewable and residual resources are growing

In 2012, around 350 GWh/year of the total energy consumed in the city of Barcelona came from renewable and/or residual energy from local sources, a share of 2.08%. Though small and clearly insufficient, this amount is still considerable, taking into account the starting point of 0.33% in 1999, involving a sizeable change after the first Energy Plan.

In 2012 Barcelona's self-sufficiency level, meaning the energy generated from local (renewable and residual) resources, as compared with the total energy consumed, was 2.08%.

0.8% of the energy consumed was renewable and generated locally, i.e. in the city itself. This 158.37 GWh/year of renewable energy was generated as follows:

Thermal solar energy: 49%
Photovoltaic solar energy: 10%
Biogas (inc. Garraf share): 32%
Mini hydraulic: 2%
Biomass: 8%

As far as electricity is concerned, 225.59 GWh of the city's total electricity consumption (7,162.8 GWh) is considered to have been produced using local (renewable and residual) resources, which represents 3.15% of the electricity consumption of the city.

Today Barcelona is one of the cities with largest area of solar panels (88,755 m^2 planned) and it has legislation making it compulsory to use solar energy in any new builds and restoration work. As regards photovoltaic solar energy, Barcelona has 12.39 MWp installed capacity.

1.2.3 Barcelona, one of the cities in the western world with the lowest emissions per capita

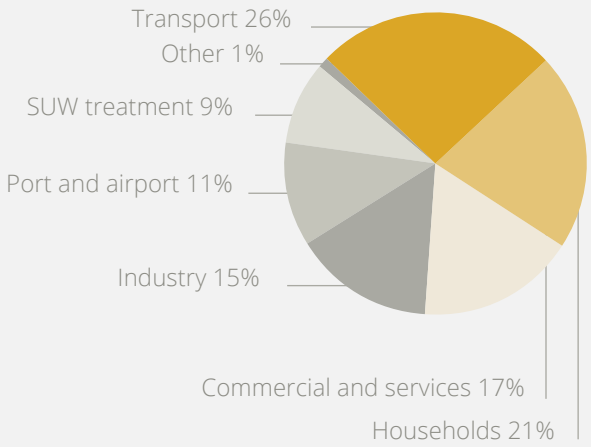
Barcelona is one of the cities with lowest greenhouse gas (GHG) emissions per capita in the western world. The efforts made to combat climate change, with measures to improve energy efficiency and savings and to promote renewable energy sources, are being rewarded with low levels of emissions.

In 2012 Barcelona emitted a total of 3,690,037 tonnes of CO_2, representing 2.28 tonnes CO_2-eq per capita, notably lower than the emissions rate in 1999 which was 3.19 tonnes CO_2-eq. From that year there was an upward trend until 2005, when it reached its ceiling with 3.44 tonnes CO_2-eq, and since then the trend has changed direction, turning downwards.

These emissions are mainly produced by the transport sector (26.46%), followed by households (21.45%) and the commercial and services sectors (17.28%). The rest is divided between industry (14.48%), the port and airport (10.93%), the processing of solid urban waste (8.88%) and other sectors (0.53%).

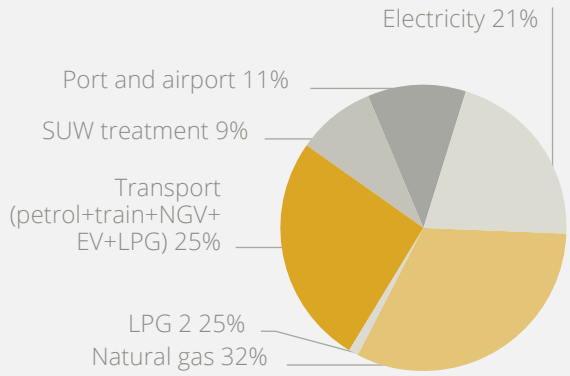
As for sources, 31.5% of the emissions stem from natural gas, 26.46% from transport, including petrol/diesel and electric vehicles (electric trains, natural gas vehicles, electricity for electric vehicles and liquefied petroleum gases) and 21.03% from electricity. The rest is emitted by the port and the airport (10.93%), by the processing of solid urban waste (SUW) (8.88%) and by liquefied petroleum gases (LPG) (1.15%).

In 2010 the emissions per capita produced by transport in Barcelona were 0.59 tonnes of CO_2/inhab. In 2012, greenhouse gas emissions from the consumption of energy were 0.219 kg of CO_2-eq/kWh final energy consumption.



In 2012, transport, followed by households, was the sector producing most emissions.

In 2012, natural gas was the energy source producing most emissions.



1.3 Measures taken to reduce energy consumption and mitigate climate change

True to its commitment to climate change mitigation, Barcelona has taken different planning measures over the last few years to create a general framework and route map marking out the strategic lines to be taken. It has also implemented energy-saving and efficiency measures and promoted the generation of renewable and local power.

1.3.1 Commitment and planning to combat climate change

Signing of the Covenant of Mayors in 2008

On 19 November 2008 Barcelona signed the Covenant of Mayors, once more taking part in the lobby of cities committed to combating climate change. As signatory, Barcelona City Council has undertaken to reduce, by 2020, the greenhouse gas (GHG) emissions of all services under its direct management by 20% compared with the emissions for 2008.

As a result of signing the Covenant of Mayors, Barcelona drew up its own Barcelona Action Plan for Sustainable Energy (PAES). This Plan covers all spheres of action under municipal rule and applies across the board to all areas involved in city and municipal administration. This action plan forms part of the Energy, Climate Change and Air Quality Plan 2011-2020 (PECQ).

Energy, Climate Change and Air Quality Plan 2011-2020 (PECQ)

This Plan reinforces the link between climate change and air quality, prioritising the management of demand and promoting participation among those involved, right from the initial stages. The Plan's main objective is to have reduced per capita greenhouse gas emissions by 23% in 2020 compared with the 2008 levels.

This Plan also applies across the board as it concerns measures in different spheres already being dealt with by other departments, and its structure is based on an initial introductory part common to two parallel programmes on different scales:

- A city programme: related to all the general aspects of the city, concerning both the Council's management and the behaviour and actions of citizens as a whole.
- A municipal programme: related to aspects that come directly under the Council. One of the main parts of the municipal programme is the Plan for the Energy Self-Sufficiency of Municipal Buildings (PAEEM), providing a specific response to compliance with the commitment stipulated in the Covenant of Mayors.

Plan for the Energy Self-Sufficiency of Municipal Buildings 2010-2020 (PAEEM)

The consumption of municipal buildings and installations accounts for around 10% of the total energy consumption associated with municipal activity and public transport. This Plan is therefore one of the mainstays of Barcelona's municipal programme in its Plan for Energy, Climate Change and Air Quality. The PAEEM is designed to save 2,355 tonnes of CO_2-eq/year in the power consumed at municipal facilities.

Barcelona Energy Self-Sufficiency Plan 2024

Bolstering Barcelona's strategy and goal to move towards energy self-sufficiency, the PECQ has made way for the Barcelona Energy Self-Sufficiency Programme. This works with the aim of achieving 10% energy self-sufficiency in 2024 by implementing energy-saving and efficiency measures with a view to reducing the city's energy consumption as far as possible, taking advantage of local renewable and/or residual resources in order to meet this consumption, thereby bringing generation closer to consumption and promoting widespread, local generation.

The PAEEM continues to play a fundamental role within this strategy.

1.3.2 Innovation and technology used to bring about energy savings and efficiency

Measures for overcoming barriers to hiring ESCOs

Hiring Energy Service Companies (ESCOs), and public-private cooperation in general, is becoming an essential tool to improve the energy efficiency of installations, directly reducing energy consumption but also providing other advantages: transferring the risk of installations to the maintenance company, ongoing availability of technical expert advice; setting a stable budget and user satisfaction through the proper maintenance of the installations.

The Barcelona Energy Agency has drawn up a study to analyse the contractual framework and to encourage the hiring of Energy Service Companies (ESCOs).

In spite of all this, hiring the services of this kind of company is still an extremely complex task today, requiring lengthy administrative and legal procedures because of the different legal barriers encountered. The Barcelona Energy Agency has produced a study entitled "Technical Assistance for appraising and overcoming the barriers encountered to hiring ESCOs by Barcelona City Council", providing an in-depth analysis of the contractual framework of ESCOs and proposing

A lot of municipal facilities take advantage of the building's roof to install photovoltaic panels to produce electricity.

measures to overcome these barriers and encourage the hiring of ESCOs to implement energy efficiency measures in public buildings. Work is also being done on a tender for energy management based on the ESCO model for a large number of municipal buildings.

Promoting the regulation and control of buildings as an energy-saving and efficiency strategy

The optimisation of regulation and control is a key measure to implement energy-saving and efficiency strategies. This is an efficiency tool applicable to any kind of system (DH&C, lighting, office automation, communications, among others). It guarantees reductions in energy consumption with no drop in the quality of the service provided and lengthens the useful life of the installations, resulting in economic savings both by reducing the electricity bill and the maintenance required. In November 2011 the Barcelona Energy Agency published its "Basic Guide on energy efficiency in municipal buildings" which describes specific efficiency measures for buildings. It has also drawn up a communication protocol for the energy monitoring systems of buildings with the SENTILO municipal sensor platform and the Agency's own display platform. There are currently 37 municipal buildings being monitored, housing 43 services. It has also monitored municipal renewable energy installations (photovoltaic, mini-wind power, thermal solar facilities, etc.).

Installation of new smart street lighting in Barcelona

In accordance with the new General Plan for Lighting, in 2013 work started on installing new street lighting that is brighter, more efficient and uses new technology. The aims of this new lighting system are to prioritise pedestrians over road users, to improve lighting levels, incorporate systems for control and regulation that improve energy and functional efficiency and to personalise streets, buildings and monuments. Up to 2015, 15 million euros will have been invested to renew 100 street sections and 2,500 lighting points in the city.

1.3.3 Encouraging local energy generation to increase self-sufficiency

Consolidation of thermal solar energy for buildings

2011 saw the approval of a new Environment By-Law whose Title 8 specifies that thermal and photovoltaic solar energy systems must be installed. This applies to almost all new and renovated buildings in the city. Now thermal solar energy is a reality for new builds and renovated buildings, forming an integral part of their construction, like any other element. In 2012 Barcelona had 88,775 m^2 of planned thermal energy installations and thermal solar energy is still being promoted for the existing stock of buildings. Other uses are now also being promoted, particularly solar-powered DH&C, taking advantage of the fact that there's more solar radiation available (in the summer and at midday) when demand for air conditioning in buildings is at its peak.

Municipal renewable energy installations

Barcelona has been working on various renewable energy projects of different types, most applied to buildings and areas owned by the municipality. A large number of these projects aim to continue the public authority's promotion of the use of renewable energy resources and, at the same time, to make users of municipal facilities and citizens in general more aware of the technologies for and management of energy efficiency. Barcelona currently has a significant number of renewable energy installations, such as: photovoltaic power generators on municipal buildings and urban elements such as pergolas and shared constructions, thermal solar installations to produce domestic hot water, thermal solar installation for DH&C on the Peracamps building and at CEM Can Caralleu, geothermal systems for DH&C, a pilot hybrid photovoltaic and mini-wind installation on the roof of a block of flats and in a public area (Finestrelles lighting). It also has the first practically energy self-sufficient

cemetery in the city with a thermal and a photovoltaic solar installation plus battery, so that it can function every day of the year without being connected to the main grid.

1.3.4 New DH&C networks that take advantage of residual heat and cold

Consolidation and extension of Districlima, the first urban cold and heat distribution network in Barcelona

Districlima was built in 2002 to be used for heating, air conditioning and domestic hot water, taking advantage of the heat left over from the treatment of solid urban waste. Initially the project was located in the area developed to hold the 2004 Universal Forum of Cultures but has gradually been extended. Investment currently totals 97 million euros, 50 million of which come from public funding.

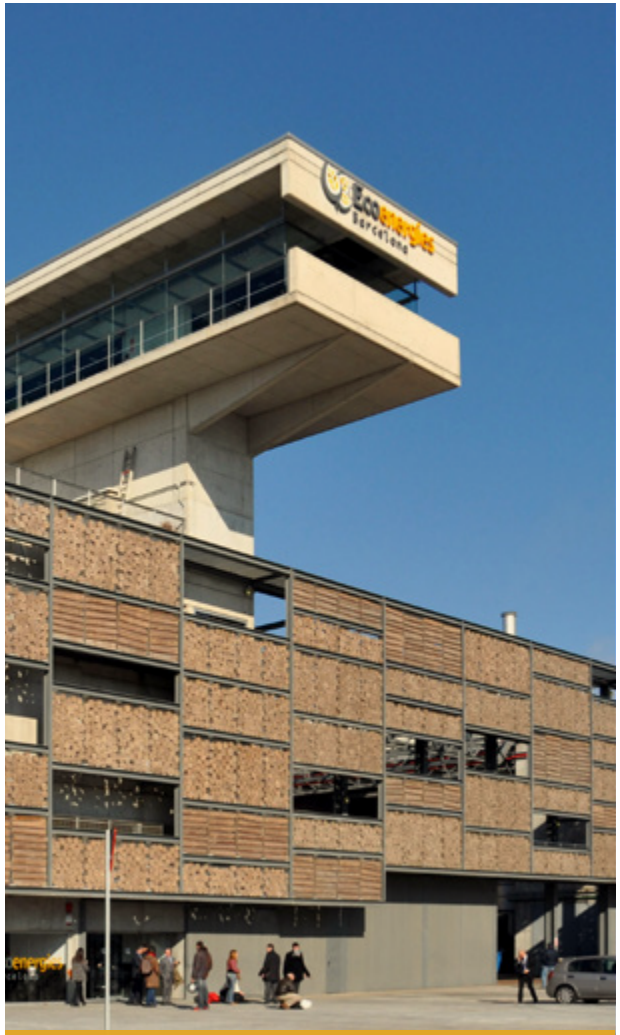
The energy capacity of the Districlima network is:
Total hot water: 90°, 52.2 MW
Total cold water: 5°, 73.7 MW
Recovery of 24 GWh/year of steam from the TERSA waste treatment plant.

Ecoenergies, recovery of cold energy from the regasification of liquefied natural gas at the Enagas plant

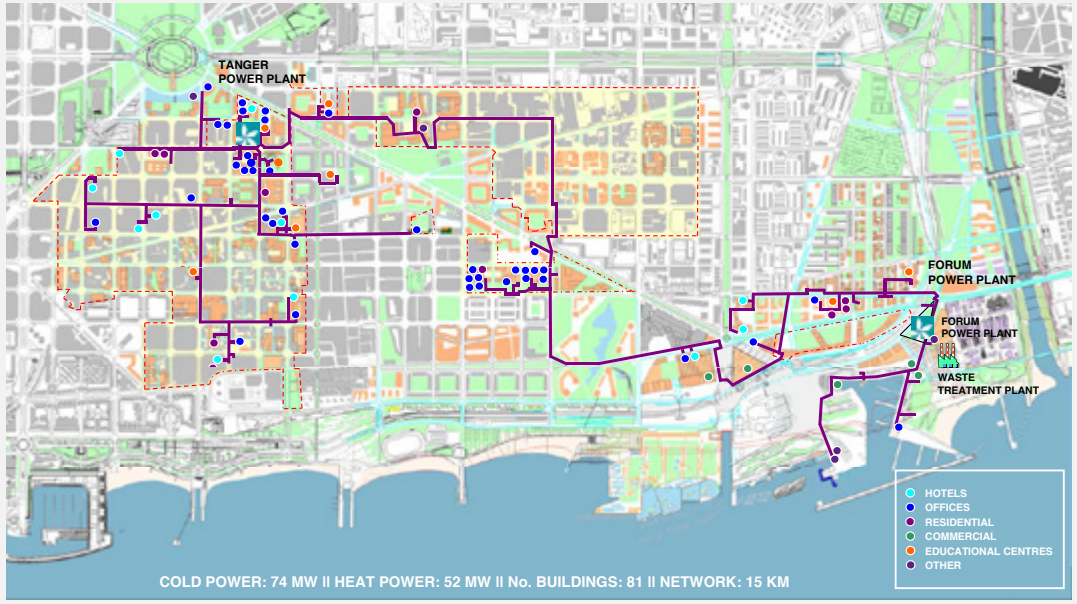
The port of Barcelona contains one of the largest regasification terminals in southern Europe, with a capacity of 625,000 m^3(N)/hour. The project makes use of the cold produced during the gasification process, which heats up liquefied natural gas using sea water. This project is being implemented in several phases; since 2011, the year when it started up, it has provided several clients with cold and heat. In the second phase, 30 MW of the cold produced by the port's regasification will be used. Barcelona also produces up to 15,000 tonnes of biomass from the city's public parks which can be used to generate energy.

9 clients are currently connected but a project has been started to connect Mercabarna to the network so that, by 2017, all the cold required by Barcelona's main market will be supplied using residual cold from the industrial process (the transformation of liquefied natural gas into natural gas).

The current capacity of Ecoenergies is:
Heat power under contract = 17.8 MW
Cold power under contract = 12.6 MW



The Ecoenergies plant at Barcelona port makes use of the cold produced by the regasification process.



The Districlima network has been expanded, reaching 13 km with 81 buildings connected in 2013.

The Ecoenergies network, which re-uses cold produced by the regasification process, is currently 7 km in length.

1.4 Future goals and measures

In addition to the goals established by the PECQ to reduce GHG emissions at a general level, Barcelona also wants to move towards self-sufficiency, thereby reducing its dependence on external energy sources, to this end promoting the presence of local, renewable and networked energy production. Among the many social and economic benefits, a reduction in the energy imported lowers dependence on fossil fuels, boosts the local economy by creating jobs associated with renewable energy sources and energy efficiency and positions Barcelona as a pioneering city in the installation and use of renewable systems in the urban environment, a task that is not always easy.

1.4.1 Planning the medium and long-term energy strategy

Barcelona Energy Self-sufficiency Plan

This instrument is the channel towards self-sufficiency. The Plan aims to maximise the generation of renewable energy within the city itself, as well as reduce the overall consumption of energy via efficiency measures. These two lines of action are the main strategic tool to improve efficiency and reduce greenhouse gas emissions, as well as the emission of other contaminants with a local effect.

The Plan aims to increase self-sufficiency, currently at a level of 1.9%, and fulfil the city's commitments regarding the targets set by the European Union to reduce emissions by 20% in 2020 and by 80% in 2050.

The Barcelona Self-Sufficiency Plan contains measures for the domestic sector, for transport, public spaces and the municipal area.

Monitoring installations is the first step to determining the energy consumption patterns of buildings and identifying energy-saving measures.

MAIN MEASURES FOR EACH OF THE AREAS OF ACTION

Domestic and tertiary sector

- Promote the refurbishment of buildings and their installations in energy terms
- Encourage self-sufficient buildings and blocks ⊕, with a zero energy balance
- Install renewable or residual energy sources into existing buildings
- Promote energy-saving and efficiency measures

Transport sector

- Encourage the implementation of electric and hybrid vehicles in the city's fleet of buses
- Promote the electrification of taxis, vans, commercial vehicles and motorbikes
- Redesign the distribution of goods, especially over "the last mile"

Public spaces and infrastructures

- Encourage DH&C micro-networks plus new connections for existing networks
- Incorporate thermal solar energy within the existing DH&C network
- Promote energy storage (heat and electricity)
- Encourage new installations of renewable energy sources (thermal solar, mini-wind, photovoltaic, offshore wind)

Municipal

- Develop the Energy Self-sufficiency Plan for Municipal Buildings
- Electrify the municipal fleets of vehicles
- Roll out the General Lighting Plan for Barcelona ⊕
- Install self-sufficient urban elements (bicycle rental sites, garden tool sheds, beach bars, etc)

Resilience and climate change adaptation

Barcelona is adapting to the risks and effects of climate change

Resilience and climate change adaptation

Vision of the future

Becoming a city that tackles risks and guaranteeing citizens' quality of life

Current situation

Climate change: Main impacts

- **+ 0.5º** by 2020
- **- 40%** rainfall in summer; **x 2** frequency of downpours and droughts
- sea level **+ 20-60** cm by 2100

Main challenges

- Heatwaves
- Urban heat island effect
- Drought
- Floods
- Wildfires
- Coastal erosion
- Reduction in tourism
- Increase in demand for water
- Change in energy consumption patterns

Lines of work

Governance tools
'Resilience boards (TISU)'
'Situation room'

Guaranteed resource supply
'Desalination plant'
'Energy self-generation'

Flood management
'Rainwater storage tanks'

Planning
'Resilience and climate change adaptation plan'

Protecting the sea front
'Plan to stabilise beaches'

2.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to be a city able to proactively tackle its challenges, impacts and crises, overcoming them while learning, getting stronger, adding value to the city and guaranteeing the quality of life of its citizens.

Located on the Mediterranean coast, Barcelona is a historical city with a dense, compact urban structure that's facing the challenges typical of a productive, dynamic city of the 21st century. Although a relatively small municipality, it's an important economic engine and the hub for one of the metropolitan areas with the largest population in Europe. Resilience management and climate change adaptation in this complex urban system involves overcoming challenges and maximising opportunities.

- **Resilience and adaptation require a paradigmatic change in governance**, that entails the incorporation of risk management and cost-benefit analysis in planning, being flexible when defining adaptive solutions given the uncertainty of future projections, a perspective on many different levels and work that crosses both disciplines and sectors. Barcelona has already embarked on this path and started to incorporate this vision in its policies in all areas.
- **New operational tools are required to reduce vulnerability and increase resilience**. The right mechanisms need to be provided to detect and assess risk early; preventing and/or reducing the impact of stress so that the city can continue to withstand and recover while maintaining its essential functions; improving response capacity and recovery time; providing information and tools to help in decision-making.
- **Barcelona has a significantly high level of risk due to its location on the Mediterranean coast**. According to the ESPON Climate project, Barcelona is heavily exposed to extreme climate effects (droughts, heatwaves, flooding). Some important economic activities such as tourism may be affected by the city becoming less appealing. At a metropolitan level, the large green area of Collserola will be affected by an increase in drought and the number of forest fires.
- **Barcelona is vulnerable to the effects of climate change**. It has a large concentrations of population and activities of great added value as well as highly dense infrastructures and facilities. Consequently, the material and personal costs resulting from climatological phenomena could be very high. Its infrastructure networks (transport, communications, water and energy) are also highly interdependent, so that any failures in the city's system could have a knock-on effect.

2.2 General context and current situation

Urban resilience is seen as the ability of an urban system to prevent, withstand and recover from any plausible hazard or risk. In 2007 Barcelona suffered a series of incidents that highlighted its vulnerabilities: problems with the high-speed train line, a severe threat of drought and particularly a cut in the electricity supply that lasted more than 3 days. The desire to reduce such vulnerabilities and their impact resulted in a new line of action aimed at improving urban resilience.

Although resilience concerns natural, technological and social aspects, this chapter will mainly deal with risks resulting from the climate and specifically aspects related to climate change adaptation.

A possible increase in sea level would lead to a loss of sand and beach area.

2.2.1. Barcelona, vulnerable to the impacts of climate change

Like a number of cities in the world, Barcelona is facing increasing risks from climate change. Cities are highly vulnerable to risks because they have high densities of population and services. It's difficult to quantify the long-term risk but the economic and personal costs of the increase in risk associated with climate change could be very high.

According to Catalonia's Meteorological Office (Servei Meteorològic de Catalunya), the Mediterranean zone where Barcelona and Catalonia are located will probably be one of the zones on earth that will undergo the most significant changes. The main risks forecast for Catalonia and Barcelona, and which have actually started to be felt in the last few years, are as follows:

- **Rising sea level**. The IPCC concludes that the sea level will increase by between 20 and 60 cm by 2100. This increase might be slightly lower in the Mediterranean as it's an enclosed sea. The stability of the beaches depends largely on land and sea deposits of sediment, which have decreased significantly over the last few years and the current situation is critical. It's estimated that 1 metre of beach is lost for every centimetre rise in the Mediterranean's level.

- **Rising temperatures**. The temperature in Catalonia is expected to rise until 2020 and might become 0.5 °C higher than the average for the end of the 20th century. The number of tropical nights has been growing at an ever-increasing rate since the 1980s, with an average trend for the whole of Catalonia of 1.7 days/decade, although this could reach 5 days/decade on the coast. A seasonal analysis shows that the most marked rise in temperature occurs in summer, with considerable heatwaves.

- **Change in the rainfall pattern**. The annual average reduction in rainfall, in general, will be from 5% to 15%, with possibly a slight increase in winter. This average reduction could reach 40% on the coast and in the summer. Downpours may become twice as frequent and their associated peak rainfall rates could increase by approximately 20%. Droughts may also double in frequency and maintain their intensity for longer periods.

Regional area	Air temperature at 2m (ºC)		Rainfall		Average windspeed at 10m	
	Scenario A2	Scenario B1	Scenario A2	Scenario B1	Scenario A2	Scenario B1
Coast and pre-littoral	+4.4	+2.3	-	-	-3%	-2.3%
Seasonal scale on the coast and pre-littoral						
Summer	The average air temperature might increase by +4ºC and average rainfall could decrease by 50% (Scenario A2)					
Spring	Average rainfall might decrease between -11% and -18%					
Autumn	Higher temperature but great uncertainty as to rainfall					
Extreme phenomena on the coast and pre-littoral						
→ More dry months and longer periods of drought → Significant reduction in very cold months → Big increase in frequency of very hot months → Greater likelihood of months with little wind						

Scenario A2 (more unfavourable) and Scenario B1 (average)

Climate change is expected to lead to significant changes in air temperature, rainfall and windspeed.

2.2.2. Climate change presents new challenges for the city

The effects of climate change on the pattern of temperatures, rainfall and changes in biodiversity will impact the population, economy, resources, governance, infrastructures, coastline and civil protection services.

→ **Challenges to people's health**: due to the increase in frequency and intensity of heatwaves, made even worse by the urban heat island effect. This will affect air quality and might intensify heart, respiratory and allergic complaints. The most vulnerable are the elderly and children.

→ **Challenges to natural resources**: forest fires are expected to get worse and might significantly affect the Collserola Nature Park. An overall reduction in biodiversity is also expected with even more opportunities for new invasive species and a larger reduction in endemic species, as well as changes for flora and fauna dependent on wetlands as their habitat is more likely to dry out.

→ **Challenges to the coast:** the coast is already being substantially eroded as a result of stronger easterly winds and sea storms. Climate change will intensify this situation. Between 1988 and 2007, 3 million m^3 of sand was deposited on Barcelona's beaches to restore them. Groynes have also been built as part of the Beach Stability Plan.

→ **Challenges to economic activities**: tourism is one of the city's main economic activities, providing 10% of its GDP. A higher average temperature could affect this tourism. According to the PESETA Project,

fewer tourists are expected to arrive in the summer, preferring spring and autumn. Climate conditions will improve in northern Europe, which could reduce the number of tourists to the Mediterranean coast. In spite of the negative effect this would have on the economy, it would reduce tourism-related stress at certain times of the year.

→ **Challenges to resources such as water and energy**: current studies point to the demand for water rising by 5-12% due to a reduction in comfort, increase in evapotranspiration of vegetation, tourism, etc. Added to lower rainfall and smaller rivers, this will put a lot of pressure on available resources.

Regarding energy consumption, the number of days of heating is expected to fall while the days that air conditioning is used will rise. The net change in energy demand is difficult to predict but there will be considerable changes in the patterns. The challenges involve guaranteeing energy supply and the ability of infrastructures to adapt to these changes in consumption patterns.

Climate change poses a threat to urban infrastructures, such as treatment plants where the increase in torrential rainfall could outstrip their capacity.

→ **Challenges to waste water infrastructures**: the increase in intensity and frequency of torrential rainfall could outstrip the capacity of treatment plants and lead to floods. The waste water system needs to be expanded to be able to handle runoff, prevent floods and preserve water quality along Barcelona's coast.

→ **Challenges to governance**: the challenges resulting from climate change entail a paradigmatic change in terms of governance.

→ **Challenges to civil protection:** in its planning and the Municipal Action Plan, Barcelona has included recommendations and obligations from Catalonia's emergency plans, as well as having its own municipal emergency plans (PAEM), particularly those concerning heatwaves, lack of drainage (floods), forest fires, etc., and its Specific Municipal Emergency Plans (PEEM)⊕ when supplies fail in electricity, gas, etc.

2.3 Measures taken to boost resilience and climate change adaptation

Most impacts resulting from climate change in Barcelona are phenomena that are already happening (droughts, floods, heatwaves, etc.) and what we expect are changes in frequency and intensity. In this respect, although Barcelona has yet to define its strategy of resilience and climate change adaptation, for some years now it has already been working to minimise such impacts.

2.3.1. Creating new tools to improve governance

Preliminary assessment of weak points in the supply of services

Barcelona City Council, via the different departments involved and with the collaboration of network owners and operators, carried out the 3S Project (Guaranteed Service Supply) to ensure that supply and interconnections between these and the different infrastructures in the urban systems all work properly.

The 3S Project (Guaranteed Service Supply) relates to the supply networks (water, energy and telecommunications), health (sewerage, food, waste, environmental monitoring, social and health services and public health) and communications (public transport, mobility, infrastructures).

Creation of a Resilience Department

The Council now has the organisational structure required to lead and coordinate urban resilience projects. The Resilience Department reports to the Adjunct Office for Infrastructures and Urban Coordination and its objective is to reduce the vulnerability of Barcelona city, improve its ability to respond and recover as quickly as possible and reduce the impact of critical situations.

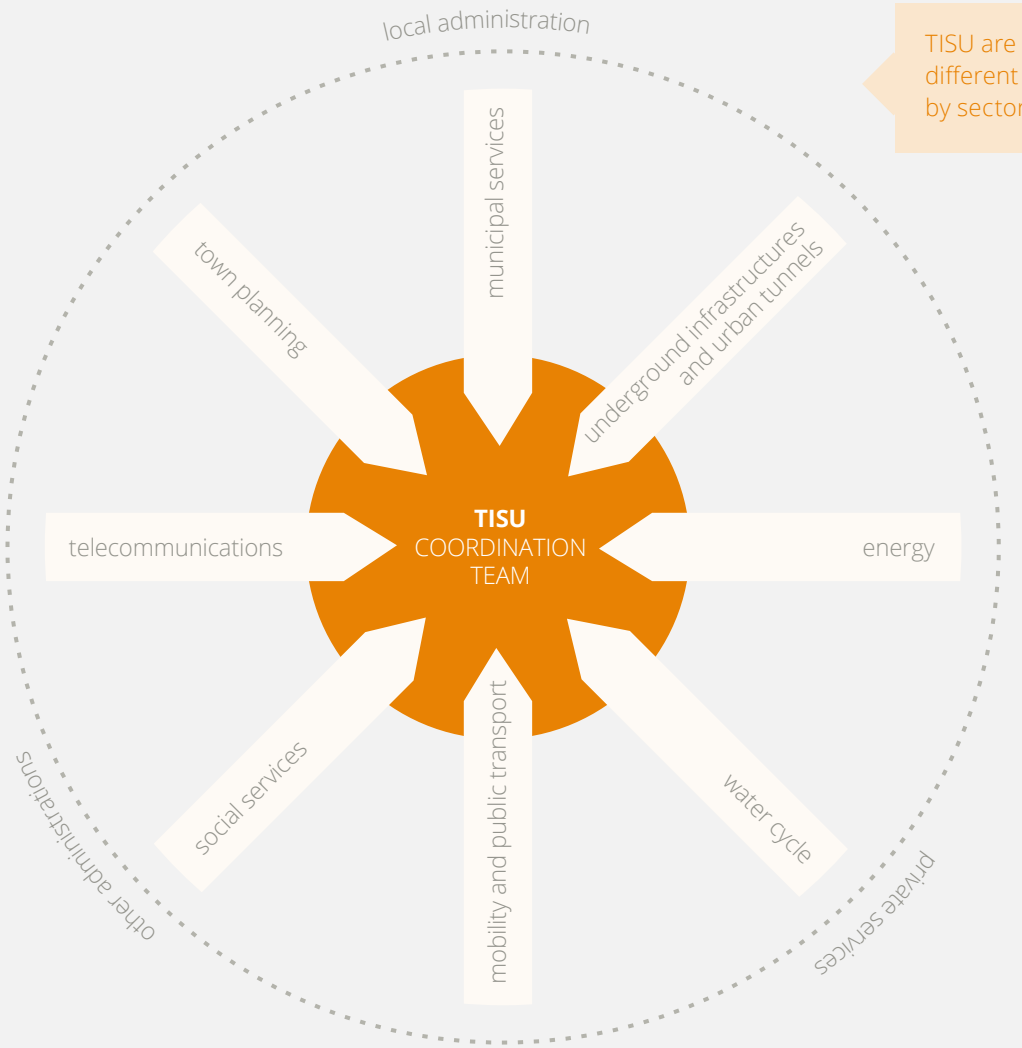
The department is based on the three areas that make up the cycle of continued improvement to create resilience.

It manages incidents affecting the city's services via the Operations Centre, analyses the city's problems via the Situation Room (information management platform) and implements projects to reduce vulnerability and risk via Resilience Boards (TISU).

Creation of Resilience Boards (Urban Service Infrastructure Boards - TISU) to improve work across the board

In 2009 TISU were set up, organised into work groups by sector and carrying out specific projects in order to reduce any vulnerabilities identified. This methodology for working on resilience entails the cooperation of all agents involved and is based on four fundamental steps: 1) risk detection; 2) risk assessment; 3) assessment of resilience; and 4) building up resilience.

Apart from determining certain goals and an action plan to set about achieving them, each improvement project generated by this process must establish a monitoring and improvement system in order to evaluate its degree of success, thereby completing the



TISU are organised into different work groups by sector

cycle going from defining the project to communicating and updating it, with its subsequent redefinition, where applicable.

We should stress the value of these boards in terms of the change in working culture at the Council, thanks to the involvement of interest groups and the multi-sector and multidisciplinary work carried out.

Situation Room, the platform for analysing and managing information

Managing the city is a complex matter due to the large number of operators and agents involved, because of the obvious interdependencies to be found between the different urban systems and the way information is often managed in isolation. The Situation Room is a tool that provides new ways of managing and sharing information with all the agents involved. It enables the joint analysis of data which were previously not correlated and provides new knowledge for making decisions, in both the strategic and operative areas. It has vast potential, one currently operational example being that it can be consulted online. This is a lengthy process to which other services will gradually be added.

Sharing knowledge with other cities

Experiences and information can be shared by taking part in international projects and networks of cities and multilateral bodies. For example:

→ ICLEI, with projects such as Cities Adapt, Ramses, Open European Day and Resilient Cities.

→ The "City Resilience Profiling Programme" (CRPP) ⊕ , is now being implement via the UN-HABITAT offices in Barcelona. With the cooperation of ten cities, this programme seeks to identify a conceptual and practical framework for urban resilience, with software applications and an improvement in the implementation and monitoring of results.

→ UNISDR, with the 'Making Cities Resilient' campaign, which calls Barcelona a "role model city" in its infrastructures and urban services for the work carried out with TISUS, and has given it a place on the Steering Committee.

→ C40, a network of cities on Resilience and Risk Assessment of Risks stemming from climate change.

Barcelona has also prepared a benchmarking system on other cities' plans for adaptation to climate change ⊕ .

On a global scale, apparently different cities share comparable problems that increase the fragility of the systems and the impact on people. That's why it's important to encourage cities to share their experiences.

2.3.2. Prevention and support for people's health

Action Plan to Prevent the Effects of Heatwaves on Health (POCS)

Catalonia launched this Plan in 2004 and implements it annually with the aim of forecasting weather-related risk situations as early as possible, minimising the adverse effects on people's health and coordinating existing measures and resources. When the Plan is activated, the main measures which are carried out are:

→ Preventive operations for the vulnerable: this provides information on the risk status and monitors the situation through services that care for those at risk (Remote Assistance, Home-Based Care Service, social service centres, etc.). A number of measures are activated in order to prevent the most vulnerable people from going outside at times of greatest heat ('meals on wheels' arranged, extending activities at day centres for the elderly, etc.).

→ Specific operations on the street: a service made up of 21 professionals and 6 vehicles coordinated by Barcelona Social Emergency Centre (CUESB) goes out to provide, in the field, anyone at risk with care and advice. They distribute water to the homeless, inform them of the possibility of using the available air-conditioned reception centres, etc.

2.3.3. Fomenting environmental services for green areas

Creating a management and planning tool: the Barcelona Infraestructure and Biodiversity Plan 2020 ⊕

This strategic instrument defines the municipal authority's challenges, objectives and commitments as regards the preservation of green areas and biodiversity and how well city people know, enjoy and take care of such resources.

Improving knowledge of urban green spaces by establishing cooperation schemes with research centres

The Plan establishes lines of action intended to gain in-depth knowledge on the effect of climate change on natural vegetation, the selection of species in accordance with their water requirements and their ecological functions and the use of alternative water resources for watering the city's vegetation.

Microclimatic regulation and minimisation of the heat island effect

Plentiful vegetation provides shade, humidity and fresh temperatures, thereby improving the comfort of public space. That's why different green corridors are being designed *(see Chapter 4, urban green spaces and biodiversity ⊕)* and opportunities are being sought to

provide a larger area of vegetation (green roofs and walls). Barcelona has 65 hectares of roofing to be occupied, counting only buildings for public use, and 95.7 hectares if we add private amenities such as hotels, museums, clinics and schools. These green roofs and walls make a contribution to microclimate regulation by:

- Improving the heat insulation of buildings.
- Cooling down the atmosphere, thus improving the efficiency of solar panels.
- Holding back rainwater, cutting down the amount of water collected by the sewerage system and therefore also the pollutant content reaching treatment works, etc.

Preservation of biodiversity is a priority for the city.

2.3.4. Preserving biodiversity as an asset for the city

Preserving the biodiversity of species vulnerable to climate change

The Programme to protect amphibians is an example of this. According to the IUCN, 52% of amphibians are sensitive to climate change. In cooperation with the Galanthus association, Barcelona Zoo and Barcelona

The roof of the Northern Zone Library (or other municipal initiatives such as the Fàbrica del Sol) is a good example of how important this kind of roof garden can be.

University (UB), a programme has been adopted since 2008 establishing protocols for action and management for personnel carrying out maintenance work in parks and gardens with ponds. This involves carrying out censuses, reintroducing individual specimens, enhancing habitats, removing exotic fauna from the ponds and disseminating the project to raise people's awareness and involve them. 158 toads, 146 tree frogs and 85 Perez's frogs have been released and 450 tadpoles have been rescued.

2.3.5. Planning and major works to guarantee water supply

Technical Plan for Making Use of Alternative Water Resources 2012-2015

This Plan points out the many existing resources that can potentially be taken advantage of, both in terms of groundwater resources and also water regenerated at El Prat Wastewater Treatment Plant. It also states that there are demands which can be met with these alternative resources and provides an analysis of the different types of non-drinking water and the quality requirements for different uses *(see Chapter 9. Water cycle ⊕).*

Building the desalination plant

On 20th July 2009 Barcelona's desalination plant in El Prat de Llobregat became operative. It has a production capacity of over 60 hm^3 of drinking water a year (25% of the water supplied to Barcelona and its metropolitan area) even though it's only running at 10% of its capacity at present, in order to carry out maintenance work on the installations.

Improvement of the system's redundancy

Carrying out building work to connect the header tanks for the 2 Llobregat – Besòs basins and drafting contingency plans for the different pressure coordinates in order to guarantee supply.

Municipal Action Plan for Drought Risk

This Plan helps to anticipate a drought and apply specific drastic measures to save water, as well as informing the public and making them duly aware of this. The measures taken by the Council (in a Level I Emergency Situation) generate savings of about 83,000 m^3/a month. Some of these involve reducing the hours that fountains are on, increasing the use of groundwater to 67% for cleaning the streets and for irrigation, etc.

Actions to raise awareness of reducing water consumption

(see Section 9.3.4 Awareness-raising campaigns ⊕)

2.3.6. Flood management and coastline protection

Improving the planning and management of the sewerage system

Progress has been made by implementing the system for remote controlled management and another was to create a specific TISU *(see 2.3.1 Creating new tools to improve governance ⊕)* to study the critical points of the network and, depending on the results obtained, to prioritise and plan investments to improve the drainage network.

Flood management with a network of underground tanks to collect rainwater or anti-USD (Unitary System Discharges)

In order to prevent rainwater from running directly into the sea, since this water is highly contaminated from city runoff, and also to prevent flooding, there is a network of tanks which retain this water. After the rainy period is over, the water is taken in a laminar flow to the water treatment plant, increasing the share of rainwater that's treated before being dumped in the sea. The water retained also has a lower contamination level thanks to the sedimentation caused during collection.

Annual rainfall in 2011 was 758 l/m^2, spread over 58 days of significant rain. The level of rainfall classed as an alert was reached on five occasions and the emergency level was triggered three times. In all this rain, the retention tanks

stopped the drainage network from being overloaded at the most critical flood points. They also meant that 1,784 tonnes of solid material suspended in the water did not have to be dumped into the sea, by treating 7.15 million m^3 of water.

Another step in flood management, which helps the rain falling in the city to permeate the subsoil and increase underground water reserves in higher, newly-developed zones, are Sustainable Urban Drainage Techniques (TEDUS), which make the peak flows laminar and reduce the volume of runoff. Ten green spaces have been designed with sustainable drainage techniques.

Managing the coastline via Barcelona's Beach Stability Plan

This Plan sets out to protect the city shoreline and prevent the loss of sand that takes place every year through the effect of storms at sea. The project consists of reinforcing the sea front in order to make sure the sand stays on the beaches, as well as guaranteeing the environmental quality of the water.

With a cost of 33,000,000 euros (financed by the Ministry of the Environment), the project covers a length of almost 5000 m of Barcelona's coastline. The project will be carried out in different phases and the first measures will be extensions and construction of groynes to counteract the sea currents that remove sand from the beaches, as well as supplying over 700,000 m^3 of additional sand.

2.3.7. Energy savings, efficiency and renewable sources, the keys to guaranteeing energy supply

Creating planning and management tools

The Plan for Energy Self-Sufficiency defines the strategies required to ensure increasing energy efficiency, the presence of renewable energies and the reduction of local emissions of pollutants.

As regards the Plan for the Energy Self-Sufficiency of Municipal Buildings, this considers measures to be taken at municipal facilities to reduce their energy consumption, accounting for 10% of the consumption of all municipal activity and public transport.

Barcelona's Lighting Improvement Plan has led to improvements in the management of the city's lights. Over the last few years the number of bulbs has increased while energy consumption has been cut by over 3.7 million KWh per year. The traffic lights system has also been renewed, now using LED technology.

Commitment to local energies through solar by-laws and reusing waste

Since 1999 Barcelona has had its own Thermal Solar By-Law, an internationally groundbreaking piece of legislation which makes it compulsory to include thermal solar panels on renovated buildings and new builds. In 2012 the Photovoltaic Solar By-Law also came into force.

The waste generated in Barcelona is also processed at different facilities in order to obtain energy. For example, at Sant Adrià del Besòs waste recycling plant they produce 16,900 kWh of heat and 108,000 kWh of cold a year. The ecoparks which serve the city also have installations to produce and make use of biogas to generate electricity and heat thanks to a cogeneration plant. These ecoparks generate 196,135,203 kWh a year by processing organic waste.

Improving energy efficiency with DH&C networks

As far as efficiency is concerned, we should note the production of electricity and the supply of cooling and heating by means of the new Ecoenergies power station in Zona Franca. This combines different systems, making it particularly efficient: taking advantage of the cold left over from the Port regasification system and building a biomass and a tri-generation plant. The DH&C network at the Forum and 22@ zone (Districlima), which makes use of the heat produced by the Sant Adrià waste recycling plant, provides DH&C to a surface area of 360,000m^2, containing 49 service buildings and 4 residential blocks.

