



Sustainable Tourism Observatory of Malaga

Climate change



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Context

The goal of making cities resilient to global climate change is addressed in the United Nations 2030 Agenda and the Sustainable Development Goals (SDGs), by Goal 11 which aims to “make cities and human settlements inclusive, safe, resilient and sustainable”.



According to a report prepared by the WTTC and UNEP in 2021, global emissions for the tourism sector are estimated at a range of 8-11% of the total. Therefore, to combat climate change, destinations are increasingly working on action plans and strategies to reduce CO2e emissions.

The latest assessment report by the IPCC, the Intergovernmental Panel on Climate Change, published in 2023, forecasts an increase in extreme temperatures, a decrease in precipitation and a consequent increase in aridity and forest fires in the Mediterranean region. In addition to highlighting the vulnerability of the region to climate change, it specifies the elements on which it is possible to act through the implementation of adaptation actions to reduce vulnerability and exposure to risk through a focus on vulnerability and a better knowledge of the territory. As far as Spain is concerned, the report highlights the exponential increase in average sea temperature since the last century, both in the surface layer and in intermediate and deep layers. In addition, the general temperature also shows an upward trend, especially in the areas located to the south-east of the peninsula, where Malaga is located.

The Green Paper on adaptation to climate change, adopted in 2007 by the European Commission, mentions tourism as one of the economic sectors dependent on climatic conditions, which will be strongly affected by climate change, and calls for the necessary measures to be taken to adapt to this circumstance. It mentions the impacts on tourist infrastructures and the redistribution of tourist flows in summer.

Subsequently, in 2009, the Commission published the White Paper on adaptation to climate change, which sets out economic arguments for applying a strategic approach to adaptation. The approach respects the principle of subsidiarity and supports the fundamental objectives of the European Union on sustainable development through preventive actions that offer economic, environmental and social benefits. Likewise, the Commission presents the PESETA Program, which analyses the economic impacts of climate change in some sectors, including the tourism sector, where it states that some tourist flows could be altered, especially affecting Spain due to its geographical position and the type of tourism. The effects derived from sea level rise are also noted.

At the national level, the National Climate Change Adaptation Plan (PNACC) has an impact on the vulnerability of the tourism sector. In Andalusia, Act 8/2018, of October 8, on measures to combat climate change and for the transition to a new energy model in Andalusia, points to changes in demand and tourist supply as the main impacts of climate change, and provides as mitigation proposals to adopt the progressive replacement of fossil-based energies by clean energies, as well as a rational and sustainable use of water resources.



In Andalusia, through the Ministry of Sustainability, Environment and Blue Economy, we participate in the Interreg Europe NACAO project (Nature-based Carbon Offsets), where we work with five European partners from environment and/or climate change departments to propose solutions and emission compensation measures to achieve the climate neutral goals. The Andalusia Horizon 2020 General Plan for Sustainable Tourism includes a series of measures to be applied with the aim of diversifying the tourism offer, based largely on sun-and-beach tourism, which is particularly sensitive to climate change, and promoting other segments such as culture and gastronomy, while also looking for other less seasonal models, such as wellness tourism, congress tourism and urban tourism.

At the same time, it is necessary to take into account the effects that climate change can have on the visitor's motivation. The higher number of hours of sunshine together with remarkably mild temperatures have been important factors for attracting tourists, especially for visitors from northern Europe. However, there are warnings of decreasing trends in the number of tourists with these motivations, due to the increase in temperatures, both in their countries and in the destination.

Furthermore, the private sector is increasingly aware of the urgency of taking climate action to reduce climate risks. The signatories to the Glasgow Declaration on Climate Action in Tourism adopted at COP26 in 2021, 61 in the case of Spain, commit to taking measures to reduce emissions by 50% by 2030 and to reaching net zero by 2050. In 2021, the World Travel and Tourism Council (WTTC), together with the United Nations Environment Programme (UNEP), presented a net-zero roadmap for travel and tourism companies.

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Targets

- Annual emissions reduction of 7.3% to 2030.
- Reaching carbon neutral by 2050.
- Quantifying the environmental impact generated by a tourist in the destination through their carbon footprint.
- Reforestation in the city's peri-urban parks to combat desertification and biodiversity loss.
- Enhancing the sustainability of Malaga's businesses.

Results

Strategic planning to combat the effects of climate change in the city of Malaga

The 2050 Climate Plan (Alicia) is linked to the strategy of Malaga's Urban Agenda, with the aim of being a global and integrated structure to serve as a roadmap for the city in the fight against the risks derived from the climate crisis.

The 2050 Climate Plan (Alicia) is linked to the strategy of Malaga's Urban Agenda, with the aim of being a global and integrated structure to serve as a roadmap for the city in the fight against the risks derived from the climate crisis. In addition, it is aligned with the United Nations 2030 Agenda and the SDGs, mainly with objectives 7 (affordable and clean energy), 11 (sustainable cities and communities), 13 (climate action), 14 (life below water) and 15 (life on land) and with the contents of the 2019 Spanish Urban Agenda.

