



EUROPEAN UNION



# EU MISSIONS

ADAPTATION TO CLIMATE CHANGE



October 2025

## Transforming a busy road into a public open green space in Bilbao, Spain

A green corridor in the city centre reduces urban heat and urban traffic

*Adapting the road to urban heat with trees, shrubs, and public spaces reduces inner-city temperatures, pollution and increases public space quality.*

### Key Learnings

- **Improving air quality:** Greenery at one of Bilbao's most polluted roads, close to the city gateway, has significantly reduced the daily number of cars, improved air quality and the surrounding environment.
- **Permeable surfaces:** Sustainable Urban Drainage Systems, with better water retention capacity compared to conventional solutions, have increased the permeable surface area and reduced the risk of flooding during heavy rain.
- **New public space:** Allocating roads to public spaces for local citizens has increased public empowerment and shifted priorities from privately owned vehicles to community spaces and democracy.
- **Green infrastructure design:** Green infrastructure such as trees, shrubs and green spaces, improves air quality but also provides other services to local residents. Its implementation requires a thought-through design to benefit largely from it. Tree location, light reflection and solar radiation, material selection, shade and many more influence outdoor space quality, thermal comfort and citizen wellbeing.

## About the region

Bilbao is in the province of Bizkaia within the Basque Country, in the northern part of Spain. Bilbao is a medium size city with about 350,000 inhabitants and a high population density (8,500 inhabitants per km<sup>2</sup>). It is located in a narrow valley surrounded by mountains and crossed by the river Nervion. Bilbao is the capital of the metropolitan area with almost 1 million people. The region's Atlantic climate is humid with mild winters and moderate summers. As Bilbao is in a narrow valley, the city faces a high flood risk, such as at the severe flooding in 1983, and heat waves are becoming more frequent.

## Climate Hazards

Flooding, Hot Temperatures

## Sector

Urban, Biodiversity protection,

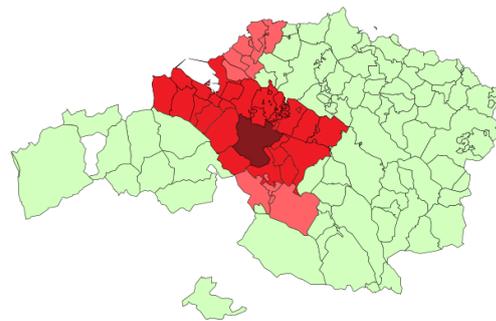
Water Management

## Key system

Critical Infrastructure,

Ecosystem and Nature Based Solutions,

Water Management



## Climate Threats

### Floods

The Nervión River, which crosses Bilbao, flows through a narrow urban basin and is close to the sea, increasing flood risks. High tides combined with heavy rainfall can trigger severe upstream flooding, as in August 1983, when 600 litres/m<sup>2</sup> of water caused 34 fatalities. Figure 1 shows flooding return periods, with areas in red indicating new urban development projects. Some of these projects, particularly in the southwest, are located in zones with high flood risk.

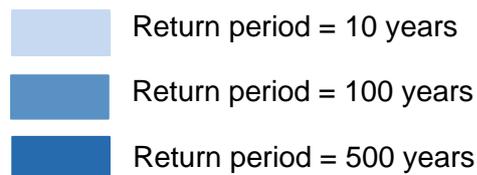
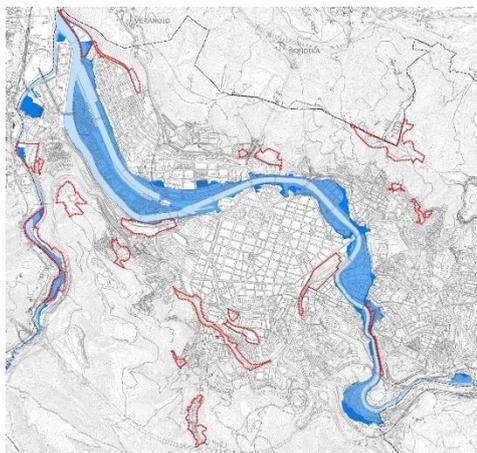
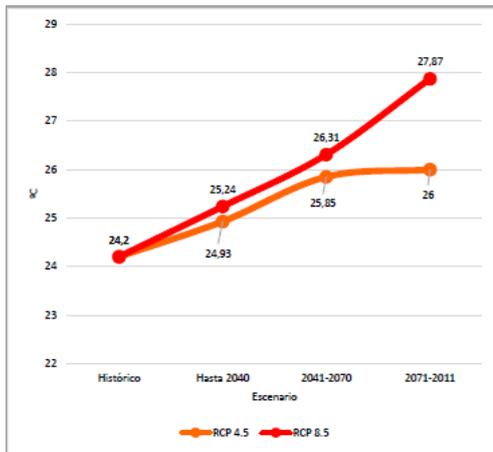


Figure 1: Flooding return periods of the Nervion River. Image Credit: Bilbao City.