Improvement of incident management

Action protocols have been set up so that, in certain cases, any incidents which might be critical can be identified, notifying the services responsible in time for them to be able to determine the impact level, deal with the interdependence with other systems and thereby reduce any knock-on effect.

The Districlima network produces and distributes hot and cold water by making use of the incineration of urban waste and energy from seawater.

2.4 Future goals and measures

In recent years resilience and climate change adaptation have been a priority for the city, as can be seen in the large number of measures that have been carried out. However, there is still a long way to go, with measures designed to go on improving knowledge, improve planning and management and fulfil international commitments.

2.4.1. A commitment to an adaptation strategy

International commitment by joining the Covenant of Mayors for adaptation

This was assumed by Barcelona City Council, which signed this voluntarily. In accordance with the European Strategy on Adaptation to Climate Change (EC, 2013) the Council will undertake to implement a strategy of local adaptation (with a deadline of 2 years from when the covenant was signed).

The Covenant of Mayors on adaptation (Mayors Adapt) is a European initiative to get local authorities involved in adapting to climate change.

2.4.2. Planning to become a more resilient city

Plan for Resilience and Climate Change Adaptation, a basic planning and management tool

Barcelona is drawing up its Plan with the following objectives:

- Involving all agents and improving interdepartmental and institutional liaison to tackle risks and build a more resilient and less vulnerable city.
- Extending training, professional skills and personnel development in order to guarantee the availability of professionals qualified in critical recovery and resilience-building.
- Incorporating the variables of resilience and climate change in planning, programmes and legislation and establishing criteria for making decisions.
- Systemising and defining a methodology to identify and assess risks, as well as their impact on the economy, the environment and citizens.
- Defining measures to take into account the protection, improvement and reinforcement of existing systems. After a crisis, rebuilding and updating methodologies in accordance with past experience.
- Defining key actions to tackle the city's vulnerabilities, establishing the relevant responsibilities, resources and timelines.
- Defining criteria and methodologies to prioritise the measures described, considering the uncertainties of risks and their consequences.
- Defining a system to monitor resilience, improving the availability of data and producing information tools for better analysis (mapping, visualisation and communication systems).
- Raising general awareness of resilience and climate change and getting the city's inhabitants involved through participatory projects.
- Consolidating Barcelona as a forerunner in resilience in the Mediterranean region.

Mobility and urban transport

Barcelona, for safer, fairer, more sustainable and efficient mobility

Mobility and urban transport

Vision of the future

Becoming a city where mobility is more sustainable with a better quality of life in the districts

Current situation

Daily journeys

7,662,339

Internal journeys
64.6 %

Connecting journeys
35.9 %

Lines of work

Promoting cycling
'Increasing cycle lanes'
'Improvements for Bicing'

Street pacification
'Widening the area for pedestrians'
'Containment of private vehicles'

Connectivity and efficiency 'Orthogonal bus network'
'Electrifying mobility'

Goods management
'Electric vehicles for the last mile'

Safety
'Road safety plan'

3.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to become a city where mobility is more sustainable and where the quality of life is improved in the districts, democratising the use of public space and promoting more sustainable forms of movement. It also aims to internalise the environmental costs of its mobility, tackling the impacts generated. In this respect, it's essential to replace conventional, fossil-fuel driven vehicles with electric vehicles.

Barcelona's mobility is partly affected by the city's geographical location as this has considerable physical limits as well as a distinctly central position, making it a hub and driving force for Catalonia, attracting a large amount of activity and consequently a lot of journeys to and from the city.

- **Barcelona is surrounded by hills, rivers and the sea**. For this reason there are only four access corridors (along the Llobregat and Besòs rivers and towards the north and south). These corridors are full of infrastructures and their narrowness makes it difficult to construct new ones.
- **It's the central point for a large metropolitan area**. It's the centre of a complex territorial structure that is highly dense and made up of a series of medium-sized towns. Over the years, activity (especially industrial) has moved to these towns, leading to fast growth in mobility requirements between Barcelona and its surrounding area.
- **A lot of journeys pass through the city**. Barcelona's strategic location in the middle of the Mediterranean corridor and with one of the Mediterranean's most important ports, as well as it being an important economic centre for Catalonia, means that a large amount of traffic passes through the city.
- **Large thoroughfares divide the city**. The presence of large capacity road infrastructures in the city centre such as the Meridiana and Gran Via does not only have direct environmental impact (pollution, noise) but also physically splits the city.
- **Barcelona is a dense, compact, complex city**. These features mean that there are relatively short distances between locations which, together with the city's mixture of uses and services, encourages walking.
- **It's one of the world's most popular tourist cities**. Most tourists travel by public transport and their needs must therefore be included in the city's mobility planning.
- **The bus network is very complex**. Inherited from the 1950s, its aim was to connect the historical centre with the city's different districts. As a result, the current network is not isotropic, making it difficult to fit with the city's transformation in urban planning terms.
- **Barcelona's hilly terrain affects mobility**. A large part of the city is on a slope, making walking and cycling more difficult, as well as access by public transport (that's why district buses have been introduced in many areas of Barcelona).
- **There's no tradition of bicycle use**. Bicycles have yet to become widespread in the city of Barcelona. However, since the "Bicing" bicycle hire service was introduced and the cycle lanes were widened, cycling has become more popular.

3.2 General context and current situation

Transport in Barcelona is currently the main cause of air and noise pollution and also a significant source of energy consumption. The transport of people and goods has become the main consumer of energy in the world, with more than 40% of primary energy and 24% of the consumption of final energy. Moreover, the transport industry is still not very diversified in energy terms with petroleum products accounting for 95% of all the sector's energy requirements.

The transport industry in Barcelona is responsible for:

37% of the city's GHG emissions

Over 50% of the emissions of NO_x and particles

Over 80% of the city's noise

The progressive motorisation of society, the increase in forced mobility, dependence on private vehicles, accidents, congestion, environmental repercussions, etc., require the current mobility model to be redesigned towards more sustainable mobility.

In the area of mobility, authority in Barcelona is shared between different bodies and cooperation between them is therefore vital to achieve the strategic goals. There's a wide range of public transport networks, namely: Underground, Metropolitan Train (Ferrocarrils de la Generalitat de Catalunya or FGC), Railway (local, regional and state - Renfe), Tram, Bus (including district and tourist buses) and intercity bus.

Regarding road infrastructures, the Spanish government is responsible for the basic state and European network, the Catalan government for the basic Catalan network and the government of Barcelona province for the local network. The County Council of Barcelonès is responsible for the complete maintenance of the ring roads in Barcelona and the City Council is responsible for managing the traffic and the safety of roads, pedestrians and bicycles, as well as goods distribution.

Barcelona's public transport networks are managed by 4 different administrations

Administration responsible	Owner of the infrastructure	Owner of the service
Catalan government	Railway: Underground, FGC, Tram	FGC (including 7 Renfe local train lines*), intercity bus
Metropolitan Area of Barcelona (AMB)		Underground, Barcelona bus, AMB bus. Taxi
Spanish government	RENFE state railway network	RENFE (state, regional and 6 local lines)
Metropolitan Transport Authority (ATM)		Tram

3.2.1 Different modes of transport for internal and connecting journeys

A total of 7,662,339 stages of journeys are made in Barcelona every day, of which 64.06% correspond to internal journeys and 35.94% to connecting journeys (between Barcelona and the exterior).

Mobility has decreased over the last few years, both for internal journeys, although there was a slight upswing in 2010 and 2011, and also for connecting journeys, probably related to the economic recession which started in 2007.

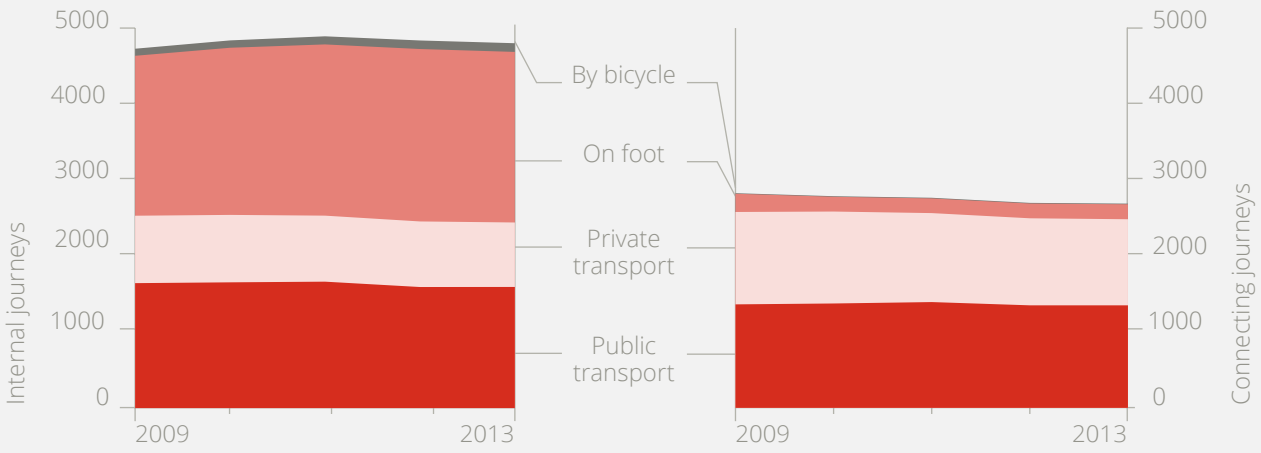
For internal journeys, the predominant modes are cycling and walking with 49.14%, while public transport predominates for connecting journeys with 50.20%. Regarding private vehicles, these are used much more in connecting journeys, accounting for 42.15%, than in internal journeys, where they represent 17.67%.

Mobility using more sustainable modes has increased over the last few years, probably because of the effects of the economic crisis.

3.2.2 Cars are losing relative importance in the city

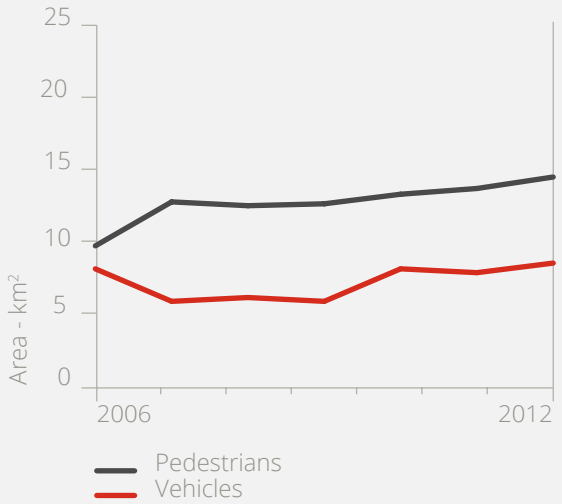
Mobility on foot is increasing. New zones have been created with priority for pedestrians, with journeys on foot reaching 32.7% at present for internal and connecting journeys as a whole.

Journeys by bicycle are increasing. The number of stages increased by 1.7% last year, with a total of 118,151, of which 109,282 were internal. In 2013, 7.9 km of cycle lanes were built, the current figure now totalling



Private transport has decreased progressively since 2008, both for internal and connecting journeys.

The area prioritised for pedestrians has gradually increased over the last few years



64% of the population lives < 3 minutes from a Bicing point (200 m).

104.9 km, representing 0.06m/per capita. Regarding the use of bicycles as public transport or "Bicing", in 2013 the number of bicycles in service remained stable and the number of users returned to the level of 2011, namely 14.2 million travellers per year.

Mobility via public transport remains quite stable. Compared with 2010, the number of public transport ticket validations has fallen by 2.4%. The economic crisis has possibly led to public transport being replaced by journeys on foot or by bicycle in the last two years.

98.9% of the population lives 300 metres from some form of public transport.

Mobility via private vehicle is falling. The number of journeys by private vehicle went from 2,227,000 in 2008 to 2,028,000 in 2013. The total number of vehicles also decreased from 2009 to 2012 by 1.4%, representing 13,571 fewer vehicles on the road, while the car occupation rate continues to be very low (1.21 people/car). Of note is the case of vans and trucks, falling by 15.1% in the same period (2009-2012). The carriageway currently accounts for 57% of all the area occupied by roads but mobility via private vehicle only accounts for 26.7% of mobility

Mobility by motorbike represents 17.4% of all private vehicle mobility and the total number of motorbikes and motorcycles accounts for 30.6% of all private vehicles.

In 2013 there were 436.4 km of "30 zones" in the city, where the speed limit is 30 km/h, calming the traffic and reducing accidents.

Last year the number of traffic accident deaths was the lowest of the century, totalling 22 victims.

Services	1999	2004	2008	2012
Natural areas at 300 metres	99.4	99.5	99.4	99.3
Urban transport at 300 metres	98.7	98.7	99.9	98.9
Recycling points at 300 metres	99.9	99.2	99.2	58.4
Educational centres at 300 metres	62.7	68.5	67.3	89.3
Educational centres at 300 metres	28.8	28.1	34.2	32.5

In general terms, Barcelona is a city where different services are close to people.

3.3 Measures taken for more sustainable mobility

The cycle lane network is increasing, routes are being diversified and journeys between the sea and the hills and also along the Besòs-Llobregat corridor are improving.

The measures implemented over the last few years have been aimed at transforming Barcelona into a city for people, improving and extending public transport and promoting more sustainable and safer mobility.

3.3.1 From the Mobility Pact to the Urban Mobility Plan

Mobility Pact

This covers the participation between the Council and civil society via more than thirty organisations, associations and experts in mobility, working together to define a mobility model based on sustainability criteria. It is essentially an advisory body with citizen involvement for issues affecting the city's mobility.

Urban Mobility Plan 2008-2012

As part of the Mobility Pact, Barcelona Council drew up the previous Urban Mobility Plan 2008-2012 which establishes the strategic lines to be followed for the city's mobility and has recently been updated.

3.3.2 Around Barcelona, on foot or by bicycle

Encouraging journeys on foot

Implementation of several measures to encourage and improve mobility on foot, such as:

- Widening the area for pedestrians on pavements or zones exclusively for pedestrians, with restrictions to motor vehicle access.
- Traffic calming in zones that combine pedestrians and vehicles, where pedestrians always have priority and the speed of any vehicle is limited.
- Signage of pedestrian routes.
- Installation of lifts on steep inclines.

→ Reduction in obstacles on public highways and improved accessibility.

→ Consolidation of School Paths so that children can go to school on their own, improving social cohesion and local relations in the districts.

Improvements for bicycle journeys

The measures carried out to increase the use of bicycles are:

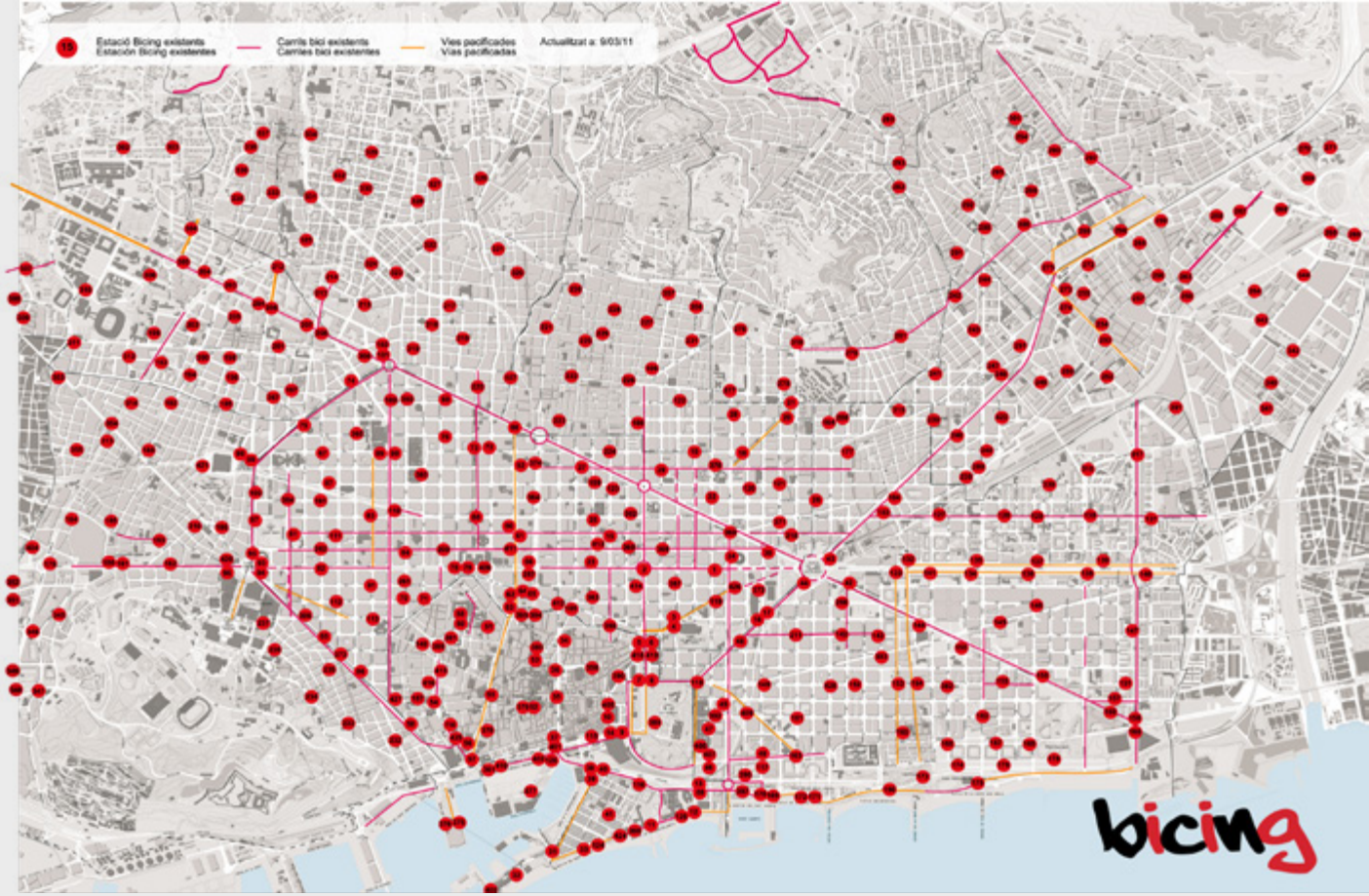
→ Drawing up the Bicycle Promotion Plan 2012.

→ Extending the cycle lane network.

→ More parking spaces for bicycles: there were 22,350 places in 2013.

→ Extending the public transport use of bicycles (Bicing) and their parking points.

→ Communication campaigns such as "Bicivism" and "Bike Week".



Bicing rental points and the cycle lane network spread throughout a large part of the city.

3.3.3 The city's public transport, more and better quality

Extension of the underground network

More kilometres of tunnels and new stations, reaching the current figure of 102.6 km in length. The first section of line 9/10 is now in operation, as well as the extensions of lines 2 and 3 (Canyelles-Trinitat Nova) and a new section of line 5, between Horta and Vall d'Hebron. The number of stations has also increased, now totalling 141.

There's also continuous service throughout the night at the weekend.

Commitment to transport networks being accessible to everyone

through the Universal Access Master Plan drawn up by Barcelona's Metropolitan Transport Authority (TMB) in 2010. Access to public transport networks is currently as follows:

- **Underground**. At December 2013, 86% of the stations had been adapted for people of limited mobility. Some of the measures are: voice-guidance systems, route markers for the blind, door closure lights, easy access platforms, etc.
- **Bus**. Since 2007, all buses can be used by people with functional disabilities: inside the vehicles, with adapted areas and visual and acoustic warnings for stops; outside the vehicles, with access to information for the blind. 1,400 stops have vehicle access platforms.
- **Montjuïc cable car**. This facility has been completely adapted since 2007. In 2008 it was awarded the Universal Access Certificate.

To encourage journeys by public transport, TMB has prioritised the accessibility of the different transport networks (bus, underground, cable car).

The new orthogonal bus network includes more direct routes to shorten journey times.

New, more efficient orthogonal bus network

In 2012, Barcelona Council and TMB started to redesign the current bus network based on an orthogonal network of fewer but more efficient lines.

This new network will have 28 lines (17 vertical, 8 horizontal and 3 diagonal) replacing the current ones, of which 10 have currently been implemented. The new network also includes strategically located changeover areas between lines and other modes of transport.

The new network is:

→ **Faster**, at intervals of 5-8 minutes thanks to the new, more direct routes and the improvements made to traffic light management. Almost half the population will be able to travel to any point in the city in less than 40 minutes.

→ **More efficient**, thanks to better connection points. 95% of citizens will be able to travel to any point in the city with just one changeover.

→ **Easier** for citizens to understand thanks to the system's simplicity and the new image and signage.

Greening the public transport fleet

TMB has reconverted its fleet of buses to reduce their environmental impact and they can now be considered to be among the cleanest in Europe. One of the technologies being most widely implemented as a stage prior to electrification (another goal being worked on) is that of hybrid vehicles, combining electric with combustion engines. These vehicles help to reduce fuel consumption and emissions by between 22% and 35% and they also provide net savings of 28,000 euros per bus at the end of its useful life (14 years).

TMB's fleet of buses totals 1,065 vehicles, of which 132 are hybrid.

	Vehicles	Environmental characteristics
Low-emission diesel or with anti-pollution filters	534	Euro 4 o Euro 5
Compressed natural gas	398	Environmentally enhanced vehicles (EEV), comparable with Euro 6
Diesel converted into hybrid	70	Comparable to Euro 5
Natural gas converted into hybrid	13	Environmentally enhanced vehicles (EEV) with lower consumption
New hybrids	49	Euro 5, Euro 6 or EEV
Pure electric	1	Zero emissions
Total	1.065	

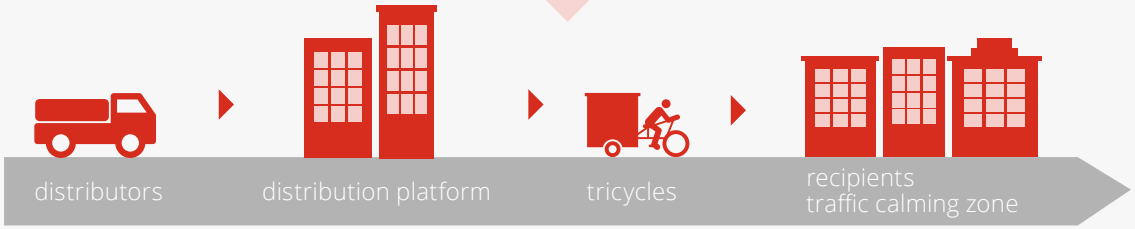
Regarding the underground, of note is the effort made over the last few years to acquire more efficient trains, taking part in European projects (SEAM4US) and evaluating and optimising the energy consumption of various stations, acting on the lighting, power supply, vertical transport equipment, etc. New optimum speed signs have also been implemented, producing savings of up to 15%.

3.3.4 Goods management: from trucks to tricycles

Pilot test for goods distribution via electric tricycles ⊕

A pilot scheme has been implemented for 6 months in the Ciutat Vella district, co-financed by the European programme Smile. A micro-platform has been built, creating a mini-quay for loading and unloading where trucks and vans can leave the goods and from which a fleet of electric tricycles completes the delivery process, along the route known as "the last mile". The main aims of this project are to make the logistic process more efficient, modern and sustainable, as well as achieve savings in time and kilometres travelled, save on fuel, reduce emissions and calm traffic.

The micro-distribution of goods helps to prevent trucks and vans entering the old quarter.



3.3.5 Private vehicles, regulated and contained

Containing private vehicles and reducing accidents

The aim of municipal policy is to encourage a more rational use of private vehicles via two major actions:

- Limiting the area devoted to traffic, with calming measures such as "30 zones" and combined pedestrian and vehicle zones, which also help to reduce the number of accidents.
- Regulating parking, such as implementing "green" metered zones and diversifying the types of parking spaces (free, free at night, blue zones, for motorbikes, reserved, etc.). Between 2007 and 2011 these measures led to free parking for cars decreasing by 45% while the Preferential Green Area increased by 59.8% and pavement motorbike parking increased.

Private vehicle management

Traffic management measures have been implemented to optimise private vehicles, increasing vehicle occupation and encouraging car-sharing (a platform where members share vehicles) and car-pooling (a system to share journeys using the same vehicle).

Barcelona Road Safety Plan 2013-2018

Educational and awareness-raising measures have been planned to reduce the number of deaths by 30% (in line with the European Union's target to reduce deaths by 50% by 2020 compared with 2010) and the number of serious injuries by 20%, as well as actions related to prevention and control and also corrective measures to improve traffic infrastructures. The priority has been to take action with those groups in society that are most vulnerable to such accidents, namely pedestrians, cyclists and motorbike riders.

Promoting sustainable, safe mobility

Various campaigns have been run to contain private vehicles and encourage more sustainable mobility. Some of these are as follows:

- Sustainable Mobility Week.
- Day Without Cars.
- "MOTOCIVISME", a preventative campaign for the responsible use of motorbikes.
- "New Barcelona Traffic Lights", campaign to raise awareness of the new traffic lights as part of the Basic Centralised Network Renovation Plan.
- Specialist seminars on urban signage.
- 17th Barcelona Road Safety Forum.

Park(ing) Day is an annual event held in more than 170 cities around the world where organisations and citizens place temporary stands in car parking places to demand a more sustainable model of cities.

3.4 Future goals and measures

Barcelona has two key planning instruments that will establish the main strategic lines for the coming years.

3.4.1 More efficiency and safety through mobility planning

Infrastructure Master Plan (PDI) of the Metropolitan Region of Barcelona 2011-2020 ⊕

This is the strategic instrument for actions regarding infrastructures, continuing the previous PDI 2001-2010. It consists of five programmes of action:

- Extension of the train (underground and FGC) and tram network.
- Deployment of the state railway network.
- Increased connectivity between different modes of transport.
- Road public transport infrastructures.
- Modernisation and improvement of existing railway networks.

The Infrastructure Master Plan (PDI) contains all the actions related to infrastructures for public transport for one decade in the Metropolitan Region of Barcelona, irrespective of the authority responsible and the operator.

The implementation of these actions will include 103 km of new railway network and 92 new stations, an 8.4% increase in public transport in journeys within the Metropolitan Region of Barcelona and at least a 12% reduction in energy consumption and emissions into the atmosphere.

The total investment required to implement the PDI 2011-2020 is €12,379.5 million (excluding VAT), 25.2% less than the proposals included in the PDI 2001-2010.

Urban Mobility Plan 2013-2018 (PMU) ⊕

This is a strategic planning instrument that sets the goals and future lines for mobility. It's made up of a diagnosis, a proposal and an evaluation of the environment.

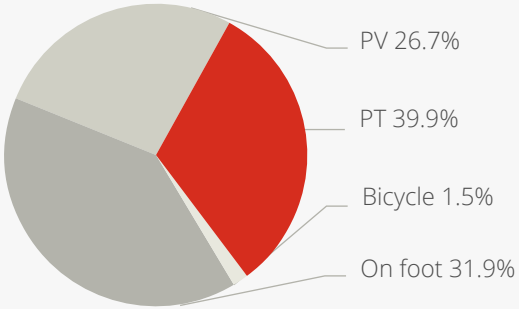
The target of the Urban Mobility Plan is for public transport to reach 41.3% by 2018.

The Urban Mobility Plan establishes quantitative targets for 2018.

		2012	2018
Safe Mobility	Application of the Local Road Safety Plan	249 serious injuries 30 deaths	-20% serious injuries -30% deaths
Sustainable Mobility	Compliance of EU parameters* regarding NO_2 and PM_{10}	NO_2: 4 stations do not comply (out of 7) with the annual average figure	Compliance of EU parameters by all stations
Fair Mobility	The new bus network reduces wait time by half	99% of the population has a bus stop at <250 metres, average frequency 12'	99% of the population has a bus stop at <250 metres, average frequency 6'
Efficient Mobility	Improving the logistical management of mobility	Conventional urban distribution system 2013 Pilot Scheme Ciutat Vella district	Logistic micro-platforms and new technologies. Efficiency occupation public space and environmental improvements

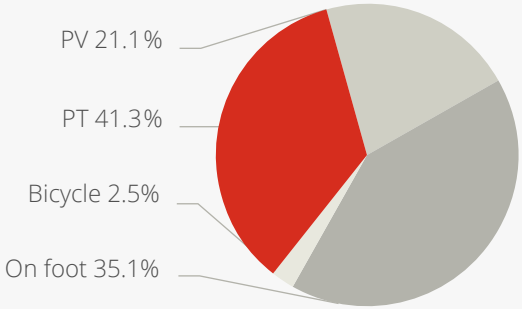
** The average annual figure for NO_2 and PM_{10} must not exceed 40 µg/m³ at any of the city's measuring stations. Neither must the daily limit of PM_{10} (50 µg/m³) be exceeded more than 35 times a year, nor the hourly limit of NO_2 (200 µg/m³) exceeded more than 18 times a year.*

2012



Private Vehicle -21 %
Public Transport +3.5%
Bicycle +67%
On foot +10%

PMU Scenario (2018)



MAIN MEASURES FOR EACH MODE OF TRANSPORT

On foot

- Increase the safety of pedestrians.
- Develop more efficient traffic calmed zones.
- Extend the area for pedestrians and improve accessibility.
- Implement 5 pilot "super-blocks" as new urban organisations whose aim is, among others, sustainable mobility *(See chapter 5. Sustainable land use ⊕).*

By bicycle

- Extend and improve the network of routes and parking places for bicycles.
- Revive the registration and marking of bicycles to prevent theft.
- Improve the adaptation of public transport for bicycle access.
- Increase people's appreciation of cycling via information, communication and promotion.

Public transport

- Consolidate the new orthogonal bus network.
- Encourage T-Mobility: single public transport ticket.
- Reduce the kilometres of empty taxi traffic.

Urban goods delivery (DUM)

- Promote DUM using low impact modes of transport.
- Study the implementation of Local Areas and Distribution Centres.
- Incorporate new technologies to improve management.

Private vehicles

- Adapt urban design to improve safety.
- Act on critical points for traffic accidents.
- Promote efficient vehicles that reduce noise, pollution or accidents.

3.4.2 Electric vehicles, an opportunity to improve the city's quality

Strategy to implement electric vehicles in Barcelona

Being aware of the potential benefits of implementing electric vehicles in the city (improved air quality, less noise, less energy dependence, help to develop renewable energy sources, etc.), Barcelona wishes to encourage their use. To this end, collaboration is required between all administrations, institutions and companies in the sector to ensure the presence of such vehicles, the possibility to recharge them (there are currently 263 charging points), provide financing, implement suitable mobility policies, etc.

Other lines of public action are a commitment to introduce EVs in municipal fleets, thereby demonstrating their viability to the market, as well as improve the recharging network in public areas, extend charging points in underground car parks and encourage and provide regulations that govern their incorporation in the private car parks of existing and new buildings. In 2013, Barcelona had more than 300 electric vehicles in its municipal fleet, used mostly by the cleaning service.

One of Barcelona City Council's aims to make electric vehicles a benchmark for private and/or public transport in the city, both individual and collective.

Urban green and biodiversity

Barcelona enjoys and benefits from green spaces

Urban green and biodiversity

Vision of the future

Becoming a city where nature and urban life interact and develop

Current situation

Urban green

18.05 m² of green space per inhabitant

35.3 % of Barcelona's municipality is **green space**

Biodiversity

1,172 **plant** species

299 **indigenous animal** species

Lines of work

Protecting spaces 'Collserola NP' 'Montjuïc Cliff'

Preserving biodiversity 'Amphibian programme' 'Control of invasive species'

Social and environmental green services and connectivity 'Network of green corridors' 'Vertical gardens' 'Living roofs'

Well-being and enjoyment 'Network of urban allotments'

Raising awareness and involvement of citizens 'Bioblitz'

4.1 Vision, challenges and opportunities

Vision of the future

Barcelona sees the city of the future as a city where nature and urban life interact and develop; its goals are therefore:

- Establish an ecological infrastructure that provides environmental and social services and that reconnects the city and the territory.
- Appreciate, preserve and strengthen the city's biodiversity and prevent the loss of species and habitats as a natural asset of the Earth and as a benefit for present and future generations.
- Take advantage of all opportunities to provide a place for nature and encourage people's contact with natural elements.

The compact nature and complexity of the city of Barcelona impose some limitations on urban green and biodiversity but also provide diversity. The main conditioning factors that should be considered are:

- **Barcelona is a compact city, geographically limited between the sea, hills and rivers and also densely populated.** One of the most densely populated cities in Europe, Barcelona has little land available to develop new green spaces.
- **It comprises a wide range of environments and ecosystems.** The two estuaries, with their deltas; the coastline with sandy beaches, the hill of Montjuïc; the Collserola range of hills inland and the plain, which is the area most occupied by the urban fabric mean that the city has a particularly varied range of habitats.
- **It's a hot city with little, irregular rainfall.** The months of June and July are critical, with minimum rain and maximum temperature. In general the lack of rain and its irregular distribution throughout the year limit the vegetation's ability to retain water, being further amplified in the urban green by the land's inability to absorb water. This situation is likely to get worse due to climate change.
- **Some fauna and flora could be invasive.** This has created problems for public and natural spaces on the outskirts of the city and could lead to indigenous species being displaced.
- **Green planning is relatively recent.** Until 1976 the city of Barcelona did not have an urban development plan including provisions for green spaces. On the other hand, the Collserola Special Plan dates from 1987.
- **Barcelona, sensitive towards urban green and biodiversity.** Barcelona has been working to protect urban green areas. Biodiversity has been included in municipal policy commitments and both human and financial resources are allocated to it, working in coordination with other institutions and bodies, both local and international.

4.2 General context and current situation

Nature is present throughout the city but often in isolated areas, without continuity. Urban green spaces provide ecological values that are essential for the city such as nature, biodiversity, complexity and connectivity and socio-cultural values, such as health, well-being, beauty, countryside, culture and helping social relations.

One of the city's priorities is and has been to develop these environmental and social services for green spaces, protect existing free spaces and extend and connect them whenever possible.

4.2.1 Barcelona, sensitive towards urban green and biodiversity

Barcelona has been working to protect free areas and biodiversity for many years now. Some of the key milestones are as follows:

→ **Barcelona's Agenda 21**. In 2001 the Citizen Commitment to Sustainability was passed, renewed in 2012, dedicating 10 lines of action to protect and improve green spaces and biodiversity.

→ **New OMA** (2011). Approval of the new OMA (General Ordinance of the Urban Green of Barcelona), whose Title 7, on green spaces and biodiversity, governs the implementation, maintenance, use and enjoyment of green spaces and biodiversity, as well as their different components.

→ **Participation in the Local Action for Biodiversity project**. This project by cities involves: assessment of urban biodiversity, institutional commitment, preparation of a 10-year biodiversity plan and implementation of 5 actions in the city. As part of this project, Barcelona signed the Durban Commitment. One of Barcelona's good practices to encourage biodiversity on a global scale is to apply criteria of sustainability to its purchases of wood.

→ **Approval of the Green Infrastructure and Biodiversity Plan**. *(see section 4.4.1 Increasing green spaces and their services, goals in the Green Infrastructure and Biodiversity Plan ⊕).*

Barcelona's natural assets are extremely varied, ranging from the large wooded park of Collserola to the coast with sandy beaches, including river zones in the final sections of the Besòs and Llobregat rivers.

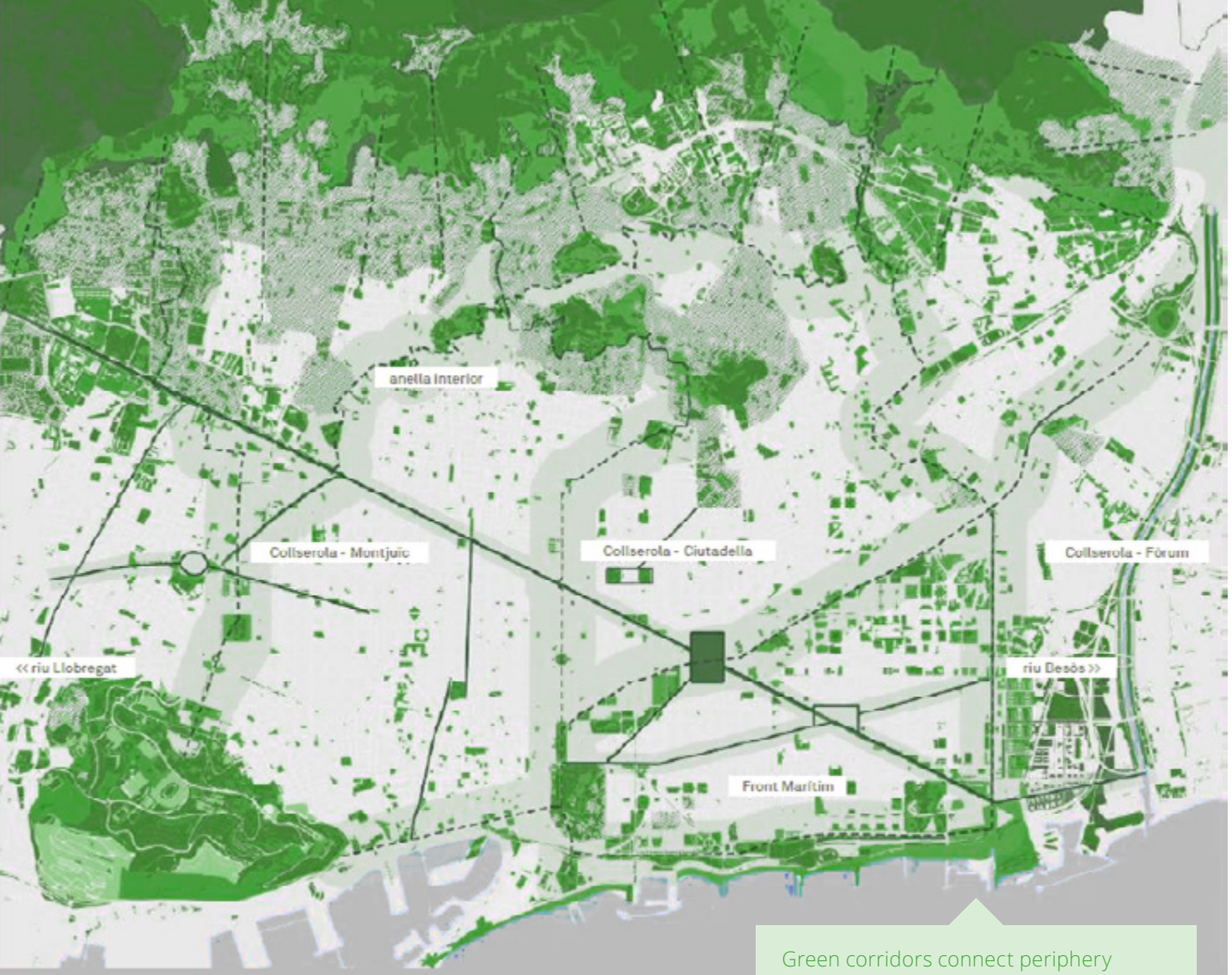
4.2.2 The amount of green area is increasing

Barcelona has remarkable natural assets thanks to the size of the Collserola range of hills, covering more than 8,000 hectares in total. Collserola Park is a wooded park that forms part of 9 municipalities; 22.5% of its area is within the municipality of Barcelona. It's the largest and most diverse wooded area in the city and the only one benefitting from specific protective measures. The park has a mosaic of habitats providing a considerable range of species. It should be noted that the EU's 1992 Habitats Directive designates three of these (*Quercus ilex* forests, pine forests and dry grasslands) as habitats to be conserved.

From Barcelona's ecological map (in an analysis of trends since 1977), it can be concluded that forests and urban green zones have increased and that crops now have a nominal presence.

Rivers and the sea complete what can be considered as Barcelona's natural environment, most of which has been modified in some way.

Also of note are the 4.5 km of Barcelona's beaches, a result of the process to recover the coastal environment



urban green corridors
spaces with natural vegetation or gardens
urban fabric with significant amount of privately used green spaces

Green corridors connect periphery natural areas with the urban area and create the city's ecological infrastructure by incorporating green spaces and enhancing biodiversity.

started in 1980, from the most westerly beach of Sant Sebastià to the beach of Llevant, created in 2006.

Regarding the extent of these areas, Barcelona has 3,615 hectares of green accounting for 35.3% of the municipality's area (2013 data). Of these hectares, 1,102 are strictly urban green (made up of parks and gardens), 1,698 correspond to the municipality within the Collserola Nature Park and it's estimated that 740 are private green spaces, located mostly in the higher part of the city. Looking only at public green spaces, this area is equivalent to 18.05 m^2 green space/inhabitant (6.84 m^2 in the urban section, without counting Collserola). The overall amount of green space is therefore quite good but only 30% is strictly public and urban. 20% of the remaining hectares correspond to private green spaces (acting as a lung for the city and providing environmental benefits but without the public being able to use them) and the remaining 50% is the wooded green area of the municipality of Barcelona that lies within Collserola.

The area per inhabitant is tending to stabilise although it increased slightly in 2013. Nevertheless, the distribution of public green zones in the city's different districts is quite uneven. Public green is concentrated mainly in the districts of Sants-Montjuïc, Sant Martí and Horta-Guinardó. If we include Collserola, then Sarrià-Sant Gervasi is the district with the largest public green area.

Apart from Collserola, Montjuïc is the city's other wooded park. With 450 hectares it's the space in the city with the greatest biodiversity. It includes 16

parks with a considerable presence of flora and fauna and Montjuïc cliff has been included in the Catalan government's Inventory of geological spaces. There are more than 60 species of vertebrates as well as a considerable assortment of ornamental plants from different bio-geographical regions. The parks of Tres Turons and Ciutadella are also particularly important thanks to their size, with very different characteristics.

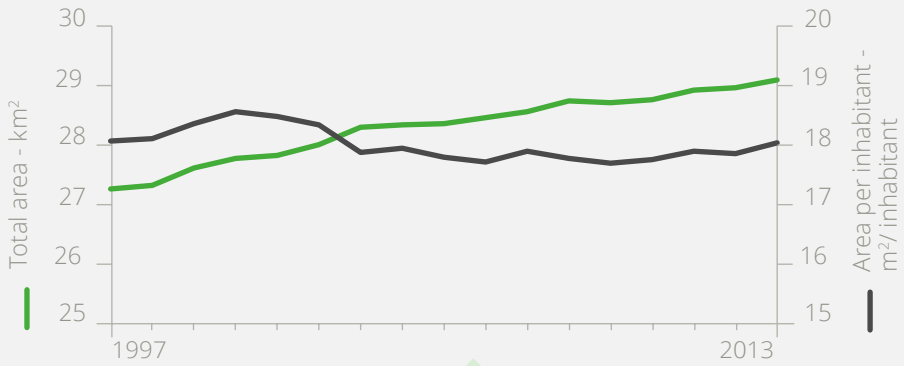
In spite of the size of the two large wooded parks, the city's predominant urban green space is modest in size (between 1 and 5 hectares) and tends to be located in the middle of the urban development, within reach of citizens. 57% of the green spaces measure less than 1,500 m² and, in general, are not very interconnected.

The trees lining the streets are also important, totalling around 161,000 units with 150 different species and cultivars. There are still 54 areas of natural interest within the city that have been inventoried but do not benefit from any protection, although there are some conservation measures.

Within the urban part of the city there are other types of urban green in addition to parks and gardens that provide a range of biodiversity: squares, allotments, flower beds, ornamental pools and ponds, walls and roofs, etc. These form a network of spaces of varying sizes. 115 green or living roofs have been counted in the city, totalling 4.3 hectares.