The Alicia Plan is divided into four main documents: (A0) Synopsis of the Climate Plan; (A1) Energy consumption and CO2 emissions in Malaga 2002-2017; (A2) Methodology and development of CO2 emissions scenarios in Malaga 2017-2050; (A3) Assessment of risks and vulnerabilities to climate change in Malaga; and (A4) Strategic lines of mitigation and adaptation.

Several public participation workshops were held during the development and implementation of the plan, bringing together about one hundred people mainly from environmental groups, from the local public administration (Urban Planning, Environment, Mobility, Social Rights, IMV, IMFE, OMAU, Transport Consortium), Oceanographic Institute, Aula del Mar, IUCN, CIEDES Foundation, Malaga Alliance and Malaga University.

CO2e emissions due to energy consumption in the city of Malaga

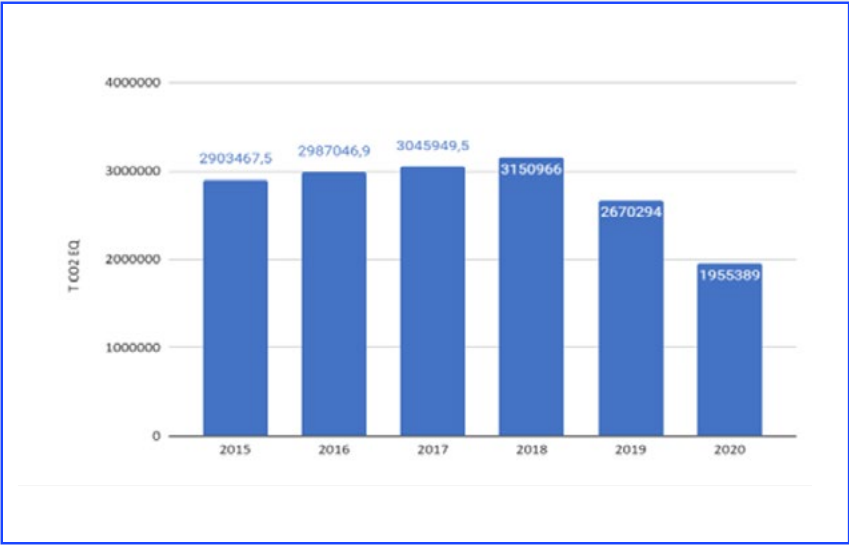
“The following stand out for their contribution to CO2e emissions from 2002-2017: private and commercial transport (30.5%), air transport (4%), maritime transport (4.6%) and tertiary buildings, equipment and facilities (7.5%).”

The total CO2 emissions produced by energy consumption in the city is characterised by a worrying growth over the last few years. In fact, in 2018, total energy consumption was 3,150,966 tCO2e, an increase of 8.5% compared to the previous year and 51.9% compared to 2002. The peak was reached in 2018, and the situation reversed in 2019 which saw a reduction of 15.6%, with a reduction of 37.9% in 2020 compared to 2018. In 2020 the process of reduction was interrupted by the COVID-19 pandemic.

Regarding the different sectors related to tourism in the municipality of Malaga, which contribute to CO2e emissions from 2002-2017, the following stand out: private and commercial transport (30.5% of emissions), air transport (4%), maritime transport (4.6%) and rail transport with only 0.2% of emissions. Furthermore, the category of buildings, equipment and tertiary facilities, which would include those related to the services and hospitality sector, account for 7.5% of total emissions.

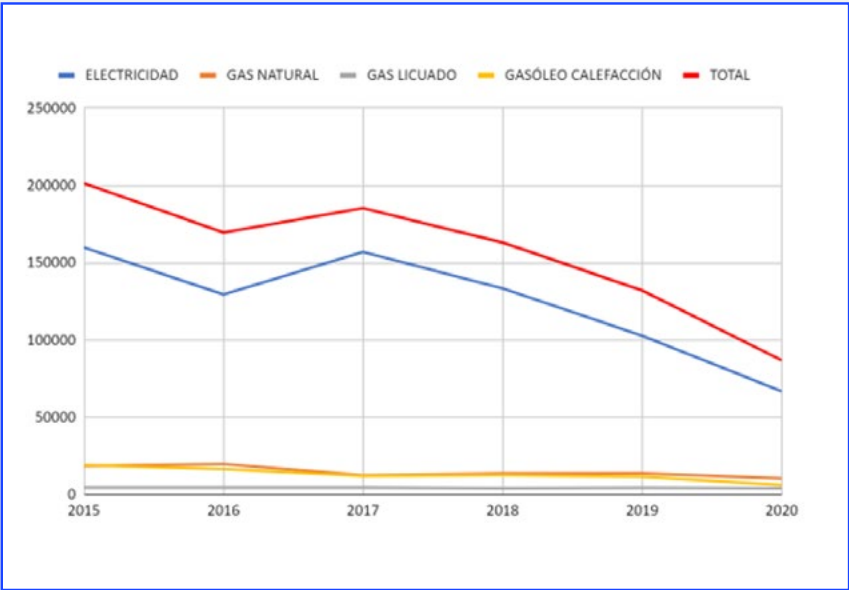
In the case of non-public buildings and facilities for tertiary use, in 2019 (the latest data available), the highest number of emissions came from electricity consumption (77.8%), followed by natural gas (10.2%) and heating oil (8.7%). The consumption of liquefied gas is the source that generates the least emissions with 3.2% of the total. Emissions in this sector seem to be tending to reduce in recent years, mainly motivated by a reduction in emissions from electricity consumption. In 2019, emissions from this type of energy were reduced by 22.9% compared to 2018, and by 35.7% compared to 2015.