## Heat Waves

In recent years, temperatures have been severely increasing, with heat waves becoming more frequent, longer and with higher temperatures.



The Intergovernmental Panel on Climate Change has calculated temperature trends under different representative CO<sub>2</sub> concentration pathways (RCP 4.5 and RCP 8.5, Figure 2), estimating prolonged and higher temperatures in the next 15 to 75 years.

*Figure 2: Projected temperature increases under RCP 4.5 and RCP 8.5 emission scenarios for Bilbao. Image Credit: Bilboa City.*

## Adapting a heavily used road to climate change by turning it into a green corridor

Before adaptation, M<sup>a</sup> Díaz de Haro Street had three lanes, parking on both sides, and two-metre-wide pavements. To address rising temperatures and flood risk, the city council transformed it into a more welcoming space, replacing asphalt with permeable surfaces and adding greenery to enhance outdoor quality for residents.

The adaptation project has two building phases, with the first section starting at Simon Bolivar Street to Autonomía Street, and the second section ranging from Gran Vía to Simon Bolivar Street by redesigning 700 metres of road in total.

The greening measures continue Dña. Casilda Garden's green infrastructure with trees and green spaces along the road. The measures include creating more space for pedestrians and increasing outdoor quality by transforming two lanes and car parking areas into green areas.



*Figure 3: M<sup>a</sup> Díaz de Haro Street from Simon Bolivar Street. Before and after de intervention: Image Credit: Bilboa City.*

Widening the pavement from two to at least four metres and adding a central park created dwelling areas and shaded spaces. The new design enhances connections between existing green spaces, incorporates additional greenery like trees, and maintains functionality for residents, including local commerce.

### *Previous state*

The plan below shows road before implementing the adaptation measures. The space included almost 3,000 m<sup>2</sup> of pedestrian and over 5,600 m<sup>2</sup> of road area, totalling more than 8,500 m<sup>2</sup> of sealed surfaces and strongly influencing urban heat in the space.

| ESTADO ACTUAL |                 |
|---------------|-----------------|
| USOS          | TOTAL           |
| ZONA PEATONAL | 2.920,54        |
| ZONA RODADA   | 5.628,00        |
|               | <b>8.548,54</b> |



*Figure 4: Street configuration before works. Image Credit: Bilbao City.*

### *Road state after implementing the adaptation measures in the first street section*

Figure 5 shows the road after implementing the adaptation measures with over 4,500 m<sup>2</sup> of pedestrian area equipped with permeable surfaces, a green corridor with deciduous, perennial and native species, adding almost 1,300 m<sup>2</sup> of retention area to the space and the road area reduced by over 2,800 m<sup>2</sup>, significantly lowering traffic volumes.

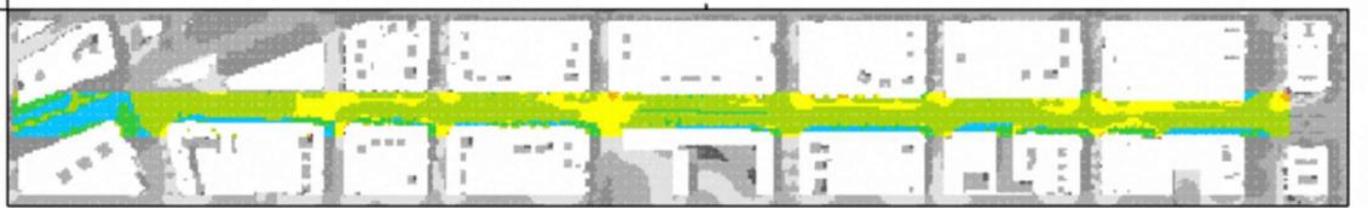
| ESTADO PROYECTADO |                 |
|-------------------|-----------------|
| USOS              | TOTAL           |
| ZONA PEATONAL     | 4.502,24        |
| CORREDOR VERDE    | 1.290,10        |
| ZONA RODADA       | 2.756,20        |
|                   | <b>8.548,54</b> |



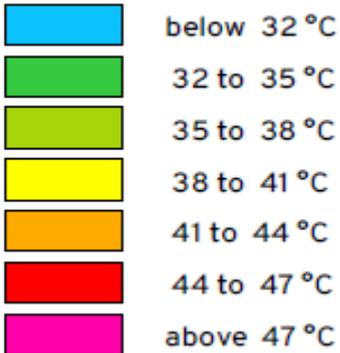
Figure 5: Final design in the first section. Image Credit: Bilbao City.