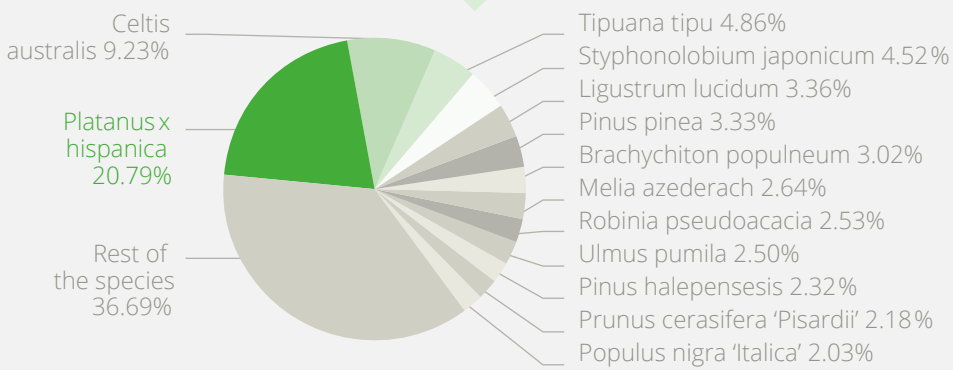
4.2.3 The biodiversity of cities must also be preserved

Barcelona has some particularly significant indigenous fauna, such as all its amphibians, reptiles and mammals (except those that constitute pests). The fish species in



The city's green surface area has increased year after year while the area per inhabitant has tended to stabilise.

Although Barcelona's trees are highly diverse, 4 species represent 40% of the street tree population (plane, nettle tree, pagoda tree and black poplar).



freshwater have been introduced, however. In terms of birds (the most numerous and with the most diversity), the most relevant species are jackdaw (the UICN classifies it as a vulnerable species which has found a haven in Barcelona), the peregrine falcon (extinct in the city but now recovered), Alpine swift and grey heron (with very important colonies within the Catalan context) and swallows (great migrants and requiring protection).

Barcelona has a wide diversity of tree species within the city although this is not spontaneous biodiversity but the result of the management model for green spaces. There are about 200 species of tree in Barcelona, of which 150 line the streets.

Group	Species					
Flora	1,172 ornamental species or varieties of broadleaf trees, bushes, conifers, palms, climbers, agavaceae, succulent and aquatic plants. 77.4% of the species or varieties are exotic and 22.6% are indigenous.					
Fauna	Order	Indigenous species urban section	Introduced species urban section	Indigenous species in Collserola	Indigenous species Barcelona **Total**	Protected species urban section
	Mammals	17	0	28	**28**	7
	Birds	75	7	176	**184**	55
	Reptiles	8	3	16	**16**	8
	Amphibians	3	0	10	**10**	2
	Fish	0	3	4	**4**	0
	Butterflies	-	-	57	**57**	-

The park of Ciutadella is a good example of the city's wide variety of trees with more than a hundred species, some of which are over 100 years old.

Exotic plant species (77.4%) outnumber indigenous species (22.6%) while, in fauna, indigenous species outnumber the introduced species. All inventories of flora and fauna have been carried out in the city's parks and gardens except for common birds, which are counted throughout the city.

4.3 Measures taken to enhance green environmental services

Barcelona is committed to conserving and improving its natural assets so that everyone can enjoy and benefit from them. The aim is to work to ensure nature and the city interact and develop and that green assets are interconnected, as well as ensuring continuity with the natural territory surrounding the city.

Along these lines, over the last few years Barcelona City Council has worked on implementing measures to conserve and manage green spaces and biodiversity, as well as to plan, design and transform the city and to provide information and encourage involvement.

4.3.1 Protection and conservation, commitments to the future

Declaration of the Collserola Nature Park

In 2010 the Collserola range of hills was declared a nature park ⊕. The declaration involved the following improvements:

- Definite demarcation of the protected area.
- Incorporation of the Catalan government in the Collserola Park Consortium.
- Priority given to conservation above merely urban planning protection.
- Improved management, such as protection against illegal behaviour, in situations of expropiation and granting licences to carry out building work.

Protecting the Montjuïc cliff

The Montjuïc cliff has a wide range of assets that are highly significant when considered as a whole: landscape, fauna, flora, history, science, social assets, etc. It's the green space of Barcelona with the widest range of vertebrate species, over 60 including mammals, birds (such as falcons and kestrels), reptiles and amphibians. The final approval of the amendment to the General Metropolitan Plan of Montjuïc Mountain identified Montjuïc as an equipped park, prioritising free areas of natural interest and guaranteeing protection of the cliff.

Programmes to preserve biodiversity

Regarding specific initiatives to control, protect and conserve protected, threatened and/or indigenous species of flora and fauna, there are various programmes:

- **Control and management of urban biodiversity in buildings**. Since 2004, Barcelona City Council has promoted the **Swallows Project** which consists of controlling and supporting the population of common swallows (*Hirundo rustica*) and house martins (*Delichon urbicum*). This programme has now become a Programme of urban biodiversity management in buildings to conserve birdlife in walls undergoing restoration (kestrels, swallows, common and Alpine swifts, crows). Since the campaigns started (2006), 210 artificial external nests have been installed in the city, 74 of these for common swifts, 62 for house martins, 36 for swallows, 23 for bats, 14 for jackdaws and 1 for kestrels. 29 colonies of Alpine swifts were located in 2013, now totalling 320. Nests integrated within walls have also been placed or adapted, taking advantage of refurbishment work, specifically 42 integrated nests from 2010 to 2013.

The World Nature Foundation promotes the project "WN refuges for fauna and flora" ⊕. Invite nature into your home!" with the aim of creating a network of havens for flora and fauna in Catalonia as well as the necessary connections to conserve species.

→ **Programme in the urban section to monitor peregrine falcons** (*Falco peregrinus*). 1999 saw the start of the project to reintroduce the peregrine falcon, which has been successful. 71 chicks have been released under this programme since 2004, using the "hacking" technique. The city currently has three stable pairs of falcons.

→ **Programme to conserve the jackdaw** (*Corvus monedula*), classified by the IUCN as vulnerable. This covers various actions aimed at improving our knowledge and conservation of this species, such as placing nesting boxes (14 in 2013) and feeding stations, as well as window stickers at the zoo to prevent birds from hitting the glass and population control (censuses, etc).

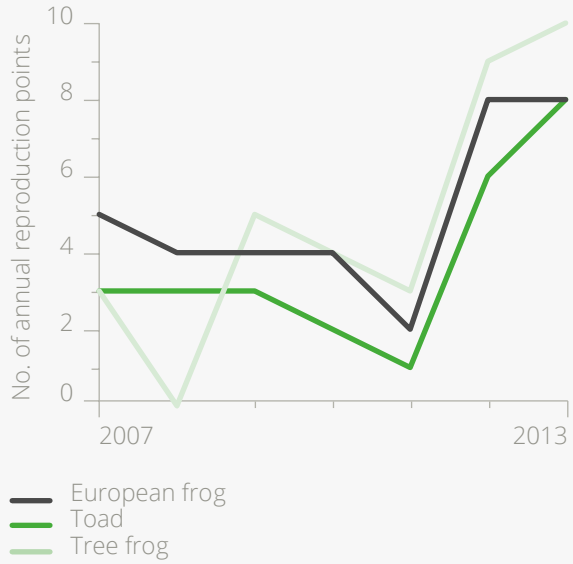
→ **Annual monitoring of the city's most common birds**. Since 2001, samplings have been taken of birds in collaboration with Barcelona University and the Catalan Institute of Ornithology (ICO). The "Monitoring Common Birds in Catalonia" or SOCC method is applied in Barcelona, counting the number of birds on both sides of an approximately straight route over a distance of 3 km, carried out four times a year, twice in spring and twice in winter.

→ **Programme to help the Zoo's ⊕ non-captive fauna (herons and hedgehogs)**. Actions have been carried out to monitor hedgehogs using radio waves which have identified a minimum population of 38 animals, as well as measures to protect them. Regarding herons, since 1974 the Zoo has had the largest colony of grey heron (Ardea cinerea) in the whole of Catalonia. Other species are now increasing their presence, such as the little egret (Egretta garzetta) and cattle egret (Bubulcus ibis). A species monitoring programme was started in 2006. There are around 150 nests.

→ **Programme to protect amphibians**. Since 2008 Barcelona City Council, in collaboration with the Gaanthus association, the Zoo and Barcelona University (UB), has been running a programme to manage the ponds and fountains in parks and gardens and to protect amphibians. The project consists of: carrying out censuses, reintroducing amphibians, rescuing tadpoles, improving habitats, extracting fish and other exotic animals, providing protocols for the work carried out by park and garden maintenance staff and promoting the project to raise people's awareness. The ornamental pond naturalisation programme is currently being applied to 79 ponds, 9 pools and one lake. 36 salamander larvae have also been released at the Laberint d'Horta park.

→ **Introduction of selective mowing**. 2013 saw the start of an experiment in selective mowing and pruning at the Parc de la Trinitat in the district of

Since 2011, the number of reproduction points for amphibians (European frog, toad and tree frog) at the Tres Pins nursery has increased.



Sant Andreu. Portions of the grass are mowed less frequently, forming geometric shapes and patterns that, in addition to saving work and being attractive, also increase the associated biodiversity, especially for invertebrate fauna.

→ **Creation of a butterfly garden at Parc de Joan Miró**. Introducing flowering species is an effective way to attract butterflies within the urban part of the city, which is why this technique is also being applied to other zones in Barcelona.

→ **Programme to control invasive species** ⊕. Gardening is one of the main sources of new invasive plants in the environment and this can endanger the natural environment. That's why Barcelona City Council has promoted two significant areas of action. The first consists of identifying invasive species and making proposals to use alternative species to prevent this. The second is aimed at managing and possibly eradicating invasive species. As a continuation of this programme, Barcelona City Council has reached an agreement with the Centre of Ecological Research and Forestry Applications (CREAF) to verify any proposals to introduce species in Barcelona and to prevent invasive species from being planted.

Barcelona, as part of its aim to conserve biodiversity, carries out various programmes to preserve protected, threatened and/or indigenous species of flora and fauna.

Production of guidelines to conserve biodiversity

Conservation guidelines, currently being produced, refer to the different natural habitats in general and to three parks of particular interest: Parc de la Ciutadella, Parc del Laberint d'Horta and Parc dels Tres Turons. Having identified the habitats, files have been produced with guidelines for each one. These files include: a description of the habitat and its potential, its surface area within the city, problems and specific features and proposals to improve conservation and biodiversity.

Prevention with allergenic species

The diversity and quantity of pollen in the city has been studied since 1994. These aerobiological reports have helped to identify the species producing pollen and what time of the year they are present. The most notable species are: *Platanus, Cupressus, Pinus, Quercus, Urticaceae (Parietaria), Olea, Gramineae, Poaceae, Chenopodiaceae/ Amaranthaceae* and *Plantago*. The epidemiological data available show a correlation between pollen in the air and respiratory allergies; acting on the urban flora can therefore help to improve the quality of life of those suffering from allergies and prevent new cases.

Comprehensive management to treat pests and diseases

The comprehensive management of pests and diseases in Barcelona's gardens prioritises those practices and products that pose less risk to human health and the environment. Barcelona City Council's commitment to sustainability, as well as increasingly restrictive legislation, have resulted in the progressive use of integrated actions to combat pests and disease. This involves a range of controls, especially biological resources employing "useful fauna". The aim is to combat pests by introducing other species of insect that are their indigenous natural enemies, thereby reducing the pest population. The Council coordinates such prevention, treatment and protection in collaboration with other organisations and in line with the regulations established by the relevant authorities.

4.3.2 Green spaces, a key element in transforming the city

Barcelona is increasing its green area

→ **The Parc de les Rieres d'Horta, measuring 4 hectares**, is located on Avinguda de l'Estatut where water used to flow from the streams coming down off the Collserola hills and where, further up, there was the old water course or "riera" of Horta, the most

important in the hydrographic system of the Barcelona plain. This park has been created as a public place for various leisure pursuits and all kinds of users. It covers 4 hectares and has been built on top of a rainwater tank (with a storage capacity of 75,000 cubic metres of water) and an important "cleaning centre" (for the city's street cleaning services).

→ **Covering the railway line** that enters Barcelona from l'Hospitalet along the section from Riera Blanca to the surrounding area of Plaça de Sants. Historically this line has impaired the urban development of the city, dividing the districts of Sants and La Bordeta. To correct this situation, this section of line has been covered by building a large concrete box on which there a "rambla" or promenade will be placed, 700 metres in length.

→ **Plaça de les Glòries**. Work has begun to transform Plaça de les Glòries, making this square a central location in the district. The aim is to rearrange the urban mobility, equipment and residences planned and maximise green space, as well as its role as an urban development that provides services which are environmental rather than merely decorative.

→ **Reclaiming interior patios** and other appropriate areas. Since the first interior patio or "island" in the Eixample district was reclaimed in 1985, namely the Torre de les Aigües, there are now 45 green spaces open to the public, in total measuring 94,000 m^2. Although of modest size (between 500 and 3,500 m^2), reclaiming interior patios has been a key process in revitalising the Eixample and has improved the quality of life of its residents given that this district suffered from a significant lack of green spaces.

→ **Vertical gardens**. Barcelona has implemented a plan to install vertical gardens in the middle of the city in order to improve the urban landscape and use natural energy efficiently. One of these actions includes the small garden of Pedró, in the heart of the

Jardí Tarradellas, located at Carrer Berlín, 109, is an example of a vertical garden acting as a green lung within the city.

Raval district, where up to eight different species have been planted, chosen from the most popular species for the district's balconies. Another wall has been transformed at the Trinitat Vella Library, with solar panels to supply electricity and a flower bed in the lower section, as well as two more in the 22@ zone.

4.3.3 Communication and involvement to raise citizens' awareness

Awareness-raising campaigns

Barcelona City Council aims to make its citizens more aware of its green spaces and biodiversity. To do so, it uses the following:

- **Publications**. Such as park guides and educational environmental guides, informative leaflets, specialist manuals, posters, books and story books. Various aspects are covered, of an informative, technical and scientific nature.
- **Promoting green spaces and biodiversity**. Work is carried out through the programme of educational and social activities with "Make your home into a garden" workshops.
- **The city's environmental facilities**. The Fàbrica del Sol and the Environmental Games Centre at Parc de la Ciutadella offer activities aimed at a wide range of people related to urban green.
- **Environmental education at schools**. Approximately 65% of the schools carrying out Agenda 21 School projects (244) do so on biodiversity. The "Get close to parks" programme encourages schools to adopt public areas.
- **Continued training in gardening and landscaping** given at the Training Centre of the Parc del Laberint.
- **Campaigns and events**, such as the Spring Festival, the Rose Contest, Music in Parks, Christmas campaign, etc.
- **Activities at Barcelona Natural Science Museum** ⊕, bringing together zoological and geological collections at the Museu Blau and botanical collections at the Botanical Gardens of Montjuïc. The main aim is to improve our knowledge and conservation of diversity, as well as promote learning and the discovery of the natural world.
- **"Rutes BCNVerda" app**. Montjuïc invites people to discover the botanical delights of its themed gardens and other green spaces on the hill.

Participation in the BIOBLITZ programme ⊕

These seminars have been held since 2010, where all the organisms in a specific location are identified over a period of 24 hours, carried out by experts and amateur naturalists. Every year the chosen zone is analysed and an inventory drawn up. Scientists are involved, studying specific groups of flora and fauna and families are invited to take part in nature rambles and learn about the city's biodiversity. At the same time, complementary activities are also offered such as talks, workshops, etc.

Urban Allotment Network

Barcelona currently has 329 plots distributed in 14 urban allotments which, in total, represent almost 25,000 m^2, making up the Urban Allotment Network, benefitting over 500 people, including the elderly, organisations and the disabled.

The Urban Allotment Network is a programme involving people aged over 65, starting in 1997.

4.4 Future goals and measures

The main aim is for urban green to be a true ecological infrastructure created by the city whose many different environmental and social advantages can be enjoyed. That's why Barcelona City Council wants to make the most of its opportune spaces, from unoccupied plots of land to roofs and balconies in all the city's districts which can be renaturalised, as well as establishing urban green corridors to connect green spaces and create a robust, efficient network.

The Green Infrastructure and Biodiversity Plan establishes that nature in the city represents a true green network which must be seen as an ecological infrastructure serving an environmental and social purpose.

4.4.1 Increasing green spaces and their services, goals in the Green Infrastructure and Biodiversity Plan

Nature Green Infrastructure and Biodiversity Plan 2020

This plan, approved in January 2013, is the strategic instrument that defines the municipal government's challenges, goals and commitments regarding the conservation of nature and biological diversity, encouraging the population to get to know its natural assets, enjoy them and look after them.

The Green Infrastructure and Biodiversity Plan contains 68 actions grouped into 10 strategic lines to achieve the following goals:

- Conserve and improve the city's natural assets, preventing the loss of species and habitats.
- Achieve the largest area possible of green spaces and their maximum interconnection.
- Obtain as many environmental and social services as possible related to nature and biodiversity.
- Increase society's appreciation of nature and biodiversity.
- Make the city more resilient to emerging challenges, such as climate change.

MAIN MEASURES OF THE BARCELONA GREEN INFRASTRUCTURE AND BIODIVERSITY PLAN 2020

Connectivity

Green Corridors project. Barcelona's network of urban green corridors will ensure the city's green spaces are connected with neighbouring green spaces and the outskirts of the city. The project has a long timescale (2050) and covers a wide geographical area as it involves the transformation of the urban fabric. Barcelona City Council has been working on this project since 2006, based on a study determining the route to be taken and the publication of a guide containing the corridors' design criteria, published in 2010. Since 2013 work has been carried out on defining the strategies and actions required to create the first Ciutadella/Collserola green corridor, planning a series of actions to be implemented over the next 4 years.

Opportune spaces

Promoting the Living Roofs project, green roofs. This consists of reclaiming roofs for different activities: an area for play and relaxation, for strolls, the installation of systems to collect rainwater and capture energy, to locate solariums, cultivate crops, etc. This is promoted by offering financial incentives and by using public buildings as an example, as well as carrying out communication and informative activities.

Promoting green roofs. Barcelona currently has 4.3 hectares of green roofs. To promote them, Barcelona City Council has planned to provide financial incentives, guidance for projects, the creation of regulations and actions to provide examples and publicise the concept.

Controlling invasive and excessive populations

Managing the problems caused by wild boar. The wild boar population is getting larger (in the 2012-13 season there were 896 individuals on the Serra of Collserola), resulting in an increasing number of incidents (659 incidents in 2013). In response to this growing problem, work is being carried out on a joint strategy between Barcelona City Council, the surrounding municipalities and the park of Collserola. The following is planned: to avoid the proliferation of wild boar by capturing them, adapting public space and improving knowledge of the procedures to report incidents, as well as passing by-laws that prohibit the feeding of boars, etc.

Conservation of species

Beehive network in the city. Barcelona aims to promote urban beekeeping in response to its commitment to conserve a species protected by Decree 110/2003. This network will consist of municipal apiaries with bees collected from incidents (in 2013 more than 100 swarms were collected) and other apiaries which will require a permit from the Council for their installation in private areas.

Management tools

Tree Master Pan (PDA). Some of the Council's documents have become tools to design plantations, select tree species, manage and maintain urban trees ("Management of roadside trees" ⊕, "Diversification of roadside tree species") but a complete management strategy is required. For this reason the Tree Master Plan is being drawn up, which will generate the guidelines to be followed when planting, conserving and managing Barcelona's trees in the long term (25-50 years). The goals have yet to be fully developed into specific actions and budgeted. This document will also become a contract to be taken into account in urban development projects.

Sustainable land use

Barcelona, a city that promotes and fosters urban quality

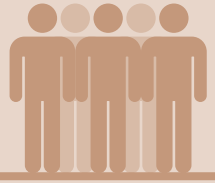
Sustainable land use

Vision of the future

Becoming a metropolis of districts at a human pace

Current situation

102.3 km² surface area



1,611,822 inhabitants

15,749 inhabitants per km²

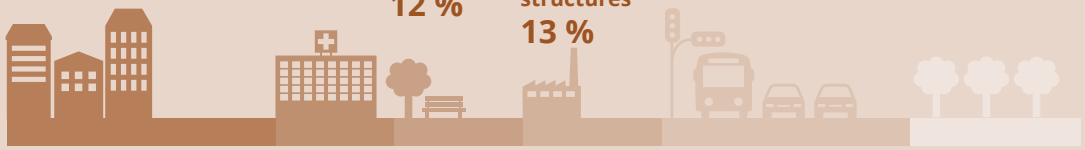
! **+ 50 %** of Catalonia's population resides in the Barcelona Metropolitan Area

Planning instruments

- Barcelona Metropolitan General Plan (PGM) **1976**
- Barcelona Metropolitan Spatial Plan (PTMB) **2010**
- Urban Development Master Plan (PDU) -currently being drafted- **2013**

Land uses (2013)

- **Residential** 25 %
- **Facilities** 11 %
- **Urban parks** 12 %
- **Industry and infra-structures** 13 %
- **Road network** 23 %
- **Wooded parks** 16 %



Lines of work

Urban innovation
'Super-blocks'
'BUITS' Plan

Governance
'Urban Habitat'
'Advisory Board for Urban Habitat'
'Public Space Board'

Regeneration 'Micro urban developments'
'Districts Plan' 'Plan to Improve Public Space'

Strategic projects
'Les Glòries'
'La Sagrera'

Planning
'Urban Development Master Plan'

5.1 Vision, challenges and opportunities

Vision of the future

Barcelona aims to become a metropolis of districts at a human pace, a city designed for people as its priority, a comfortable city seeking excellence in public space that takes into account the different elements comprising the urban habitat - the human habitat.

Throughout history Barcelona has adapted to people's way of life. Today the city's facing new challenges due to the new needs of its citizens and to the change entailed in integrating new infrastructures, technologies and communication.

- **Barcelona is a compact city where green areas often form isolated spots**, scattered here and there with no continuity. One of the city's priorities is nevertheless to protect open spaces and always connect them as far as possible, in order to take advantage of the ecological value and environmental benefits of green belts (microclimatic regulation and reduction of the heat island effect).
- **There's little permeable land.** The urban development process has made the land impermeable, through the construction of buildings and public thoroughfares and the limitation of space for urban green, leading to the need to find alternative solutions to retain rainwater.
- **Some districts are eminently residential in nature** and some streets form major thoroughfares. There must be a process of urban regeneration of these thoroughfares in order to ensure more mixed uses and make mobility compatible with the more urban roles of walking, shopping and social and economic activity.
- **Barcelona is reinventing itself as a productive city with new economic foundations.** The crisis in traditional production sectors went along with the inrush of new information and telecommunication technologies. In 22@ industrial sites are turned into a productive and innovative area. The challenge is to reindustrialise so as to create new jobs.
- **The use of information and communication technologies will add new values** to present structures. Barcelona is moving ahead in the creation of distribution networks for local interchange with metropolitan and global connections.
- **Barcelona represents a strategic point along trading and logistics routes** for goods, thanks to its geographical position in the north-west Mediterranean and the combination of the airport, the port and industrial estates connected with logistics.
- **Barcelona continuously attracts many newcomers.** Barcelona took in the first immigrants in the late 19th century and early 20th century. Since then, different migratory waves have led to considerable urban development pressure. Tourism also places a great strain on the city's services.
- **The right to housing is materialised in building affordable housing for all the city's people.** The construction of sufficient rented housing for Barcelona's social needs is vital for the cohesion and balance of the city's different districts.

5.2 General context and current situation

Barcelona has grown and developed exponentially over the course of its history. In the last two centuries the city has extended its frontiers and has consolidated its position as a great zone in the Mediterranean region with over 50% of Catalonia's population residing in Barcelona Metropolitan Area.

The urban planning of the city reflects the different periods of its history (Roman, medieval, modern) and most particularly the work carried out in the mid-19th century by Ildefons Cerdà as a result of the need to extend the city after the demolition of its town walls in 1854. The Cerdà Plan took sustainability criteria on an urban development scale into account, such as octagonal blocks with rounded street corners to facilitate circulation, leaving a green zone for public use inside. In the late 19th and early 20th century, the Universal Exhibition (1888) and International Exhibition (1929) led to intense urban planning remodelling. The great migratory waves of the 50s and 60s led to the city's fast growth without any kind of urban development planning.

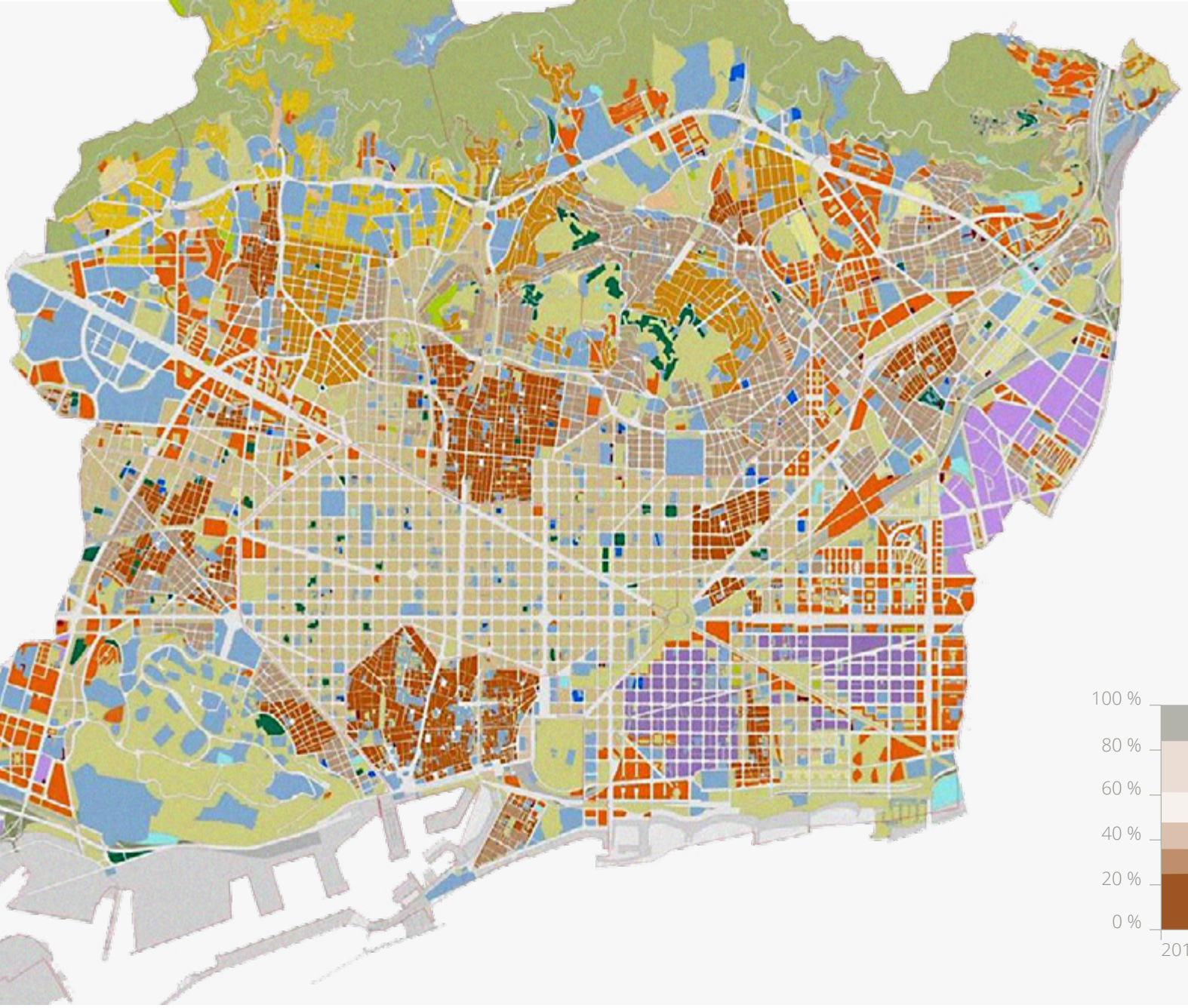
The Barcelona Metropolitan General Plan (PGM) ⊕, still effective today was passed in 1976. This corrected the deficiencies accumulated over the years by means of a determined and protracted improvement strategy. The Plan developed the criteria of the 1975 Land Act, setting minimum standards to preserve public land, thoroughfares, green spaces, amenities etc. which have helped to develop a balanced city with several modifications. The city was swept up in a further large-scale transformation process during the 80s, taking advantage of Barcelona's candidacy for the 1992 Games. A good deal of the industrial zone was then reclassified for residential and commercial uses and amenities.

One of the most significant measures involved in this transformation was the process of reclaiming the city's seafront. From the construction of the Olympic Village, the first emblematic building project for Barcelona 92, to the later work carried out for the Forum, a new seafront has been designed made up of different sections with very different characteristics as regards surface area, programmes and uses envisaged. All these were nevertheless planned applying the same criterion: ensuring a close connection between the eastern coast, its sea and beaches (currently 4.5 km in length) with the neighbouring districts, and integrating this within the city as further space for public use, in the most rational and sustainable way possible.

The Barcelona Metropolitan Spatial Plan (PTMB) covers an area representing only 10% of Catalonia as a whole but where 70% of its population live (4.8 million inhabitants).

All these events have marked Barcelona's history, turning it into a diverse, dense and compact city with a structure made up of districts endowed with the same services and quality of urban space. Public space is one of the key factors in its urban cohesion policy, as well as its network of facilities and civic structures connecting the districts through public transport, cycle lanes and pedestrian areas.

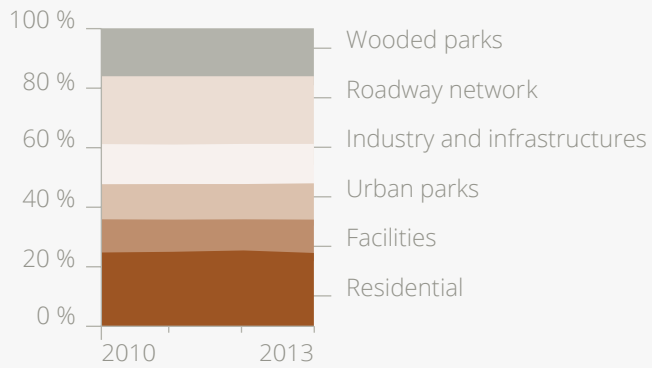
In 2010 the Government of Catalonia passed **Barcelona's Metropolitan Spatial Plan** (PTMB) ⊕. This is an instrument introduced with the aim of providing spatial planning for the area made up of the counties of Alt Penedès, Baix Llobregat, Barcelonès, Garraf, El Maresme, El Vallès Occidental and El Vallès Oriental, comprising a surface area of 3,236 km^2 and 164 municipalities. Its purpose is to structure the Barcelona Metropolitan Region as an environmentally sustainable, economically efficient and socially equitable and fair reality, as laid down by Law 31/2010, of 3 August on the Barcelona Metropolitan Area.



- Industrial land
- Wooded green space
- Green space
- Facilities
- Port
- Eixample area
- Other types of *eixample*

In the city of Barcelona, the land used for industrial activities is mainly located on the seaboard close to the Port

25% of the surface area of Barcelona is residential land



5.3 Measures taken to improve urban quality

As a priority, the policies of Barcelona City Council propose a city designed for its people, containing measures in different fields of action. Quality public space means a space for people to live harmoniously together. In recent years Barcelona has made an enormous effort to turn its different districts into quality public spaces, a process that still continues today. It has also sought to protect trade and the urban landscape as the latter is part of the urban environment which helps to guarantee the appropriate quality of life for all the city's inhabitants. The Council has created the Public Space Board (*Taula de l'espai public*), a multidisciplinary body to monitor and control using indicators for guaranteeing its quality.

5.3.1 Barcelona, a city improving its governance

Creation of the Urban Habitat area

The large-scale governance area of Hàbitat Urbà ⊕, covering urban planning, infrastructures, housing, the environment and information and telecommunications systems, is an area that operates across the board to turn Barcelona into a smart and self-sufficient city, designed for people.

Creation of the Advisory Board for Urban Habitat

This collegiate advisory body was set up by means of a Mayor's Office Decree in 2011, and consists of around thirty experts in professional, academic and scientific areas. The Board was set up in 2012 and has the role of advising municipal authorities on the major issues concerning architecture, design, sustainability, the environment, landscape, infrastructures ⊕ and information and communication technologies related to work on the urban habitat. It can also propose measures related to promotion, education and research into the urban habitat, as well as giving opinions and drafting reports on subjects covered by the aforementioned fields. It must draw up an annual report on the urban habitat and the most significant actions that have been taken in this field in the city of Barcelona. Based on the experience gained in its first year, changes were brought into its operation in 2013: extending the number of members of the executive committee and increasing the frequency of its meetings.

Architecture commissions

Architecture commissions monitor the architectural quality of the major projects carried out in the city. They are made up of the head architect, a secretary and five external architects.

5.3.2 Action taken to maintain a compact city with quality and appeal

District Plans for the city of Barcelona

This is a scheme intended for those urban districts and areas with a combination and overlapping of shortcomings in planning, building and well-being that require comprehensive actions to improve their inhabitants' living conditions. Act 2/2004, of 4 June, on improving districts, urban areas and towns requiring special attention was passed by Catalonia's Parliament in late May 2004 and in September that same year its government passed the Regulation implementing the law, enabling it to be implemented immediately.

Pavement cafés are one of the city's great attractions. The rising demand for new licences has led to a new ordinance which seeks to improve public space for civic coexistence whilst also promoting business.

The impact of applying a district plan goes beyond the surface, affecting the social fabric and collective psychology of districts and providing a firm basis for cohesion. The Plans for Districts implemented in the city that are still in force are: Torre de Baró-Ciutat Meridiana (Nou Barris), 93% completed and intended to be finished in 2016; El Coll (Gràcia) at a point of 96% completion and expected to be finished in 2015; La Barceloneta (Ciutat Vella) at 81% and Maresme-Besòs (Sant Martí) at 89%, scheduled to be completed in 2018; Bon Pastor-Baró de Viver (Sant Andreu), at 50% and expected to be completed in 2015; Raval Sud (Ciutat Vella), at 13% and La Vinya, Can Clos, Plus Ultra (Sants-Montjuïc) at 46%, intended to be finished in 2016.

Plan for the Comprehensive Improvement of Barcelona's Public Space 2013-2015

In mid-2013 Barcelona City Council passed the Plan for Comprehensive Improvement of the City's Public Space, which covers wide-ranging renovation actions in 65 streets and 13 parks until 2015. The first measures implemented in the plan were: improvements in accessibility to Horta-Guinardó squares, creation of a single platform in Prat d'en Rull in Les Corts, a new park inside the block in Sant Martí, renewal of the steps in Llerona street in Nou Barris, improvement of the drainage and rainwater collection system and renewal of the paving of pavements and road surfacing in Osona and Putget streets in Sarrià-Sant Gervasi.

Green and more sustainable walls

Barcelona has started up a plan to install vertical gardens on some of the city's buildings with the aim of improving the urban landscape and taking advantage of environmental services such as the efficient use of natural energy. Some prominent examples of the measures taken can be seen in the Raval district, where up to eight different species chosen from the ones found on many of the districts' balconies have been planted; the work carried out on the wall of Trinitat Vella Library, with solar panels which supply it with electricity and a flower bed at the bottom, and the vertical garden projects in 22@. These are examples of how a smart city adapts urban action to the needs of each building, improving the appearance of some of its walls.

New Ordinance for pavement cafés

The purpose of this new Ordinance, published on 31 December 2013, is to improve public space for people's coexistence in the city; promoting, supporting and boosting economic activity; creating an accessible and inclusive city for everyone; preserving the quality of the city's urban landscape; safety; respect for public and private property and the rights affected; and the environmental sustainability and quality of pavement cafés. It establishes criteria to decide on the location of these areas (distance from the building and from street furniture, type of street involved), the items which these can include and rules governing their operation.

It also defines spaces for special planning and provides information on how to adapt to these regulations.

5.3.3 Encouraging citizen involvement in implementing projects

Citizens' participation in urban planning

The Urban Habitat area promotes spaces for the main social agents to become involved in conceptualising and implementing projects and plans connected with urban planning. These spaces take many different forms: sector-related advisory boards, follow-up commissions, conferences and workshops, among others. Their aim is to incorporate practical and contextual knowledge of institutions and citizens in order to enhance projects and plans and to improve the way public decisions are made, both politically and technically. Some significant examples are: the Supervisory Commission for the project for remodelling Les Glòries square and its surroundings, made up of Barcelona City Council and representatives of residents' and citizens' associations in the zone; the Assessment Commission for the BUITS Plan, in charge of appraising proposals and assessing the projects put forward and made up of members from the Catalan government, the districts, all municipal political groups and representatives of residents' bodies and associations; and citizen participation in the projects of the five pilot super-blocks.

5.3.4 Improvement and revitalisation of the city's public spaces and key symbolic elements

BUITS Plan for taking advantage of unused spaces

The BUITS Plan (Vacant Urban Sites with Spatial and Social Implications) is a ground-breaking endeavour in Barcelona implemented by the Council to encourage the involvement of civil society in defining, implementing and managing different projects on unused municipal sites, either because there is no intention to build in the short term or because the final use has not yet been decided. The Plan, given the City to City award by the FAD, assigns a provisional use to these areas, helping to reclaim, adapt and promote them as areas to enhance the district's cohesion. Most of the winning projects, 12 of which are carried out by social organisations, are urban market gardens and some of these are intended to help people at risk of social marginalisation.

Micro urban developments: localised urban planning

Barcelona Council has commissioned 18 new micro urban development plans, 13 of which were carried out in 2013 and the other 5 planned for 2014. The micro urban developments already set up and the future measures planned include a wide range of schemes such as sports areas, shaded areas for relaxing, areas to promote children's games, action on sites where the previous buildings have been demolished, recreation and picnic areas, renaturalised areas and also preparing sites to improve connections between two zones. These measures are carried out on deteriorated or unused sites in the city with no definite use in the short term, to enhance them and turn them into spaces for intensive use by the local residents. The aim of the projects is to discover such sites, give them a dynamic quality and add these areas to other areas frequented by the public on a local scale.

The Micro Urban Development scheme and BUITS Plan stem from a common challenge: the need to act promptly on public spaces or sites in disuse and turn these into areas worthy of intensive use by the local residents.

22@, a project for urban, economic and social renewal

The 22@ project is turning 200 hectares of industrial sites in the Poblenou district into an innovative, productive district providing modern spaces for the strategic concentration of knowledge-intensive activities. This initiative is also an urban renewal project and a new city model which seeks to respond to the challenges of the knowledge society. Its specific features mean that this is the most important urban conversion project in the city of Barcelona in the last few years and one of the most ambitious in Europe of such characteristics, with high real estate potential and a public investment of 180 million Euros through the infrastructures plan. The 22@ district is also a test bench for smart technology and sensors have been fitted on lights and containers. Of note is the creation of the Smart City Campus, an urban innovation area which combines any companies, institutions, universities and technology centres that want to set up their own centres for innovation in the city. This initiative is intended to contribute to Barcelona's economic growth and consolidate the city as an international benchmark for new models of urban services and smart cities that serve people.

22@Barcelona represents a new model of a compact city where the most innovative companies coexist with research centres, institutions for training and technology transfer, as well as including housing, facilities and green zones.

5.3.5 Montjuïc, an asset to be preserved

Modification of the Metropolitan General Plan (PGM) in the Montjuïc area

Passed by the Council in late 2013, the aim of the modification is to preserve the area of Montjuïc, safeguarding the use of the amenities and public spaces there based on criteria of sustainability, quality of life for local residents and civic use for leisure, sport and culture.

Promotion of a major museum complex on Montjuïc

In 2013 the Catalan government, Barcelona City Council, the Catalonia National Art Museum, CaixaForum and Barcelona Trade Fair signed a cooperation agreement to jointly promote a major cultural area on Montjuïc, taking advantage of the concentration of museum and cultural facilities of great international importance: the National Museum, CaixaForum and Mies van der Rohe Foundation. This project intends to take advantage of the palaces of Alfonso XIII and Victoria Eugenia, managed by Barcelona Trade Fair, and use them as museum venues. The aim is to make Montjuïc a "mountain of culture" promoting the future "Museum Esplanade" which will also involve programming, marketing and international projection on a coordinated basis.

5.3.6 Striving towards a quality model of urban planning

Barcelona Lighting Master Plan

The implementation of the plan, begun in late 2013, has meant selecting the appropriate lighting criteria for a series of streets according to social criteria, thereby facilitating the city's new lighting system. The plan gives priority to the lighting of zones for pedestrians and improves the levels, uniformity and energy efficiency of lighting, adapting this to specific uses and also focusing on vertical lighting (buildings, monuments, etc.). This work involves an investment of over 22 million euros, 160 stretches of streets with improved lighting and 3360 renewed lighting points. The Plan also intends to use lighting to create special urban spaces, giving these their own personality, such as in Passeig de Gràcia and Paral·lel, among others.

Greening the municipal building work

The Decree to ensure the greening of municipal building work sets out to reduce the environmental and social impact of public works with a budget of 450,000 euros or more. Building projects must also include an environmental report stating the measures taken to reduce any environmental impact caused. The City Council's model specifications have been modified to include a report and an environmental management plan as contractual documents.

Incorporation of resilience criteria in planning

Urban resilience is gaining ground as a new strategy for the planning and management of urban services -such as the electricity network and public transport-, especially for preventing problems and malfunctions caused both by technical incidents and by natural catastrophes. The Council has created a specific Urban Resilience Board to handle the introduction of resilience criteria in planning.

La Marina del Prat Vermell, Barcelona's new district ⊕

The transformation in urban development that is taking place in this area covering 80 hectares of land located between Montjuïc and the industrial part of Zona Franca will help to change the existing uses into combined usages, as well as making residence more compatible with economic activity. This new district is being designed according to ecological efficiency criteria. Of particular importance is the implementation of a centralised hot and cold water system, which will reduce emissions by roughly 13,400 tons of CO_2 a year; taking advantage of the groundwater in the subsoil to clean urban items and infrastructures; lighting with LED technology and functional optimisation and management features; the centralised management of traffic lights and zones to recharge electric car batteries, among others. In order to improve mobility and accessibility, almost all the interior streets will have a speed limit of 30 kph (30 Zones), allowing the use of bicycles in the whole area with no need for separate cycle lanes.

5.3.7 Sharing knowledge leads to learning and improving

City Protocol ⊕

The Urban Habitat promotes City Protocol ⊕, which analyses the anatomy of the city and its habitat providing a common global language, helping to define standard solutions for all the world's cities. This analysis is carried out together with other cities through the City Protocol Society.

In the district of La Marina del Prat Vermell, a large central park is to be built with 1,184,657 m² of floor area, catering for a potential number of 30,000 residents.

5.4 Future goals and measures

One of the current challenges faced by cities is to resolve the contradiction arising between citizens' wishes (greater convenience, a higher quality of life and economic progress) and the need to reduce the ecological footprint on an urban scale. Progress towards a more sustainable city necessarily involves finding innovative solutions for everyday problems, whether this is from a social standpoint or that of material resources. Barcelona City Council's approach is to implement projects to make the city work in a more combined and compact, efficient and diverse way, as established by the Citizen Commitment to Sustainability 2012-2022.

5.4.1 The process underway to define new urban planning instruments

Meeting to review the current General Metropolitan Plan 1976

As part of the new urban planning stipulated in Act 31/2010, of 3 August, on the Metropolitan Area (Metropolitan Urban Planning Master Plan), a municipal meeting was held in late 2013 to reflect on criteria to review the current General Metropolitan Plan 1976 (PGM-76) ⊕. This session was attended by around seventy people from different municipal technical and legal fields connected with urban planning, building projects, information technologies, services and the environment, from Hàbitat Urbà and organisations reporting to this, and also representatives of other municipal spheres of mobility, trade and quality of life services.