Figure 1: Total emissions in the city of Malaga tCO2e (2015-2020)



Source: Alicia Plan and Urban Environment Observatory (OMAU)

Figure 2: CO2e emissions from energy consumption of the tertiary sector (2015-2020)



Source: Alicia Plan and Urban Environment Observatory (OMAU)

The trend in the private and commercial transport sector is that of a slight increase in the level of emissions in recent years. In 2019, it increased by 1.4% compared to the previous year and by 7.3% compared to 2015. In terms of type of emissions, diesel A generates the most emissions with 77% of the total.

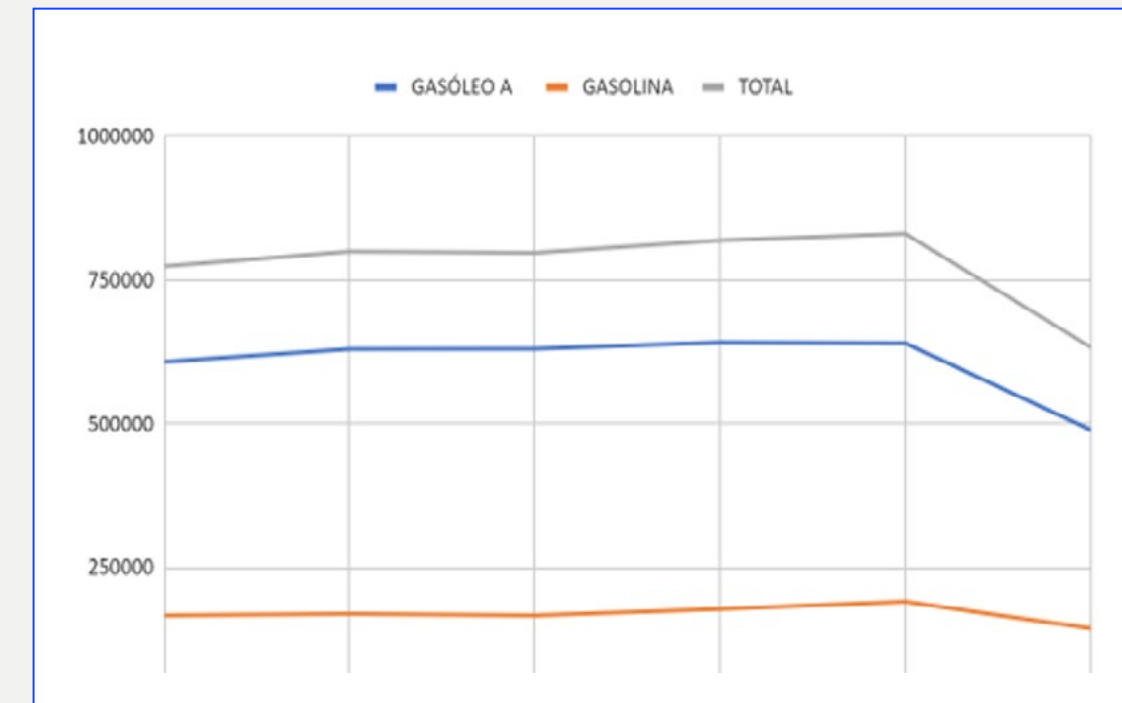
Lastly, the Ministry of the Environment, Sustainability and Blue Economy calculates emissions from electricity consumption in the trade sector. If we compare that with the results presented above for buildings in the tertiary sector, the results are very similar, appreciating this decrease in emissions from electricity consumption.

Given this situation, the city of Malaga has set the objective of reducing emissions. In the medium term, it aims to achieve an annual emission reduction rate of 7.3% to 2030. This would reduce emissions to around 1,140,000 tons of CO₂e, and compliance would mean a 45% reduction compared to emissions in 2002. As a long-term goal, by 2050, it seeks to achieve carbon neutrality, which is estimated at 207,000 tons of CO₂e. Malaga would achieve neutrality through an annual reduction of 7.8% in the period 2017-2050.