### Measuring heat reduction to assess effectiveness

After implementing the greening measures, the council's sustainability department assessed their effectiveness. Thermal comfort (how comfortable people feel outdoors) was evaluated using the Physiological Equivalent Temperature, comparing how warm or cold a person feels in the given environment, before and after implementing the measures under changing climatic conditions. A third calculation estimated ways to optimise the greening measures for improved outdoor quality. Figure 6 shows that greenery reduces the Physiological Equivalent Temperature.



## PET



## TRAMOS DE PET EN DIFERENTES ESCENARIO RECORTADO

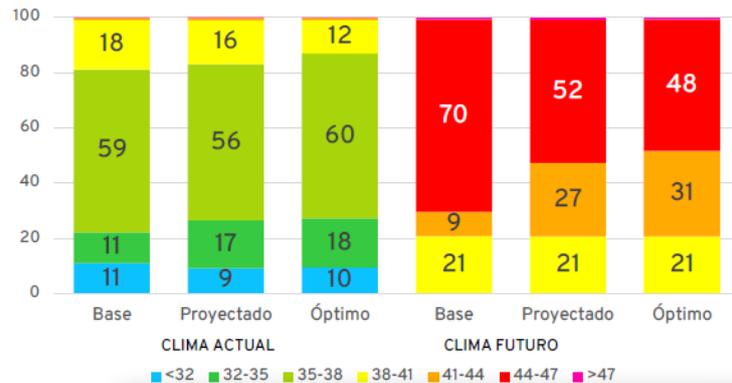


Figure 6: The image shows how public space Physiological Equivalent Temperature improves by implementing green infrastructure. Image Credit: Bilboa City.

The effectiveness of planting greenery –key for climate resilience - becomes increasingly important under rising temperatures. When Physiological Equivalent Temperature exceeds 41°C, calculations show that these measures lower perceived temperatures across all future scenarios.

## Additional actions to tackle heatwaves

Besides implementing greening measures, Bilboa city authorities asked the project team to:

- Calculate the maximum green infrastructure implementation capacity to achieve thermal comfort under hotter conditions than today
- Create, maintain and improve the Climate Refugee Network to help the population avoid heat waves. The Climate Refugee Network includes open spaces (65) and buildings (66), where people can go when heat stroke occurs. Trained employees provide first aid.
- Develop a heatwave protocol to provide guidance and implement prevention measures when high temperatures occur in the city. The protocol is a list of recommendations announced by the city council in the mass media, informing the population what to do and not do during extreme heat. The recommendations, for example, include not doing sports at midday.
- Include implementation criteria in urban plans that require green infrastructure, such as trees, and blue infrastructure, such as fountains. Include climate change indicators (surface permeability, retention capacity, canopy cover for shading, etc.) in tendering projects.

*“Turning from taking green infrastructure as ornamental to considering it as a service will help to face climate change hazards, mainly, heat waves.”,*

*Mikel González Vara, Head of Environment Department, Bilbao*

## Project success

- The first success has been public acceptance, as people have realised that even in a densely built-up area, it is possible to create a more pleasant, healthy, and comfortable environment.
- It remains essential to monitor additional ecosystem services, as climate change hazards require diverse responses. However, some health benefits, such as improved air quality and reduced noise, are already evident.



*Figure 7: Simon Bolivar Street before (left) and after (right) the greening measures. Converting a three-lane road into a one-lane street and creating a new public space. Image Credit: Bilbao City.*



*Figure 8: From Simon Bolivar Street before (left) and after (right) creating public spaces. Image Credit: Bilbao City.*

## Summary

In Bilbao, Spain, a major urban adaptation project transformed M<sup>a</sup> Díaz de Haro street, a heavily trafficked road, into a green public corridor to address climate risks such as flooding and urban heat. By replacing asphalt with permeable surfaces, expanding green infrastructure, and reallocating space to pedestrians, the project significantly improved air quality, reduced flood risk, and enhanced thermal comfort. These changes also promoted citizen engagement and public well-being. Post-implementation assessments confirmed reduced perceived temperatures and greater resilience to future climate conditions. Public acceptance has been strong, and the initiative underscores the importance of treating green infrastructure as a functional climate service, not just ornamental greenery.



Figure 9: From Simon Bolivar to Autonomia Street. Before and after implementation. Image Credit: Bilbao City.

## Further information

The work presented in this adaptation story has been developed by the City Council and financed by the European Union's Next Generation Programme.

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