Urban Development Master Plan (PDU)

In late 2013 the Barcelona Metropolitan Area started the process of drawing up the Metropolitan Urban Development Master Plan (PDU) which is intended to be completed in May 2015. Its text is based on three fundamental factors: debate and technical reflection furthered through themed workshops with groups of experts; setting up a team to draft the Plan itself, and communication and participation as key aspects that enhance the plan with the concerns and wishes of institutions, associations and city people themselves. Unlike the PGM-76, this new plan will focus more on conversion than urban development due to the small area of land still to be developed and occupied. It will have to combine regulatory efficiency with a certain degree of flexibility to enable reasonable adaptations to changing situations.

5.4.2 Urban conversion to make a city for people

Alterations to Les Glòries ⊕

In February 2013 an international tender was held to select a team of architects with the aim of turning the current road system into a city space for people, through the in-depth improvement of a highly valuable and strategic metropolitan setting as an axis for social-economic revitalisation and a space for renaturalisation with the major presence of urban green and civic meeting places.

This is a restricted tender involving a jury (made up of 12 members). In a first phase the Jury selected a maximum number of 10 teams. There were also public meetings for local residents and teams of architects to evaluate the criteria, challenges and opportunities. The decision on the tender is due to be made in February 2014.

In late 2013 phase 0 of the project was started with the building work to adapt the streets around Les Glòries, as well as the access ramp for the ring road.

The deconstruction of the ring road will enable the provisional development of the square over 2014 and 2015, providing the area with temporary spaces to be used by local residents and citizens until the final project has been completed, as they themselves requested. The implementation of the final design for the square, in order to make Les Glòries a large, peaceful green park, will be carried out from 2016, as space in the square affected by the building work for the future tunnel is gradually made available.

La Sagrera, a new central station and urban centre ⊕

The Sant Andreu - La Sagrera operation forms part of a series of urban renewal measures to extend the centre of the city towards its north-eastern side. The construction of the high-speed line and the new La Sagrera station are a chance to renew and reclaim obsolete industrial zones, large areas used for the railway and infrastructures for power and drainage that had been left isolated. The project intends to cover 38 hectares of railway land, to build 1.7 million square metres of floor area and to create a large green park nearly 4 km long to provide the city with more green infrastructure. The park's social aspects will be improved by linking the districts lying on either side with a number of paths through the park, as well as creating collective settings and uses and involving local residents in managing the project and its uses.

The La Sagrera project provides for the creation of a large park almost 4 km long and covering over 40 hectares on top of the huge platform which will cover the railway and transport infrastructures.

Els Tres Turons, scaling a new park

The aim of this project is to combine the urban life of the nearby districts with the creation of a new benchmark leisure area for the city. This is a project covered by the General Modification of the Metropolitan Plan (MPGM) which intends to give a more human and realistic dimension to the park and to improve the living conditions of the people using it.

Extension of the Passeig de les Aigües, an emblematic path ⊕

This superb natural path, with its outstanding views, crosses the Collserola range of hills that looms over the city from end to end. With over two thousand visitors a day, the path is very frequently used for walking, sport or just enjoying the hills. At present a project for extending the Passeig de les Aigües is underway, which will link up with the section that goes to Torre Baró in the Nou Barris district. This means that the future path will stretch for a total of 21 kilometres and have a new 157–metre footbridge over l'Arrabassada road, bridging the gap between the hills.

Passeig de les Aigües is an emblematic path that's very popular with the people of Barcelona for walking, sport or just to enjoy the wonderful views.

5.4.3 'Super-blocks', new districts at a human pace

Five pilot 'super-blocks' in Barcelona

Over the next four years, it is intended to set up five pilot "super-blocks" in the areas of La Maternitat and Sant Ramon, in Poblenou district, in Les Glòries square, in L'Antiga and Nova Esquerra of the Eixample and in the district of Hostafrancs. Super-blocks are urban units larger than the usual demographic and spatial planning concepts based on specific objectives of sustainable mobility, the revitalisation of public space, fostering biodiversity and urban green, social cohesion, energy self-sufficiency and citizen participation. These areas are defined through citizen participation in order to reinforce the structure of social relations and cohesion and for residents to be able to adapt this new urban organisation. The plans have a budget of 10 million euros and have been developed by Hàbitat Urbà with the collaboration of the Urban Ecology Agency.

Reclaiming the function of Carrer Pere IV as an axis for the city connects the major public spaces and different urban developments in Poblenou and 22@

5.4.4 Remodelling emblematic aspects of the city

Redevelopment of Pere IV

The aim of this project is to turn Pere IV into a civic and heritage axis linking up the area's major public spaces and different urban elements. For historical reasons, the path taken by this street was separate from the layout of the Eixample and its urban development was not in keeping with its importance. The alterations, which will incorporate energy efficiency and sustainability criteria, will improve the structure of public spaces and the existing facilities and heritage items in an urban development compatible with the 21st century. It will also include the restoration or improvement of conservation, by private initiative, of 17 buildings classified as industrial heritage located near the street and will promote public initiative projects such as the new premises of the MUHBA.

"Smart" alterations to the Passeig de Gràcia

The first phase in the comprehensive Plan to improve Passeig de Gràcia promoted by the City Council was begun in 2013. This plan aims to achieve a quality avenue for its residents while preserving its role as a structuring and connecting element in the city, establishing Passeig de Gràcia as one of the key areas for mobility and leisure in Barcelona. These measures aim to regenerate public

space by rearranging areas and uses, improving the quality of paving, street furniture, signage and signposting and the general arrangement of services, taking citizens, architecture, trade and tourism into account. As part of the Master Plan for ICT, a new lighting model will also be introduced prioritising the areas used by pedestrians, promoting energy efficiency and enabling the development of smart management networks. Passeig de Gràcia will become the first smart major avenue in the city.

Remodelling the Paral·lel avenue

This project seeks to make Avinguda Paral·lel into a benchmark thoroughfare for people, performing arts and food, reinforcing its uniqueness. The action sets out to improve the public space by giving more area to pedestrians, moving bicycles into the centre of the roadway and creating six new small squares where the road crosses streets in the Eixample district. It also includes improvements to lighting, signposting and accessibility of the L3 underground station in Poble Sec.

Alterations to Avinguda Diagonal

This project rearranges the different purposes for which the same space was used until now (pedestrians, cyclists, loading and unloading areas, motorbike parking, etc.), turning one of Barcelona's main thoroughfares into a friendlier, safer, more appealing and accessible area and improving well-being and quality of life. Work involves extending pavements up to seven metres in width, a separate lane for cyclists, motorcycle parking areas, the reduction of traffic more in keeping with residential areas and the incorporation of specific loading and unloading zones.

The alterations to the Diagonal between Francesc Macià square and Passeig de Gràcia represent a chance to consolidate the Avenue as a strategic thoroughfare for the city in social, economic and also mobility terms.

Barcelona is also carrying out other remodelling measures to transform and revitalise representative areas in the city as leading thoroughfares for people, such as the development planned for Balmes and Mitre.

5.4.5 Renaturalising the city

Green Space and the Biodiversity Plan

In keeping with the approach of the plan *(see chapter 4. Urban green and biodiversity ⊕)*, it is intended to develop urban green corridors enabling a real network to be set up. This will provide a solid, functional ecological infrastructure, taking advantage of opportune areas of different types and sizes, ranging from unoccupied land to roofs, walls and balconies, in order to renaturalise and revitalise them.

5.4.6 Children's recreation areas: increasing quality

Children's Recreation Area Plan to extend and improve recreation areas

This Plan proposes 10 newly created children's corners and the renewal of 44 existing play areas from 2014 to 2015. It also covers the introduction of innovative items connected with new technologies and theme-based actions such as the 'Ona the Giraffe's House' play area in Sant Miquel square. For coming years the plan intends to renew 220 more children's recreation areas and to redefine these areas to boost intergenerational contact between children and adults. The plan will be implemented over the next five years with the intention of improving the city's range of children's play facilities in the open air, bringing play areas closer to residents and ensuring a fair distribution.

As part of the alterations to the Diagonal, the paving of this avenue has been replaced, incorporating new paving that improves the environmental aspects and performance of this public thoroughfare; namely the special "Diagonal" tile.

Local air quality

Cleaner air to guarantee citizens' health in Barcelona

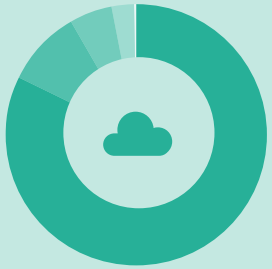
Local air quality

Vision of the future

Improving the quality of the air we breathe in the city

Current situation

Main sources of air pollution generated in Barcelona (NO_2 and PM_{10})



- **76.0 %** Traffic
- **8.7 %** Residential and tertiary
- **5.1 %** Industry
- **2.4 %** Port
- **0.2 %** Cement mixers and extraction

	NO_2 (EU annual limit value: 40 µg/m³)	PM_{10} (EU annual limit value: 40 µg/m³)	$PM_{2,5}$ (EU annual limit value: 25 µg/m³)
Urban background stations	✓	✓	✓
Moderate traffic stations	✓	✓	✓
Heavy traffic stations	✗	✓	✓

✓ compliance
✗ exceedance

Lines of work

Actions in key areas 'Mobility' 'Energy' 'Port' 'Construction' 'Awareness-raising'

Commitment and planning 'Agreement of the Network of Cities and Towns towards Sustainability for Cleaner Air' 'Barcelona Air Quality Improvement Plan 2011-2015'

Innovation 'Resurfacing with autoclaved aerated concrete or new photocatalytic materials'

Communication and information transparency 'Website for spreading air quality information in the city'

0-emissions mobility within the city 'Barcelona Urban Mobility Plan 2013-2018'

6.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to improve the quality of the air we breathe in the city and to guarantee compliance with the levels permitted by regulations.

To achieve this the city is moving towards energy self-sufficiency, changing current energy consumption, minimising energy consumption and demand, and producing sufficient local energy to cover this demand, leading to more sustainable and efficient mobility. It aspires to be as efficient as possible and to reach zero emissions to guarantee the health and quality of life of its citizens.

Like other European cities (Paris, London, Berlin, or Rotterdam), Barcelona has on occasion exceeded the limits established by the EU on annual average concentrations. Nevertheless, in recent years there have been improvements which have resulted in the reduction of concentration levels as well as compliance, in 2013, with PM_{10} and NO_2 limits; the latter pollutant was only exceeded in heavy traffic zones. This involves the adoption of new action strategies at all levels to improve air quality in the city and its metropolitan area. The main challenges are:

- **Barcelona is the centre of a large conurbation with more than 7.6 million daily commutes.** Mobility is a necessity and the resulting motorised transit has a high environmental impact. Traffic in the city is the factor that emits most air pollution.
- **The city is located within the area of influence of two large mobility infrastructures:** the Port, managed separately and thereby limiting the city's powers in relation to its management; and the Airport, which lies beyond the municipal reach of the city, meaning that Barcelona does not have powers in this case either.
- **Barcelona is the centre of a large urban system** with a high degree of integration and interdependence between the city, the Barcelonès county, the Metropolitan Area, and the Metropolitan Region, and where functional dependencies and exchanges are constant.
- **Barcelona has some peculiarities that condition the dispersion of its pollutants.** Firstly, physical aspects: as a coastal city, with the Collserola range of hills acting as a barrier, a peripheral distribution of industrial activity, and 55% of winds below 3m/s, the dispersion of pollutants is not very effective. Secondly, climatic peculiarities: climatological conditions can affect the concentration of pollutants and these can in turn affect the weather. Thirdly, the "heat island" effect which, in Barcelona, is generally concentric and focused mainly on the Eixample district, which is therefore a more sensitive area. Lastly, air currents coming from other places, such as the Sahara, bring large quantities of particulates and are difficult to control.
- **The emissions generated by traffic act as a kind of screen,** due to the density and height of the buildings, which also inhibits the dispersion of pollutants.

6.2 General context and current situation

Traffic emissions, those that come from large mobility infrastructures (port and airport), residential emissions, and construction emissions dictate the level of air pollution in Barcelona. But air pollution is also caused by emission sources located some distance from the city, so-called regional background pollution. As well as the diversity of emission sources, the conditioning elements and peculiarities of the city must also be taken into account. Currently, Barcelona is updating its emissions inventory.

One of the main changes experienced by the city in the last 30 years which has influenced air quality is the increase in the total number of privately-owned vehicles, a fact which has caused an increase in concentrations of nitrogen oxides and of particulate matter. The strategy to improve air quality requires cross-cutting and comprehensive action from all the sectors involved, such as mobility, energy, waste, urban nature, etc.

In accordance with state and European regulations on the assessment and management of air quality, Catalonia is divided into 15 air quality zones with no cross-overs between them. The zones are defined by joining areas with similar characteristics in terms of climate, terrain, types of emissions, etc.

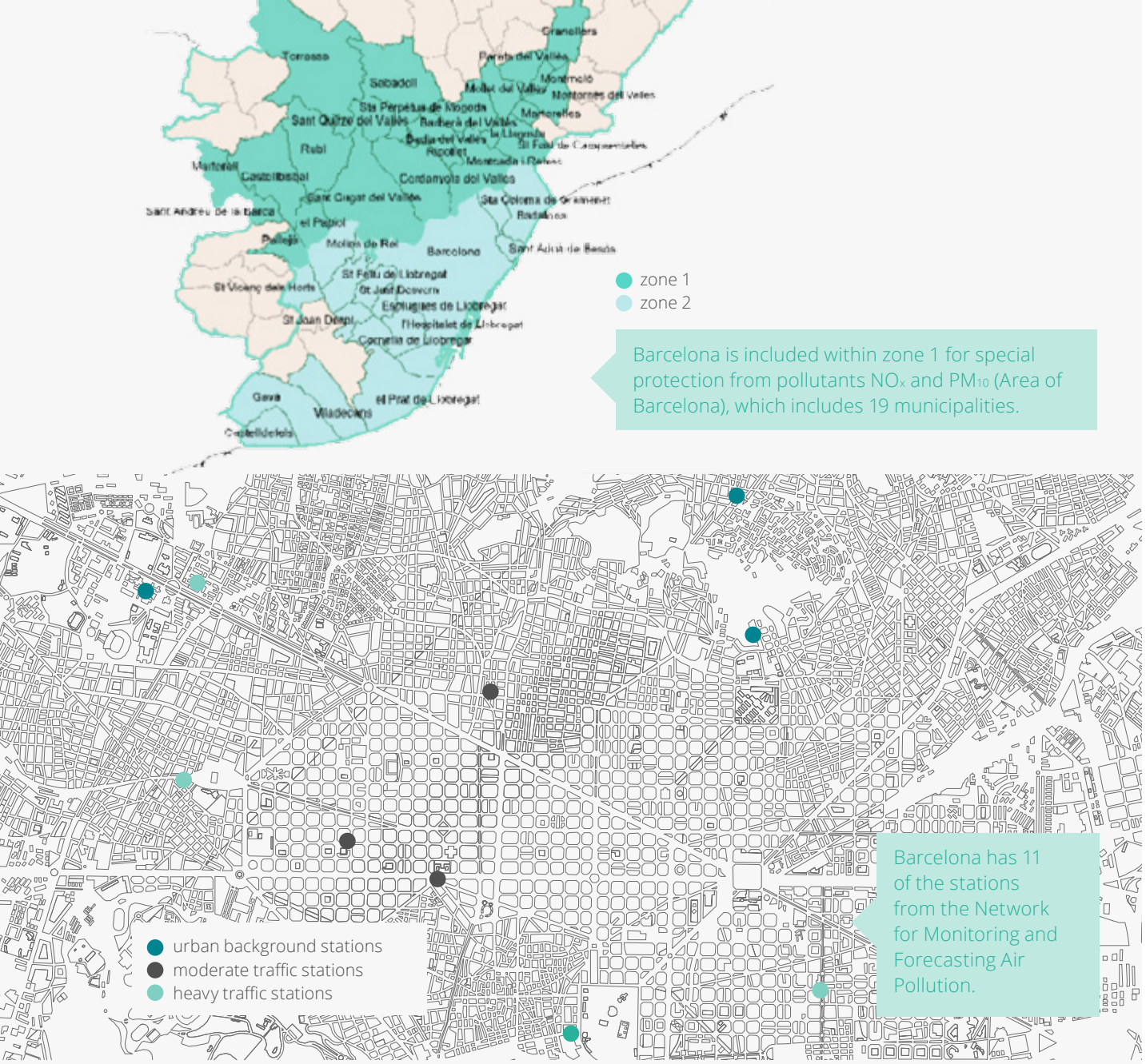
The Metropolitan Region of Barcelona Air Quality Improvement Plan (2007-2009) affected 40 municipalities in the region that were declared zones of special protection due to the high levels of pollutants (NO_2 and PM_{10}) detected in the air. The Plan's main objective was to establish the necessary actions to prevent and reduce emissions of NO_2 and PM_{10} and to adjust the emissions to the limits established in European Union legislation for the year 2010.

The official approval of the Barcelona Air Quality Improvement Plan, horizon 2015, is expected in mid-2014. Pending approval, during 2013 many of the Plan's measures were implemented, mainly affecting the mobility of people and goods, as well as citizens' habits. These measures aim to reduce pollutant emissions and to achieve the air quality levels of PM_{10} and NO_2 established in European legislation. Some of the measures implemented by the Catalan government include the possibility of access to HOV lanes for low-emissions vehicles, the 'greening' of heavy-duty vehicles that form part of Barcelona Metropolitan Transport (TMB) and the Metropolitan Transport Authority (EMT), and the environmental quality guarantee label for clean transport that has become the first ecological labelling initiative recognised at a European level to include transport fleets. One of the future measures envisaged is charging at tollbooths on the basis of urban pollution.

It is estimated that the decrease in pollutant emissions will mean numerous benefits for the health of the inhabitants of the metropolitan area of Barcelona and will increase quality of life and life expectancy.

Origin of emissions *(% of total) Data from 2008*	**NO_2** (average)	**PM_{10}** (average)
Background	18.7%	88.1%
Regional	8.6%	47.9%
Local	10.1%	40.2%
Generated in Barcelona	81.3%	11.9%
Traffic	65.6%	11%
Residential and tertiary	8.6%	0.1%
Industry	4.8%	0.3%
Port	2.1%	0.3%
Cement mixers and extraction	-	0.2%

Traffic is the main source of emissions within the city



6.2.1 Exhaustive air quality control

In the city, managing all the aspects related to air quality involves different agents:

→ **Network for Monitoring and Forecasting Air Pollution (XVPCA)** ⊕. This is the system for detecting the emission levels of the main pollutants affecting air quality in Catalonia. It is made up of a set of measuring stations distributed throughout Catalonia, in which the air pollutant sampling and analysis equipment is located.

The city of Barcelona has 11 air quality measurement stations that form part of the XVPCA, of which 10 are urban (4 urban background stations, 3 moderate traffic stations, 3 heavy traffic stations) and 3 are industrial (located in the port area). These stations are distributed on the basis of the levels of the population's exposure, physical aspects, and dispersion characteristics, and they measure emission levels of NO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, CO, O_3, heavy metals, polycyclic aromatic hydrocarbons, and C_6H_6. The types of pollutants measured, the regularity with which they are measured, and the start-up operations vary depending on the station.

→ **Barcelona Public Health Agency** ⊕. Its functions in this field are: assessment of the impact on air quality of traffic and fixed emission sources, participation in action plans to reduce the levels of nitrogen dioxide

and suspended particulates (PM_{10}), regulated control of combustion boilers (from 2014 this will be the responsibility of Hàbitat Urbà), management of the city's information system on air quality, and the annual publication of an evaluation report on air quality in the city of Barcelona.

→ **Hàbitat Urbà** ⊕. This is the municipal department that has taken on the challenge to lead Barcelona towards sustainability, working on the definition and achievement of a mode of urban living for the city today and for the next 50 years.

6.2.2 The city's air quality improves

Air quality levels are defined with the aim of avoiding, preventing and reducing adverse effects on human health. This principle is reflected in autonomous, state and European legislation in the area of air pollution. The relevant state legislation for the assessment of air quality is Law 34/2007, of 15 November, on air quality and protection, and Royal Decree 102/2011, of 28 January, on air quality improvement.

European legislation also regulates and establishes legal limits on the concentration values of carbon dioxide, nitrogen dioxide (NO_2), suspended particulates (PM_{10} and $PM_{2.5}$), tropospheric ozone (O_3), and sulphur dioxide (SO_2). As well as legal regulations, the World Health Organization (WHO) also establishes limits on levels of air pollution.

The air in Barcelona complies with the majority of the pollution parameters ⊕ regulated by state and European standards on the assessment and management of air quality, displaying a slight tendency toward a decrease in pollutants. In 2013, a significant and overall improvement was detected in the levels of the two critical pollutants in air quality in Barcelona (PM_{10} and NO_2).

NO_2

In 2013, the annual limit value for NO_2 is complied with in all moderate traffic stations and urban background stations in the city, being exceeded only in those stations oriented toward heavy traffic (Eixample and Gràcia-Sant Gervasi). The annual levels in 2013 are the lowest since 2000 in 5 of the 7 stations in the city. However, the annual limit value is still exceeded in heavy traffic stations. Following this tendency, a decrease has also been produced in the number of hourly exceedances of the limit value. The 5 exceedances that occurred in 2013 are concentrated in the heavy traffic stations and on the same day of the year.

The European Union establishes the legal limits of concentrations of NO_2, PM_{10} and $PM_{2.5}$ and the World Health Organization establishes recommended levels for health which in some cases are more restrictive than the legal ones.

	European Union *(emission limits established by the EU since 2010)*	**World Health Organization**
NO_2	Hourly average: 200 µg/m³ Annual average: 40 µg/m³	Hourly average: 200 µg/m³ Annual average: 40 µg/m³
PM_{10}	24h average: 50 µg/m³ Annual average: 40 µg/m³	24h average: 50 µg/m³ Annual average: 20 µg/m³
$PM_{2.5}$	Annual average: 2010: 25 µg/m³ 2015: 25 µg/m³ 2020: 20 µg/m³	Annual average: 10 µg/m³ 24h average: 25 µg/m³

PM_{10}

In 2013 the city complies, for the first time, with the maximum number of exceedances of the daily limit value for PM_{10} particulates in all urban stations in the control network, placing the annual concentration averages between 27 µg/m³ in heavy traffic stations and 19 µg/m³ in urban background stations.

Following the tendency of the yearly levels, a significant decrease is detected in the daily exceedances of PM_{10}, halving the 90.4 percentile during the period 2006-2013.

$PM_{2,5}$

During 2013 a significant decrease was detected in the city's levels of $PM_{2,5}$, placing the annual average between 18 µg/m³ in heavy traffic stations and 12 µg/m³ in urban background stations.

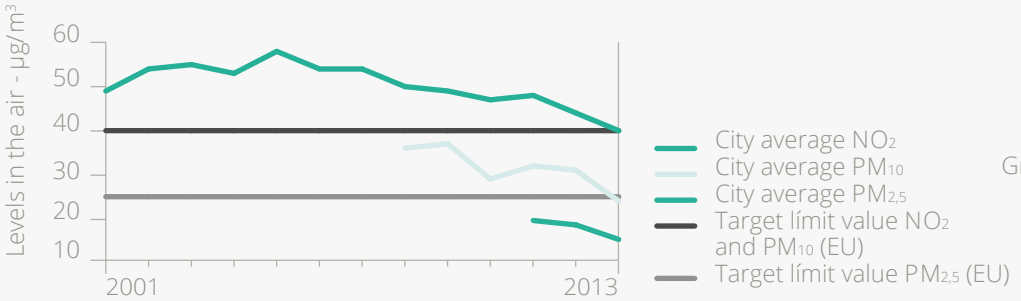
33% reduction in overall PM_{10} levels in the city in 2012 in comparison to the previous year, 50% reduction in PM_{10} levels in traffic-oriented stations in the period 2006-2013

O_3 and other pollutants

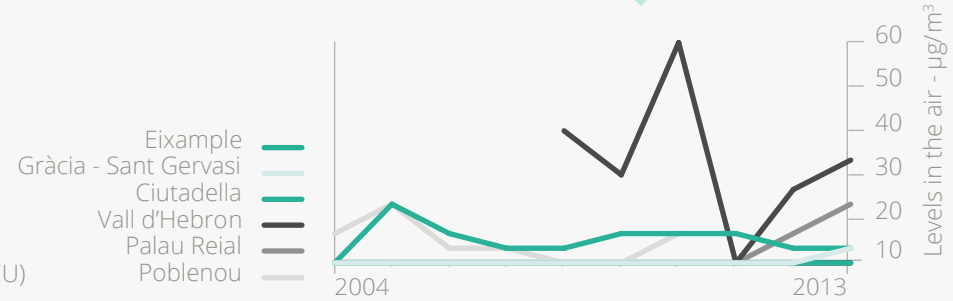
In 2013, the city continued to comply with the respective limit and target values for gasses (CO, SO_2 i O_3), volatile organic compounds (benzene), metals (Pb, Cd, Ni, and As), and polycyclic aromatic hydrocarbons (benzo[a] pyrene).

In 2013 the maximum hourly levels of O_3 experienced a slight increase in comparison to the previous year, not exceeding, however, the threshold for informing the population. This increase is also detected in the number of days that the maximum 8-hour target value was exceeded.

In 2013 the annual average of NO_2 was at 39.6 in µg/m³, thus complying with the permitted limit of 40 µg/m³. In all the stations the annual limit value of $PM_{2.5}$ was complied with for the year 2015 and even the annual limit value envisaged for the year 2020.



2013 saw an increase in the number of days that the 8-hour maximum target value was exceeded.



6.3 Measures taken to improve air quality

With the aim of improving air quality in Barcelona a set of measures has been implemented in recent years, some framed within the action plans.

6.3.1 Barcelona formalises its commitment to cleaner air

Signing the Agreement of Cities and Towns towards Sustainability for Cleaner Air

The City Council of Barcelona's plenary session on 26 April 2013 approved an Institutional Declaration of Support for the Agreement of Cities and Towns towards Sustainability for Cleaner Air. With this support, it shows its interest in the improvement of air quality and it commits to the need for the measures taken to be of a structural nature, with a general geographic scope, and coordinating in a responsible way with the different administrations and institutions.

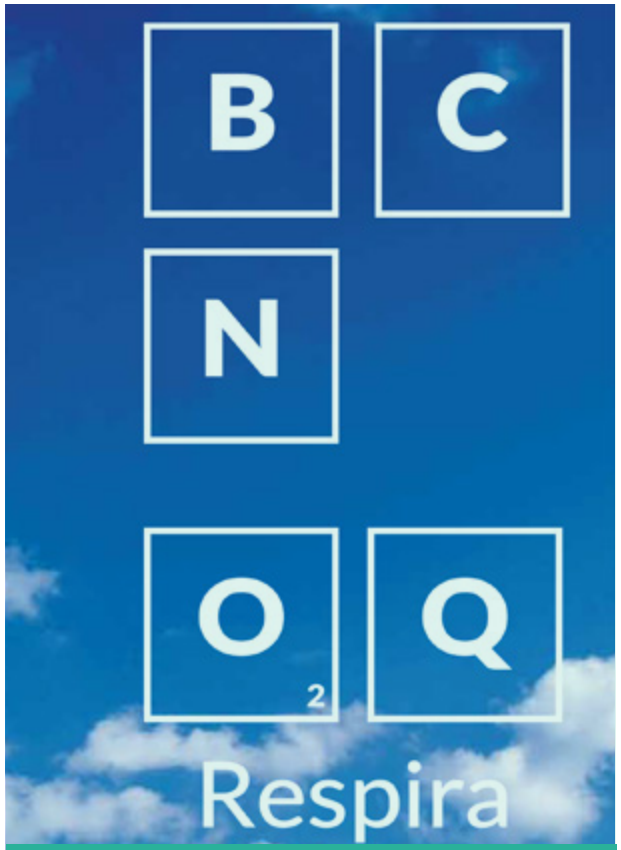
The Barcelona Air Quality Improvement Plan 2011-2015 includes 5 areas of action: mobility, energy, port, urban services, construction and urban nature and communication and information transparency.

6.3.2 Mobility, energy, and awareness-raising: key aspects for cleaner air

Barcelona Air Quality Improvement Plan 2011-2015

This brings together other plans in the city: Municipal action plans, sector-based planning instruments like the Energy, Climate Change and Air Quality Plan 2011-2020, and the Urban Mobility Plan 2006-2012, as well as other additional measures. Its objective is to gather the actions underway and already implemented in the city during the period 2011-2015 to improve air quality in Barcelona and to achieve the levels permitted by the regulations. The actions are characterised by their efforts to favour and stimulate behaviour and relationships between citizens and the urban space that could boost the improvement of air quality and quality of life in the city.

Below are details of the most significant measures implemented in each of the five areas of action.



The pamphlet 'Respira' (Breathe) forms part of an informative campaign on the actions that the City Council of Barcelona carries out to improve air quality in the city.

MOST SIGNIFICANT MEASURES IMPLEMENTED IN EACH OF THE FIVE AREAS OF ACTION

Mobility

Promotion of electric vehicles in the Metropolitan Area through the public-private platform Live Barcelona (Logistics for the Implementation of Electric Vehicles). At the end of 2013, the city has 136 charge points and the City Council has a fleet of more than 300 electric vehicles for cleaning and street-lighting maintenance.

New orthogonal bus network. This involves a reorganisation of the urban bus service in Barcelona to create a fast network formed by routes that cross the city horizontally, vertically, and diagonally, taking advantage of the structure of the roads in the Eixample district. In 2012, the service was launched with 5 such routes and the network was expanded in 2013 with 5 more.

Greening of municipal fleets. In 2013, a high level of greening was carried out on heavy-duty vehicles that form part of Barcelona Metropolitan Transport (TMB) and on vehicles for street-cleaning in the city thanks to the incorporation of hybrid vehicles and vehicles fuelled by compressed natural gas, the reconversion of diesel cars into hybrids, the application of anti-pollutant filters in the remaining diesel cars, and the introduction of a systematic plan for preventive maintenance of vehicles.

Urban services, construction, and urban nature

Greening of construction. 2009 saw the entry into force of the Decree of Mayors for the 'greening' of construction with the aim of reducing this sector's environmental and social impact. It affects public works being undertaken with a budget equal to or greater than €450,000, promoted by municipal operators, autonomous-level bodies, or municipal companies. For example, of note is the creation in 2013 of the Monitoring Commission (Comissió de Seguiment) for the project to remodel the Plaça de les Glòries and its surroundings, formed by the City Council of Barcelona and representatives from neighbourhood and citizens' associations in the area.

Energy

Energy Self-Sufficiency Plan. The Plan involves different actions both at the level of the city and at the level of the City Council, all aimed at reducing energy consumption through the improvement of energy efficiency in buildings, facilities, amenities, and vehicles, as well as the use of facilities that take advantage of the local renewable or waste resources available to cover this consumption, with the aim of consuming less from the mains supply. From an energy point of view, the plan assesses the commercial sector and the services sector in Barcelona and contains measures to reduce consumption by 20% in the year 2020, in comparison to 2008, and consequently to reduce the emission of air pollutants.

Barcelona Port

Gasification of Barcelona Port. Thanks to an agreement signed by the Barcelona port authority and Gas Natural Fenosa, the sea and land users of the port area can access liquefied natural gas for their engines. This is a cross-cutting initiative to reduce emissions from boats and service vessels and also from the trucks and machinery that operate on dry land.

Communication and information transparency

Environmental awareness-raising and educational programmes. These include informative campaigns (e.g., control of emissions from the most polluting vehicles), courses in efficient and economical driving, exhibitions, conferences, and debates. The pamphlet RESPIRA (Breathe) has also been published for this purpose. ⊕

6.3.3 Regulation and control of combustion facilities to reduce pollution

Programme for the inspection and cleaning of combustion facilities

In order to improve air quality in the city and in accordance with Article 29-1 and 29-2 of the Environmental Ordinance, citizens and companies are obliged to present an annual certificate of inspection and cleaning of combustion facilities (heating, boilers, etc.) that do not operate with natural gas. The programme is addressed to facilities used for heating, sanitary hot water, or steam generation, both in companies and in homeowners' associations. Inspection helps to reduce pollution and to optimise consumption.

6.3.4 Studying air quality: a basis for defining the measures to be implemented

Public health benefits from reducing air pollution in the metropolitan area of Barcelona ⊕

Directed by Dr. Nino Künzli, from the Environmental Epidemiology Research Centre (CREAL), commissioned by the Department of Health and the Department of Environment and Housing of the Catalan government, this study shows that the improvement of air quality carries clear health benefits. The study shows that decreasing air pollution to the levels recommended by the WHO would contribute significant benefits to the population of the metropolitan area of Barcelona in terms of morbidity, mortality and life expectancy. Specifically, the study estimates that the annual benefits of reducing average exposure to PM_{10} in the area of study (57 municipalities) to the average annual values recommended by the WHO (20µg/m^3) are: 3,500 fewer deaths per year and representing an increase in average life expectancy of 14 months, 1,800 fewer hospital admissions for cardiorespiratory reasons, 5,100 fewer cases of chronic bronchitis in adults, 31,100 fewer cases of acute bronchitis among children, and 54,000 fewer asthma attacks for all ages.

Emissions inventory of the city of Barcelona (currently being updated)

The tool for modelling pollutant dispersion allows for a diagnosis of air quality in the city, bearing in mind different variables like mountainous terrain, types of emission sources and their spatial distribution, and the area's meteorology. Currently, air quality is monitored every hour, including emissions of NO_x, PM_{10}, and other significant pollutants, and the estimated emissions are linked through a predictive model to the real emissions measured by the stations located in the city. The data obtained allow for short-term air quality forecasts.

Ecological services provided by urban nature in Barcelona ⊕

Developed by the Centre for Ecological Research and Forestry Applications (CREAF) in the Autonomous University of Barcelona and commissioned by the City Council of Barcelona's Strategy Department, the study estimates the quantity of air pollutants absorbed by green spaces in the city (including the Collserola Park) using a North American model called i-Tree Eco. From the results it can be deduced that urban green in Barcelona absorbs up to 306 tonnes of air pollutants annually: 5.6 t of CO, 54.6 t of NO_2, 72.6 t of O_3, 166 t of PM_{10}, and 6.8 t of SO_2. The economic value of this service would be slightly greater than one million euros per year. The study concludes that the contribution of urban green to air quality in Barcelona is modest but not to be disregarded, especially in the case of PM_{10}. The implementation of strategies based on strengthening the city's green infrastructure should allow for this contribution to be more and more significant, at the same time as other ecosystem services (recreational uses, microclimatic regulation, etc.) are also provided.

Barcelona has a network of stations for measuring different pollutants that facilitates accurate information on their levels in different parts of the city.

6.4 Future goals and measures

Improving the quality of the air we breathe in Barcelona and reaching the levels permitted in the regulations are the main goals of Barcelona's Air Quality Improvement Plan 2011-2015. The City Council is currently working on updating the plan for 2018.

6.4.1 Innovative measures with a commitment to the future

Study on the efficiency and application of CMA (calcium magnesium acetate) on roads to reduce the re-suspension of particulates

The incorporation of this additive to cleaning water allows the particulates to remain deposited for more time on the ground thus making it easier to remove them with rain and cleaning water. The study, carried out via an agreement with the Spanish National Research Council (CSIC), concluded that this was not an effective measure for Barcelona.

Resurfacing with autoclaved aerated concrete helps to avoid the suspension of particulates in the air.

Improvement of air in schools

Pilot test that consists of assessing the effectiveness of different corrective measures to improve air quality in sand yards in two schools in Barcelona: the CEIP Pau Vila and the CEIP Vila Olímpica. For this, the sand in the yards will be analysed to determine what the best types are, the effectiveness of irrigation for avoiding the re-suspension of particulates will be assessed, and air purification systems will be installed in the gyms.

Resurfacing with autoclaved aerated concrete

The results obtained from pilot tests using this material were used to take decisions regarding its application in other parts of the city. In some public places in Barcelona, like squares, gardens, or playgrounds, you can find sand. In specific cases these spaces are located in areas exposed to high levels of traffic or to particular climatic conditions that lift the sand on windy days, with a correlation existing between wind and levels of PM_{10}. As well as resurfacing with autoclaved aerated concrete, in the Can Mantega park a nanopolymer was applied which also prevents the re-suspension of particulates. With the aim of evaluating the effectiveness of the measure, a small study was carried out showing the positive effects of this nanopolymer.

Use of new photocatalytic materials to reduce the concentration of NO_x in the air

Photocatalytic paving is capable of reducing polluting substances present in the air, such as NO_x, SO_x, or benzenes, transforming them in the presence of sunlight (or of another kind, with a wavelength of less than 400 nm) into non-toxic substances at a speed 30 times faster than that produced naturally. Through an agreement with the Polytechnic University of Catalonia (UPC), pilot tests will be carried out demonstrating the effect that certain materials with photocatalytic capacity may have on certain pollutants like NO_x and the organic part of suspended particulates.

Special-purpose vacuum

With the aim of greening construction to reduce the emission of pollutants, the City Council will incorporate the enforceability of using special-purpose vacuum machines to collect dusts and other residues.

6.4.2 Improvement of infrastructure to offer natural gas in Barcelona Port

Construction of a gas supply plant

In order for users to be able to access natural gas, a gas supply plant will be built for vessels and a liquefied gas service station for trucks and machinery. Moreover, the boats that use this fuel for their main or auxiliary engine will benefit from a reduction in port charges.

6.4.3 Zero-emissions mobility within the city of Barcelona

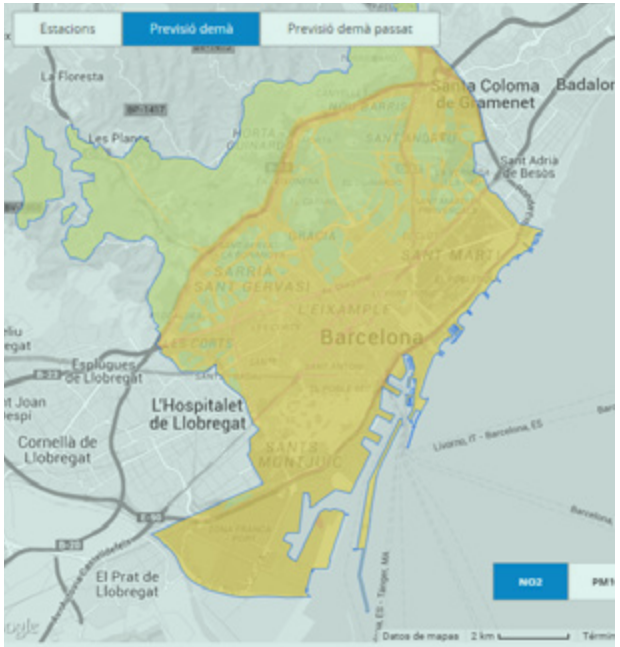
Barcelona Urban Mobility Plan (PMU) 2013-2018

The development of this new Plan consists of three work phases: diagnosis, proposals and environmental assessment to determine the effects that the measures planned will have on the environment. The Plan is structured into 5 blocks, each with its own objectives and the respective actions to achieve them: mobility on foot, mobility by bicycle, public transport, urban freight distribution and private vehicles (cars and motorbikes). In its diagnosis, the Plan analyses the externalities of the mobility system and refers to two factors that require priority action: firstly, the type of vehicles circulating, because air quality is influenced by how old the vehicle is (the newer, the more efficient), the fuel used (diesel emits 3 times more NO_x and up to 8 times more suspended particles than petrol) and the type of vehicle. Secondly, the speed of circulation, which is a key variable. The average optimum speed in terms of energy, between 40km/h and 70 km/h, is hard to reach in an urban area but an average speed of 30 km/h would mean a significant reduction in consumption by cars. Current congestion problems are a critical issue when it comes to fuel consumption.

6.4.4 Real-time information and pollution forecasts

New website for spreading air quality information in the city

Promoted by the City Council of Barcelona, the website ⊕ will show data in real time and on the basis of the weather forecasts it will make its own forecast of pollution levels for the following 24 to 48 hours. It will also provide information on the regulations in force, with the permitted threshold for each type of air pollutant, as well as information on what an air pollution episode is and on Barcelona's Air Quality Improvement Plan. During the summer period, when there are more air pollution problems, it will promote citizen-targeted campaigns. Among other functions, it will include a warning system for the population that will inform on air quality in general and not only in emergency situations as was previously the case. The warning system includes a series of action protocols.



The air quality website contains a map with the air quality index forecast for NO_2 and PM_{10} over the next 2 days.

Acoustic quality

Barcelona, controlling and preventing noise for a more comfortable city

Acoustic quality

Vision of the future

Improving Barcelona's acoustic quality

Current situation

By day

Traffic, is the main source of noise

85.45 % Population exposed

> 55 dB (A)

96 % compliance of the noise capacity in sections of streets

By night

Nightlife, is the main source of noise

87.79 % Population exposed

> 45 dB (A)

86 % compliance of the noise capacity in sections of streets

Lines of work

Minimising noise
'Electric vehicle'
'Noise-reducing asphalt'
'Covering railway lines'

Assessment and planning 'Plan to Reduce Noise Pollution in Barcelona 2010-2020'
'Barcelona Strategic Noise Map'

Control and monitoring
'Outdoor sound level meters, noise limiters for night-time venues and concerts'

Raising citizen awareness 'Summer campaigns and pilot tests in nightlife zones'

Education at schools
'2015-2016 Education Programme to deal with noise at schools'

7.1 Vision, challenges and opportunities

Vision of the future

Barcelona Council is committed to improving the city's noise quality by fostering and implementing priority measures and programmes, cooperation, coordination and information structures enabling the city's general noise pollution to be cut down, above all in zones where limits are exceeded, and protecting quieter zones from any increase in noise levels.

Barcelona has to integrate noise control within the city's management, not as something exceptional but as another environmental variable for Barcelona. Sound and noise form part of a lively, dynamic city and everyone generates noise at some time, in different ways, as well as being on the receiving end. That's why global action is required, taking all the agents involved into consideration, even the Council itself.

Certain historical and geographical conditioning factors should be taken into account in this process of improving the noise quality of the city. Some of them represent challenges that have to be overcome while others are opportunities which should be taken advantage of.

- **City people are increasingly sensitive to noise**, for objective reasons and through changing and dynamic sociological perceptions. A certain culture of noise comfort has also increased, making city people more demanding and valuing peacefulness as a key element in the quality of life.
- **There has been a change in the activities which generate noise over the last few years**. The noise produced inside commercial and industrial premises is easier to regulate nowadays but there has nevertheless been an increase in noise in the street produced by leisure activities, and this is harder to control.
- **The complexity and compactness of the city generate sound and noise of different kinds**. Its high density and the extremely dynamic city-wide mobility should also be included in these factors..
- **Barcelona attracts tourism** through its wide range of commercial and cultural attractions and services, including leisure activities. This is a tourist destination with over 7.5 million tourists in 2013 and with prospects for growth. Ciutat Vella is the district with the most tourism in Barcelona and is the only one in the city where noise pollution has grown by day and also by night since 2009.
- **The good weather and Mediterranean nature of the city create a favourable setting for life in the open air**, entailing a greater volume of noise in the street until later in the day, all year round since the seasonal aspect has now disappeared. The Anti-Smoking law has led to greater activity in the street and at pavement cafés (popular public venues) but nevertheless the increased control and citizen awareness have resulted in more compliance of regulations, highlighting the fact that all the agents involved in generating noise in the street now feel jointly responsible.
- **The perception of noise is a subjective phenomenon**, meaning that not all people perceive this or are affected by it in the same way. Its effect on each person depends on a large number of factors, so reactions can differ. The response to noise is a complex reaction which depends on both acoustic factors and psychosocial, contextual, symbolic and emotional aspects.

7.2 General context and current situation

As in other cities, the main sources of noise in Barcelona are traffic, major transport infrastructures, leisure pursuits, shopping areas and industrial activities. Traffic is its main source although this has become general environmental noise which does not cause as many complaints as other more specific and localised sources. For example, nightlife represents the second biggest cause of noise but, unlike traffic, this is found in highly localised zones of the city.