Climate change risk and vulnerability assessment in the tourism sector

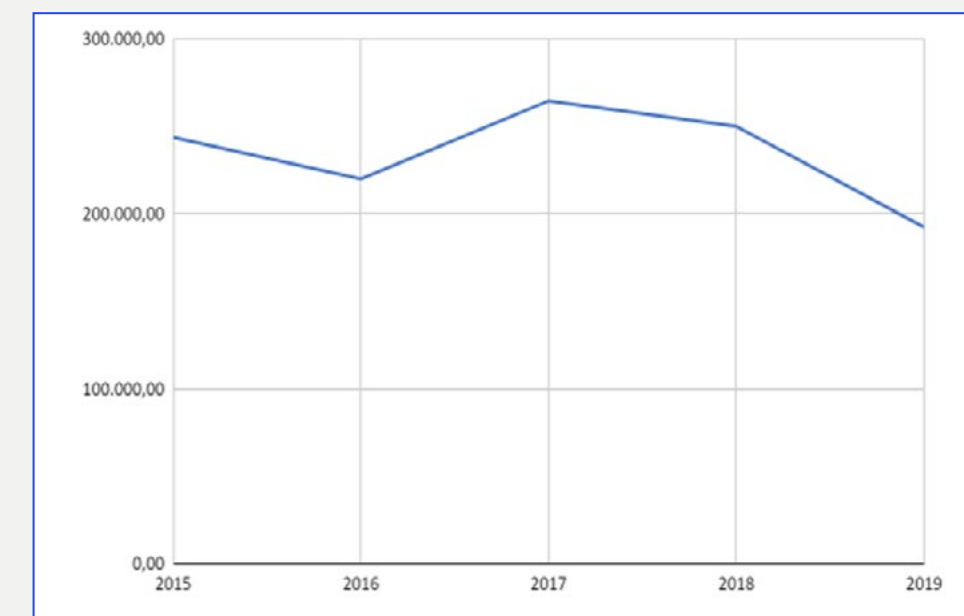
The plan pays special attention to the consequences of climate change on the city's tourism sector, carrying out a qualitative analysis of the main impacts that Malaga will have to face. Firstly, it points out that the rise in the average sea level, together with the increase in torrential rainfall, could cause flooding, generating damage to infrastructures aimed at "sun-and-beach" tourism. Any risk of recurrent flooding could also affect cultural tourism through the deterioration and erosion of historic buildings constructed with more vulnerable materials, in addition to the loss of competitiveness of the destination. Nature tourism could also be compromised if coastal wetlands are affected by factors such as, for example, salt intrusion. Another consequence would be the accessibility problems that these floods and extreme rainfall would pose, affecting functionality of roads, airports and railways.

Figure 3: CO₂e emissions from private transport (2015-2020)



Source: Alicia Plan and Urban Environment Observatory (OMAU)

Figure 4: Emissions from electricity consumption in the commercial sector (2015-2019)



Source: Ministry of Sustainability, Environment and Blue Economy. Carbon Footprint of the municipalities of Andalusia

Although Malaga does not have a very marked seasonality, the consequences of the climate crisis could modify the seasonality throughout the European Mediterranean, increasing the tourist season in the non-summer months, with a more equitable distribution in the consumption of energy and water in tourist establishments.

As for the municipality’s Protected Natural Areas, they occupy 12.1% of the area in Natural Parks and 0.21% in Natural Areas. Here it is worth highlighting the number of threatened species of flora and fauna found in the municipality of Malaga, which could suffer the effects of climate change as their habitats are altered. In addition, these spaces are used by residents and tourists for leisure activities related to nature. One case, the Montes de Málaga Natural Park has 10 vertebrates and 7 flora species under threat; and the Desembocadura del Guadalhorce has 55 vertebrates under threat¹.

Climate risk indicators: Identification of vulnerable areas

“The historic centre district, where the city’s main tourist attractions and offerings are concentrated, has a risk index rated 1.627 out of 2.”

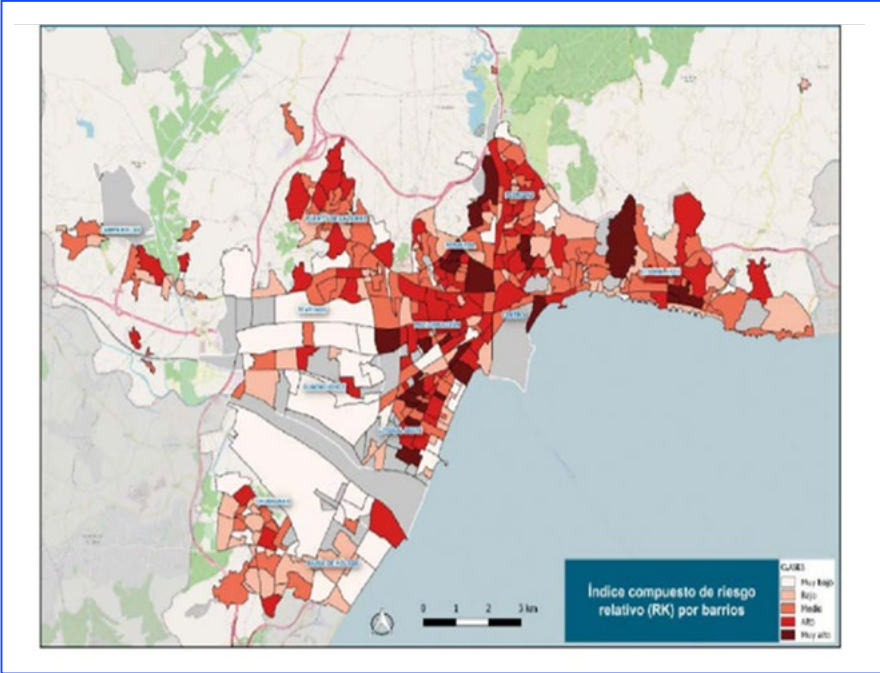
The Alicia Plan establishes a series of indicators, some related to the tourism sector, and establishes the neighbourhood as a territorial unit in order to identify which areas or zones are most vulnerable within the city. Composite vulnerability and risk indices are developed for each of the indicators, standardised and scaled between a minimum value 1 and a maximum value 2.