Barcelona City Council is striving to improve the noise quality of the city by carrying out a wide range of measures. These endeavours are structured in the Strategic Noise Map and Plan to Reduce Noise Pollution of the City of Barcelona 2010-2020, covering the most appropriate formulas to minimise noise pollution by combining the different uses of the city, taking into account the interests of the different sectors and promoting respectful coexistence. The different municipal areas are involved in these measures and especially the districts, these being the areas that have to carry out the most direct actions to progress towards a less noisy city, making citizens also responsible for this.

Over the last few years a regulatory framework has been developed at a European, state and autonomous community level, which has determined the strategies to be implemented as regards controlling and reducing noise pollution. On the European scale, Directive 2002/49/EC of 25 June 2002 defines the standards to assess and manage environmental noise and create strategic noise maps, as well as action plans as basic tools to manage noise in cities. At a state level there is Act 37/2003 on Noise, of 17 November 2003, Royal Decree 1513/2005, of 16 December, and Royal Decree 1367/2007, of 19 October. Catalonia has Act 16/2002 and its Regulation D176/2009, on protection from noise pollution, making it compulsory to draw up strategic maps and to implement these.

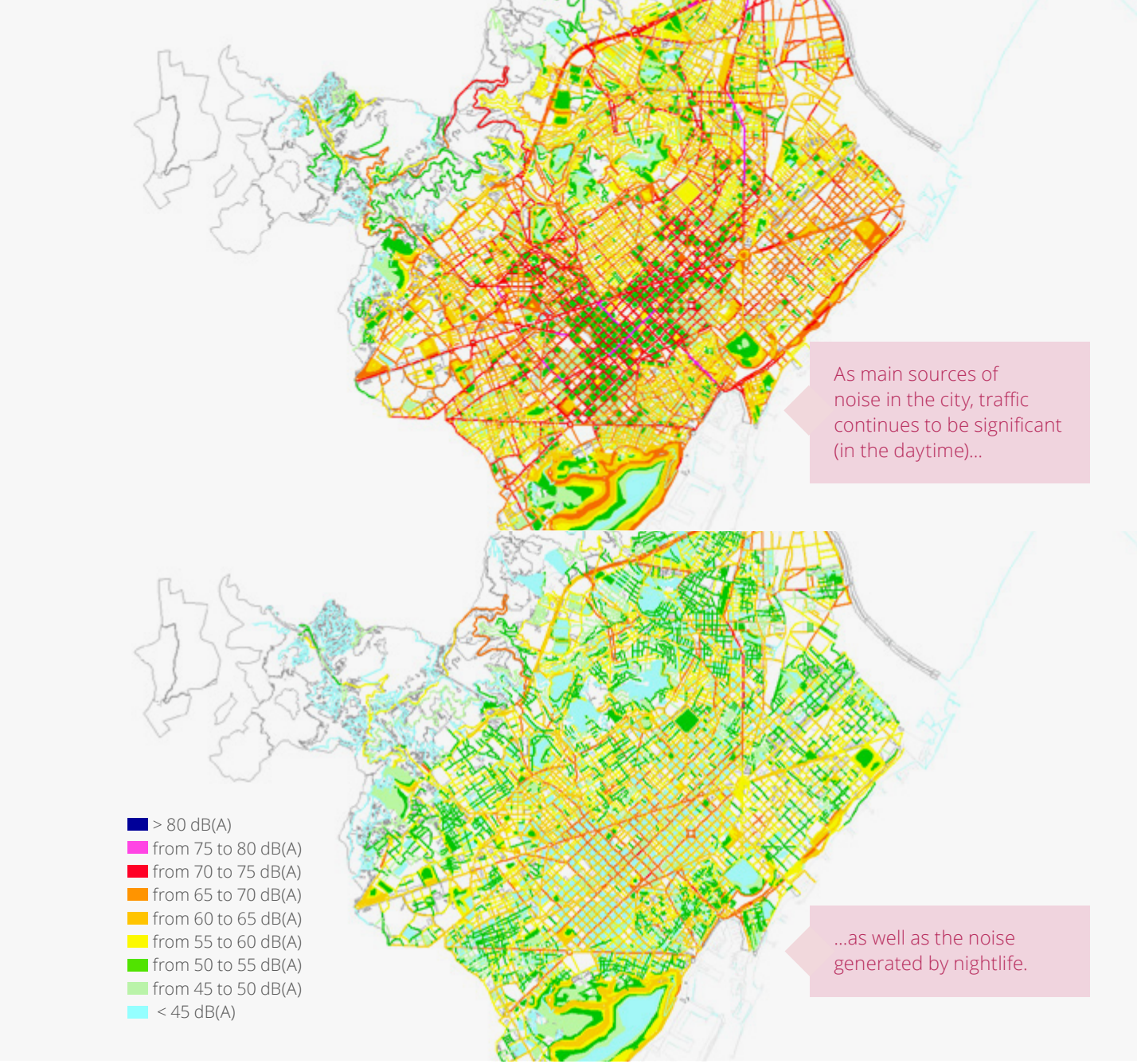
At a municipal level there is a section on noise in the Environmental Ordinance ⊕ (OMA) adapted to the requirements of the regulatory framework that regulates and rectifies certain shortcomings detected over the last few years. Its appendices will be modified over 2014, which shows how work is constantly being carried out

The noise limits established by the WHO and the EU coincide. Barcelona City Council establishes 3 levels of noise sensitivity.

	Limits recommended by the World Health Organisation	**Directive 2002/49/EC on assessment and management of environmental noise**
Outdoors by day	65 dB (A)	65 dB (A)
Outdoors by night	40 dB (A)	40 dB (A)

Emission limit values established by the Environmental Ordinance (OMA) of Barcelona City Council

	High noise sensitive zone	Moderate noise sensitive zone	Low noise sensitive zone
Outdoors by day	60 dB (A)	65 dB (A)	70 dB (A)
Outdoors in the evening	60 dB (A)	65 dB (A)	70 dB (A)
Outdoors by night	50 dB (A)	55 dB (A)	60 dB (A)



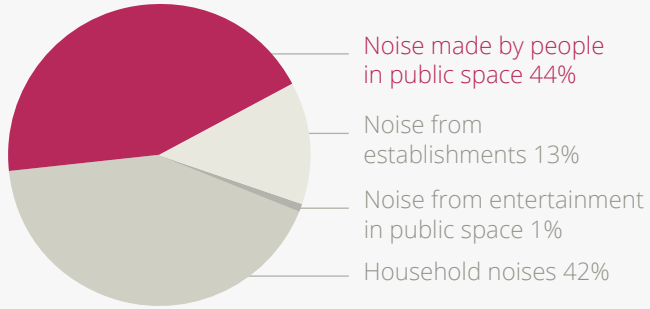
to adapt to the new situations arising in the city. This ordinance establishes a classification of the outdoor levels that is practically identical to the one defined by the Catalan government and by the Ministry of the Environment, equivalent to that of the other Spanish cities.

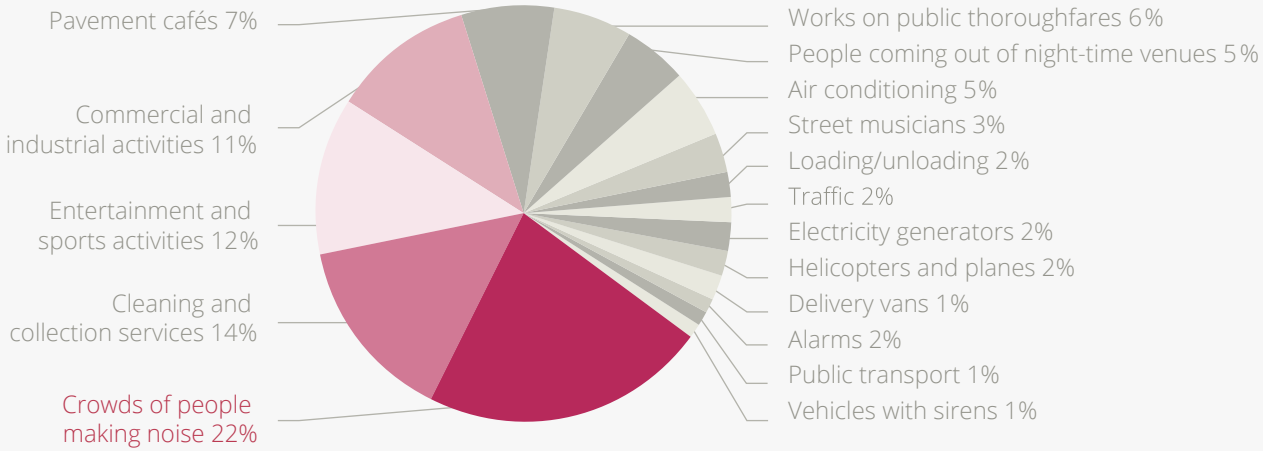
The limits to outdoor noise recommended by the World Health Organisation are stricter but do not take into consideration the reality of Mediterranean cities, with an extensive range of leisure possibilities and more life in the street, making compliance with these more difficult. With regard to the maximum noise levels allowed in homes, the ones set by the WHO agree with the levels defined by the OMA.

7.2.1 Update of the strategic noise map

Updating Barcelona's strategic noise map, made up of the noise map, the acoustic capacity map and the excessive noise map, enables us to make a regular diagnosis of the city and appraise the measures implemented. Based on data for 2012, the map reflects the city's noise situation and allows us to ascertain developments compared with the previous version. To draw up the map, real measurements were taken in different stretches of city streets by day, in the evening and at night, and these were contrasted with the acoustic capacity of each section, according to their configuration and

People gathering in public space is the main reason for complaints about noise in calls made to Barcelona City Police Force (GUB) during 2013.





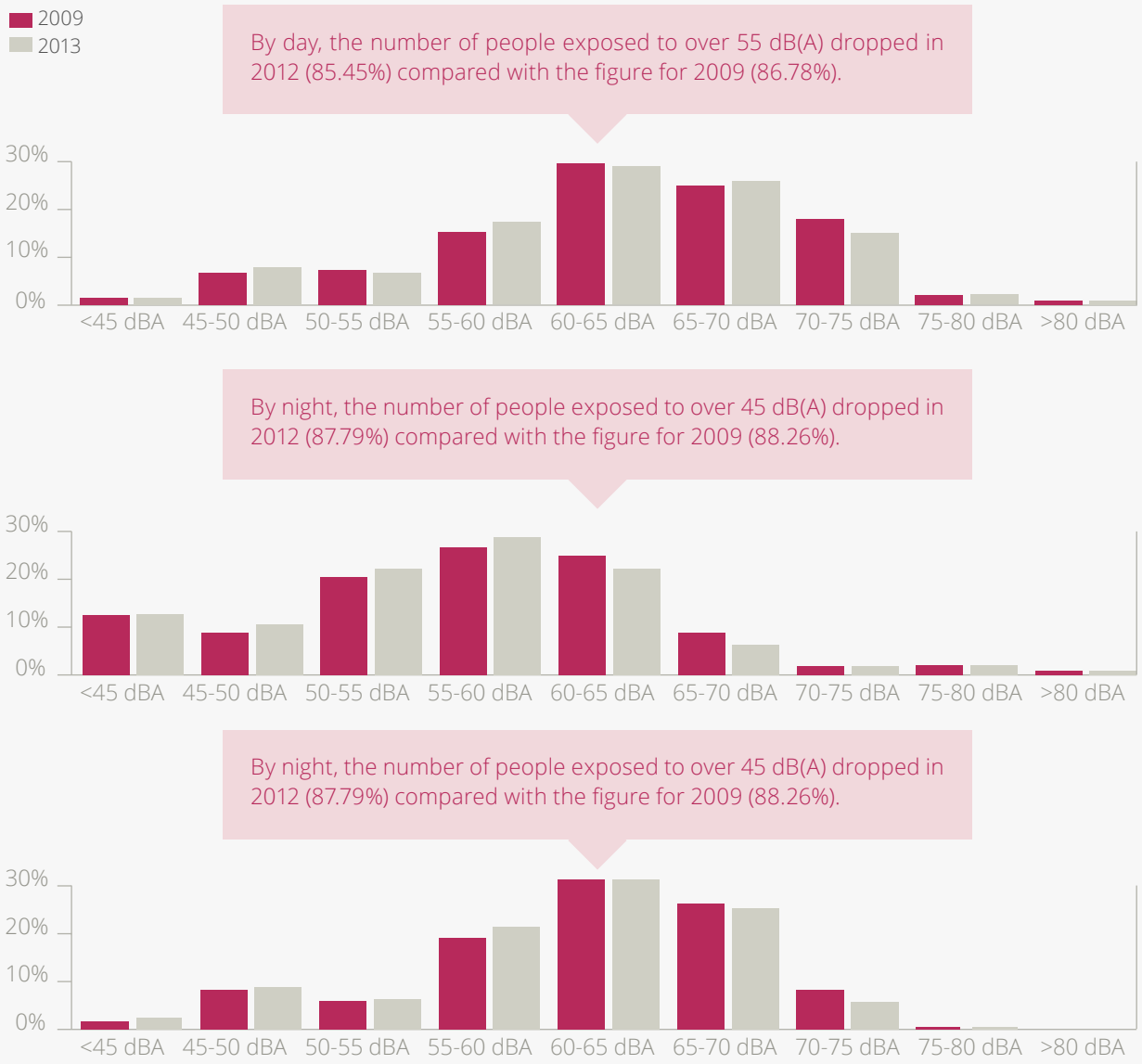
In 2013, 22% of the complaints made to the Council were due to crowds of people making noise.

classification into zones of high, moderate or low noise sensitivity. The new map incorporates new sound level meter measurements of the sections with changes in their urban development and particularly lively zones, as well as sections where there is any variation in sources of noise. It includes the action areas marked in the Plan to Reduce Noise Pollution of the City of Barcelona 2010-2020. The map can be consulted on this website http://w20.bcn.cat/WebMapaAcustic/mapa_soroll.aspx?lang=en ⊕ .

7.2.2 Traffic and nightlife, the main sources of noise in the city

The main sources of noise in the city are traffic during the day and nightlife-associated activities at night. As regards traffic, a technical differentiation is made between lower intensity internal traffic and the noise generated by traffic in the city's major thoroughfares (entrances and exits), which is known as major infrastructure noise. Other sources of noise are industry, shopping hubs and railway infrastructures.

From the point of view of people's perception of noise, the trend seen in the last few years has continued, with the main cause for complaint being noise made by people in public space.



7.2.3 Drop in the number of people exposed to the highest noise levels

Compared with the previous edition of the map (with data for 2009), the population exposed to noise levels of over 70 decibels by day has fallen and most citizens come within the intermediate sections.

53.87% of the population exposed to levels from 60 to 70 dBA during the day.

72.38% of the population exposed to levels from 50 to 65 dBA at night.

21% of the population is under 50 dBA in the night-time band.

Most of the city's districts keep noise levels similar to the previous edition of the map or have improved their exposure to noise in the last five years.

As regards time bands, the noise level starts to drop significantly around 23.00 hours and in general noise has improved over the last few years by some zones being developed as interiors of blocks, by improving the infrastructures of main road and rail routes in the city, reducing industrial zones and a 12% decrease in interurban traffic and 6.7% in urban traffic. During the night, the main problem involves nightlife, stemming from

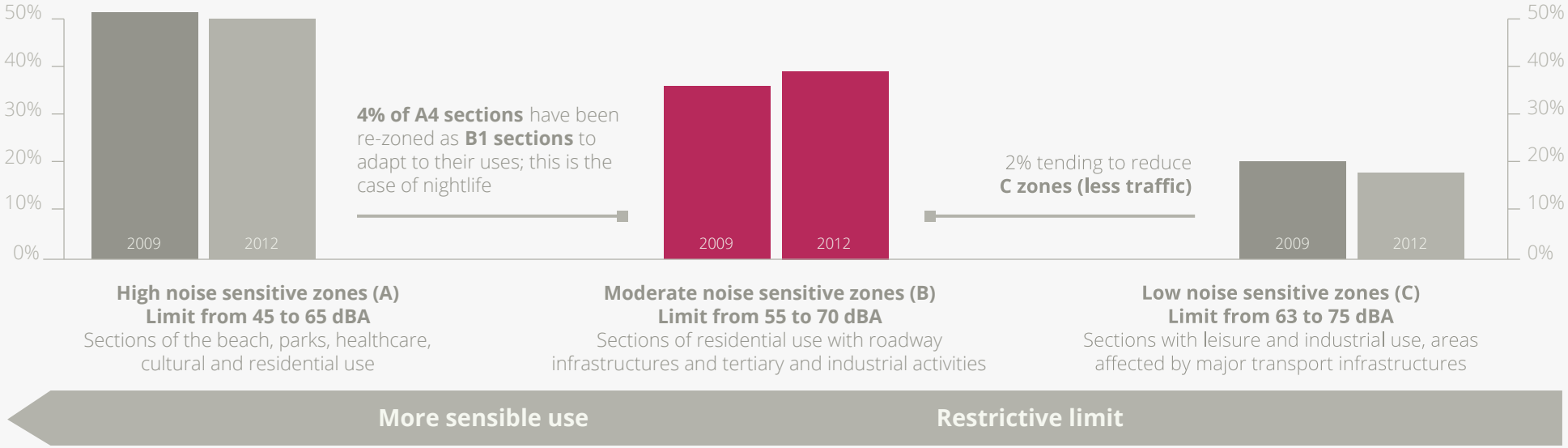
the behaviour of people who use public venues and mainly of crowds of people gathering in public spaces. This has ceased to be a seasonal problem and now occurs all year round. The situation has only worsened in the Ciutat Vella in the night-time band.

17% of the sections of the city are of low noise sensitivity due to the concentration of leisure and show zones, industrial estates or major infrastructures.

7.2.4 Zoning the city according to its noise sensitivity

The noise map marks the noise level required due to the configuration, activities or infrastructures in each section of the city. 83% of Barcelona is in zones of high noise sensitivity (with limit values from 45 to 65 dB(A)) and moderate noise sensitivity (with values from 55 to 70 dB(A)). These classifications apply to most of the city: beach zones, those of residential, cultural and healthcare use (48%) and residential use with roadway infrastructures, tertiary and industrial activities (35%).

Barcelona has two special regime noise zones (ZARE) which are particular cases due to the presence of a large number of activities, in Gràcia (Plaça Virreina, Sol, Revolució and Vila de Gràcia) and Ciutat Vella (La Rambla, Rambla del Raval and Plaça Reial). It also has a number of zones with special noise quality (ZEPQA) where very low noise levels are recorded: Horta–Guinardó districts (Laberint park and Les Heures park), Sarrià – Sant Gervasi (Can Caralleu) and Nou Barris (Torre Baró), the surroundings of the Collserola Park and Sants - Montjuïc, on Montjuïc mountain.



96% of street sections comply with their noise capacity during the day.

86% comply with this at night.

As regards other quiet zones of the city with a noise emission level under 50 dB(A) during the day and 45 dB(A) at night, Barcelona differentiates between three types: parks and gardens, specific blocks or 'islands' and interior patios, and 2.3% of some street sections in the city's residential areas.

The excessive noise map identifies those sections of the city where noise levels exceed the limits set by noise quality targets. In Barcelona, only 4% of the city exceeds its capacity by day, with levels above 3 dB(A), and these are considered as targets for priority action. They are located in Ciutat Vella, Sarrià-Sant Gervasi and Gràcia. At night, this exceedance rises to 14% of the city's area, concentrated in the same districts.

7.3 Measures taken to improve noise quality

The Council's objective is to improve the city's noise quality through comprehensive action being taken by all the municipal areas, with comprehensive actions including mobility, building and roadworks, nightlife and tools for information and awareness-raising.

7.3.1 Assessment and planning instruments to define action plans

Plan to Reduce Noise Pollution of the City of Barcelona 2010-2020

This is the reference framework for all measures taken by the Council as regards controlling and reducing noise. It acts on different fronts such as by increasing space for pedestrians in all development operations, promoting electric vehicles and cycling and monitoring noise emissions at building sites, a pilot trial to reduce the noise of nightlife in Ciutat Vella, Eixample and Sarrià-Sant Gervasi, and starting up a website that can be consulted by all citizens.

The Plan has a ten-year timeframe (2010 - 2020) and includes specific actions for each of the following strategic areas:

- Improving the noise quality of urban space.
- Furthering the incorporation of noise criteria in the design and management of the city.
- Adapting the Council building for noise enhancement.
- Engaging citizens and raising awareness on matters of noise pollution.
- Introducing and furthering mechanisms for control and knowledge of the city's noise quality.

Drawing up Barcelona's Strategic Noise Map

This instrument provides an overall appraisal of city people's exposure to noise produced by different sources in a particular zone and acts as a basis for preparing or updating action plans. Regulations require strategic maps to be drawn up by local bodies forming a group of over 100,000 inhabitants, in the municipal or supra-municipal spheres, and the authorities

A network of outdoor sound level meters, made up of fixed and mobile sensors, enables the sound levels of the city to be monitored.

responsible for transport infrastructures. These maps have to be drawn up every five years and be placed at the public's disposal.

7.3.2 Improving the noise control and monitoring network

Network of outdoor sound level meters

Installation of these meters, which started in 2005, means studies can be carried out in specific zones: ZARE, ZEPQA, conflictive activities, etc. The aim is to maintain and update information on the noise situation of the city. This network, made up of 25 noise-monitoring terminals, currently has a fixed part, mainly for monitoring the noise in nightlife zones, and a mobile part available to district bodies, other departments or as internal needs require. In order to speed up the downloading and processing of the data, a data processing application has been created which means that data can be downloaded and processed in the same way whatever the model or manufacturer of the equipment.

Installation of sensors in the city

Work has started on installing sensors in public spaces using equipment with a lower cost and lower accuracy but which can detect the city's performance in order to improve the quality of life. The Department for the Control and Reduction of Noise Pollution has defined the measurements which must be complied with by this kind of device. Work is also being done on integrating sensors into the computer platform of class I outdoor stations. The aim is to create a platform for integrated management of the whole noise-monitoring network. Taking advantage of the implementation of the new Lighting Master Plan, some sensors have been fitted into the new smart lamppost model installed in the city.

Installation of noise-limiting devices

Considering that noise stemming from nightlife is one of the main causes for complaints, the Environmental Ordinance lays down that popular public venues with an indoor music noise level over 70 dB(A) must install a noise limiter or recorder. A noise limiter is a device which is installed between the output of the mixer desk and the power amplifier to ensure that all amplified music on

the premises is limited and enables the noise emission level of the activities to be controlled, restricting the volume of the amplified music and recording the noise levels inside the premises. Limiters are therefore not only tools for controlling the noise emission levels of premises but also a highly important prevention tool which means action can be taken when high levels are detected before complaints are received for this reason. Since they don't only limit levels but also record them, other noise not controlled by the limiter can also be controlled, such as the noise made by people and other sources (parallel music equipment).

Limiters are also installed at municipal open air concerts and especially large-scale ones such as the festivals of Gràcia, Sants, La Mercè, among others. In 2013 over 500 concerts made use of noise limiters. Apart from limiters, at each concert an acoustic assessment is carried out of the concert venue in order to plan the best position of the stage or the location of the speakers, among others aspects, with the aim of minimising inconvenience for people in nearby buildings. As regards privately arranged concerts such as those of Primavera Sound, Sonar, etc., the installation of noise limiters is also required, in this case depending on the results of the noise impact study carried out.

Programme to supervise and control noise emissions by building work

Barcelona is one of the few cities that require all companies working in the city to carry out a noise impact study and make a noise level plan, with ongoing supervision of the noise emitted. It also limits the noisiest work to the morning and restricts this during evening hours and at night.

7.3.3 Citizen information and awareness-raising to reduce noise levels

Summer campaigns in parts of the city where most nightlife occurs

The Council is seeking to further measures intended to improve sound comfort and reduce noise levels, with particular emphasis on zones with higher levels due to the presence of bars, pavement cafés and large crowds of people in the street. As part of these campaigns, measures have been implemented for information and to encourage civic behaviour regarding the problems associated with nightlife and residents' difficulty in sleeping, as well as awareness-raising measures regarding the need to reduce noise level in zones with a high concentration of nightlife, among others.

Pilot trials to reduce night-time noise in public spaces

These measures are intended to measure the current situation and appraise proposals to reduce the problem of noise stemming from nightlife in public space. Its scope of action covers the districts of Ciutat Vella (Montserrat zone), Eixample (Enric Granados zone) and Sarrià - Sant Gervasi (Tuset and Lincoln zones). Popular public venues in the zones covered by the study assisted in these trials by sharing criteria and their areas of work. The zones were also monitored by installing equipment on lampposts and facades to enable recording noise levels before, during and after the implementation of the measures. Among these measures are awareness-raising campaigns involving the presence of 10 promoters with intensive action in the pilot zones, communication elements and media support for one campaign.

As well as general actions, specific measures were also carried out such as the one intended for tourists occupying apartments in the district of Ciutat Vella, where a sign has been produced to be hung up and an item to be placed on the door of tourist apartments as a reminder of the importance of ensuring neighbours are not disturbed.

7.4 Future goals and measures

Reducing noise levels continues to be one of the environmental objectives of Barcelona City Council which is why it has set up a road map for improving the noise quality of the city. One of the main sources of noise is nightlife, especially in the Ciutat Vella, Gràcia and Sarrià-Sant Gervasi districts, where the established limits are exceeded. For this reason management of the use of public space at night is an aspect of particular concern and interest for the Council. The aim is to improve noise comfort in zones with the highest concentration of nightlife: pavement cafés, nightlife entertainment venues, squares and other areas.

7.4.1 Barcelona updates its Plan for Reduction of Noise Pollution

Update of the Plan for Reduction of Noise Pollution of the City of Barcelona

Updating the strategic noise map acts as a basis for adjusting and defining new measures to improve noise comfort in addition to the ones already applied and included in the Plan. In view of the dynamic nature of the city, the Plan is currently being reviewed and its updated version is expected to be published in late 2014.

Implementation of the Plan for Reduction of Noise Pollution in the City of Barcelona 2010-2020

Over the last few years many of the fields of work materialised in the Plan have been got underway. Some nevertheless still have to be consolidated and others implemented. The Plan is just at the halfway stage of its effective period. Some of the measures in the Plan that will gain momentum in the coming years are described in the following table, detailed by their strategic approach.

The streets of Barcelona renewed over 160,000 m² of their surfacing, being covered with noise–reducing asphalt that helps to improve road safety and reduce noise contamination.

MAIN MEASURES IN THE PLAN TO REDUCE NOISE POLLUTION IN THE CITY OF BARCELONA 2010-2020

Improving the noise quality of urban space

Promoting electric vehicles, increasing the area allocated to pedestrians in thoroughfares (47% new space is gained for pedestrians in all the conversion projects underway in the city, as a whole), encouraging the use of public transport and incorporating noise criteria in the planning of works in public thoroughfares.

Furthering the incorporation of noise criteria in the design and management of the city

Promoting the "Super-blocks" programme in Barcelona, incorporating the concept of "acoustic capacity" in the planning of mobility, implementation of the Scheme for heat and noise insulation of windows and doors in private residences (double glazing) and the Scheme for soundproofing activities that produce disturbing noise.

Adapting the Council building for noise enhancement

Optimisation of the Intranet for noise management, improving the system to manage noise incidents, providing training schemes for technical staff in the districts and for the City Police Force and incorporating noise criteria in municipal service fleets.

Citizen engagement and awareness-raising in terms of noise pollution

Signing Commitment Programmes with the agents involved in generating noise, greater citizen participation (for example, the *Govern Obert* or 'Open Government' platform), fostering campaigns to reduce noise stemming from night-time venues and pavement cafés and setting up channels to access environmental information on noise pollution.

Introducing and furthering mechanisms for control and knowledge of the city's noise quality

Introducing new technologies in the sensor-monitoring network, defining a new noise index for the city, maintaining and furthering technical support and advice for districts and the City Police Force and for monitoring noise levels in streets paved with noise-reducing surfacing.

Implementation of the Urban Mobility Plan

The Urban Mobility Plan aims to increase travel on foot by 10% by 2018 and to reduce use of private vehicles from 26% to 21%, encouraging public transport and cycling, surfacing almost all the roadway network with noise-reducing asphalt, eliminating viaducts (such as in Plaça de les Glòries) and covering railway tracks in inhabited parts of the city (such as the Sants tracks). Work will continue on the Escoles + Sostenibles or 'More Sustainable Schools' schemes, with measures to raise awareness and provide information on noise for schools, organising specific activities and workshops.

7.4.2 Noise as a subject to work on at schools

Education programme 2015-2016 for dealing with noise at schools

The programme seeks to make pupils aware, and have them act on and participate in improving the sustainable management of their environment by identifying problematic spaces with high noise levels, at school in this case: dining rooms, playgrounds, multi-purpose rooms, gymnasiums, etc. where measures and action need to be taken. The aims of the scheme are to improve the quality and quantity of noise, create a network for swapping education experiences on noise, provide data on the degree of noise pollution at different locations in the school and report on the actions taken to improve noise quality carried out at schools and in the city.

Educational initiatives

Barcelona City Council will continue the different schemes and educational resources promoted in the last few years intended to make pupils more aware of the problem of noise.

→ **How does Barcelona work?** ⊕ This is an environmental education scheme promoted by the Environment and Urban Services areas of Barcelona City Council with the aim of educating in sustainability based on a knowledge of what we might call the "city's metabolism". The wide range of education activities includes visits to facilities related to Barcelona's environmental management, helping to reflect on the impact of everyday activities such as noise levels. It also includes a workshop on noise prevention entitled "Mec-mec, plam, brmm, ssst!" intended for the later years of primary school and the early years of secondary education. Work is carried out at the workshop on the concepts of noise and silence and noise measurements are taken and their results interpreted, with a hands-on approach to the measuring equipment.

→ **Sound and noise suitcase** ⊕ . An educational resource made up of the Sound and noise ⊕ guide, published as part of the collection of guides of Barcelona's Agenda 21 Escolar, and a set of materials (stories, guides, CD, DVD, musical instruments, etc.) to deal with and foster noise education and improve the noise quality of our environment.

→ **Sound and Noise**. A selection of educational resources ⊕ to handle the issue of noise pollution in the classroom, make pupils more aware and find ways to reduce noise. The resources are available on loan from the Environmental Education Documentation Service.

Children work on the concept of noise at school to make them more aware of the importance of noise quality.

Waste production and management

Barcelona, a city progressing with less waste

Waste production and management

Vision of the future

Becoming a city that takes advantage of 100% of the waste generated

Current situation

Waste generation

2009 **864,758 t**

2013 **730,285 t**

2009 **1.46 kg/inhab./day**

2013 **1.23 kg/inhab./day**

Selective collection

2009 **32 %**

2013 **36 %**

green points

2009 **478,322** visits

2013 **741,086** visits

Waste treatment

55.5 % Mechanical-biological treatment

35.5 % Material Recovery

5 % Energy recovery

4 % Controlled dump

Lines of work

Planning 'Plan to improve street cleaning' 'Waste Prevention Plan for Barcelona 2012-2020'

Rethinking '*E + S (Embolcalls + Sostenibles / Esmorzars + Saludables)*' (More Sustainable Wrapping / Healthier Meals)

Reduction 'Taking advantage of food' 'Census of shops selling loose goods'

Reuse 'Renew your clothing'

Recycling 'New cleaning contract' 'Collection of toys at green points'

8.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to become a city that takes advantage of 100% of the waste generated.

Beyond preventing waste generation, Barcelona wants to build a model of consumption and development with the lowest possible ecological footprint and to move towards a circular economy. The milestone is to prevent waste as far as possible and for any refuse generated to be turned into quality raw material. This can only be done by ensuring the co-responsibility of citizens and social and economic agents as a whole. We therefore need to continue explaining the global and local benefits of good waste management.

Prevention of waste is a necessity, an opportunity and a priority: a necessity because we cannot keep up waste management with such high long-term costs and an opportunity because consumption habits have changed over the last few years and the selective collection of waste has become more fully established; also a priority because prevention is the way to disconnect growth in the economy from rising waste generation. The main challenges and opportunities that have to be tackled are:

- **The compact urban structure makes it easier to manage waste** by reducing distances between people and collection points, making it unnecessary to take waste very far. The diversity of urban areas nevertheless requires an adaptation of collection systems to offer a service available to everyone and consistent with the setting in which this is found.
- **The number of inhabitants and their diversity is an aspect directly affecting the quantity of waste generated and the quality of the waste collected.** The city now has over 1.6 million inhabitants as well as a considerable number of tourists. Their seasonal presence and lack of knowledge as to how the city works makes waste management harder. The city's foreign residents also have lower levels of environmental awareness.
- **There are general limitations which make it hard to influence citizens' consumption habits** such as market limitations in options for sorting products or the fact that certain products have a limited lifetime. Over-packaging and the disappearance of products sold in a loose format are also significant factors.
- **There are limitations connected with management instruments,** such as regulatory development and planning which favour local and super-municipal endeavours that are still in their early stages or the lack of prevention consolidation in certain areas of management.
- **Ensuring optimised selective waste collection that functions correctly** enables its impact on city people to be minimised and reduces noise pollution and the emission of local contaminants.
- **Obtaining quality materials in waste recovery processes,** such as urban mining, is of key importance in finding a market for them, thus contributing to the circular economy. In spite of this the present economic situation encourages the breaking of material circuits (theft of copper, metal, etc.), making it necessary to create parallel circuits in order to integrate them.
- **The incorporation of smart and innovative technologies** helps to improve the operation of the waste management model, making this more efficient and sustainable.

8.2 General context and current situation

Barcelona City Council is responsible for cleaning public space and managing the different types of municipal waste produced by the city ⊕. The Council can nevertheless handle the collection and transport of different waste fractions and even the installation of treatment on its own account or delegate this to private companies or social organisations by means of contracts or agreements of a particular timescale depending on each fraction and/or generator.

Decree 1/2009, of 21 July, defines the powers and functions of local bodies as regards prevention and taking action intended to accomplish the aims defined in the Catalonia Municipal Waste Management Programme 2007-2012 (PROGREMIC) ⊕. According to this Decree, the management of waste is the responsibility of the municipality. As regards planning for prevention, the Law on waste and contaminating soils, Act 22/2011, of 28 July, lays down that local bodies can, within the framework of their authority, draw up programmes for waste management in accordance with the National Framework Plan and the Autonomous Community waste plans.

European, state and Catalan regulations determine a hierarchy which establishes the order of priorities to be applied in waste management policies: prevention, preparation for reuse, recycling (even composting) other types of recovery (for example, energy recovery) and elimination (or disposal). On a European scale, this hierarchy is covered in Directive 2008/98/EC, of 19 November 2008. At a state level, Act 22/2011, of 28 July, on contaminating soils and waste, states that public administrations should pass programmes for waste prevention, setting the prevention targets and describing the existing prevention measures. Apart from this, there is also a National Integrated Waste Plan (PNIR) 2008-2015, Urban Waste of Household Origin, a text approved by an agreement of the Council of Ministers of December 2008. Finally, at the Autonomous Community level, there is also the Catalonia Municipal Waste Management Programme 2007-2012 (PROGREMIC) ⊕ and the Metropolitan Plan for Management of Municipal Waste 2009-2016 (PMGRM) ⊕.

At the municipal level, cleaning public space and managing waste is regulated by means of different ordinances passed by the City Council. This establishes the criteria for classifying waste within municipal competence, either special or not special, as well as any waste whose nature or origin means it must be handled by carriers and managers authorised by the Catalan Waste Agency.

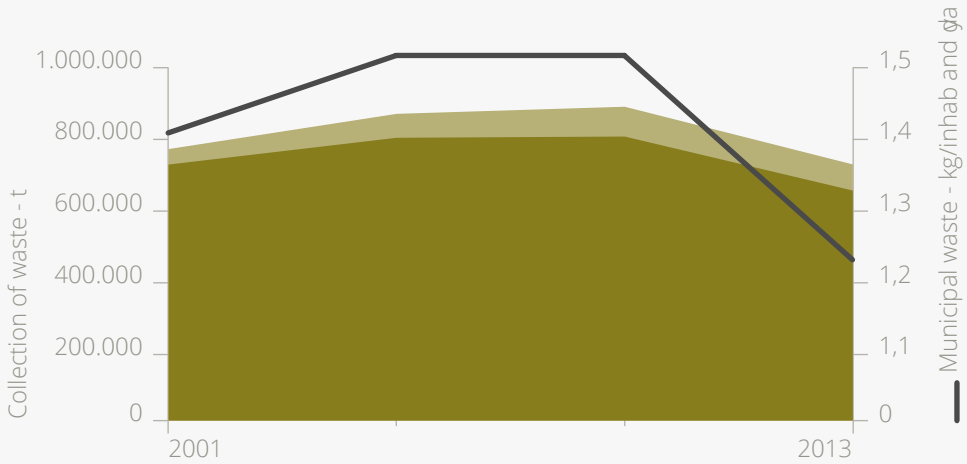
8.2.1 The total volume of waste is dropping

In the last five years the waste collected in the city has dropped by 16% to 730,285 tonnes in 2013. At the same time the rate of waste generation per person has also fallen, reaching 1.23 kg/person/day.

The actions carried out since November 2012 reveal the potential of waste reduction provided by the measures contained in the Waste Prevention Plan for Barcelona 2012-2020. The generation of waste in the second half of 2013 indicated a change in trend and incipient stabilisation to some degree.

In 2013 the amount of waste avoided thanks to the implementation of the measures described in the Waste Prevention Plan ⊕ was 1,846,209 kg. These data provide some initial measurements regarding the viability of the different measures and the sectoral and global potential in the medium and long term.

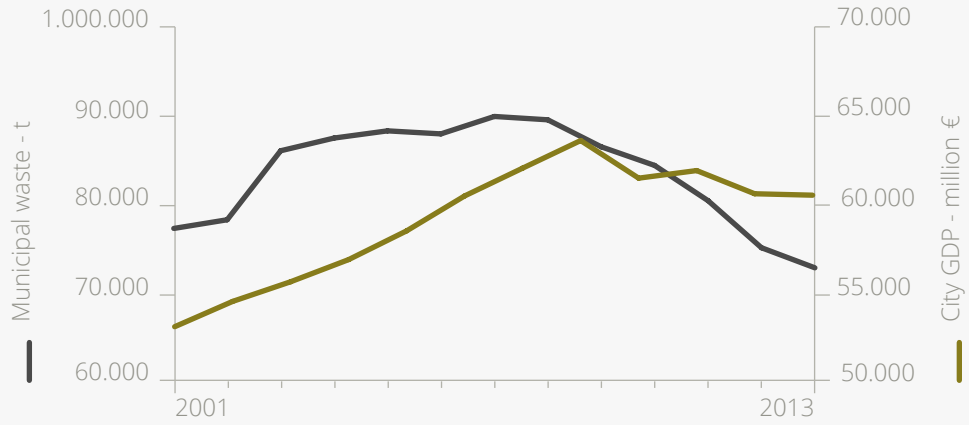
Waste collection incorporates quality and sustainability criteria and also has the necessary instruments to ensure respect for the environment.



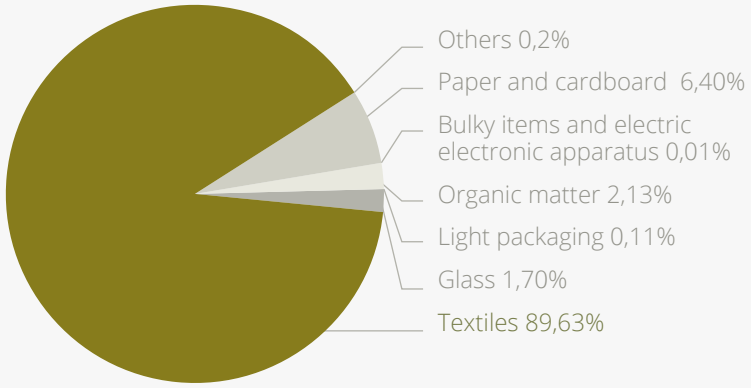
Collection of commercial waste (t)
Collection of household waste (t)

2013 was the sixth consecutive year in which a drop was recorded in the total volume of waste collected in the city. 89.8% of the waste generated was from household sources.

It is clear that prevention is the way to disconnect economic growth from an associated rise in waste generation and break a consumption circle which does not provide any added value for the well-being of society.



Most of the waste avoided involves textiles (89.63%).



8.2.2 Different types of waste collection for greater effectiveness and efficiency

In view of Barcelona's diverse uses and urban structure, different types of collection are implemented with the aim of ensuring an effective and efficient collection of municipal waste, promoting selective collection and furthering reintroduction into the production and consumer cycle for all those resources whose useful life is not yet over.

- **Household**. This is the waste originating from the city's housing and from shops and services that don't have any specific commercial collection. This is mainly done by means of community bins, where citizens can separate waste by fraction (organic material, glass, packaging, paper-cardboard and residual waste). Apart from promoting the selective collection of recoverable waste, this system also reduces the volume and diversity of waste coming into the processing installations. The collection is handled by several companies contracted by the City Council, each of which is responsible for one of the zones into which the city is divided, in line with technical and efficient management criteria.

- **Commercial**. This is the waste generated by shops with a specific collection system, such as big stores, economic activity centres and industries with waste that can be assimilated in this category. The system involves the separate collection of fractions of organic material, packaging, glass, paper-cardboard and residual waste. The owners of businesses generating waste can opt for the municipal waste system which is assigned to them by quantity and/or zone or manage this by means of a carrier authorised by Catalan Waste Agency, with documents to certify the management system.

- **Markets**. This is the waste generated by the 40 municipal food markets and the different markets and street markets, except for Mercabarna, Barcelona's wholesale market. Organic material, paper-cardboard and residual waste are separated for collection.

- **Collection of bulky items (furniture and junk)**. There is a free collection system in which each street has a set day assigned to it and another system where residents can pay for items to be collected from their home within 36 hours.

- **Other collections**. Collection of organic material, apart from residual waste, in the parks and gardens of Barcelona City Council. At Mercabarna, the collection of residual waste, organic material and paper-cardboard; also dead animals, which is mainly done by social organisations.

Apart from these types of refuse collection, the Council provides different services for citizens which enable all the waste that should not be included in the residual waste fraction to be separated:

- **Green points** ⊕. These facilitate the collection and provisional storage of waste that will not fit in the selective containers to be taken later to the processing plants. The city has 7 zone green points, 23 district green points, 96 stops for the mobile green point and 2 mobile green points which can be requested by schools and institutions, as well as by civic bodies or associations.

- **Collection of clothing**. The City Council and the Training and Work Foundation have signed an agreement to implement a new service for the door-to-door collection of used clothing in 2012. This service allows citizens to ask to have used clothing collected from their homes – minimum 2 bags, free of charge, by calling one of the citizen service phone lines.

Over the last few years Barcelona has introduced improvements into municipal processes and services for collection and management as regards changing habits and patterns of behaviour of citizens and of different social and economic agents with regard to the selective collection and recovery of resources which have not ended their life cycle. Particularly of note is the introduction of the selective collection of organic material. The active involvement of citizens in selective collection is largely the result of the communication campaigns carried out, creating a favourable social context, and the cooperation with hundreds of organisations, organisations, companies and institutions connected with waste generation in the city.

8.2.3 Consolidation of waste collection habits

The people of Barcelona have consolidated their recycling habits. In absolute terms, 264,044 tonnes were collected in 2013, 5.6% less than in 2012. This reduction is explained by the decrease in the total generation of waste in the city. In 2013 selective collection also dropped 3.3 per cent as compared with the total amount of waste in comparison with 2010, the year in which it reached its peak (39.5%) coinciding with the time when organic material started to be collected from the city as a whole and the number of green points was extended.

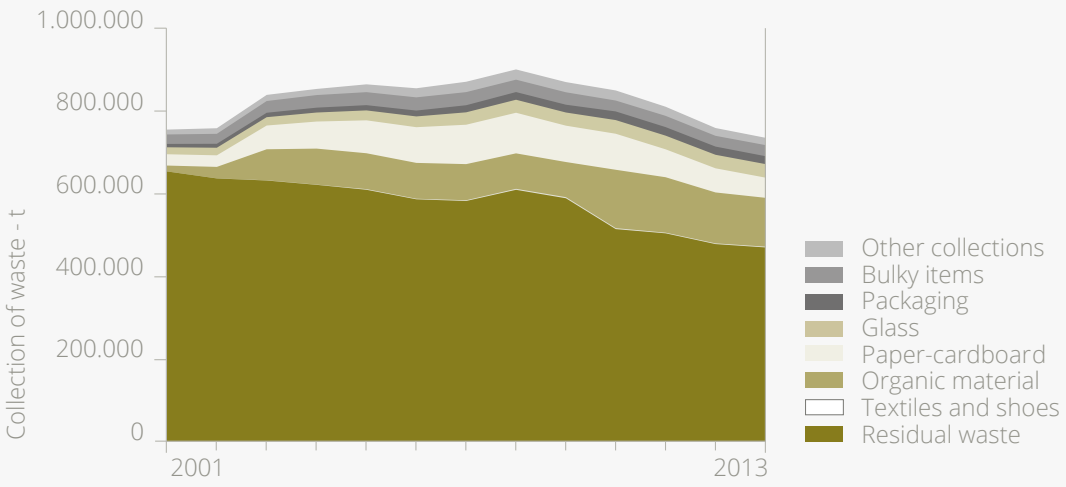
In spite of this the percentage for 2013 was still almost 4 points higher than in 2009. The reduction in the percentage of selective collection for 2013 can be largely explained by the decrease in the amount of paper and cardboard collected, partly caused by thefts from bins and partly by the economic crisis.

The relative increase of glass and packaging fractions and the increase in the use of green points also indicate that the people of Barcelona have consolidated their waste separation habits.

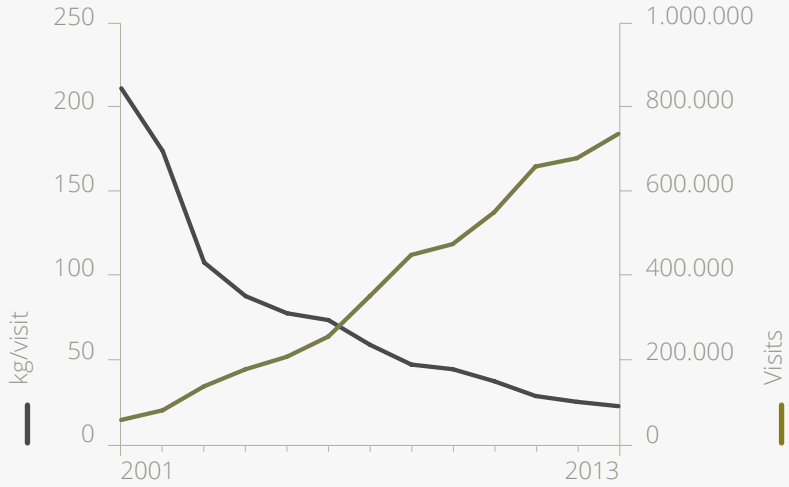
→ **The drop in tonnes of paper and cardboard collected** is mainly due to the decrease in commercial activity and to unofficial collection.

→ **The amount of packaging and glass collected has remained fairly stable over the last few years**.

264,044 t of waste was handled by selective collection in 2013, 5.5% less than the previous year.



The increase in users of green points is due to a more widespread use of the network and indicates a higher degree of awareness.



The network of green points in the city is made up of the zone green points, which are large-scale and located on the outskirts, the district points, which are smaller and located inside the city area, mobile points made up of trucks to be closer to hand for citizens and the school mobile unit, as an educational resource for pupils and their families.

The collection of packaging waste remained stable in 2013. The relative increase in the collection of glass indicates that citizens are increasingly aware of this.

→ **In 2010 there was a considerable increase in the tonnes of organic material collected compared with previous years**. Since then the collection of this fraction has remained stable in relative terms. Inappropriate waste – refuse thrown out by mistake amongst the organic part as well as nappies, which should go into general waste, has remained at around 20% since 2010.

The number of citizen visits to Barcelona's network of green points increases year by year and this has become consolidated as a reference facility. In 2013 these green points were visited by 741,086 users, the highest figure of the last few years. The rise in green point visits indicates the increasing awareness of citizens.

8.2.4 The best treatment for each kind of waste

The generation of waste entails a number of environmental impacts at differing scales (local, regional or global) related to its collection, transport and processing such as energy consumption, emissions into the atmosphere and the contamination of water and soil. Other impacts such as noise, smell, occupation of public space or the landscape or visual impact may also affect the quality of life. Reducing this is therefore the main way to prevent such an impact, as well as optimising the transport routes for its collection and ensuring this is given the best treatment in line with the hierarchy laid down by current legislation:

→ **Organic material**, both coming from specific generators (e.g. Mercabarna) and from selective collection, can be treated by either composting or anaerobic digestion.

→ **Packaging** is separated at sorting plants and, as part of the Comprehensive System for Waste Management of light packaging, the sorted material is taken to authorised recovery organisations.

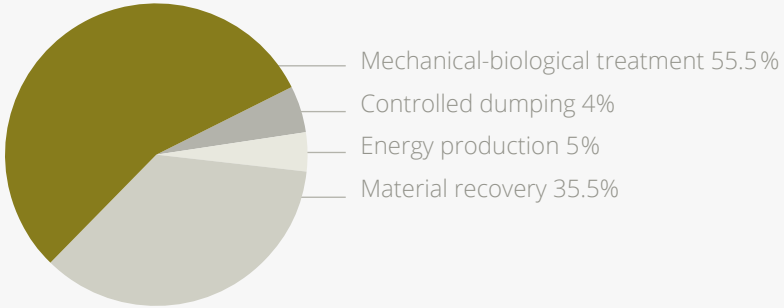
→ **Paper-cardboard** from shops is collected separately via a special system and assigned to authorised recovery organisations. In 2008 Barcelona City Council was given "Tu Papel 21" certification from ASPAPEL (Spanish Association of Manufacturers of Pulp, Paper and Cardboard) for its good management of the selective collection of paper and cardboard.

→ **Glass** is taken to authorised recovery organisations.

→ **Bulky items** from municipal collection or dumps (small amounts) are taken to the bulk waste sorting plant in Gavà-Viladecans.

→ **Residual waste**: in accordance with the PMGRM, which aims to process such waste before using it

In 2013 55.5% of waste was given mechanical-biological treatment



for energy recovery or disposing of it, this is sent to mechanical-biological processing plants (Ecoparks) where an attempt is made to reclaim and recover the maximum possible amount of materials before carrying out its final processing.

The residue from this processing cannot be recovered any further and can only be used to produce energy or disposed of via controlled methods.

The different treatments given to waste are therefore.

→ **Material recovery:** this includes the recycling of glass, paper and cardboard, light packaging items, bulky items, waste from green points and other specific collection systems; the composting of organic waste from parks and gardens and the organic fractions selectively collected. It also includes organic waste sent for mechanical-biological treatment.

→ **Mechanical-biological treatment:** treatment of the residual waste fraction, where recyclable materials are separated (the resulting residue is later used to produce energy).

→ **Energy recovery:** waste sent directly to produce energy.

→ **Controlled dumping:** waste that is sent directly to a controlled dump.

Composting is a biological process that transforms degradable organic waste under controlled conditions into a stable, sterilised product known as compost, which can be used as organic fertilizer.

8.3 Measures taken to reduce waste generation and improve selective collection

Barcelona is striving to reduce the amount of waste generated and raise the quality and quantity of selective collection by implementing measures to improve management and increasing people's awareness.

8.3.1 Planning based on prevention, reuse, recycling and awareness-raising

Municipal Waste Prevention Plan 2012-2020

In keeping with established Catalan and Metropolitan objectives, the plan sets the target of reducing the waste generated per capita by 10% for 2018 and keeping to this amount until 2020, reaching a rate of 1.386 kg/inhab./day. The figures for per capita generation for 2011 (1.33 kg/inhab./day) and 2012 (1.27 kg/ inhab./day) are already within the Plan's targets but are nevertheless affected by the economic crisis and the drop in consumption and not yet influenced by the implementation of a prevention plan integrated within the everyday operation of production and consumption cycles.

The Municipal Waste Prevention Plan 2012-2020 aims to encourage the reduction of waste in the city by involving all the agents involved (citizens, companies, shops, organisations, associations and administrations).

As quality targets, the Plan seeks to promote and reactivate the possibilities for reuse and recycling and in particular to increase the degree of awareness-raising and participation of citizens and agents involved. It also aims to convey the message of prevention and responsible consumption to the people of Barcelona and to consolidate prevention measures as part of the management of municipal refuse.

The plan stresses prevention, reuse and recycling and its application framework includes all municipal waste flows plus those that can be assimilated to municipal flows generated within the city's administrative boundaries. Below are details on some of the measures already implemented to improve the prevention potential for each fraction.

The bins placed all over the city encourage the selective collection of waste in an easy, accessible way for everyone.

MAIN MEASURES TO IMPROVE THE PREVENTION POTENTIAL FOR EACH FRACTION

Bulky items and "RAEEs" (waste from electrical and electronic equipment)

Initiatives to lengthen the useful life of objects. Of note is the work carried out by the Environmental Department of the Barcelona Metropolitan Area with its "Better than new, 100% old" scheme to encourage people not to throw things away until their useful life is over. This is done by disseminating the different possibilities for reusing items at repair workshops, second hand shops and markets and websites for exchanging and buying and selling goods. It also gives advice on different techniques for repairing things oneself in the "Repaired, better than new" project.

Light packaging

Reduction of drinks packaging. Different measures are carried out to achieve this aim: the pilot trial on the implementation and proper use of deposit, refund and return (SDDR) systems, the introduction of vending machines with waste prevention criteria especially at facilities, and fostering the consumption of tap water by citizens.

Organic material

Reduction of food wastage. The following measures were carried out in 2013 in order to cut down food wastage and encourage responsible consumption habits: cooking workshops to make the most of food and theatrical performances in municipal markets to teach recipes for keeping and making the most of food, attended by over 7,000 people; publication of the guide entitled "Let's make the most of our food" intended for hotels, restaurants and catering firms; a website designed for citizens to share strategies and recipes to make the most of food; publication of the study entitled "Food waste at school dining facilities. Conclusions of a study and proposals for action"; publishing the "Guide to prevent food waste" and short educational videos for children.

Glass

Encouraging the reuse of cava bottles. Their specific characteristics mean that cava bottles are ideal for reincorporating in the reuse circuit. Barcelona City Council encourages people to take cava bottles to Green Points, especially over the Christmas period.

Paper and cardboard

Reuse of text and reading books. The schools in Agenda 21 have carried out different experiments in reusing text and reading books.

"Book corner". Zone and district green points have a facility for reusing reading books.

"+ Sustainable Council" Scheme. with the aim of making the Council more environmentally friendly, since paper makes up 60% of the waste generated. Trays are distributed to promote the reuse of paper as well as eco-paper bins for recycling.

Other fractions

"Renew your clothing" . This is an initiative to encourage the selective collection of clothing and footwear and its reuse, promoted by organisations, associations and municipal facilities of the city with the City Council's support. As part of the 5th European Week for Preventing Waste, the initiative gave workshops, talks, short films and the action entitled "The evidence of waste", promoting the Waste Prevention Plan.

8.3.2 Encouraging selective waste collection

Main results of the new cleaning contract

Since late 2009 Barcelona has had a cleaning contract with the aim of improving the collection service by increasing the number of collection points by 37%, a target which has already been attained. The framework of the contract involved extending selective collection to shops and large generators and the selective collection of organic material has been introduced. Among other measures, in late 2009 the deployment of 27,000 new bins designed to be accessible for everyone was begun. These containers have a foot-operated manual opening system (the pedal design means they can be opened more conveniently and less strength is required to open them) and they also have a delayed closing system and touch-sensitive marks for the visually impaired.

+ Sustainable Wrappers is a project carried out by the Cleaning and Waste Management Department of Barcelona Council, the + Sustainable Schools Scheme and the Catalan Society for Environmental Education, to encourage a reduction in wrappings, the introduction of reusable packaging and to make pupils more aware of waste prevention.

"Where can I get rid of my waste?" website

This website provides information on the most appropriate place to dispose of each type of waste, as well as helping to locate the closest green point.

8.3.3 Raising awareness for prevention

Implementation of education measures

In the Framework of + Sustainable Schools, the following projects are worthy of mention:

- **E+S Project (Embolcalls + Sostenibles/Esmorzars + Saludables)** (More Sustainable Wrapping / Healthier Meals) for encouraging educational centres to reduce the packaging used for lunches based on a wrapping prevention plan, at the same time as proposing an analysis of types of lunch and taking more steps to promote healthier eating habits.
- **"Eating it all up"**, which starts off with the Think, buy, cook, eat" guide to avoid food waste, to raise awareness on food wastage at the dinner services of Barcelona schools as well as calculating the ecological footprint of certain foods commonly used in school meals, with the cooperation of school catering service companies.
- **"Let's make compost and learn"**, given by the +Sustainable Schools scheme, sets out to bring household composting into the everyday lives of the city's educational centres. To this end it provides them with different materials and services for composting to help introduce waste management and prevention as both a theoretical and practical part of the curriculum.
- **Civic conduct has its reward**. An agreement between Barcelona City Council and the CiviClub means that civic attitudes, solidarity or sustainability, such as taking items to be recycled at a green point, giving blood or making use of the Bicing cycle hire service are rewarded with discounts and promotions for leisure activities.
- **Network of Metropolitan Composting Units**. With the aim of fostering the campaign for household composting, Barcelona Metropolitan Area has promoted the creation of a Network of Metropolitan Composting Units (XCM), open to both composters and technical staff of the public administration, as well as companies from the sector and the academic world. This network encourages household composting in the city, both in gardens and on terraces, as well as vermicomposting.

8.3.4 Starting up the Plan to Improve Street Cleaning

Plan to Improve Street Cleaning

In 2009 the first phase of the plan was implemented, modernising and reorganising the cleaning services in order to improve the city's cleaning, with particular emphasis on the places used most intensively by people in all districts. The Plan also contained a communication plan to convey to citizens the message that cleaning the city is everyone's responsibility, also including backup work by the authorities with the City Police Force paying special attention to anti-civic behaviour connected with cleanliness.

The second phase of the Plan, begun in 2013, emphasises four different aspects with regard to the cleaning service: it promotes the initiative entitled "Giving the district a thorough clean on Saturdays", cleaning up stains and chewing gum, with incentives for the collection of excrement and cleaning the shutters of shops, at no extra cost to the city's municipal cleaning system. The Plan also intends to update and reorganise the cleaning service to ensure better results in city cleaning.

8.4 Future goals and measures

Barcelona has already achieved the target of cutting down waste generation per capita by 10% by 2018. To consolidate this figure and improve on the quality of the fractions collected, the Council will continue to improve and establish new strategies to encourage a more efficient and rational use of resources and to encourage the prevention of waste generation, reusing and recycling.

The Municipal Waste Prevention Plan 2012-2020 establishes new strategies to encourage a more efficient and rational use of resources and to further prevention, reuse and recycling.

8.4.1 Making progress in minimising waste generation

Follow-up and review of the Waste Prevention Plan for Barcelona 2012-2020

As envisaged in this Plan itself, work has been and continues to be carried out to exhaustively assess the application of the measures in the Plan on an ongoing basis and to ensure flexibility in order to incorporate any changes considered to be appropriate. These follow-up tools are specifically: annual reports on the evolution and state of planning, reviews in each period - phase, follow-up reports on actions and the drafting and calculation of a series of prevention indicators.

Creating virtual exchange networks

Through these networks, people do not have to be physically present to make a swap. It acts as a series of windows to allow people to show their reusable items and to manage supply and demand by users. It includes bulky items and electric and electronic items recovered by the Council or by non-profit organisations from repair centres or dumps, or from donations of property by private people or organisations, etc.

Consolidation of the collection of toys at green points

After the pilot trial to reuse used toys left at district green points or the city's mobile points, the current objective is to consolidate this channel. The idea behind this service is to extend the useful life of toys which are still useable and to ensure those that cannot be reused are disposed of properly.

Census of shops selling loose goods

As part of the structure to prevent light packaging, the prevention plan includes the preparation of a database of the shops in Barcelona which sell loose goods in the area of household consumer products. This action seeks to prove that it is not only a matter of focussing efforts and resources on identifying waste and its proper separation but also of finding those things that can stop becoming waste, as well as promoting this new model of consumption.

8.4.2 Barcelona will continue to make citizens aware of this issue

Making municipal markets aware to recycle more and better

The aim of the campaign promoted by the City Council will be to improve the collection of organic waste at municipal markets through awareness-raising and education. This task is being carried out by 7 environmental information agents who will visit the city's 29 markets. They will go stall by stall to inform people of the basic concepts and answer any doubts on the separation of waste.

There are a lot of shops in Barcelona which sell loose products nowadays, going back to more traditional forms of consumption.

8.4.3 Application of environmental and social criteria in new cleaning contracts

Drawing up the new cleaning contract

The present contract has a major environmental commitment and stresses the minimisation of the carbon footprint. The intention of the new contract is also to reduce noise pollution and to minimise the emission of local contaminants. It will seek the maximum electrification of the fleet, new cleaning processes for street cleaning and collection to move towards a circular economic model and foster the protection of people's health and the environment, as well as aspects on the treatment of data and information transparency. As regards management, the system of dividing the city into zones of action to keep up competitiveness between companies will continue. The principle of the licensee's overall responsibility in each zone will be kept, grouping cleaning services and waste collection in one zone under the same concession. Greater involvement and responsibility on the part of licensees will be required, related to financial compensation systems with a view to achieving measurable results.

Water cycle

Barcelona, well on the way to comprehensive water management

Water cycle

Vision of the future

Protecting water as a basic vital resource

Current situation

Water consumption

1999
114.46
million m³
total drinking water

2013
94.67
million m³
total drinking water

67.37 % Household

27.27 % Shops and industry

5.34 % Municipal services

2013
108.42
l/inhab. x day
household water

Sustainability index
(groundwater consumption/ total water consumption)

1999
3.43 %

2013
19.95 %

Treatment

100 %
treated
water

beaches
4.78 km
3,755,000 users

Lines of work

Quality 'Checks on drinking water' 'Management of bathing water'

Savings and efficiency 'Taking advantage of alternative resources' 'Savings in management of green areas, cleaning and sewers'

Awareness-raising 'Fostering water savings' *'Fonts Bcn'* app

New management models *'Barcelona Cicle de l'Aigua, SA (BCASA)'*

Flood management 'Remote control and urban drainage'

9.1 Vision, challenges and opportunities

Vision of the future

Barcelona protects its water as a basic vital resource. That's why it's a priority issue for the city to ensure comprehensive water cycle management, taking into account the resources, demand, inhabitants and impact of human infrastructures. It's also essential to ensure bodies of water are in a thoroughly good condition, to promote savings and efficiency, take advantage of alternative water resources in the public and private spheres, and implement technological advances in infrastructures to improve their management

Like any other city in the world, Barcelona interferes in the natural water cycle, both through its demand for drinking water and the disposal of its waste water. The concentration of the population and a large number of human activities within a limited area therefore generate a demand which would in many cases exceed the resources available. That's why policies are required to preserve drinking water and promote alternative water resources for uses such as the irrigation of green spaces, street and drainage cleaning, ornamental fountains, fire hydrants, etc. The city must specifically consider the following challenges and opportunities:

- **Barcelona, a Mediterranean city with high temperatures and irregular, seasonal rainfall**. Periods of drought and torrential rain have historically been one of the most serious problems the city has to handle. Climate change, rising temperatures and the seasonal variation in rainfall may worsen this problem even further.
- **Barcelona, a city between two Mediterranean rivers**. Barcelona lies between the river Besòs and the river Llobregat. Both of these have all the typical features of Mediterranean rivers: fluctuations in flow over the year with minimum levels reached in summer and much lower overall flows than most European rivers. The authorities have made great efforts over the last few years to compensate the deterioration suffered by both the Llobregat delta, currently turned into a very valuable nature reserve, and the mouth of the Besòs, which is now a park called the Parc Fluvial del Besòs.
- **Barcelona, a somewhat seasonal tourist city**. 2013 was another year in which Barcelona reached a record for tourism, with over 7.5 million visitors, 1.8% more than in 2012. The city's weather, its cultural appeal, its ability to hold large trade fairs and congresses and low prices have all enabled Barcelona to compete with major European cities in attracting international visitors. Under such conditions, the peaks of floating population brought by tourism could increase the city's impact on the surrounding environment and, more specifically, on everything to do with the water cycle.
- **Barcelona, a city becoming aware of water efficiency and savings**. In the last decade Catalonia experienced several droughts, some of which were extremely serious such as the ones in 2007 and 2008. These experiences have enabled us to learn and inform citizens, who considerably reduced their household consumption at the time, and also public administrations, with medium and long-term policies guaranteeing the universal availability of this resource.

9.2 General context and current situation

Barcelona City Council makes a great effort to protect and improve the Environment and Urban Habitat and believes that water is an essential factor in any decision for the city. That's why the Council has set up the *Barcelona Cicle de l'Aigua, SA (BCASA)* a company to manage the city's entire water cycle, carry out activities and provide services directly or indirectly involving the water cycle, beaches, coastline and environment. The company was approved at the Council's Plenary Session of 28 October 2013, reports to the Assistant Management of the Environment and Urban Services, part of the Urban Habitat Management Division, and carries out its functions under the leadership, supervision and control of the Directorate for Water Cycle Services (DSCA).

Responsibility for managing water in the city of Barcelona is divided among different organisations. In general terms, the autonomous community administration is responsible for supplying water at high pressure while its distribution to users is the responsibility of a group of municipalities or concession.

The City Council can take part in the better management of water on a general basis or, in the case of droughts, by reducing superfluous municipal consumption and carrying out awareness-raising campaigns. With the Catalan government it also acts as the health authority to control mains water quality, through the Barcelona Public Health Agency (ASPB).

The strategic focuses of Barcelona Cicle de l'Aigua, SA (BCASA) are to further rational policies for water consumption, promote the use of alternative water resources and advance policies to improve urban drainage and the comprehensive management of the coastline and city fountains.

The Council also manages groundwater, as well as working to reduce leakages from the distribution network, in which it has the cooperation of the water distribution company responsible for the system's maintenance.

Barcelona City Council shares responsibility for the low pressure water supply, for supervision and inspection and for actions when there is a risk of drought.

	Catalan government	Metropolitan Area	Barcelona City Council
Water planning	●		
High pressure supply	●		
Low pressure supply		●	⊛
Supervision and inspection	●	●	●
Approval of rates	●	●	
Action in drought risk situations	●	●	●

**Barcelona City Council delegates this responsibility to AMB.*

9.2.1 Water shortages require diverse resources

Water supply sources come mainly from the surface, although in the last few years there has been a significant increase in the presence of underground resources from the subsoil and in the near future regenerated water and desalinated seawater will be used.

The surface resources used come from the rivers Ter and Llobregat. The water from the Llobregat is regulated in La Baells, La Llosa del Cavall and Sant Ponç reservoirs and is made drinkable at the Sant Joan Despí and Abrera plants before being put into the network. The water in the Ter is obtained from the system of reservoirs in Sau-Susqueda-El Pasteral and is processed at the El Ter treatment plant. These two networks are interconnected to form the Ter-Llobregat System in order to guarantee the distribution and final quality of the water. The water is stored in two large tanks at La Trinitat and La Fontsanta. The supply of these resources is managed by different companies in the metropolitan area.

As regards underground resources –used for non-drinking water– these are drawn from the aquifers of the Llobregat and Besòs deltas and from the Barcelona Plain. The gradual closing of the wells once used by industry has made the groundwater level gradually rise, returning to its natural equilibrium at certain points. This has led to problems in basements, underground car parks and public services such as the underground train network. This large volume of water has become a source of water resources for municipal uses. At present the usage of groundwater resources is over 1.3 million m^3 a year while technical and economic criteria mean that its usage ceiling is 4.02 hm^3/any.

As regards the potential for reusing the water from treatment plants, the Waste Water Treatment Plant (EDAR) in El Prat de Llobregat is currently being prepared to regenerate a flow of 3.25 m^3/s. The uses envisaged are: as a barrier against the intrusion of salt water, environmental use in the river, farming irrigation, maintenance of wetlands and industrial use.

El Llobregat desalination plant is ready to guarantee and meet drinking water demands where necessary. It can handle up to 60 hm^3/year of desalinated sea water, with a maximum volume capacity of 200,000 m^3/day.

9.2.2 Water consumption goes down year after year

The consumption of mains drinking water in Barcelona in 2013 was 94.67 million m^3, 19.79 million m^3 less than in 1999.

Households made up 67.37% of the consumption (63.78 million m^3 a year), shopping and industry 27.27% (25.82 million m^3) and municipal services 5.34% (5.07 million m^3).

The water from the River Llobregat is not only of great environmental importance but also economically vital, since this is one of the main sources of water to supply the Barcelona Metropolitan Area.

The reduction in the consumption of mains drinking water since 1999 was 12.55% for homes and 21.85% for shops and industry.

The domestic consumption of drinking water per inhabitant followed the same trend as overall consumption. Consumption per inhabitant and day was 108.42 litres in 2013; 24.48 litres less than in 1999.

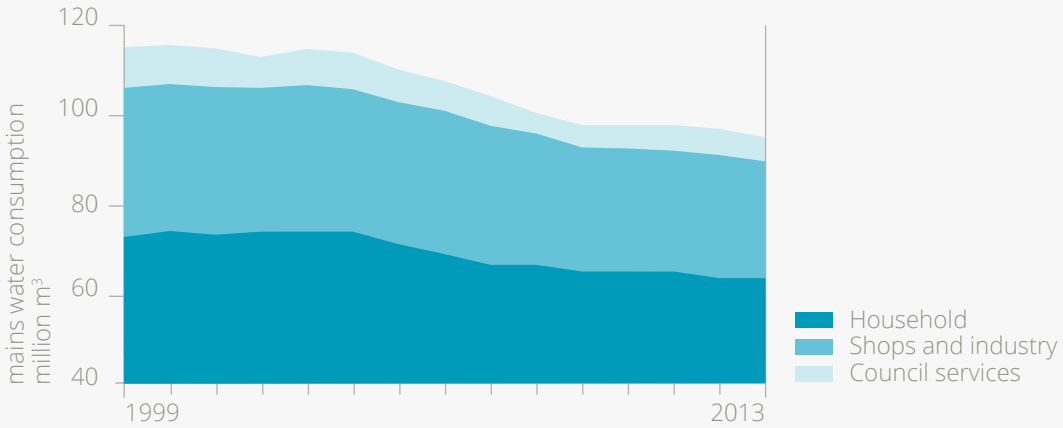
Mains drinking water consumption by municipal services was 5.07 million m³, 3.42 million m³ less than in 1999, a reduction of almost 40.28%. From 2007 to 2008 the reduction was over 35%, the drought situation undoubtedly having an influence on this. This is the sector that underwent the greatest reduction, due both to improved efficiency in water use and to the use of alternative water resources, mainly groundwater.

The total consumption of municipal services in 2013 (drinking water plus groundwater) was 6.33 million m³, 2.46 million m³ less than in 1999; a reduction of 28.00%.

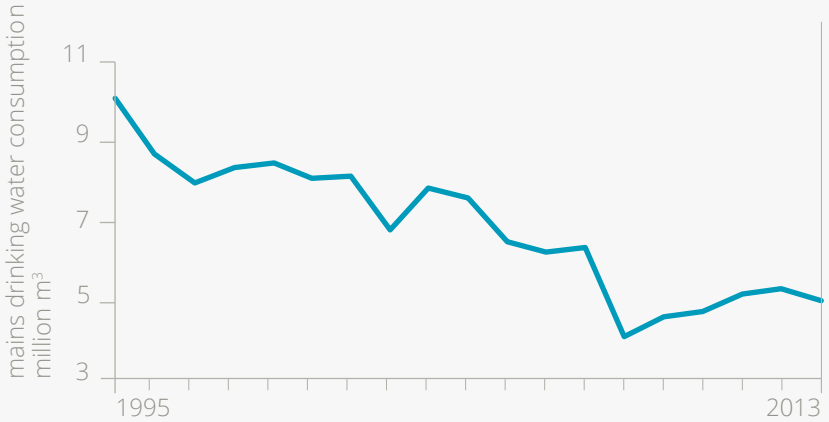
The consumption of groundwater has multiplied by 4.17 since 1999 (from 301,730 to 1,263,150 m³) exceeding a million m³ a year.

As regards the sustainability index, namely the proportion of water consumed from groundwater compared with total water consumption (groundwater + drinking water), in Barcelona this went from 3.43% in 1999 to 19.95% in 2013, which means that the consumption of groundwater has risen, saving mains water.

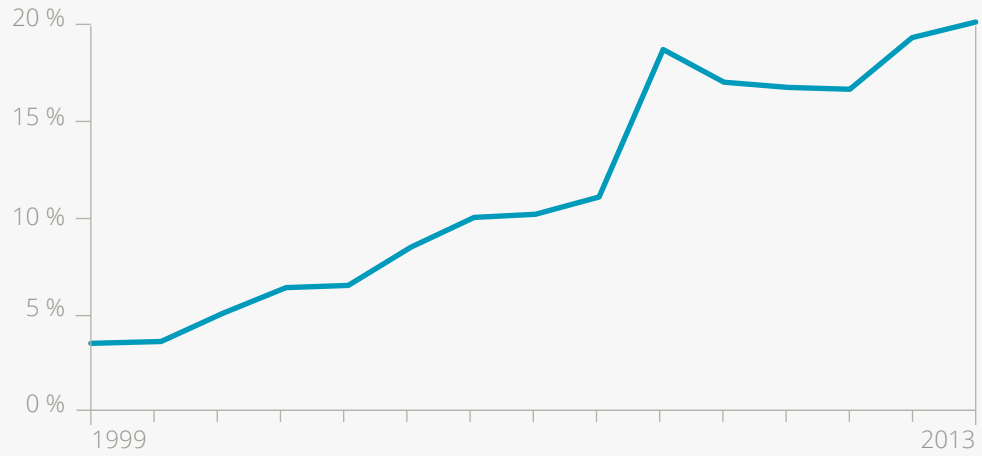
The consumption of mains water dropped in all sectors with households consuming the most.



The consumption of mains drinking water by municipal services has tended to decrease through the use of groundwater from the subsoil and through improved efficiency.



The sustainability index [100 x groundwater consumption / total water consumption (groundwater+mains water)] of the municipal services has considerably improved.



9.2.3 The sewer system and its historical planning

Barcelona has had sewer systems ⊕ since its very early days and these have evolved at the same pace as the city itself. The earliest systems date back to Roman times but the present system is the result of different plans developed over the last century, right up to the present day:

→ **1891. Project for Draining the Subsoil (García Faria)**. Even though this project was not fully applied, it marks a watershed in the history of Barcelona's sewers and thus in the quality of its inhabitants' lives.

→ **1954. General Sewer System Plan (Fernando Josa, Luis Jara)**. This plan revealed the most significant shortcomings of Barcelona's subsoil.

→ **1969. Drainage Plan (Albert Vilalta)**. This set out to solve the problems of impermeability arising as a result of the major urban growth. The Besòs and Bogatell treatment plants were built (the latter now demolished).

→ **1988. Barcelona Special Sewer Plan (Pre-Olympic PECB '88)**. Computer methods were used for the first time, simulating how the network would work under different intensities of rainfall. This formed the basis for the major Pre-Olympic sewer works.

→ **1997. Barcelona Special Sewer Plan (PECLAB '97)**. This plan introduced the concept of regulators to avoid large collectors, as well as real-time control of the network. The hydrological-hydraulic modelling of the network started to be generally applied, involving a large number of works to extend and modify the network.

→ **2006. Barcelona Integrated Sewer Plan (PICBA '06)**. This involved further development of the computer simulation of an increasingly extensive network which was measured in great detail, increasing the protection against flooding and DSU (discharges from the unitary system). This plan was adapted to European directives [Framework Water Directive (2000/60/EC) and Bathing Water Directive (2006/7/EC)].

Barcelona's sewer system is 1,693 km long and serves all the city's homes as well as its commercial and industrial establishments.

Today Barcelona has a unitary sewer network, which means it carries waste water and rainwater through the same channels. The network covers 1,833 kilometres, 1,000 of which can be visited. Roughly 145 hm^3 of water pass through this network each year and it serves 1,611,822 inhabitants of the city (2013) and shopping and industrial establishments located in more than 81,500 properties located within the 98 km^2 of the municipal area.

9.2.4 Barcelona treats 100% of its waste water

The Besòs treatment plant is located under the Fòrum square in Barcelona. This is considered to be the largest covered treatment plant in the world integrated within the urban structure and has a highly sophisticated system to chemically cleanse odours. It has a treatment capacity of 525,000 m^3/day and treats 65% of the city's waste water. It has a biological treatment system as well as sludge treatment by dehydration.

The Prat de Llobregat treatment plant, located on the Llobregat delta and running since 2006, has a treatment capacity of 315,000 m^3/day and treats 35% of the waste water. It has a biological treatment system to eliminate nutrients and tertiary treatment with ultra-filtration and osmosis to regenerate water. It treats sludge via anaerobic digestion combined with cogeneration, dehydration and drying.

Both treatment plants generate energy by heating the resulting sludge through a cogeneration plant. At present, the Llobregat plant generates roughly 40% of the power required to operate the plant itself.

There is also a small treatment plant in the Vallvidrera channel, to the north-east of the city of Barcelona, with a treatment capacity of 1,100 m^3/day which serves the housing estates in the area. It biologically treats waste water and treats sewer sludge by thickening and dehydration.

The sludge resulting from treatment at the plants can be used in agriculture, for composting, as fuel at cement factories, etc. In 2013 a total amount of 56,536 tonnes of dry material was generated in the Barcelona Metropolitan Area.

9.2.5 Maximum quality beaches in spite of their intensive use

Barcelona's beaches, extending over 4.78 kilometres, are visited all year round thanks to the city's characteristically good weather although the most intensive use is in spring and summer, by both residents and tourists, nearly 3,755,000 of them from May to September in 2013. During this period the Council has to equip and supply the beaches with services so that they can be used as sunbathing and swimming areas complying with all possible guarantees in terms of safety, lifesavers, healthcare and environmental guarantees.

Barcelona Integrated Coastal Zone Management Plan places particular emphasis on environmental aspects. Environmental control includes meteorology, the quality of the sand, of the water and the management of waste and noise. The information is given to visitors by several different means, including environmental information staff, information panels on the beaches and real-time monitoring the state of the beaches on the Internet ⊕ and with the iBeach app for smartphones.

The monitoring and maintenance of these quality standards for the management of Barcelona's coastline has ISO 14001 certification, an environmental policy with a commitment to continued improvement, to prevent pollution and ensure compliance with current environmental legislation.

In recent years Barcelona's beaches have become one of our city's main public spaces, with special features that make them particularly appealing.

9.3 Measures taken to reduce water consumption

Over the last few years the Council has drawn up several technical plans to improve the management of water in the city related to the sewers, to the use of alternative resources and the integrated management of the coastline. A large number of water-saving and efficiency measures have been promoted as part of these plans, resulting from a commitment to sustainability, with particularly significant work being carried out related to municipal facilities and services.

9.3.1 Efficient use of resources and the distribution network

Technical Plan to Take Advantage of Barcelona's Alternative Resources (2013)

This identifies the existing water resources, analyses what uses and needs can be met in accordance with their chemical and biological characteristics, estimates the potential demand and determines which infrastructures are required to take advantage of such resources.

The plan highlights the importance of potentially exploitable existing resources, both as regards groundwater (which it sets at a maximum exploitation limit of around 11 hm^3/ year), the water regenerated at the El Prat de Llobregat treatment plant (reaching a maximum of 2.6 hm^3/ year) or the water drained off from underground infrastructures (3 hm^3/year), the total volume standing at 16.6 hm^3/year.

Minimising losses in distribution

Some of the measures for minimising losses in the distribution of drinking water and improving its control, to succeed in reaching the present theoretical technical limit, are splitting the distribution network into sectors, its renewal and repair, the installation of high-precision electronic meters in order to detect any leaks, informing users of these and correcting them more quickly, etc.

9.3.2 The City Council saves water in municipal uses

Efficiency in managing urban green

Over the last few years, even though the total area of green spaces in Barcelona has increased, the consumption of drinking water has dropped thanks to the control of leaks, the use of groundwater, automation of watering and use of plants that need less water. 12% of all green spaces and all recently planted street trees are watered with groundwater, and 10 green spaces have been designed with sustainable drainage techniques (TEDUS).

Of particular note is the smart water project for the remote management of irrigation, which started in 2013 and is planned to cover 79 hectares, 27% of the city's total area. Remote management of irrigation means the volume of water consumed can be cut down by around 25% compared with the current consumption, by adapting the irrigation to the type of plant and the theoretical needs of each green space, by quantifying the amount of useful rain, monitoring the real water reaching plants and detecting leaks in the network more promptly.

The Council uses groundwater for cleaning and the sewer network

The municipal street and drainage cleaning services have reduced the consumption of mains water over the last few years by increasingly taking advantage of groundwater. At present the manual hosing down carried out by the sweeping services and cleaning of rubbish and paper bins uses this water (by means of tanker trucks).

Reducing consumption in municipal buildings

The Council has implemented different initiatives to gradually reduce consumption at its buildings, such as the replacement of inefficient systems with water-saving mechanisms, the installation of dry urinals at work centres, carrying out campaigns to give tips and spread good practices among municipal workers, etc. Specific savings measures have been applied at some amenities, as is the case of some city markets that use mechanical cleaning instead of manual techniques, the control of leaks and of demand at specific consumption points, etc.

Saving water at schools

Schools are encouraged to implement measures for savings and the efficient use of water as part of the More Sustainable Schools scheme. Schools are also provided with didactic material related to water saving and efficiency.

Alternative water resources for ornamental ponds and fountains

The Font Màgica, Gran Llac and the Gran Casada de la Ciutadella, the Llac de l'Espanya Industrial, the Llac de Diagonal Mar and other water features make use of underground water and do not consume any drinking water. Ornamental fountains are also fitted with recirculation systems and have physical-chemical or biological treatment systems to ensure the water has the required hygienic-sanitary conditions.

Saving water at public drinking fountains

In Barcelona there are 1,645 public drinking fountains providing water for passers-by, which represents just over one drinking fountain for each 1000 habitants. All of these are fitted with time-controlled taps and flow regulation devices.

9.3.3 Drinking water quality: a priority for the city

Quality control of drinking water

The household supply of water for human consumption in the city of Barcelona forms part of the overall water supply of all metropolitan municipalities. Since 2003 Barcelona's Public Health Agency (ASPB) has taken over the authority for public health previously held by the Catalan government and the Council and is the sole public health authority in Barcelona. The system for supervision and control carried out by the Agency includes the following activities:

- Supervision of the Barcelona Metropolitan Area and the operator, Aigües de Barcelona, in terms of supply management.
- Supervision of disinfection. The ASPB analyses and monitors the levels of disinfectant in public fountains.
- Supervision of the health standards of water supplied. ASPB carries out regular campaigns to take samples and analyse them.
- Health inspections on installations of water for human consumption in the city (tanks and distribution network).
- Control at the consumer's tap. ASPB is responsible for carrying out routine inspections and sampling at establishments and homes as well as in response to citizens' requests.
- Control of the health standards of the city's natural fountains regularly used by people.

The results from controls at the consumer's tap are published annually in the annual health report published on the ASPB website. The results from the other activities are published in a specific report on the health standards and quality of water for human consumption in Barcelona, also available on the ASPB website.

9.3.4 Awareness-raising campaigns

Raising citizens' awareness to encourage water savings

The Council has carried out different actions with the aim of making citizens more aware of how to save water. Some of these measures are:

→ Website on the water cycle, with educational materials as well as eco-advice, many of these on water.

→ World Water Day, which the Council takes part in through different measures.

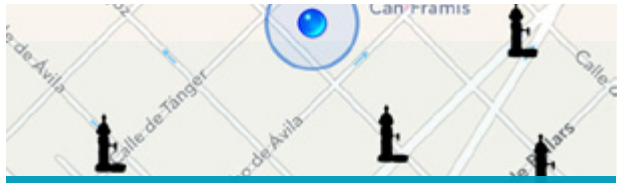
→ Informative material such as 'L'Espai de Mar', 'L'aigua i la ciutat' and exhibitions.

Enhancing the value of Barcelona's fountains

A large number of ornamental fountains can be found in Barcelona (301) for both historical and traditional reasons and also due to the aim to provide the public with a free, high quality service. The Council has undertaken different schemes concerning water in order to promote their value:

→ Fonts BCN ⊕. A free mobile application to help locate the city's 1,600 drinking water fountains. This is intended for citizens in general but above all has been designed for people carrying out sports as well as tourists who wish to obtain information about their special or historical features, encouraging people to drink water at the fountains to save and reduce the production of waste.

→ Camins d'aigua ⊕. "Water routes" with itineraries and guided routes to discover the wide range of public and ornamental fountains and water features and their cultural, social, historic and natural value.



The app "Fonts BCN" places city fountains' and also provides information.

9.3.5 Underground tanks and remote control for better drainage management

Flood management with the network of underground tanks to retain rainwater

In the last 20 years the city has set up protection in the form of 13 tanks preventing torrential rain from flooding the city, so that the water is gradually sent to the treatment plant after a rainy spell. The tanks have a storage capacity of 454,180m^3, 65,225m^3 of which came into service in 2013 with the rainwater retention tank of Les Rieres d'Horta.

Advanced management of the urban drainage and sewer system

The Remote Control System of Barcelona's sewer system is made up of the remote supervision of the network sensors and remote control of the different mechanisms. Remote supervision means that all the data on the sewer system can be gathered, stored and supplied in real time: the intensity of rainfall, level and flow of water in the collectors, amount of water, position of sluice gates, operation of pumping stations, state of the tanks, operational capacity of treatment plants, etc. The remote control system provides a centralised system that activates mechanisms installed in the network (sluice gates, valves, pumps).

9.3.6 Increasing the permeability of urban space

Sustainable urban drainage techniques (TEDUS)

Implemented in newly developed zones, the TEDUS scheme has been promoted to improve drainage problems associated with the decreased permeability of urban space *(See Chapter 2. Resilience and adaptation to climate change ⊕).*

Improving permeable paving

Of particular note is the use of permeable paving and the creation of water reservoirs or semi-natural wetlands and drainage areas which help water to enter the aquifers more effectively, increase surface evaporation and relative humidity, decrease the degree of urban soil compaction and improve its structure, resulting in savings in irrigation water and optimising the management of resources.

9.4 Future goals and measures

Cities play a vital role in the natural water cycle. Managing water sources by ensuring overall responsible action on the whole water cycle is essential and involves all the bodies of water to be found, including the supply of available water sources, the urban drainage and sewer network, public fountains and ornamental ponds and beaches.

9.4.1 New models to improve management

New model of sewer management

This new model prioritises the management of cleaning work as a result of inspections carried out on the network. It will enable more efficient resource allocation for cleaning and maintenance of the sewer network, carrying out maintenance work more efficiently as well as providing in-depth knowledge on the network to improve planning and repair work. Sensors are fitted in the installations which will provide data in real time. Another alternative implemented by Barcelona City Council and BCASA is participation in an international project for the use of robots for inspection work, monitoring and taking samples from sewers.