Impact of Extreme Temperatures and Heat Waves on Human Health

The increase in extreme temperatures and the number or duration of heat waves is considered a determining factor in exposure to climate hazards. 360 vulnerable areas were identified, which constitutes 87% of the urban area of Malaga.

¹ Natural Resources Management Plan (PORN), Red Book of Threatened Wild Flora of Andalusia and the Red Book of Threatened Vertebrates of Andalusia

Figure 5: Risks of climate change due to the impact of extreme temperatures and heat on human health. RCP 8.5 and Horizon 2100 scenario.



Source: Alicia Plan

Table 1: Risk Indicators in the Centro and Prolongación neighbourhoods

Barrio	Riesgo
CAPUCHINOS	1.669
CENTRO HISTORICO	1.627
CRISTO DE LA EPIDEMIA	1.858
EL EJIDO	1.714
EL MOLINILLO	1.706
LA VICTORIA	1.621
CARRANQUE	1.688
CRUZ DEL HUMILLADERO	1.691
LA UNION	1.753
LOS TILOS	1.697
MARMOLES	1.748
PERCHEL SUR	1.631
PLAZA DE TOROS VIEJA	1.656
LA TRINIDAD	2.000

Source: Alicia Plan

The historic centre district, where the city’s main tourist attractions and offerings are concentrated, has a risk index rated 1.627 out of 2.

Other neighbourhoods located on the periphery of the centre have high values in terms of the index, such as the neighbourhood of La Victoria, El Molinillo, El Ejido and Cristo de la Epidemia, with this last standing out with a risk level of 1.858. Other neighbourhoods close to the centre such as El Perchel, Trinidad, and in the new urban centre of the train station, such as the neighbourhood of La Unión, Cruz del Humilladero and Los Tilos, also present a high degree of risk and vulnerability (table 1).

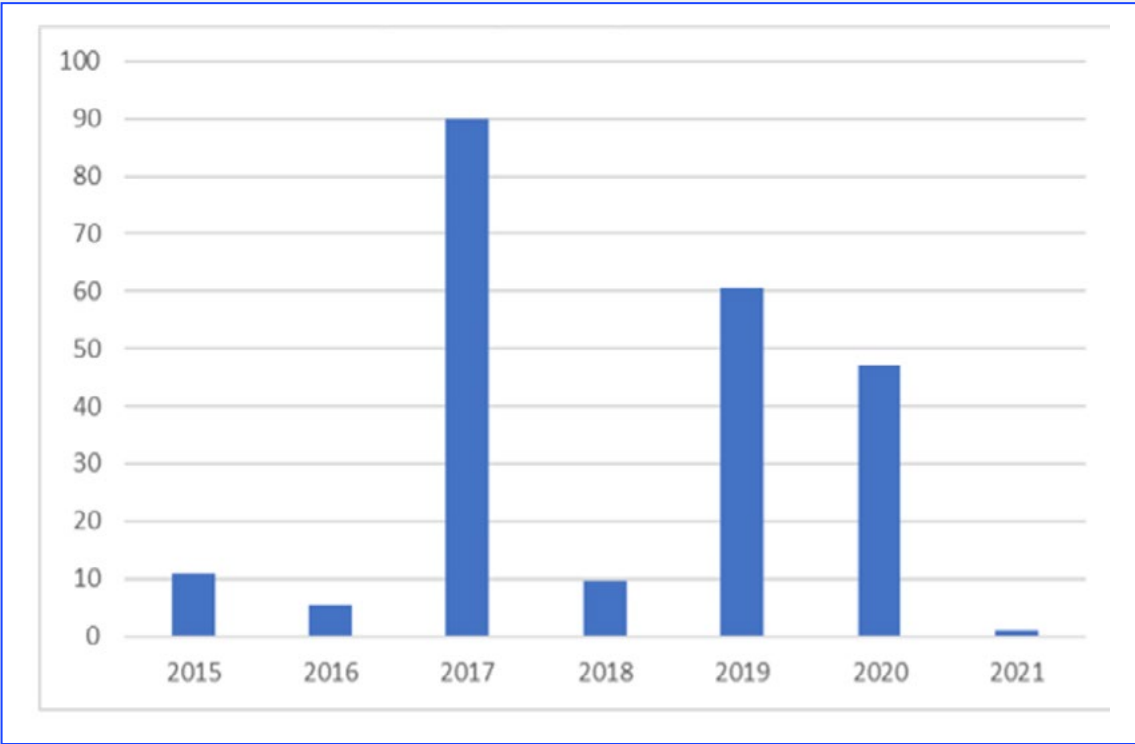
On the eastern coast, the neighbourhoods most at risk are El Palo (1.943) and La Malagueta (1.857). On the western coast, an area that has seen expansion and tourist development in recent years with the creation of the promenade, the creation of the metro line and the museum offer (Automobile and Fashion Museum and the Collection of the Russian Museum), there are many that present a high degree of risk, such as La Luz (1.996), Las Delicias (1.838), Puerta Blanca (1.832), Finca el Pato (1.828), La Paz (1.827), Huelin (1.807), La Princesa (1.773) or Jardín de la Abadía (1.748).