New model of management for public and ornamental fountains

This new model of management for public and ornamental fountains will help us to improve the environmental quality of these features, affecting the environmental health of the urban environment. Naturalised fountains will be managed in such a way as to increase biodiversity and indigenous flora and fauna in our city, reducing the use of chemicals and increasing the sustainability of ponds, adding beauty, coolness and health to the urban habitat.

9.4.2 Taking advantage of alternative water resources

Implementation and development of the Technical Plan for Alternative Water Resources

There is a significant amount of existing resources that can potentially be used, both from groundwater resources (from 2 to 3 hm^3/year in Barcelona Plain, from 5 to 8 hm^3/year in Besòs alluvial area, plus 1 hm^3/year of the 3.8 potentially usable extracted from the underground railway system) as well as regenerated water from Prat del Llobregat treatment plant.

Barcelona has over 300 ornamental fountains, ponds and drinking fountains in avenues, streets and parks.

The Plan makes it clear that current municipal demands can be met with alternative resources quantified at a maximum of 4.02 hm^3/year (2.85 at present plus 1.17 stemming from the city's urban development). The non-municipal demand for alternative resources to drinking water could reach 2.49 hm^3/year and the combined total would therefore be 6.51 hm^3/year.

9.4.3 Managing the coastline: a priority for the city

Barcelona Integrated Coastal Zone Management Programme ⊕

As well as determining the needs for facilities and services and appraising the management of beaches, the annually-reviewed Barcelona Integrated Coastal Zone Management Programme places particular emphasis on monitoring environmental indicators. The main aims of the programme are as follows:

- Prioritising the protection of bathers' health with the obligation to take management measures to reduce hazards associated with contamination.
- Producing a profile for each bathing zone where all the potential sources of contamination are identified, as well as their severity.
- Increasing and improving user information so that people can decide where and when to bathe, by means of signs at bathing zones and information on the internet.
- Providing emergency plans for exceptional circumstance.

The quality of beaches is monitored by implementing certified systems for managing beaches, analysing the water and sand, checking noise pollution and the blue flag system, among others.

Municipal greening and the green economy

Barcelona City Council, an environmental benchmark for the city

Municipal greening and the green economy

Vision of the future

Leading the change towards a more sustainable model by its own example

Current situation

Tourism and mobility

'Biosphere World Class Destination' Certification

Greening of the fleet of vehicles used in the cleaning and waste collection contract

Procurement

100 % of municipal contracts contain compulsory environmental criteria

100 % of municipal nursery schools provide organically farmed food

Environmental products and services

70 % of the paper consumed is **recycled**

78 % of the wood consumed has some **sustainable management certification**

CERTIFIED

Lines of work

Greening of contracts and procurement 'New Government Measure' 'New Mayor's Office Ordinance'

Efficient management of resources and facilities 'Energy monitoring and savings in municipal buildings'

Sectoral planning 'The Prevention, Security and Mobility Management's Strategic Sustainability Plan'

Networking and exchanging practices 'Smart-spp' 'Procura plus'

Training and awareness-raising of workers 'Do things at the Council as you would at home' campaign

10.1 Vision, challenges and opportunities

Vision of the future

Barcelona City Council aims to lead the way towards a more sustainable model by its own example, acting consistently with the message that it conveys to city people.

There's a firm municipal commitment to sustainability and local and global self-sufficiency in order to reduce the environmental and social impact caused by the municipal organisation. To achieve this aim the City Council seeks to foster a sustainable economy and production, using the Administration's potential as a responsible consumer, and to extend the Council's environmental and social consistency.

For some time Barcelona City Council has assumed the firm commitment to foster social action and respect for the environment in its work and management. One priority field of action is the greening of its own organisation.

- **Barcelona City Council is a compartmentalised and delocalised organisation**, with about 12,000 workers and a council structure with a large number of departments and divisions to manage the city, which makes its coordination a complex matter. What's more, the location of these employees in over a thousand buildings and/or facilities makes communication between them more difficult and relations more distant.
- **Barcelona City Council is advancing towards a new organisational culture which provides greater across-the-board management.** The coordination and extension of its sustainability strategy to the entire organisation is one of the greatest challenges of the + Sustainable Council programme.
- **Barcelona has an increasingly aware population.** Barcelona's population in general, and the municipal workers more specifically, are increasingly mindful of environmental aspects. The City Council has made an effort with internal communication (also addressing city people in general) and its awareness-raising message which has enabled better results in environmental management in the different fields of action.
- **Barcelona City Council has a big enough scale** to make its actions, apart from being an example for the other sectors of the population, also have a real effect on the greening of the city in such domains as the quality of air, noise or mobility, among others.
- **Barcelona City Council has a wide range of its own communication and information media** (captive transport fleets, information channels in buildings and the underground, etc.) which make it easier to put across messages and consequently boost the exemplifying nature of internal measures.

10.2 General context and current situation

In the process of transition towards sustainability, Barcelona City Council has the main responsibility to further policies and schemes incorporating social and environmental criteria. This is a key strategy for reducing the impact of public activity and for giving incentives for sustainable production using the administration's potential as a responsible consumer and also through its exemplifying role.

The European Union fosters and regulates a type of public procurement known as "socially responsible procurement". Public expense on products and services makes up 19% of Europe's GDP, which reflects the enormous potential of the public administration in restructuring supply chains and fostering a change in the markets. With the Publication of Directive 2004/18/EC of the European Parliament and the Council[1], of 31 March 2004, on the coordination of the procedures for awarding public works, supply and service contracts, the European Union is going to update the norms regulating public contracts based on the principles in force on the internal market while bringing in innovations in an endeavour to simplify, harmonise and modernise this area. The use of environmental and sustainability criteria is authorised through this update.

In 1995, the Council agreed to sign the Aalborg Charter, a first step towards creating the Local Agenda 21 plan. After an intense participatory procedure, Barcelona drew up its Agenda 21 in the Citizens' Commitment to Sustainability ⊕ , a document with widespread consensus which defined the objectives and fields of action for the 2002-2012 period. In late 2012 the content of the Commitment was updated with the participation of the signatories for the 2012-2022 period *(See Chapter 11. Joint responsibility ⊕).* The City Council, as a signatory of the Commitment, has undertaken the + Sustainable Council programme (*A+S* Programme), based on the positive experience of the Green Office programme.

The A+S Programme ⊕ is led by *Hàbitat Urbà* and works across sectors with the other municipal areas, districts and institutions. It sets out to improve the environmental and social sustainability of everyday operations of municipal services and facilities. Its strategic objectives were defined in 2010 in the A+S (More Sustainable Council) Convention, an internal participatory process lasting one year which involved over 300 council staff. The social and environmental objectives, specified in 30 fields of action, act as guides for the internal greening programme in the medium and long term (2020). The programme envisages everything from procurement of products and services to works for urban development, building or refurbishing buildings and the greening of events.

The change towards a more sustainable Council is bolstered by the following internal rules that have already been passed: the Government Measure on the greening of municipal services (2001), the Government Measure on the greening of municipal contracts (2006) to ensure the overall incorporation of environmental criteria in contracts and two Government Measures on responsible procurement (2008 and 2013) to include environmental and social aspects and detail their incorporation in public contracts, and the Government Measure for energy savings and efficiency for municipal installations, which led to the approval of the Energy Self-Sufficiency of Municipal Buildings plan (PAEEM) (2009). In 2013 the Mayor's Office Ordinance for responsible procurement with social and environmental criteria was also approved.

The participation of the A+S (More Sustainable Council) Programme in regional and international projects and networks represents an opportunity to swap best experiences: Network of Cities and Peoples towards Sustainability ⊕, Procura + Campaign ⊕, SMART SPP ⊕,

1. In March 2014 the Official Journal of the European Union intends to publish a new directive ⊕ on public procurement that the member States will have to incorporate. The directive will require public contracts to comply with the obligations applicable in environmental, social or employment fields established by EU Law and in the ILO Agreements on trade union freedom, forced labour, minimum age for child workers, discrimination and pay, among other agreements.

Sustainable Timber Action ⊕ , Projecte LandMark ⊕ , Electronics Watch ⊕ , Clean Clothes Campaign ⊕ , Eurocities ⊕ , amongst others. The city also works in close cooperation with other key city agents such as universities, manufacturers' associations, suppliers, NGOs etc.

10.2.1 Barcelona City Council, a benchmark in responsible public procurement

Recognition received. In recognition of its role in this sphere, the Council has received the following distinctions: prize for the best example of good practice in green public procurement in the Seminar for Green Public Procurement in Avilés (2006); case chosen as good practice by the European EPSA Awards 2011; Diamante prize for procurement awarded by the Spanish Association of Professionals in Purchasing, Contracting and Supplies (2012) in the Sustainability Category and a second prize in the Public Sector category.

EPSA is a prize open to all levels of European public administration with the aim of publicising experiences, making these transparent, accessible and useable.

10.2.2 Coordination with the main Catalan public administrations

Work group for integrating responsible public procurement. In 2012 a working group was created made up of representatives of Barcelona City Council, the Diputació de Barcelona regional administration and the Catalan government, in order to integrate socially responsible public procurement as a feature across the board in the Catalan administration's purchasing and contracts, through the demand for social criteria made on suppliers in their contract conditions, and also to raise their awareness on respect for social rights (mainly employment) in their production chain.

10.2.3 Furthering the greening of public contracts

Furthering green contracts. 100% of municipal contracts incorporate compulsory environmental criteria, such as the contractor's obligation to ensure the proper environmental management of the service or including risks on the environment as serious infringements. 37% include at least one optional environmental criterion, for example the possibility of requiring technical capability in the environmental field or giving marks for environmental improvements. In 2010 environmentally focused contracts represented 43 million euros in economic terms, equivalent to 96% of municipal expense and to 71% of the schedules of conditions for these groups of products.

10.2.4 The City Council consumes environmentally friendly products and services

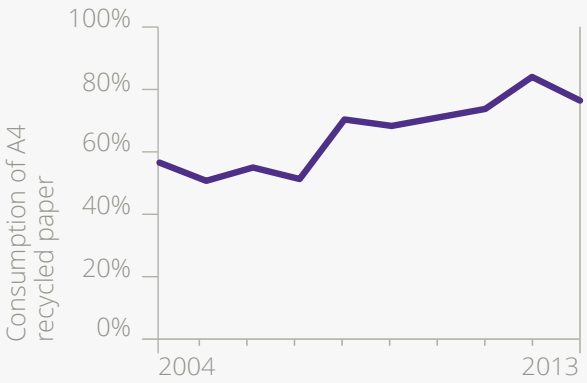
Fostering green public procurement. In line with the products and services identified by the European Commission as priorities for implementing green public procurement (COM/2008/400), the main contracts for paper, cleaning services, computer equipment, transport, furniture, electricity, food, textiles and gardening now include environmental clauses.

For years now the Council has been giving priority to purchasing environmentally friendly products and services.

→ **Wood.** In the 2004-2012 period, 78% of the 8,437.73 m3 of wood purchased, for which information is available, has some kind of certification of sustainable management or documents accrediting that this is in the certification process and a fifth of the wood has origin certificates.

→ **Cleaning products and waste collection.** The contract for cleaning municipal buildings includes the use of less toxic products, selective collection and reduction of the waste generated.

Consumption of recycled paper represents over 75% of total paper consumption.



→ **Food.** The catering services at municipal nursery schools incorporate food produced by organic farming.

→ **Paper.** Actions are carried out in two areas: minimising the total consumption of paper (this has been reduced by 35% as compared with 2009) and for any waste paper to be recycled.

→ **Electronic equipment.** The equipment purchased by the Council complies with energy efficiency criteria and is Energy Star and/or TCO-certified, as well as meeting other environmental standards.

→ **Textile.** Including environmental and social criteria in the schedules of conditions for clothing represents a benchmark. The working clothes of the staff for Parks and Gardens and BSM incorporate environmental criteria for their fabrics, minimising the use of toxic substances during the manufacture of the cloth and fostering the use of fibres from organic farming.

In the sphere of sustainability in public thoroughfares we should note the acquisition of bins adapted for the handicapped and the greening of the fleet by incorporating hybrid and electric vehicles. As regards the greening of building work, noise and contaminating emissions have been reduced, amongst other aspects.

Implementation of environmental management systems. Four municipal organisations involving over 12,000 workers are currently certified in accordance

Body	Fields of action with ISO 14001 certification
Hàbitat Urbà	Management and maintenance of public green zones and street trees in the city of Barcelona, urban cleaning, maintenance of paving and road and street structures, furnishings and signposts, maintenance of public lighting, control of ventilation in tunnels, maintenance of escalators and lifts, maintenance and control of the urban drainage system, purity of bathing water on the coast, maintenance of public, artistic and illuminated fountains, making use of groundwater, noise control work, environmental promotion activities, administrative work proper to the area, maintenance of the building where its headquarters are located.
Transports Metropolitans de Barcelona (TMB)	Management of buses in public thoroughfares.
Clavegueram de Barcelona (CLABSA)	Management of the sewer system by means of an integrated system of environmental quality.
Barcelona de Serveis Municipals (BSM)	Olympic Ring Divisions (Palau Sant Jordi and the Olympic Stadium) and Montjuïc-Fòrum (management work for Montjuïc Park and the Fòrum Park).

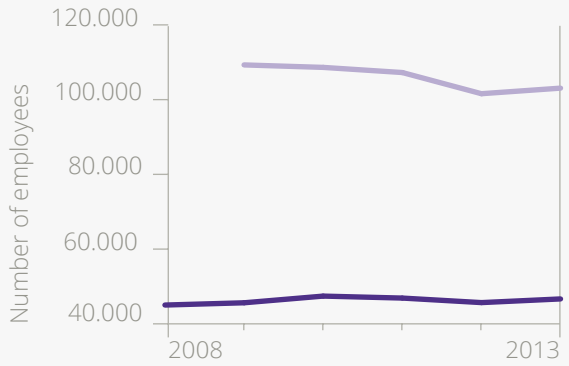
with ISO 14001 environmental management system.

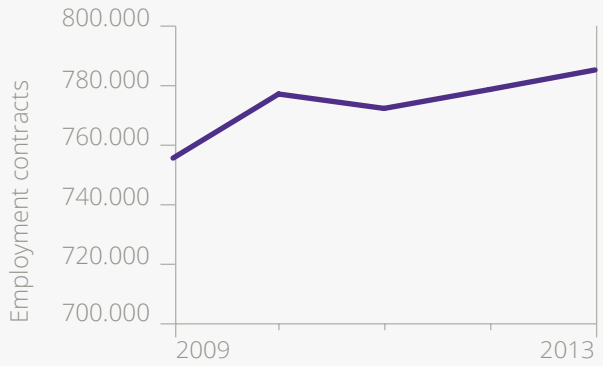
In 2013 the expenditure of Barcelona City Council in urban maintenance and environment was 445.2 M€, which represents 24.21% in respect of the budget for the year (current expenses).

10.2.5 Creation of jobs with high added value

Barcelona is a venue for high knowledge activity sectors. The business sectors connected with new information and knowledge technologies, the green economy, the social economy, biotechnology or sustainability, amongst others, are niches for job creation which show how far the city's development and innovation have gone. 22@Barcelona takes in part of these professional profiles.

The creation of jobs of work is one of the main priorities for Barcelona City Council, which opts for the social economy and technology as generators of well-being to achieve this.





Creative sectors, includes the following activities: clothing manufacture, the leather and footwear industry; graphic arts and printing; publishing; cinema, video and music; radio and television; software, videogames and electronic publication, architecture and engineering; research and development; advertising, design and photography, writers, performing arts, visual arts and crafts; and activities connected with public heritage.

Ground-breaking technology sectors, which includes the following activities: cinema, video and music; radio and television, telecommunications, information technology services; information services and research and development.

The creation of jobs of work with high added value has remained relatively stable in spite of the impact of the economic crisis on employment.

10.3 Measures carried out to environmentally enhance the Council

Selective collection is encouraged at the offices of Barcelona City Council through the installation of bins for separating waste into its different fractions.

The Council's commitment to greening has gradually consolidated over recent years, with successive internal rules promoting responsible procurement, as well as improvement actions promoted as part of the + Sustainable Council scheme.

10.3.1 Environmental criteria in the procurement of products and services

New Government Measure and new Mayor's Office Ordinance

In 2013 a new Government Measure on responsible procurement was passed, as well as the Mayor's Office Ordinance on responsible procurement with social and environmental criteria. The ordinance is applicable to public sector contracts signed by Barcelona City Council and the organisations reporting to this which have powers to award contracts.

Environmental improvement of the schedule of conditions for cleaning and waste collection from municipal premises

The new contract includes the use of less toxic products and the encouragement of use of cleaning products with eco-labels, improvement of internal selective collection (paper/cardboard, glass, light packaging and organic fractions, as well as toners and ink cartridges) the use of memory sticks, using one's own glasses or cups and choosing products with the least packaging.

The advancement of large-scale responsible procurement ensures consistency between the government's social and environmental policy and procurement and purchasing services and products.

Greening of offices

In accordance with the instruction given to services for use of recycled paper (2002) and the Mayor's Office Ordinance on responsible wood purchasing policy

(2004), the A+S (+Sustainable Council) Programme strives to have recycled paper used and to minimise total consumption of paper. This is done by means of measures such as the distribution of bins for reusing paper, establishing printing on both sides of paper as default setting, the use of new technologies or minimising paper consumption in the dissemination of information. As regards office material, the Council's endorsement includes items with positive environmental characteristics. Lastly, the council fosters the "Do things at the Council as you would at home" awareness-raising campaign, focussing on workers' active cooperation in the selective collection and saving of water, energy and other resources.

Introduction of more sustainable, supportive and healthy products at municipal premises and services

Since 2008, the municipal nursery school meals service has been fostering the incorporation of food from organic farming (seasonable fruit and vegetables, cereals, dairy products and juices). Some catering contracts are awarded to social integration companies with triple - environmental, social and ethical - added value. Work is also being done for the Council's automatic food and beverage machines to consider environmental criteria (such as organic farming or energy efficiency of these machines), social aspects (products from fair trade or integration companies) and health criteria (drinks with low sugar content, natural juices, cereals, wholemeal biscuits, fresh fruit or dried fruit and nuts). Food from organic farming and fair trade is also being introduced in contracts for assigning the use of different public amenities with a bar service, such as civic centres or bars on the beach.

The Catalan Network for Ethical Public Purchasing is made up of administrations wishing to fight against work exploitation in poorer countries through their consumption and purchases.

Responsible procurement of clothes

Environmental and ethical criteria are included in competitive tenders for supply of working clothing. The use of toxic substances during the manufacture of the fabric in the garments worn is minimised, fostering the use of fibres from organic agriculture. The City Council also takes part in national and international initiatives such as the Landmark Project, the Clean Clothing Campaign and the Catalan Network for Ethical Public Procurement.

Responsible purchasing of wood

The incorporation of sustainability criteria in the procurement of wood products for public space, works, furniture, etc. is also promoted to guarantee that wood from illegal sources is excluded and give priority to products accredited with the most demanding certifications.

Greening of building works

The Decree for the Greening of municipal building works has the aim of reducing the environmental and social impact of public works with a budget of 450,000 euros or more. Along with works designs, a compulsory environmental report also has to be submitted, in which the measures intended to reduce the environmental impact possibly caused by the work are detailed.

10.3.2 Efficient management of water and energy for municipal use

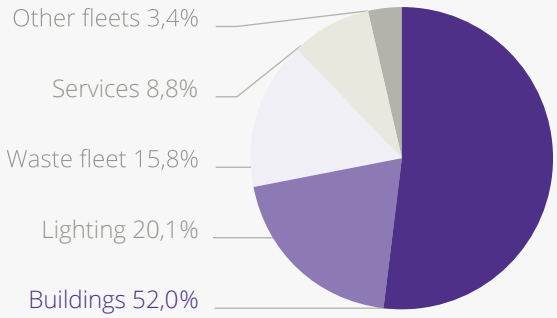
Measures for energy saving and efficiency

In keeping with the aims defined in Barcelona Energy Self-Sufficiency Plan, work is being carried out on rationalising the use of energy in new and existing facilities. Other objectives are to reduce the impact of municipal mobility and lower the proportion of primary fossil fuel energy with an extension of the current network of municipal photovoltaic and solar-thermal power stations, the heating and cooling network or the increased use of energy produced by renewable sources.

Barcelona's generation map currently has 44 photovoltaic installations, 167 solar-thermal plants, 1 biomass installation, 1 hybrid photovoltaic and mini-wind power

plant, 2 solar cooling units and different installations with a geothermal heat pump. The production of photovoltaic energy of municipal facilities as a whole is 2,203,978 kWh/year and thermal solar production is 9,573,560 kWh/year.

The consumption of the City Council's own buildings and facilities makes up nearly 52% of the total energy consumption associated with municipal services. The Plan for Energy Self-Sufficiency of Municipal Buildings (PAEEM) includes measures for improving energy efficiency and savings and carrying out work for energy improvement and renewable energy installations, with the aim of improving its energy self-sufficiency. To this end, Barcelona Energy Agency is implementing a project for monitoring energy consumption of 37 municipal buildings, for 46 services. With this measure and the information on production of photovoltaic installations located in municipal buildings, also being monitored, it will be possible to ensure ongoing evaluation of the energy self-sufficiency of these facilities.



52% of municipal energy is consumed by buildings.

Measures for saving and reusing water

In accordance with the Government Measure for promoting the rational use and saving of water (2007) measures are being promoted to increase the reuse of groundwater and treated waste water for watering parks and gardens, cleaning streets and drains or ornamental fountains, for improving the efficiency of the irrigation network in parks and gardens and for fostering water savings in municipal facilities and services.

Mains water consumption of municipal services has dropped from 8,158,331 m^3 in 2001 to 5,067,482 m^3 in 2013, through the increase in use of groundwater and improvements in management (the installation of economisation mechanisms in washbasins and taps, use of dry urinals, campaigns for disseminating advice, etc.).

Measures to environmental enhance the mobility generated

In keeping with the Urban Mobility Plan 2013-2018, the environmental improvement of mobility generated by municipal activity is advancing in two fields of action:

→ **Greening of the council's own fleet of vehicles and those of service contracts.** Bringing environmental criteria into the contract for city cleaning and waste collection has enabled reducing the environmental impact of the vehicles, since 35% of these run on biodiesel, 35% with natural gas and 30% are electric or hybrid. Apart from this we should also note TMB's commitment to natural gas and hybrid buses or that of BSM to electrical mobility. TMB has incorporated a 100% electric bus made by Chinese firm BYD and two units of the Irizar model i2e. Two units of the Solaris Urbino 18e articulated model are intended to be brought into service in 2015. Lastly, the Live ⊕ platform was created in Barcelona in 2012 to encourage electric vehicles and turn the city into a worldwide source of innovation in electric mobility.

→ **Fostering sustainable internal mobility**. The use of the bicycle for municipal staff is promoted through the "BICIA't" (Get Biking!) project.

10.3.3 Integration of sustainability in the city's events, parks and gardens

More sustainable acts and events

A large number of public acts and events are held every year, such as district festivals. The incorporation of environmental criteria enables more sustainable habits to be promoted. Some of the actions carried out are the prevention and selective collection of waste, the use of organic and fair trade products and the encouragement of sustainable mobility.

Management and sustainable maintenance of parks and gardens

The improvements in the management and maintenance of the city's parks and gardens include: application of good practice in sustainable gardening (selection of species or use of products of organic origin); increased efficiency and savings of water in irrigation, composting, etc.; introduction of criteria in purchasing clothing, urban mobility and vehicles; hiring services from employment integration companies or special work centres and incorporating environmental requirements in permits for the assignment of spaces for filming, festivals and other events.

One of the actions carried out by Barcelona City Council to ensure the events it organises are more sustainable is to hire sustainable catering services.

10.3.4 The Council seeks to become 'smart'

Innovation and smartoffice

The aim is to make the Council more efficient and productive through innovation, creativity and talent. The City Council is a pioneer in developing innovation at the service of technology and in building a city of people for people, what is known as the smart city (*See section 12.3.2 The commitment to a new model of governance*). Innovative solutions have been introduced in procurement through the following initiatives:

- Prior contact activities with the market to foster the introduction of innovative and energy-efficient technologies in municipal services, for example, participation in the international SMART-SPP project.
- Introduction of new tools for intelligent management of the city's resources, such as the smart irrigation system and the New Lighting Master Plan to illuminate the city more efficiently.
- To empower the use of the city as an urban laboratory in 22@.
- Introduction of new projects such as the OpenData and the eContracte to facilitate the consultation and use of public data and to make procedures more efficient.

10.3.5 Participation, joint responsibility and training for all agents involved

Communication and awareness-raising to foster more sustainable habits and conduct in daily work

The involvement of all the agents involved in the internal and external greening strategy is vital for the success of the A+S Programme. The main channels of communication and awareness-raising used are: regular electronic newsletter INFO A+S (1101 subscribers in 2013), website for the A+S programme ⊕ , email for consultancy ajuntamentsostenible@bcn.cat, distribution of material resources (eco-paper bins, brochures on reuse of paper, reusable cups, etc.) and dissemination of communication materials (posters, brochures, etc.).

The 'Do things at the Council as you would at home' campaign attempts to raise the staff's awareness so that they only use the materials required and thereby reduce their volume.

Training to accomplish the cultural change towards sustainability

Training sessions are given, as well as collaboration in the publishing of environmental education guides ⊕ (Sustainable selection of wood in urban items ⊕ , Guide to the Green Office ⊕, More Sustainable Congresses ⊕ , More Sustainable Hotels ⊕ o More Sustainable Festivals ⊕) and other publications and materials for awareness- raising with the aim of spreading examples of greening to other production sectors.

10.3.6 The Prevention, Security and Mobility Management's Strategic Sustainability Plan for the transition to the green economy

Strategic Sustainability Plan 2013-2022

The Management Unit, Security and Mobility (PSM) has drawn up the Strategic Sustainability Plan 2013-2022, the PES, in order to move towards sustainable development in the different areas of its work on a gradual, cross-sector and participative basis.

Its purpose is to foster the transition towards a green economy and a smart, environment-friendly city while respecting social rights. A good deal of its content consists of applying a responsible procurement policy at all levels of management.

Its content is being implemented via more than 100 measures grouped into action programmes and strategic tools (infrastructures, logistics, telecommunications, mobility, communication and training).

10.3.7 Biosphere certification accredits Barcelona as a sustainable tourist destination

"Biosphere World Class Destination" Certification ⊕

In 2011 Barcelona was given this certification by the Responsible Tourism Institute (ITR), a body associated with the UNESCO and the World Tourism Organisation (WTO) and a member of the Global Sustainable Tourism Council (GSTC), sponsored by the United Nations Foundation. Barcelona has therefore become the first city in the world to obtain the Biosphere certificate, a byword for responsible tourism management and a sustainable tourist destination in economic, socio-cultural and environmental terms. This certificate, along with the introduction of the Responsible Tourism System, marks the creation of a quality tourism model in Barcelona, furthering the balance between residents and visitors to guarantee the sustainability and continuity of this phenomenon's success in the future. The tourist tax levied for staying in the city will also be used to resolve environmental challenges.

10.4 Future goals and measures

The greening of the Council is a challenge in the medium and long term (2020), which is why work will continue to be carried out in different fields of action to accomplish this in coming years.

10.4.1 Barcelona will continue to forge ahead in the greening of its work

Review of the A+S Programme's strategic objectives to align this with the new Commitment

As part of the Citizens' Commitment to Sustainability 2012-2022, the Strategic Plan of the A+S (+ Sustainable Council) plan is being reviewed with the definition of new objectives:

- Extending and reinforcing green space and biodiversity in municipal areas and buildings.
- Promoting sustainable internal mobility.
- Improving the environmental quality and health of municipal workers.
- Furthering a smart, efficient organisation with zero emissions.
- Making a rational use of resources and promoting responsible procurement.
- Exercising good governance and social responsibility.
- Guaranteeing the well-being of workers and social cohesion.
- Fostering the green economy.
- Extending a new internal organisational culture of sustainability.
- Increasing the organisation's resilience and minimising its ecological footprint on the planet.

These objectives will be materialised in actions in the following strategic fields: communication, training and awareness-raising, support tools, observatory, working as a network, continuous improvement and consultancy, differentiation of three levels depending on the degree of involvement (leadership, cooperation and influence). The main strategic tools are responsible procurement (2014-2018) and the strategic sectoral plans (2015-2022).

Responsible Procurement Ordinance

With regard to this new regulation, which came into force on 15 December 2013, Barcelona City Council will, in coordination with the different areas in charge, define specific criteria for different groups of priority products and services such as food, electricity, vehicles, wood, clothes, etc. These criteria will be formalised by means of circulars, guides or instructions of compulsory compliance by all contracting bodies.

Definition of an action Plan to improve sustainability in Managing the Urban Habitat

The Strategic Plan entitled 'More Sustainable Urban Habitat 2014-2022' will include actions to guarantee sustainability in the internal management of Hàbitat Urbà's administration, in order to progress towards sustainable development in different areas on a gradual, cross-sector and participative basis. Its objectives are:

- To be a good model in the management of internal organisation, establish best practices and make environmental quality an element in change management.

→ To carry out actions at an internal level to accomplish the city's strategic objectives and foster an economy based on innovation, clean energies and the efficient use of natural resources.

→ To compile existing good practices, consolidate continuous improvement processes and generate a suitable framework for improvement of the environment and the staff's well-being.

The following measures are worthy of mention: eco-audits in buildings, demand management, monitoring, greening of procurement (Smart Tendering), prevention of waste at offices (Circular Procurement) and internal mobility, teleconferences and teleworking.

Implementation of the Environmental Quality Label for cultural facilities

Five culture facilities, The City's Historic Archive, the Frederic Marès Museum, the Arús Public Library, the Born Cultural Centre and the HUB Design Centre, are in the process of obtaining the environmental quality guarantee label in the category of cultural facilities. The objectives of this process are to promote eco-efficiency and environmental sustainability in the planning, projection and management of these services, to minimise environmental impact and to promote sustainable development, beyond the requisites stemming from compliance with current legislations. The environmental criteria for granting this label involve energy savings and efficiency, waste management, procurement, mobility, the efficient use of spaces, environmental qualifications, noise and vibration and environmental training.

The HUB Design Centre is currently in the process of obtaining an Environment Quality seal for the category of cultural facilities. Some of the environmental criteria applied are: sewerage (separate system to take advantage of rain water), heating (using heat from refrigeration plants, natural gas boilers, etc.), centralised management of the facilities, etc.

Joint responsibility

In Barcelona, everyone's involved in sustainability

Joint responsibility

Vision of the future

Becoming a fairer, more sustainable, more prosperous and more self-sufficient city through a shared project

Current situation

Reference framework

Citizen Commitment to Sustainability 2012-2022

298 organisations, businesses and institutions

332 educational centres from the *Escoles + Sostenibles* (More Sustainable Schools) programme

Actors

City Council
30 lines of action for internal greening (2020)

Organisations and Businesses
160 organisations and Businesses have made their sustainability actions public

Schools
Dubai International Award supported by the United Nations (2010)

Citizens
Services and resources through **6 facilities**

New tool

***Barcelona + Sostenible* (More Sustainable Barcelona) map**
A collaborative tool with interesting sustainability resources, experiences and information for citizens

Lines of work

Involving schools
'Let's make compost and learn' 'Come to the Parks'

Joint initiatives and networking "Let's Network!' 'Sector-based networking'

Monitoring and evaluation 'Definition of new sustainable development indicators in the city'

Citizen education and action 'La Fàbrica del Sol' (The Sun Factory) 'How Barcelona works'

Promoting participation
'Conventions for Commitment signatories' 'New Citizen Council for Sustainability'

11.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to become a fairer, more sustainable, more prosperous and more self-sufficient city through a project shared by different entities (organisations, businesses, educational centres and institutions) and citizens that want to contribute to the city's improvement.

The Citizen Commitment to Sustainability 2012-2020 is a reference framework with strategic value and an inspirational goodwill that strengthens joint responsibility among all those involved so that the ideas for achieving a new city may evolve collectively.

The Citizen Commitment to Sustainability 2012-2020 (which emerged from the global Agenda 21) shows the strong interest that citizen organisations in Barcelona have in assuming responsibilities and, through participation, contributing their opinion, their creativity and their strength to move together towards a shared vision of the future in 2022. Despite the progress achieved so far, with the global and economic crises new challenges and new types of awareness have emerged and must be tackled. The main challenges and opportunities we are faced with are:

- **The Citizen Commitment to Sustainability 2012-2022** is not only a framework for the city but also a space for reflection and debate on the city, strengthening democracy and joint responsibility.
- **There is continuous commitment to working in networks in order to progress collectively**. A network with more than 600 signatories, including the City Council of Barcelona, has strong creative potential and the transformative capacity to jointly lead the process of building the city's future.
- **The Commitment signatories not only take on its principles and goals** but also commit to undertaking concrete actions in their specific fields to contribute to reaching them.
- **The City Council of Barcelona has communication and information channels that help to establish a permanent and participative dialogue with the actors involved**. As well as providing information, these channels facilitate collaborative development, consultation, deliberation and participation in planning, as well as the monitoring and evaluation of the actions promoted.
- **The City Council is just another member of the network** but it also acts as facilitator through a support team that boosts the activity of the different signatory sectors and of the network in general.
- **The main challenge is to involve and empower all of the citizens and organisations** so that they may be truly jointly responsible for the shared goals.

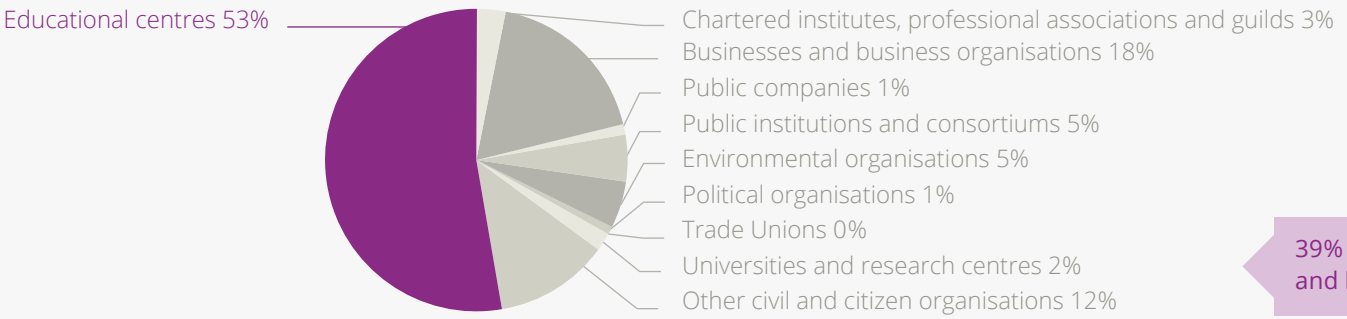
11.2 General context and current situation

One of the best examples of Barcelona's contribution to sustainability is the Citizen Commitment to Sustainability, which was renewed in 2012. It is a commitment that emerged from an extensive participative process that serves as an inspirational and educational point of reference.

11.2.1 From Agenda 21 to the Citizen Commitment to Sustainability 2012-2022

In 1995, the City Council of Barcelona signed the Aalborg Charter, the Charter of European Cities and Towns towards Sustainability. After four years of participative work diagnosing, making proposals and building consensus around the main goals, in 2002 the Citizen Commitment for Sustainability 2002-2012 – Agenda 21 was approved in Barcelona, to advance towards a more sustainable city. Different actors in the city were invited to sign the Commitment, including organisations, businesses, institutions and educational centres. The signatories take on joint responsibility in the creation of a more sustainable Barcelona and they commit to working actively and to making the concrete actions of their contribution public. Each signatory organisation laid out the concrete measures it would undertake voluntarily to contribute to the collective goals and put them into practice. Since its creation, the Commitment has shared its fruits through a range of environmental and social actions in areas as diverse as energy, education, water management, social welfare, or public health.

After 10 years in force and with a network of 800 signatories, a participative process was carried out during 2012 with the organisations that form the network in order to renew the Commitment, tackling pending issues and gauging the new challenges for the city. At the end of 2012, the citizen network and the City Council signed the new Citizen Commitment to Sustainability



39% of the signatory organisations are businesses and business organisations.

2012-2022 ⊕ for a fairer, more prosperous and more self-sufficient Barcelona.

On 31 December 2013, the Citizen Commitment for Sustainability 2012-2022 was renewed by 298 organisations, businesses and institutions, which together with the 332 educational centres from the Escoles + Sostenibles programme make a total of 619 network members.

In 1998 the Municipal Environment and Sustainability Council was created to promote Agenda 21 in Barcelona.

It is an advisory council formed by 101 members, all Commitment signatories and 13 experts from different fields. In the Barcelona + Sostenible Secretariat work is carried out in support of the Council Secretary. During 2013 different activities were undertaken, especially aimed at tackling the reform of the Council at that time

The renewed Commitment incorporates new types of awareness and updates the contents in accordance with Rio+20.

AGENDA 21
LOCAL ACTION PLANS,
strategic planning for sustainable development

AALBORG CHARTER,
principles of action

6.000 city councils in 113 countries have adopted A21

10 AALBORG COMMITMENTS tool to help with the application of the principles

Renew political commitment
Assess progress (ICLEI)
New challenges

?

1972
The Limits to Growth (MIT) is published

UN meeting on environmental and development issues, Stockholm

1974
United Nations' environmental programme

1987
'Sustainable development' concept (Brundtland Report)

1992
Earth Summit

1994
Aalborg (Denmark) 1st European conference of sustainable cities and towns

1995 - Signing of the Aalborg Charter

1998 - Municipal Environment and Sustainability Council

2002
RÍO + 10

2002 - signing of the CCS 2002 - 2012

2004
4th ICLEI network conference

2009
3 key UN challenges and approaches

2010 - 2nd convention

2012
RÍO + 20

2012 - signing of the new CCS 2012 - 2020

1980 1990 2000 2010

to adapt it to the challenges of the new Commitment. Among the activities we can highlight the interviews carried out with a significant sample of organisations from the different sectors of the Council and the creation of specific working groups.

11.2.2 *Barcelona + Sostenible*, the city's action plan

The Local Agenda 21 in Barcelona is implemented through the *Barcelona + Sostenible* programme

In order to advance towards the Commitment's goals, the network is organised into different programmes:

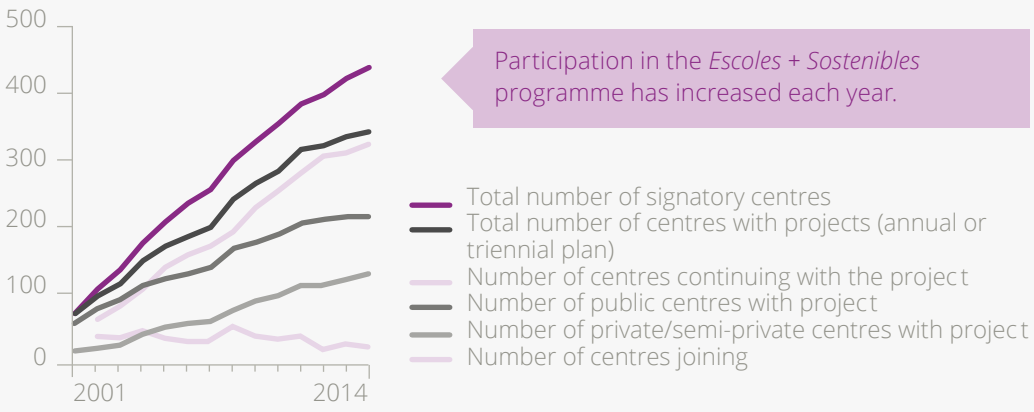
→ **Escoles + Sostenibles** ⊕ (until now known as Agenda 21 Escolar – Agenda 21 for Schools): a programme created to facilitate the involvement of educational centres in the project to imagine and to build a better and more sustainable city, starting with intervention in their most immediate surroundings. In recent years the programme has grown continuously and currently boasts the participation of 332 centres.

In 2010 Barcelona's Agenda 21 Escolar Programme was granted the Dubai International Award supported by the United Nation's HABITAT Programme that recognises good practices in improving living conditions. The award's purpose is to promote progress towards the sustainable development of human settlements on the basis of mutual international cooperation.

→ **Entitats i Empreses + Sostenibles (More Sustainable Organisations and Businesses)** ⊕ (up until now known as Acció 21 – Action 21): a programme aimed at organisations and businesses that, on signing the Commitment, assume their joint responsibility in the creation of a more sustainable Barcelona and commit to contributing to this goal, each from within their own field.

→ **Ajuntament + Sostenible (More Sustainable City Council)** ⊕ : internal municipal action programme *(See chapter 10. Municipal greening and the green economy ⊕)*

→ **Ciutadania + Sostenible (More Sustainable Citizens)**: offering services and resources and fostering activities targeting individuals and groups to



Participation in the *Escoles + Sostenibles* programme has increased each year.

In 2012, the Commitment 2002-2012 had a total of 826 signatories.

In 2013, the signatories of the new Commitment added up to a total of 712.

La Fàbrica del Sol is a space that is open to anyone – organisations, students, businesses, etc. – that wants to learn about resources and good practices to be applied when facing the challenges of sustainability

make the Commitment reach non-organised citizens. Barcelona has different facilities for this purpose:

- **La Fàbrica del Sol (The Sun Factory)** ⊕. Sustainability education and action facility for citizens. It forms part of buildings that are a benchmark in rehabilitation and sustainable management with the integration of environmental measures and solutions.

- **The Beach Centre** ⊕. Benchmark facility in environmental education and information on Barcelona's beaches.

- **Sea Space** ⊕. A facility for everyone that favours knowledge and enjoyment of Barcelona's coast and promotes the improvement of people's health through sport and physical activity. In the second quarter of 2013, the facility's management was handed over to the Barcelona Sports Institute.

- **Environmental leisure area in the Ciutadella Park** ⊕. Families with infants aged 0-3 years can enjoy this open-air space where educational facilities and instructors allow for the development of social relations and environmental activities through games involved in and involving nature.

- **The Laberint Training Centre** ⊕. Municipal facility specialised in training and outreach in gardening and landscaping, which offers training to those interested in gardening, professionals and technicians and families. The Laberint Centre Library has a rich collection of documentary material on gardening, horticulture, landscaping and other related subjects.

- **Environmental Education Documentation Service** ⊕. Documentation services and resources open to all citizens and specialised in environmental education issues. The facility is affiliated with the *Barcelona + Sostenible* Technical Secretariat.

- **Renova Programme**. This is an initiative to promote awareness on consumption and the prevention of waste, with collaboration between organisations, associations and facilities in the city and with the support of the City Council.

11.3 Measures taken to improve citizen action

Citizen joint responsibility has been and is one of the key concepts in the process of development, consensus building and deployment of the Barcelona + Sostenible programme. In 2002, when the Citizen Commitment to Sustainability was approved, it was proclaimed that 'sustainability means joint responsibility'. This means the participation and joint responsibility of all citizens, as well as the public authorities.

11.3.1 Commitment and work to foster joint responsibility among citizens

Renewal of the Citizen Commitment to Sustainability 2012-2022

With the goal of incorporating new types of awareness and updating the contents with pending issues and challenges emerging in accordance with the spirit of Rio+20, the Commitment was updated in 2012.

The 800 organisations, professional associations, guilds, trade unions, universities, educational centres and businesses that have signed were called on to participate in its renewal. With 100 lines of action, the new Commitment pursues the following 10 objectives:

- Biodiversity: from urban green spaces to the re-naturalisation of the city.
- Public space and mobility: from the street for getting around to the street for living.
- Environmental quality and health: from standards to excellence.
- An efficient, productive and zero-emissions city: from technological Barcelona to smart Barcelona.
- Rational use of resources: from the consumer society to responsible consumption.
- Good governance and social responsibility: from sector-based intervention to effective coordination.
- People's wellbeing: from the welcoming city to the cohesive city.
- Progress and development: from a concern for sustainability to an economy that fosters sustainability.
- Education and citizen action: from awareness-raising to informed joint responsibility.
- Adaptability and responsibility towards the planet: from isolated responses to comprehensive action.

New image and discourse

The Agenda 21 brand has been updated; it is now called Barcelona + Sostenible. The new 'Barcelona + Sostenible' collectively owned seal can be adapted individually, on the one hand for the different groups (schools, organisations, City Council, map group, etc.) and, on the other hand, for the signatory types (member or promoter).

BARCELONA
+SOSTENIBLE

Agenda 21 has been transformed into Barcelona + Sustainable and launched a new and more attractive image.

Boosting the signatories' network

The *Barcelona + Sostenible* Technical Secretariat is the authority promoted by the City Council of Barcelona to serve the signatories' network, offering advice and resources to all of the signatory organisations and to those who wish to join. The Secretariat launches different types of training and informative activities and experience exchanges for signatories and manages the different resources on offer. The activities ⊕ traditionally carried out in businesses and organisations include information days adapted to the signatories' needs, working sessions to present innovative actions by the signatory organisations, visits to get to know the signatories' actions and facilities, conferences on international strategies for a sustainable world, support workshops for developing action plans and other activities in different formats to present tools and resources.

Promoting joint initiatives and networking

The *Barcelona + Sostenible* programme facilitates collaborative initiatives between Commitment signatories. Some examples include the Make the Most of Food Platform ⊕ formed by people and organisations linked to the prevention of food waste, the Renova programme, the Participative Energy Plan (PEP) ⊕ which emerged from the second convention for Commitment signatories, or the group in charge of the *Barcelona + Sostenible* Map. The proposals resulting from these participative processes include actions to be undertaken by the City Council and others to be undertaken through networking and collaboration between organisations and all those interested.

11.3.2 Schools, agents of transformation in the city

Half the signatories are educational centres (early-learning, primary, secondary, adult and special education)

They have a specific programme and a specialised support team, aimed at making the Commitment a reality in school communities and promoting education for sustainability.

Schools are of great importance for civic life, not only because of their function in terms of students' education, but also in their role as examples for other groups in the community like families, non-teaching staff and neighbours. Through the Escoles + Sostenibles programme, students and teachers can analyse the conflicts in their closest surroundings, consider alternative perspectives, contribute to solving the problems identified and transform this process of analysis and action into an educational resource. The key is to involve the school community in projects for real change in their environment. This creates opportunities for the formation of action criteria and already constitutes a successful experience since the process itself is the main lesson.

The educational centres' activity as agents of sustainability forms part of the citizen movement and is not independent from it. Each centre carries out its action, which forms part of the Escoles + Sostenibles programme, which forms part of the Barcelona + Sostenible citizen network. Everyone shares goals and achievements.

The educational centres develop projects to improve sustainability education in schools and their surroundings and they work with other actors in the city. There are many examples of collaboration and networking, some of which constitute sub-programmes and concrete campaigns:

- Come to the Parks ⊕. The schools study and adopt a green space, with the basic idea that to make responsible use of a space you must understand it, live it, enjoy it and, if possible, undertake actions to improve it.
- More Sustainable Packaging/Healthier Breakfasts ⊕. This involves action to reduce breakfast packaging on the basis of a packaging prevention plan in educational centres and the analysis of breakfast types to move towards healthier food habits.
- Let's make compost and learn ⊕. In collaboration with the Barcelona Metropolitan Area's home composting programme, material and services for school composting are made available to educational centres with the goal of introducing the concept of DIY composting into daily life in schools and in families.

→ Let's look after the planet ⊕. An international project inviting young people aged between 13 and 16 to reflect and to act to try to improve the planet, seeking their commitment and responsibility in a process of discussion and exchange involving young people from all around the world.

→ Eating it all up ⊕. Participant schools dedicate one week a month, from January to May, to analysing and studying the degree of waste of a particular food item: bread, yogurt, meat, fish and potato. The objectives are: to be aware of food waste in school canteens and to learn about the ecological footprint of certain foods that are used daily in school meals. Work is carried out through networking with the food companies.

→ Renew your clothing ⊕. This is an initiative to boost the selective collection of clothes and footwear and their reuse, promoted by municipal organisations, associations and facilities in the city and with the support of the City Council.

As part of the 'Renew your clothing' programme, activities (workshops, talks, displays, shows...) related to responsible consumption, creativity and reuse of clothes are organised.

11.3.3 Promoting sustainability action and education among citizens

Environmental education programmes and activities

The City Council of Barcelona offers different environmental education activities and programmes aimed at strengthening sustainability culture and contributing to the acquisition of new values, attitudes and behaviour on the part of the citizens, through reflection and action.

Programmes

→ Urban allotments ⊕. Programme targeting people over 65 years of age in the city, with the goal of incorporating them into environmental improvement activities by growing different vegetables following the principles of organic agriculture (13 allotments, 343 plots).

→ Bioblitz Barcelona ⊕. Citizen science activity celebrated in Barcelona since 2010 through open conferences on scientific research. Schools, kids and adults interested in nature participate and are accompanied by scientific experts in the observation and knowledge of urban biodiversity, promoting knowledge of biodiversity, its values and the need to preserve them.

→ How Barcelona works ⊕. An educational programme that offers resources to schools because through knowledge of the city's environmental management facilities we can generate habits and values that may lead towards a more sustainable Barcelona.

→ Ecology classroom. Promoted by the City Council of Barcelona together with the UAB (Autonomous University of Barcelona) and CREAF (Centre for Ecological Research and Forestry Applications), a conference series was carried out which provided a space for reflection and debate to contribute to sustainability culture and energy self-sufficiency in the city. Each conference was presented by a professional expert in a subject linked to sustainable practices.

Other activities

→ Music in the parks ⊕. Programme of summer concerts that began in 1997 and that brings quality music to all types of audiences and promotes the presence of young performers, at the same time as it aims to boost the possibilities and benefits of parks as urban green spaces for shared living and leisure.

→ International new roses competition ⊕. An international competition created in 2001 to promote knowledge of the Barcelona rose garden. Aimed at breeders and cultivators of new rose species, it also includes rose-related activities for all the public.

→ Turn your house into a garden ⊕. Thematic workshops on basic gardening techniques to bring domestic gardening and knowledge of parks closer to citizens. It is promoted by the City Council in collaboration with the Catalan Confederation of Ornamental Horticulture (CHOC).

→ Renew your clothing ⊕. An initiative to boost the selective collection of clothes and footwear for their reuse, promoted by municipal organisations, associations and facilities in the city and with the support of the City Council.

11.3.4 A participative process that keeps on going

Second and third conventions for Commitment signatories

The goals of the second convention (2010-2011) were to collectively evaluate Agenda 21, give visibility to the work carried out by the network of signatories, detect emerging needs and new trends and plan the work for the following year. As a result of the convention, working groups were created in different thematic fields on key priority issues that were tackled in working sessions and virtual forums to form action proposals to be developed during the following two years. Some examples of the resulting projects include the Participative Energy Plan for Sant Martí de Provençals and La Verneda i La Pau ⊕, the map of Barcelona's urban allotments ⊕ and participative seminars.

On 18 October 2012, more than 200 organisations attended the third signatories' convention to reach an agreement on the contents of the new Commitment. There were 14 intense and highly productive working sessions for debate and consensus and two sessions where secondary students also made proposals.

Sector-based networking for tailored responses

In order to begin sector-based work within the network of organisations and businesses, three training and experience exchange sessions were held during 2013 on sustainability as a strategic factor for businesses, associations and the tourism sector.

Barcelona + Sostenible collaboration initiatives with the City Council and other organisations

With regard to sector-based networking, there are some particularly noteworthy collaborative projects and lines of work between different departments of the City Council of Barcelona and other organisations:

→ Corporate Social Responsibility (CSR) Project in the hotel sector promoted by the City Council in collaboration with the Responsible Tourism Observatory of Sant Ignasi's Tourism Board, the Tourism and Event Management Office, the Hotels Trade Association and Barcelona Activa (local development agency).

→ The Barcelona social economy network ⊕ to boost

Different departments in the City Council of Barcelona collaborate with various organisations to boost sustainability in the city.

social entrepreneurship and innovation, favouring social and labour-market insertion for people at risk of exclusion and for the most vulnerable groups, as well as making businesses' good CSR practices visible. The network is coordinated by Barcelona Activa and is also promoted by the Municipal Institute for People with Disabilities and the Quality of Life, Equality and Sports Department.

→ Jussana Tower – Services Centre for Associations ⊕. A municipal facility managed jointly by the City Council and the Barcelona Council of Associations (CAB). It offers services and resources to the city's associations and works to promote, bolster and strengthen them with the aim of broadening their impact among citizens.

→ The City Council of Barcelona's Trade and Consumption Office ⊕. An office that promotes quality and sustainable trade in Barcelona to generate wealth in the city and to facilitate social integration. Among the initiatives it carries out we can highlight the Barcelona, best store in the world ⊕ award that recognises the collective effort of people from the business sector that contribute to making Barcelona a modern and dynamic city with a wide, competitive and quality offer. In the 16th year of the award two new strategies were included in the areas of sustainable trade and locally-based cultural trade.

→ Municipal Institute of Markets in Barcelona ⊕. An independent organisation for the direct management and administration of municipal markets, under the authority of the City Council of Barcelona. The IMMB's action is focused on three areas: improve infrastructure and services, update what is on offer and incorporate trade promotion policies. It also carries out programmes on healthy eating or the programme entitled 'For a balanced diet I shop at the market!', which invites primary and secondary students to visit markets and to discover their form of trade.

→ Barcelona Sustainable Tourism ⊕. Barcelona's tourism board has promoted sustainable tourism in the city by creating the programme Barcelona Sustainable Tourism in 2012, open to participation from businesses that work towards environmental, cultural, social and economic sustainability. The programme facilitates access to establishments and services that allow people to enjoy the city in a sustainable way.

World Environment Day, a collaborative project ⊕

Organising and promoting the activities of World Environment Day is more and more a joint effort between the City Council and different organisations and institutions in the city that promote more environmentally responsible behaviour.

Initiatives and resources shared among signatories

There are some initiatives and resources that signatories provide for other signatories and that promote active participation. Some examples include the Green BIZ Barcelona ⊕ workshops from the EMAS Club Social Balance ⊕ designed by the Solidarity Economy Network, as well as talks and events. The network strengthens these initiatives and promotes them among the signatories.

The City Council of Barcelona organises different activities to promote networking between people and organisations signing the Commitment.

11.4 Future goals and measures

Thanks to Barcelona's willingness to become a more sustainable and self-sufficient city where all actors are involved and with the Citizen Commitment to Sustainability 2012-2022 as a framework, the City Council will continue to work to bring different institutions and organisations together through various programmes, to monitor progress with the use of indicators and to foster environmental education and citizen participation.

Barcelona Council promotes environmental education as a tool to encourage changes in attitude.

11.4.1 The city wants to make its trade more sustainable

New *Barcelona + Sostenible* programme for trade

Currently, a programme aimed specifically at businesses is being developed.

Many businesses in Barcelona have been working in favour of sustainability for some time, with initiatives in different areas: sale of local or "0 km" products, ecological or low-impact products, waste prevention, excellence in water and energy management, consumer information, employment of people at risk of social exclusion, commitment to the community, etc. It is worth highlighting the markets model in Barcelona, which is recognised internationally. For their part, the business associations and guilds act as opinion leaders among their associates, especially in the area of waste management.

The general Entitats i Empreses + Sostenibles programme does not adapt enough to the needs and possibilities of traders for whom availability to participate in activities targeting larger organisations is unlikely; they need practical resources and promotion of their action via specific channels.

With the alignment of the Barcelona Trade Promotion and Support Plan and the Citizen Commitment to Sustainability, the motivation of organisations in the trade sector and the great potential for improvement, in 2014 a process will begin to define a programme for trade sustainability. It is expected to be launched in 2015.

11.4.2 Barcelona continues to support environmental education

Barcelona city's new environmental education programme

Currently, Barcelona city's new environmental education programme is in its development phase, with all the agents involved working together. The new programme aims to promote joint responsibility and motivation among citizens to live with sustainable values. For each of the programme's strategies described below there are specific actions defined:

→ Raise awareness of good environmental practices and management services carried out by the City Council

→ Strengthen the offer of environmental education services and activities

→ Advance towards joint programmes with other organisations

New joint initiatives

The Park(ing) Day ⊕, promoted in 2014 by the Environmental Space Association, will invite people to transform public parking lots into parks, gardens and other forms of public space to defend a more sustainable city model. Another initiative planned is the celebration of the 1st Catalan Meeting on Urban Agriculture, promoted by the Tarpuna cooperative.

New networking initiatives

With the aim of strengthening and consolidating collaborative work, different networks will be promoted to evolve towards a real large-scale network of offers and demands, exchanges, collaborations and joint projects. One example is the working session Let's Network⊕ which will include different spaces to favour contact and collaboration between participants. Another example is participation in the framework of the Barcelona super-block programme, which will enjoy the involvement of neighbours, representatives of organisations and facilities in the area, City Council experts, as well as members of the network of Commitment signatories.

11.4.3 Improved indicators for monitoring sustainable development

Definition of new monitoring and control indicators

The indictors applied in the last 10 years have been an instrument of knowledge on progress in the city from the point of view of sustainable development, since they have allowed for comprehensive information gathering on the different areas of activity as well as the analysis of their evolution.

The changes experienced in recent years in the local and global socio-economic and environmental context, which are reflected in the development of the new Commitment, show the need to develop a set of indicators better adjusted to the new goals and lines of action that are being considered. While we want to maintain some of the indicators used up until now, we also want to incorporate new ones to help analyse the evolution of other variables and parameters that were not considered in previous years.

The new proposal for indicators will emerge from dialogue between experts in the different fields analysed, as well as the active participation of representatives from institutions, organisations and groups in the city that signed the Commitment, through different working sessions. Once the process is completed and the indicators are agreed upon, the next step will be their approval at the municipal level. The process began at the end of 2012, when a specific working group was created to work on the proposal of new sustainability indicators for the city and to rethink the format of the report being developed.

11.4.4 Participation continues to form the basis of the Barcelona + Sostenible programme

Creation of the new Citizen Council for Sustainability

The Citizen Council for Sustainability will represent the Municipal Environment and Sustainability Council, created in 1998 to promote Agenda 21 in Barcelona. Most of the members of the council will be Commitment signatories, chosen by organisations in their sector (associations and civic organisations, businesses, educational centres, universities, professional associations, trade unions and public administrations).

The functions of the new Council include contributing to the spread of sustainability culture in Barcelona through the new Commitment, promoting studies and releasing

The Citizen Council for Sustainability is a sector-based advisory and participative body in the city, which represents the different groups and sectors involved in the achievement of the Citizen Commitment to Sustainability's goals and it also promotes new strategies for the involvement, joint responsibility and participation of citizen organisations.

reports on municipal actions in matters of sustainability, boosting participative processes between organisations in the network of Commitment signatories, giving account of their activity in the network and choosing priority action proposals for the future. As well as the plenary sessions, the Council will have a Permanent Commission of an executive nature, working groups open to all signatories and a technical support office.

The participation of citizens, associations, business organisations, education centres, public administrations, etc. is essential to promote sustainability.

11.4.5 More environmental and sustainability information in the city

Map of sustainable Barcelona

Barcelona will launch a Barcelona + Sostenible Map, a collaborative tool that will gather initiatives, resources, experiences and information on sustainability that are of interest to citizens *(See chapter 12. Smart City ⊕)*. In the map you will be able to find the location of environmental facilities and amenities, routes and havens for flora and fauna in the city, ecological stores, accommodation, infrastructure and, in general, all the green economy initiatives that are contributing to the improvement of the urban environment, to the creation of a fairer and more inclusive social structure and to the enrichment of communities and neighbourhoods.

As well as providing practical information on points of interest and routes, it will allow citizens to contribute additional information like stories, photographs and activities. The map will be the city's contribution to the international initiative Open Green Maps ⊕ , in which more than 850 cities from 65 countries around the world participate.

Smart city

Barcelona, a smart city designed for its citizens

Smart city

Vision of the future

Using the best solutions to improve the quality of life of Barcelona's citizens

Current situation

Internacional ranking

- **1st** Smart city in Spain
- **4th** Smart city in Europe
- **10th** Smart city in the world

The state of ICTs

- **28,500** **workers** employed in ICTs
- **90 %** **fibre optic** coberage
- **78 %** of **homes** with **internet** access

Some of the milestones reached

- **Mobility:** **262** **electric charge** points
- **Energy:** **62** **self-powered** public buildings
- **Waste:** **240** **pneumatic** waste collection points
- **Water:** **40 %** of parks with **remote irrigation** management

Lines of work

Collaborative work for digital fabrication
'Fab Lab'

Governance and transparency
'Barcelona GO'
'e-Administration'
'OpendataBCN'

Mobile solutions
'BCN in your pocket'

Sensors platform
'Sentilo'

Transformation of the city
'Self-sufficient blocks'
'Electric vehicles'

12.1 Vision, challenges and opportunities

Vision of the future

A city that uses the best solutions to provide a better quality of life for its citizens.

To achieve this it uses the most efficient resource-saving systems, optimises services management and applies innovative solutions that facilitate economic progress, making the most of its citizens' talent and knowledge. In this new city model, technology plays a key role in the comprehensive and holistic management of services (mobility, energy, green spaces, water, etc.) and in providing responses to citizens' needs.

Advancing towards the smart concept can significantly improve the habitability of the city in three key areas: enhancing the citizen's and the visitor's experience, improving the city's operating and management procedures and introducing new ways of living in and understanding the city.

- **Barcelona has a tradition of using technology and design**. Throughout history, Barcelona has taken advantage of the most innovative solutions of the hour to be a modern city adapted to the times (in the construction of sewers, street lighting, etc.). Its transformation into a smart city is a new opportunity to show its adaptability and modernity, combining technology and design to make the city more sustainable.
- **The ICT sector is well-established**. Catalonia generates 20% of national turnover in the ICT sector and practically 70% of Spain's ICT companies are located in the province of Barcelona. The ICT sector has more than 10,000 companies, generates a turnover of €17 million and directly employs more than 73,000 people. Barcelona has an extensive fibre optic network, as well as a network of sensors that provide continuous information on the state of the city: noise, air pollution, traffic, etc.
- **A city of contrasts, between modernity and tradition**. Barcelona is a city of contrasts where the innovative and the modern live side-by-side with the strength of its history, which is made evident in its traditions and culture, giving it a unique and distinctive identity. Barcelona's diversity and plurality make it an open and lively city, full of opportunities, always experimenting and growing. It is the first time that citizens are ahead of the public administration in the adoption of new tools and solutions.
- **The crisis is seen as an opportunity**. The effects of the global crisis and of climate change have revealed the need to reformulate society's operation. Structures that are now shown to be out-dated are being reconsidered and new mechanisms that are more in line with the economic, social and environmental present are being taken up.
- **The smart concept is viewed in a holistic way**. While most cities work on the smart concept through projects in different fields, focusing on a single area of the city (obtaining information, mobility, energy...), Barcelona has a holistic view, working in a cross-cutting way in all sectors and taking into account each and every one of the city's and the citizens' needs.

12.2 General context and current situation

The City Council of Barcelona decided to integrate the different areas of Hàbitat Urbà (Urban Planning, Housing, Environment, Infrastructure and Information Technologies) into a single functional unit. This has translated into the materialisation of cross-cutting projects capable of combining excellence in urban design with the integration of environmental technologies, as well as producing a positive social impact that can improve people's lives.

Thus, the idea is that each time infrastructure or large-scale projects are developed in the city, resources are made the most of, technologies are incorporated to allow for more efficient and sustainable management (sensors for detecting noise, levels of pollution, fibre optic coverage, Barcelona Wi-Fi, etc.) and respect is shown towards the surroundings.

Barcelona must also be capable of producing resources locally in order to become more self-sufficient, resilient and sustainable. This way it is possible to progress from a centralised industrial model to a new informational, distributed model in which citizens evolve from the worker-consumer to the entrepreneur-producer. And in which citizen collaboration is essential to the new city concept, not only as individuals, but also as companies or entrepreneurs.

For this reason, the City Council of Barcelona strengthens public-private collaboration with the aim of attracting new companies, talent and investment in order to be able to create employment for, above all, young people and to make the most of the city's entrepreneurial spirit and its citizens' creativity.

Thus, Barcelona is transforming itself in order to become a smart city. It has already managed to place itself among the top 10 in international rankings ⊕. Currently, it is considered to be the 1st smart city in Spain, the 4th in Europe and the 10th in the world.

12.2.1 Advancing towards new technologies

In order to advance towards the smart city concept, technology must be deployed throughout the urban network. The city's Wi-Fi coverage has increased in recent years. Currently, there are 721 Wi-Fi access points for citizens in the city. The installation of fibre optic cable is also evolving favourably and has increased its span

Barcelona Wi-Fi is a service offered by the City Council of Barcelona that allows internet connection via different Wi-Fi access points (721 points) located in different municipal facilities and public areas.

in the last 5 years. Barcelona has more than 500 km of municipal fibre optic cable, a fact which means FTTH coverage for 90% of the city. The New Municipal Network, which is formed by the different fibre optic networks in the city, means economic savings and, thanks to its scope, allows for the development of different projects in quite different areas, growing progressively and sustainably without leaving aside any element in the city and improving the quality of life of its inhabitants.

In December 2013, Barcelona had around 100 physical data sensors that could be grouped into 40 different measurement components or facilities. These sensors were installed in the Urban Lab in the 22@ zone and in the Born district in rubbish bins, parking spaces, sound sensors, flow of people... However, the plan for 2014 is to considerably increase the number of sensors, aiming to exceed 2500 with their installation in municipal buildings and urban parks, among other places.

12.2.2 A smart city for smart citizens

Barcelona, on the road to becoming a smart city to improve the quality of life of its citizens, must establish links between systems, infrastructure and technology, which provide us with information, and people, who are the engine and the soul of the city. This is a basic element for the success of Barcelona's consolidation as a smart city. Technology, on its own, would give rise to a digital city, but not a smart city.

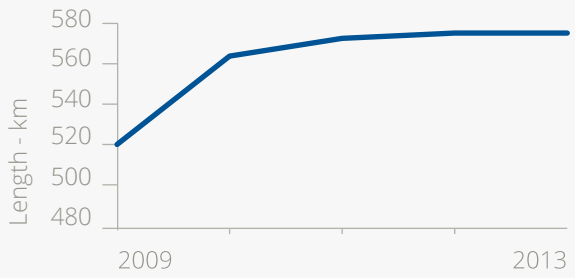
In this respect, Barcelona counts on the cooperation of its citizens who, in general, welcome innovations provided by new technologies, new systems and new applications into their day-to-day lives.

With regard to the take-up of ICTs in homes in Barcelona, mobile phone, computer and internet use have tended to increase in recent years. In 2013, 97% of citizens in Barcelona used a mobile phone, 86% used a computer and 85% used internet (and 78% of homes had internet access).

The total number of apps downloaded in 2013 was 435,999.

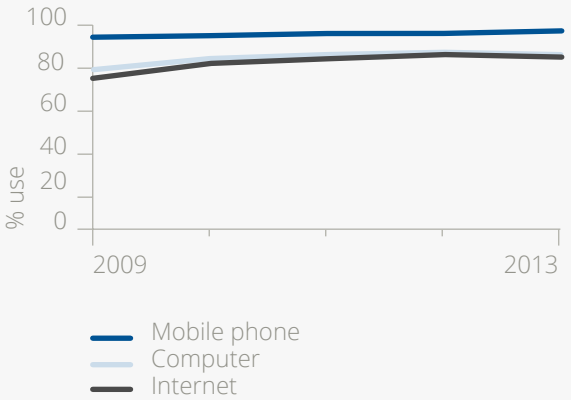
With regard to the state of the ICT sector in Barcelona, in 2012 there were 28,500 workers employed in ICT activities, which represents 3.5% of employees in the city and 54% of people employed in ICT in Catalonia. In 2008, there were 25% more ICT companies and 6.9% more employees in the sector. 40.9% of companies in the ICT sector carry out innovative activity and more than 3000 people are employed in R&D activities in Catalonia.

In order to promote technological development, the City Council of Barcelona has carried out different awareness-raising and training programmes aimed at real demand. On the one hand, the Get Updated programme was created for the professional redirection



In the last five years, the length of fibre optic cables has increased in the city, reaching 556,080 km in the year 2013.

The take-up of ICTs in homes in Barcelona is very high, which can be seen in the upward trend in mobile, computer and internet use.



of 502 people through 40 courses in the areas of design, ICT and business and international marketing. On the other is the programme to boost employment in the mobile sector, which provided assistance to 473 people, with 104 being trained in occupations linked to this emerging sector. 10,508 professionals or employees in small and medium-sized companies in the city have been trained in advanced technological skills, with the aim of increasing the competiveness of workers and companies.

12.2.3 The smart concept in different environmental aspects

Barcelona has carried out different actions that have allowed the city advance towards the smart concept. Some city projects linked to mobility, energy, waste and water (see the corresponding chapters for measures related to each environmental aspect) have reached the following milestones:

Energy

→ Improvement of knowledge on buildings' energy use in order to reduce consumption: energy monitoring in 23 public buildings and the implementation of monitoring in another 31 buildings.

→ Self-generating electric power in public buildings: 58 photovoltaic installations, 1 mini wind generator and 2 cold generators activated thermally.

→ Efficiency in energy distribution: 14 km-long urban cooling and heating network connecting 56 buildings (561,000 m2 of climate-controlled floor area).

Mobility

→ Mobility optimisation: 50 sensors in different parts of the Eixample district that allow for measuring the estimated time of urban routes.

→ The electrification of mobility is key to reducing air pollution and noise: more than 500 hybrid taxis, 294 public electric vehicles, 347 private vehicles (estimated), 20 plug-in hybrids, 130 electric motorbikes, 262 public charge points and 409 registered users.

Waste

→ 240 pneumatic waste collection points in 22@.

Water

→ Improving management to reduce water consumption: remote management of 301 public drinking fountains and 77 ornamental fountains.

→ Currently 40% of parks have an automated irrigation system.

Pneumatic waste collection is a smart system because rubbish is collected according to the containers' capacity and not merely a timetable.

12.3 Measures taken to advance towards the smart city concept

In order to advance towards the smart city concept, the measures implemented in recent years have mainly been oriented towards positioning Barcelona internationally as a smart city, applying a new, more open and transparent governance model, innovating with new technologies – with the creation of different applications and uses – and promoting citizen participation.

12.3.1 Barcelona positions itself internationally

Participation in international events

Barcelona has managed to place itself at the forefront of the smart city strategy on the international level. It has developed different actions to become a knowledge and development hub and a technological and smart city. For this it hosts different fairs, events and congresses like the Mobile World Congress, City Next, SC Expo, SC Tour, etc. It has also participated in different international events like the Latin American Digital Cities Meeting, Smart Grids, Smart Cities Forum and Smart Solutions for Sustainable Cities. Moreover, it participates in international lobbies and multinational corporate events have been held in Barcelona. Different prizes and awards reaffirm the role of Barcelona in the international arena, such as the Areté Award for Urban Innovation 2012.

Participation in international cooperative projects

Barcelona participates in different international projects that aim to make the most of all the members' knowledge and experiences related to smart strategies in order to speed up the habitable, viable and sustainable transformation of cities. In this regard, Barcelona has participated in European projects like Fireball, OpenCities, iCity, CitySDK, Arrowhead, etc.

Moreover, Barcelona promotes the City Protocol Society ⊕ , a non-profit organisation formed by cities, businesses, academic institutions and other organisations that make the most of the knowledge and experience of cities from around the world to speed up this transformation, offering a specialist guide and collaborative action options for cities.

Participation in the Green IT network ⊕

This network has the double goal of making information and communication technologies (ICTs) more sustainable and, at the same time, promoting their use to improve energy efficiency in companies. Barcelona is one of the 10 partners in the project that collaborate to share the best experiences and policies to improve knowledge of initiatives and solutions already undertaken and to transfer and adapt those that present the most opportunities. Barcelona is a benchmark in innovative companies in the knowledge industries sector and is in the vanguard of information and communication technologies in Europe. The city has many different examples of public-private collaboration to tackle the challenges that emerge from the creation of a more sustainable society and economy.

The Green IT network promotes the spread of good practices such as methodologies, projects and techniques that have been successfully tested and can be applied in other places.

12.3.2 Supporting a new governance model

e-Administration

e-Administration is the application of ICTs in the transformation of business processes both within and outside of the administration, in order to make them more accessible, efficient, effective and transparent. The main ideas in the e-Administration Plan are:

1. Personalisation: specific services and personalised folders, bringing information together and providing differentiated treatment for each group.

2. Ubiquity: facilitating access to the administration at any time, from any place and with any device.

3. Processes: improving organisation effectiveness and efficiency, redesigning ways of working and updating systems.

→ **Creation of the virtual citizen information service (OVAC)**. In line with the new governance model, the City Council of Barcelona has created this new facility with a video-conferencing screen, printer and scanner, where the citizen can interact, in real time, with municipal citizen information staff to carry out basic official procedures like registering in a particular district, accessing tax payment certificates, duplicating receipts and reporting complaints, incidents, suggestions, etc. It is a closed space to enjoy maximum privacy and allows for comfortable interaction between staff and users. The procedure is completed there and then, so that the citizen receives the corresponding document immediately.

→ **Procedures Portal**. This is a virtual office through which citizens can carry out procedures like change of address in the census, pre-enrolment in schools, requesting a library card and many others. Businesspersons and organisations can also carry out procedures via this portal: payment of municipal taxes, change of fiscal address, etc.

→ **Other related products** within the e-Administration framework include:

- Bicing (Barcelona's public bicycle rental service) app for smartphones: a tool that lets you know the location and availability of the different stations in real time, as well as the fastest and safest route.
- apparkB: service for paying and parking in the blue and green metered zones using mobile phones without having to go to the parking metre.
- Smartquesina: bus stop with new technologies that offer interactive services like consulting nearby points of interest and tourist options, planning routes, finding out the availability of Bicing bicycles, etc.

The virtual citizen information service (OVAC) allows citizens carry out various procedures in maximum privacy and comfort.

Barcelona GO (open government), a new governance model ⊕

This is based on three main pillars: transparency, participation and open data. With regard to transparency, relevant information is published for people in subjects as broad as budgets, contracting, tenders, urban planning, etc. With regard to participation, access to the participation channels is guaranteed for all people, with the commitment to take on board and respond to their contributions. In terms of open data, the information is made available to everyone in digital, standardised and open formats to facilitate access and to promote reuse.

Data for everyone through OpenDataBCN ⊕

The City Council of Barcelona has put public sector information within everyone's reach in digital, standardised and open formats that allow for their reuse. In this way society – citizens, businesses and institutions – can access it easily to inform themselves or to create new services, thus increasing social value and generating business opportunities.

With 510 datasets, some of the environmental information available includes: vehicle census, Bicing stations, list of environmental facilities and related services, list of transport facilities and related services, location of taxi ranks, etc.

12.3.3 Innovating with new technologies

BCN in your pocket ⊕

A mobile solutions project materialised in 3 important initiatives: Apps4Bcn, Barcelona Contactless and MobileID.

→ **Apps4Bcn**. This gathers all the mobile applications focused on the improvement of services in Barcelona in one single portal. Currently, there are more than 653 recommended apps. Moreover, it also has the goal of strengthening the industrial structure to create alliances for the development and application of products.

→ **Contactless Barcelona**. To facilitate the day-to-day relations of citizens and visitors in Barcelona, this initiative promotes the adoption of contactless technology (QR codes and NFC technology) in the city, allowing people carry out simple actions merely by bringing one mobile device into close proximity with another device. It already has 581 points (Bicing, Mobile World Congress, Mercè Festival...).

→ **MobileID, digital identity on your mobile**. This is a simple and safe authentication method to facilitate virtual relations with the City Council. It is an app that serves to access the virtual citizen folder (with services such as access to the municipal census, tow truck services, or services related to taxes and fines) both from a smartphone and via the Internet. Soon more services will be included from the City Council, other administrations and private services.

Accessibility via Mobile 4 all

Barcelona participates in this programme to guarantee access for everyone to mobile solutions, whether these are people at risk of exclusion, elderly people, or people with disabilities. It promotes initiatives to improve accessibility, to facilitate the evaluation of public policies and projects developed by the third sector, to facilitate managing and raising funds, to promote access to contents that allow for an increase in the knowledge base and to strengthen CSR in businesses.

Open Source urban platform, open architecture

Barcelona has created an urban platform for handling and managing data coming from all the different parts of the city. This is a clear example of innovation and excellence in the application of information technologies to the whole urban ecosystem.

Having a system of sensors and its own operating system (CityOs) allows for opening data and analysing them in a cross-cutting way to detect everything that happens in the city and to speak the same language as providers. Everything is standardised and the data can be analysed to make improvements to the city and to create new applications and systems to make life easier for people, through simpler and more solidarity-based applications or tools. Within this platform we find:

→ **Barcelona sensors platform, "Sentilo"** ⊕. The City Council of Barcelona has opened up the source code of its sensor interconnection and actuator platform to free programming through the Sentilo community. This isolates the applications that use the data from the sensors that supply them, such that any city or company can contribute with new code to connect a new type of sensor or actuator and incorporate new functionalities to build interoperable applications based on the data published with Sentilo.

→ **Barcelona Cloud. Open Data multi-councils**. This is an initiative led by Catalan municipalities that want to offer their citizens and companies open data in formats that are shared and standardised across different administrations, thus favouring territorial data continuity and the creation of services with greater added value. It also intends to share the knowledge generated and the milestones reached with other cities.

12.3.4 Promoting citizen participation

Fab Lab and fabrication centres ⊕

Fab Lab Barcelona forms part of the international network of fabrication centres promoted by MIT and present in 51 countries. These are spaces and equipment for digital design and fabrication. They constitute a meeting point for people and organisations with different career paths and training to experiment and debate about the use of technologies for digital fabrication, with latest generation machinery (milling machines, cutters and 3D printers), ideal for developing prototypes, models and new products and materials. It is planned that each district of Barcelona will have at least one fabrication centre in order to progress towards a future where digital fabrication forms part of our day-to-day life. The essential purposes of this project are training, social cohesion, boosting employment creation and bringing production closer to the city.

Fab Lab Bcn is a space for research and production that uses latest generation digital fabrication machinery for the creation of objects with digital technologies.

12.4 Future goals and measures

Barcelona City Council aims to consolidate the smart city strategy and to continue being a benchmark in the international arena. Efficient management of the different systems in the city and the correct integration of its infrastructure offer good growth and economic development opportunities as well as improving the quality of life of its citizens. For this reason, Barcelona will continue to progress in the establishment of new urban services models and different smart programmes placing the city at the service of people.

12.4.1 Planning technological infrastructure

Master Plan for ICTs in Barcelona's public spaces (PDTIC) ⊕

The plan incorporates standards on the development of smart infrastructure in public spaces. It showcases the experiences accumulated in the pilot initiatives carried out and sets the criteria for the installation of this type of infrastructure in the city.

The plan includes the government measure of implementing the smart city value chain and aims to transfer a development methodology to public spaces in the city, both to increase the level of ICT infrastructure in public spaces and to boost the progressive implementation of the smart city platform. Thus, the government measure is materialised in 3 lines of work:

- Introducing ICT infrastructure in public spaces.
- Implementing Barcelona's smart city platform.
- Streamlining electric power supplies in public spaces; design of street furniture intended for municipal services.

Promoting a new ordinance to regulate aerials

With the aim of tackling the growing demand for radio-communication technologies, generated by the multiplication of mobile devices and at the same time adapting to state regulations in telecommunications matters, Barcelona promotes a new ordinance to regulate aerials. With this new regulation, the City Council will reinforce the inspection and control of aerials guaranteeing environmental protection and public health. Currently, there are around 800 mobile communications infrastructures in the city, but many more are likely with the implementation of the new regulations, albeit with less visual impact since the new aerials are smaller and more discrete and can also be installed inside buildings.

In order to be able to create information infrastructure and solutions, we need a reference scenario to ensure that all the different actions result in an ordered, structured ICT architecture.

12.4.2 A comprehensive view of the smart city strategy

Creation of the Smart City Campus ⊕

This is an urban innovation space in which companies, institutions, universities and technology centres will be brought together in order to create innovation hubs in the city. This initiative intends to contribute to economic growth and to consolidate Barcelona as an international benchmark in new urban services models and smart cities at the service of people.

The first piece of the Smart City Campus will be Ca l'Alier, an old factory that will be turned into an Innovation Centre linked to smart cities, thanks to the collaboration established with the multinationals Cisco and Schneider Electric, which will locate their technological research and development centres there. The rehabilitation of Ca L'Alier will begin in January 2015 and will be completed in the summer of 2016. Its launch is expected to create 160 jobs.

Deploying the smart city strategy

Barcelona wants to advance towards the smart concept and to work in accordance with the principles of a smart city: define the city model and its systems, develop the services economy and define action plans to make the city more resilient and habitable. New technologies are being naturally incorporated into public spaces for citizens, integrating smart projects in a cross-cutting and progressive way. This deployment is materialised in 3 lines of work:

- Using all of the actions that take place on the streets to deploy telecommunications and sensor infrastructure like wiring, routers, access points, etc.
- Guaranteeing the correct supply of data to the system so that they can be transformed into essential information for taking decisions more efficiently.
- Designing public spaces with the necessary electrical supply points irrespective of the service they provide.

The strategy includes various local programmes, some already underway, among which the following stand out:

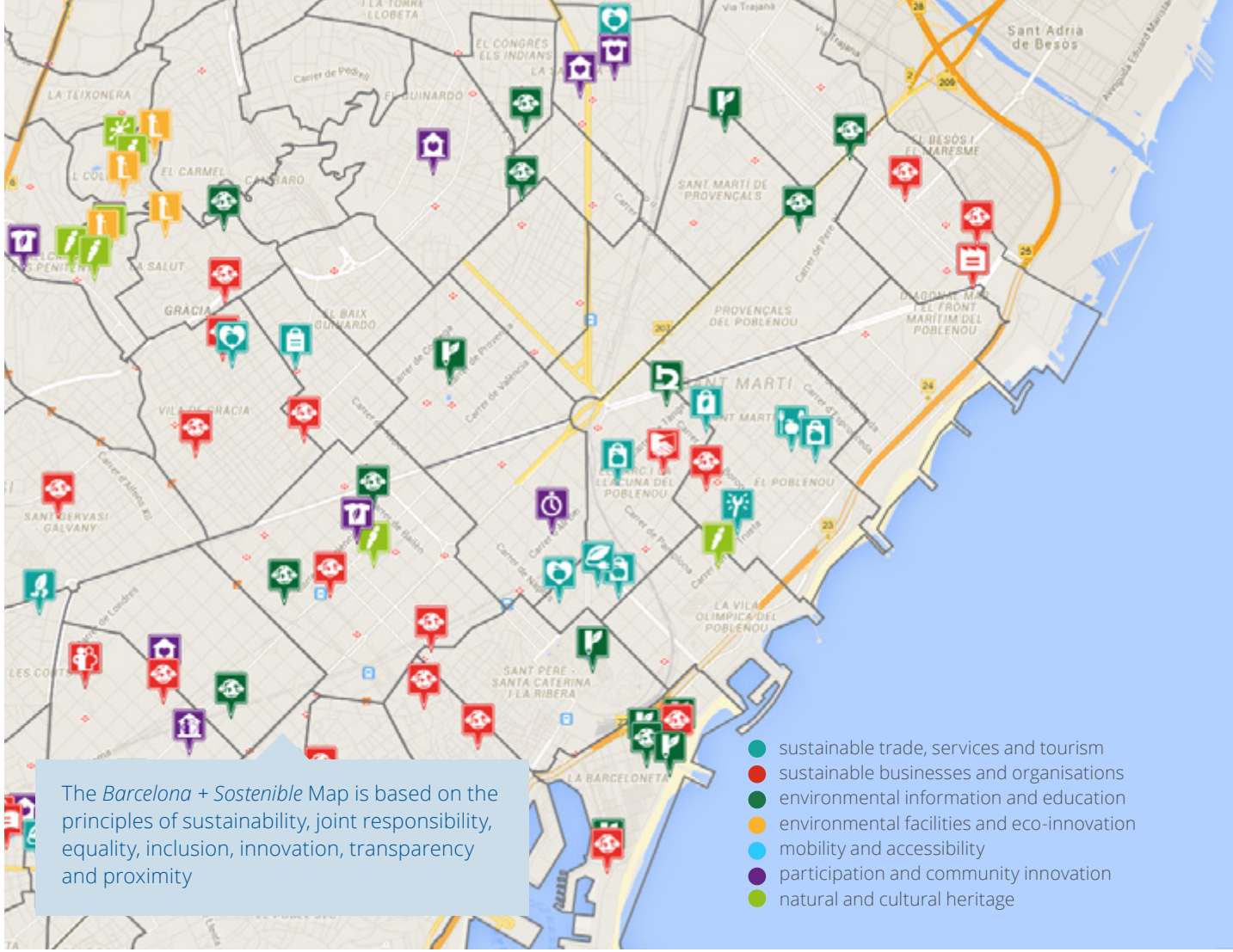
- **Integration of the city's different fibre optic networks** to achieve maximum coverage, allowing for the widespread use of sensors in the city.
- **Consolidation of the urban platform**, making technology independent from its providers and making data and municipal applications available to third parties.
- **Gathering smart data**, which when integrated and shared allow for measuring the city's level of development and the improvement of its governance.
- **Creation of self-sufficient blocks** in order to improve efficiency in consumption and the generation of energy, with the incorporation of solar roofs, mixed uses, joint heating systems for districts, water recycling and use of electric vehicles.
- **Remote irrigation management** for the installation of a centralised system that would allow for control of automated irrigation infrastructure.
- **Promoting electric vehicles** through systems that are attractive to citizens and companies such as e-sharing (bicycles, motorbikes and cars), e-trucks for the distribution of goods, e-taxi services and e-bus routes.
- **Establishment of smart parking spaces**, incorporating light signals for free spots, systems for the public use of free places in private hotel car parks, etc.
- **Promoting smart citizens** ⊕, a platform to generate participative processes for people, connecting data, citizens and knowledge.
- **Implementing the Lighting Master Plan (smart lighting)** with the aim of fulfilling lighting criteria (colour temperature, levels, contrasts, etc.) in the most energy efficient way.
- **Increasing smart street furniture**, incorporating smart city criteria and strategies (habitability, viability, sustainability).

With the implementation of the Lighting Master Plan the most appropriate lighting criteria are selected according to sets of streets and social realities. LED technology serves to improve the lighting experience.

12.4.3 Collaboration between the City Council and other organisations to promote sustainability in the city

The *Barcelona + Sostenible* ⊕, as eco-social innovation

This a collaborative project between the City Council and the organisations of the Environmental Space, the Catalan Environmental Education Society, Casa Orlandai, the Consumption Research and Information Centre, Barnamil, Science in Society and the Foundation for the Prevention of Waste and Consumption. It's an interactive virtual map that brings together relevant socio-environmental initiatives in the city, such as environmental infrastructure and facilities, havens for flora and fauna, stores with local and organic products, accommodation, businesses with added environmental value and initiatives in favour of more sustainable mobility, etc. The map is also a social network that helps citizens to share their experiences (stories, photographs and activities) of the city. The map will grow continuously with contributions from organisations and citizens through collaborative mapping workshops and individual contributions. In 2014 the website is expected to be operating and in 2015 the mobile application for iOS and ANDROID will be launched.



The *Barcelona + Sostenible* Map is based on the principles of sustainability, joint responsibility, equality, inclusion, innovation, transparency and proximity

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