Furthermore, this increase in temperatures could lead to an increase in fires and the loss of green areas (Figure 6) and recurrent periods of severe drought. Through the publication of Order 138 in the BOJA Regional Gazette, Malaga has recently been declared an area in a situation of exceptional drought with an indication of severe shortages in the Guadalhorce-Limonero System. Due to this, Malaga City Council has implemented new savings measures in line with the recommendations made by the Commission for the Management of the Drought of the Hydrographic Demarcation of the Andalusian Mediterranean Basins.

Impact of river floods on the built environment

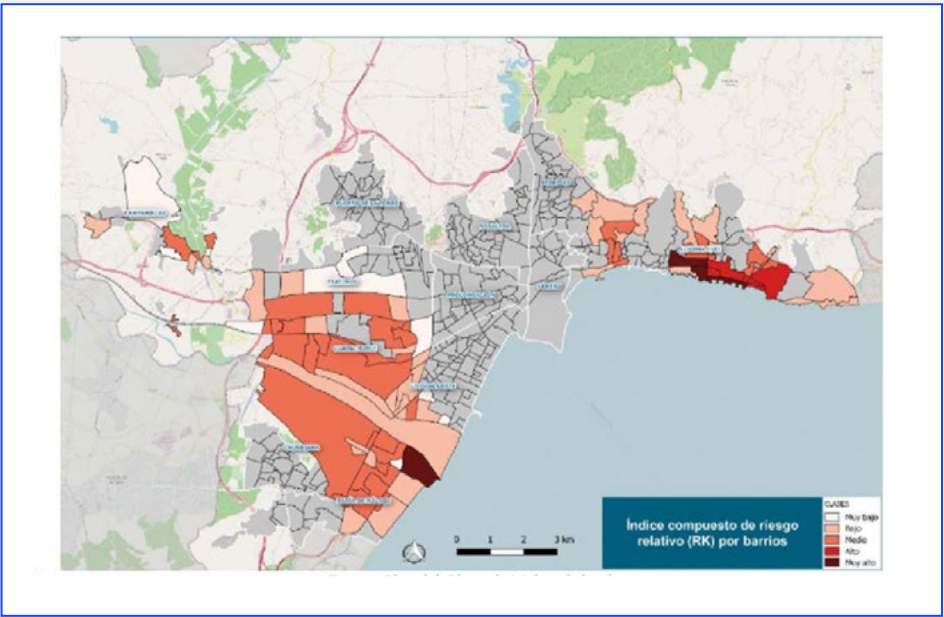
The flatter coastal area has been occupied since the 60s and 70s due to the pressure of tourism; and there are also many infrastructures that were built parallel to the coast, in an east-west direction, and that create a barrier effect by interrupting riverbeds. As a result, the urban conurbation of Malaga is one of the areas of Andalusia in which floods and inundations are most likely to occur. In fact, according to the Plan for the Prevention of Floods and Inundations in Andalusian Urban Channels, Malaga is the only capital in which the risk of flooding has been defined as maximum, with the identification of 20 risk points in the municipality.

Figure 6: Burnt vegetation area 2015-2021



Source: Urban Environment Observatory (OMAU)

Figure 7: Risks of climate change due to the impact of river floods on the built urban environment. RCP 8.5 and Horizon 2100 scenario.



Source: Alicia Plan

Malaga has two principle rivers, the Guadalhorce River in the western part of the city and the Gualdalmedina River that runs through the city centre, as well as several streams acting as tributaries to one of these rivers, or directly to the sea in the eastern part of the city. Currently, 23% of the urban area of the city (96 neighbourhoods) are exposed to this threat. This river flood hazard indicator is based on a return period of 500 years. Among them, the most affected areas correspond to the vicinity of the mouth of the Guadalhorce and on the eastern coast due to the presence of the Jaboneros and Totalan streams, among others. This is the case of Pedregalejo and Las Acacias in the eastern area, which reach the maximum value of 2 in terms of risk index and 1.895 in terms of vulnerability and 1.932 in terms of risk and 1.711 in terms of vulnerability, respectively. In the area of the western coast there is a lower risk and only the neighbourhood of Guadalmar has a high-risk index of 1.833 and 1.678 in terms of vulnerability.

Impact of floods due to sea level rise on the built urban environment

According to the RCP 8.5 scenario proposed by the IPCC, a sea level rise of 75 cm is estimated for the western Mediterranean by the year 2100. Under this scenario, the threat to Malaga is estimated to affect 9% of the urban area of the city, identifying 38 neighbourhoods. Guadalmar @ and Santa Isabel (1.958) are the neighbourhoods most at risk from this threat. These neighbourhoods are followed by some on the eastern coast, such as Pedregalejo with a risk index of 1.832.

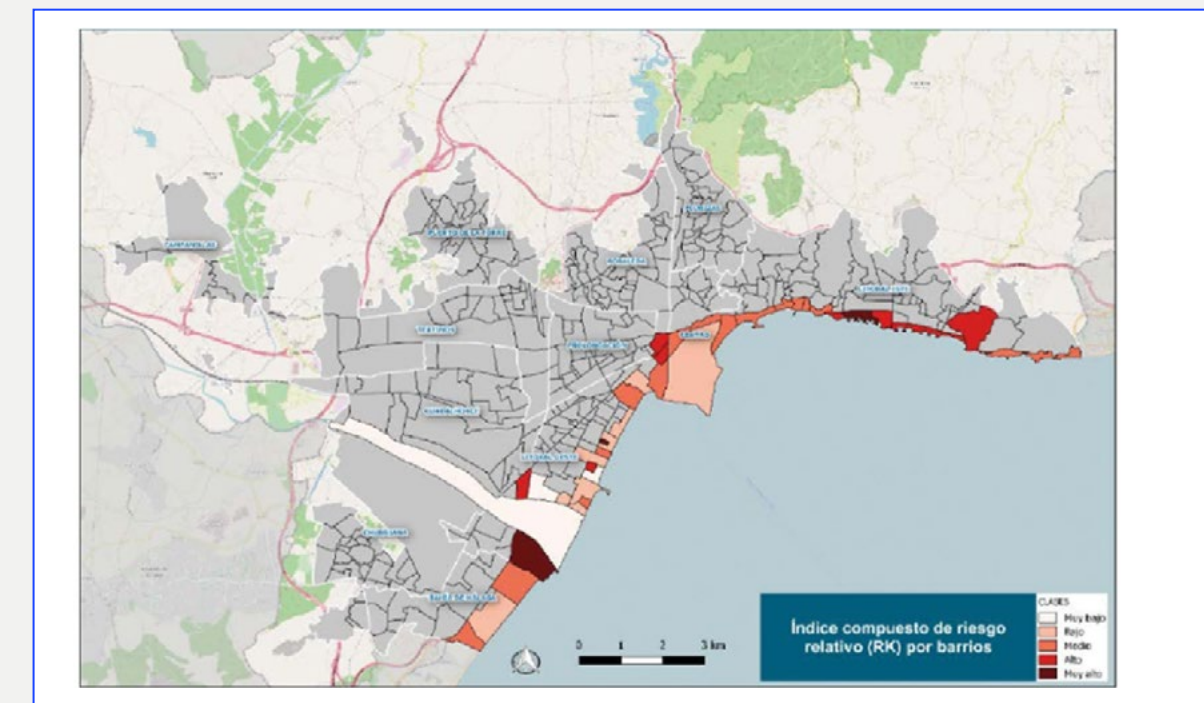
Companies with responsible climate change policies

*“A project called **Hostelería#PorElClima** has been created, which leads the fight against climate change in the hospitality sector.”*

The adaptation strategy to the climate crisis in Malaga points to the interest shown by hotel establishments in incorporating water recycling systems or desalination plants. The hotel sector is increasingly concerned about the economic repercussions of the climate crisis, especially those that may arise from a greater frequency of heat waves, such as

the loss of attractiveness of the destination by tourists.

Figure 8: Risks of climate change due to the impact of floods due to sea level rise on the built urban environment. RCP 8.5 and Horizon 2100 scenario.



Source: Alicia Plan

The city of Malaga's Department of Environmental Sustainability has an Environmental Advisory Centre. This service is aimed at supporting companies to improve their environmental responsibility. Its main purpose is to advise the business community free of charge and achieve a new image of the municipality with the aim of positioning it as a sustainable environmental benchmark within the European commercial space.

In the case of Malaga, a project called Hostelería#PorElClima (#HospitalityFortheClimate) has been created, which leads the fight against climate change in the hospitality sector. This initiative is driven by Comunidad#PorElClima and the Coca-Cola company with the support from Hostelería de España. It is an online platform where small, medium and large hoteliers commit to developing a series of environmental best practices in six areas: water, responsible consumption, energy, carbon footprint, mobility and waste prevention and management. The Malaga Hoteliers Association and Hotel Málaga Premium are members of this initiative. In addition, Malaga City Council, specifically the Department of Environmental Sustainability, grants an environmental quality certificate to environmentally responsible companies. In the case of hotels, the Expedia search engine provides filters for those hotels in the city that have some type of environmental certification, listing 2 hotels.

In the transport sector, the Empresa Malagueña de Transportes (EMT) stands out. The public company launched a Carbon Fund for a Sustainable Economy (FESCO2) Climate Project. The project consisted of replacing the fleet of buses with traditional internal combustion engines with electric and hybrid vehicles with the aim of reducing greenhouse gas emissions. Thanks to this, it was possible to reduce 126 tCO₂ in 2019. In its turn, through its participation in the United Nations programme within the framework of the Clean Development Mechanism (CDM), Malaga Metro has achieved zero carbon neutrality by offsetting CO₂ emissions. In addition, it should be noted that indirect emissions from electricity consumption have been zero since 2018, thanks to the contracting of electricity supply from 100% renewable sources.

Finally, La Concepción Botanical-Historical Garden, managed by Malaga City Council, is worthy of mention. As part of the Ibero-Macaronesian Association (AIMJB), it joined the Alliance against Climate Change created in 2018 in Melbourne (Australia) to address the impacts of climate change on botanical collections, assessing its consequences and with the overall aim of preserving biodiversity.



Conclusions

In Malaga, as in the rest of Spain, tourism represents one of the most important and dynamic economic sectors, but it is also one of the most vulnerable to the climate crisis.

“Malaga is working to combat the effects of climate change by establishing low-emission zones, promoting renewable energies, creating green spaces and investing in the circular economy.”

The climate and weather have been and are important factors for a good part of the tourism products on offer, so any change in the established conditions could have significant negative impacts in this area. The indicators analysed show that the areas of greatest tourist development in the city (historic centre and coastline) are the most susceptible to these impacts.

There are some gaps and limited knowledge on how to measure the impact of the climate crisis on the tourism sector. Therefore, it seems necessary that in the coming years the scientific community, managers and companies involved in this sector should undertake joint action strategies that allow data to be shared and thus develop indicators that prevent and anticipate the negative impacts that will affect the sector in particular and the destination in general.

Through an EU-funded NEXT GENERATION project, Malaga City Council is working to establish the municipality's Low Emission Zone (LEZ) in order to comply with sectoral regulations and the Alicia Plan. These areas in which the access of vehicles is restricted or limited aim to improve the air quality of the 437 hectares which include not only the heart of the old city, but also other peripheral neighbourhoods. Stations that will measure different gases and particles, the noise level and weather indicators are also being installed in this area.



HOSTELERÍA #PorElClima

The information collected by these meters presents an opportunity to deliver diagnoses and reports on air quality and emissions in the area, providing an opportunity to fill the

gaps described above. In addition, it can be used to identify spaces to create climate shelters, which could be used by tourists. This type of information is also very useful for other projects on which Malaga is working, such as the Tourism Sustainability Plan, which is committed to the decentralisation of sustainable tourism in the city, in which it is essential to take into account the distribution of tourist flows in other areas of the city.

The social well-being of the inhabitants, as well as the comfort of tourists when visiting the city are important aspects to take into account in the coming years. For this reason, it is important to adapt urban space to the effects of climate change. In this sense, Malaga is also developing collaborative initiatives such as Renaturalizar Málaga (Rewilding Malaga), which aims to provide solutions by transforming Malaga's urban architecture through the integration of green spaces, advanced technology, education, art and culture, generating regenerative development that integrates nature and increases biodiversity.

Another trend to consider is raising tourists' awareness of climate change and the impacts generated by their own visit. The city of Malaga has a free mobile application called AlertCops, which any citizen and tourist can use to receive real time information and alerts for any extreme event in the city, such as weather conditions. In addition, the City Council is designing a tourist carbon footprint calculator, which through various questions encourages awareness and proposes measures to compensate for the footprint. Malaga companies are also aware of this problem and are striving to mitigate these impacts with more or less effective strategies. It is expected that the private sector will increasingly adopt energy saving strategies and carry out climate-responsible practices as a differential element to be more competitive in the market.





It is worth highlighting the importance of renewable energies to achieving carbon neutrality by 2050. For this reason, the city of Malaga has as its vision to become a flagship.

Green Local Valley project for the European Union (MALAGA going to H2 GREEN Valley project) by using hydrogen as one of the main renewable energies. In relation to this, there are also plans to install photovoltaic solar panels on City Hall facilities for auto-consumption, thus improving energy efficiency.

Finally, we must highlight the importance of the Circular City concept in addressing climate challenges. In this regard, Malaga has signed the Seville Declaration for the Circular Economy, representing a commitment to further implement a model of sustainable, inclusive and resilient urban development, shifting towards zero landfill and promoting the reuse and recycling of waste. Along these lines, the eCityMálaga project is a public-private initiative that was launched by Malaga TechPark, Malaga City Council and Endesa. It will turn the technology park into a model eco-efficient city, making better use of resources by the year 2027.





<https://sto.malaga.eu/indicadores/cambio-climatico>