

Contribution and degree of adaptation to climate change of the transportation sector in Spanish cities

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1

Introduction

Sustainable urban mobility is now a strategic priority for the development of European and Spanish cities and a central element in addressing current challenges related to climate change, air quality and citizens' well-being. This priority is reflected in a complex, multi-level regulatory framework, from European directives to municipal ordinances, that demonstrates the institutional commitment to transforming the urban mobility model.

The analysis of existing regulations and strategies underlines the need for an integrated approach that addresses not only technical and financial factors but also social and environmental dimensions. This report analyses the current regulatory framework in detail, identifies the main barriers to its effective implementation and proposes specific areas of action to overcome them.

Report objectives

The main objective of this document is to provide a comprehensive analysis of the regulatory frameworks and strategies for sustainable mobility currently applied or under development in Spain, within the broader context of the European regulatory framework. Specifically, it seeks to:

1. Examine the regulatory framework in force or in preparation at the different levels of administration (European, national and regional/local), analysing their interrelationship and effectiveness in promoting sustainable mobility.
2. Identify and categorise existing barriers (technical, financial, regulatory and social) that hinder the effective implementation of sustainable mobility policies.
3. Develop strategic proposals for action to overcome the barriers identified, taking into account the participation of the various stakeholders involved.
4. Compile and analyse national and international case studies that may serve as benchmarks for the implementation of sustainable mobility policies.
5. Establish a reference base of relevant documents to support the analysis carried out and guide future action in this field.



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Methodology

This report was prepared using an analytical methodology structured in the following phases:

1. Review of Documents:

- Comprehensive compilation of existing regulations, strategies and action plans
- Review of official documents issued by European and national institutions
- Analysis of regional and local plans and strategies
- Study of practical cases and implemented experiences

2. Categorisation and analysis of barriers:

- Systematic identification of obstacles to implementation
- Classification by type: technical, financial, regulatory and social
- Assessment of the impact of each barrier on the development of sustainable mobility

3. Development of proposals:

- Formulation of specific areas of action
- Identification of stakeholders and their roles
- Definition of implementation and monitoring mechanisms

4. Validation and Documentation:

- Comparison with previously documented experiences
- Feasibility analysis of the proposed measures
- Formulation of conclusions and recommendation

An analysis of the regulations, strategies and laws relating to sustainable mobility identifies four distinct levels of governance: European, national, regional and local. This regulatory framework presents a clear hierarchical structure, with European guidelines cascading down through the lower levels of administration and being adapted to the specific characteristics of each territorial context. The continuous evolution of sustainable mobility policies is reflected in a set of recently approved, updated or developing regulations and strategies. This dynamic regulatory framework complements and reinforces existing provisions, establishing new objectives and implementation mechanisms.

European-level strategies and laws relating to sustainable mobility and the transport sector's contribution to and degree of adaptation to climate change


Document name	Date of approval	Objectives	Milestones and key targets
Alternative Fuels Infrastructure Directive (AFID) ¹	2014	To develop infrastructure for low-emission vehicles, focusing on electric vehicle charging and the alternative fuel use.	2025: Significant increase in the number of charging points.
European Green Deal	2019	To make the EU the first climate-neutral continent by 2050, addressing sustainability across all sectors, including transport.	2030: 55% emissions reduction. 2050: Climate neutrality.
Sustainable and Smart Mobility Strategy	2020	To transform the EU transport system towards sustainability and digitalisation, promoting a 90% emissions reduction by 2050.	2030: 30 million zero-emission vehicles. 2035: All new vehicles to be zero-emission.
European Climate Law	2021	To establish the legal framework for achieving climate neutrality by 2050, with an interim target of a 55% emissions reduction by 2030.	2030: 55% emissions reduction. 2050: Climate neutrality.
EU Taxonomy Regulation ²	2021	To define criteria for classifying sustainable investments, directing capital towards projects that contribute to the environmental objectives of the Green Deal.	The taxonomy forms part of the Green Deal and supports the EU's climate targets for 2030 and 2050.
Revision of the Trans-European Transport Network (TEN-T)	Under development	To improve the connectivity and sustainability of the EU transport infrastructure by requiring “urban nodes” to adopt Sustainable Urban Mobility Plans (SUMPs).	2025: Implementation of SUMPs in major urban nodes.

European-level strategies and laws relating to sustainable mobility and the transport sector's contribution to and degree of adaptation to climate change

Document name	Date of approval	Level of governance	Objectives	Milestones and key targets
Spanish Circular Economy Strategy	2020	National	To promote resource reuse and reduce waste in key sectors, including transport.	2030: Increase in shared mobility use and efficient fleet management.
Climate Change and Energy Transition Law	2021	National	To establish a regulatory framework for the decarbonisation of the Spanish economy and achieve climate neutrality by 2050.	2023: Establishment of Low-analy in municipalities with over 50,000 inhabitants. 2030: 39.5% reduction in transport sector emissions. 2050: Climate neutrality.
Integrated National Energy and Climate Plan (PNIEC)	2021	Nacional	To define objectives for emissions reduction, renewable energy and energy efficiency, including specific measures for sustainable transport.	2030: 39.5% reduction in transport emissions; electrification of fleets; promotion of biofuels and renewable energies.
MOVES III Plan	2021	National	To provide grants for electric vehicles and charging infrastructure, promoting transport electrification.	Until 2023: Funding for the installation of charging points in municipalities and households.

1. The Directive was updated in 2023 by Regulation (EU) 2023/1804, which sets mandatory national targets for Member States to implement publicly accessible alternative fuel infrastructure (in particular for electricity and hydrogen) for road vehicles, ships at berth and stationary aircraft, with a particular focus on the trans-European transport network.

2. In early 2025, the European Commission presented a proposal to limit the scope of this regulation. It is pending a vote by the European Parliament before the end of 2025.



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Update of the Integrated National Energy and Climate Plan (PNIEC) 2021–2030	2024	National	To incorporate new measures and objectives to promote sustainable mobility and the decarbonisation of the transport sector.	2025: Review of progress in decarbonisation. 2030: Alignment with EU climate objectives and reinforcement of policies on electric mobility and biofuels.
Sustainable Mobility Law	2025	National	To establish a comprehensive legal framework to promote safe, sustainable and connected mobility in Spain, regulating key aspects of transport and urban mobility.	2030: Promotion of intermodality and expansion of low-emission networks in cities.
National Pact for Safe and Sustainable Mobility 2021–2030	2021	Regional	To promote sustainable, safe and efficient mobility in autonomous communities, in line with national and European decarbonisation objectives.	2030: Implementation of sustainable infrastructure and promotion of active and shared mobility.
Andalusian Climate Action Plan	2021	Regional	To incorporate measures for climate change mitigation and adaptation in transport, including emissions reduction and promotion of sustainable mobility.	2025: Expansion of sustainable transport networks in key cities. 2030: Significant reduction in transport emissions.
Madrid 360 Environmental Sustainability Strategy	2019	Local	To drive the transition towards fleet renewal, promote public transport, integrate all transport modes, strengthen road safety and foster innovation.	2025: Declaration of the entire city as a Low-Emission Zone.
Sustainable Urban Mobility Plans (SUMPs)	Varies by municipality	Local	To develop mobility policies adapted to local contexts to reduce car dependency and promote public and active transport.	2023-2030: Expansion of Low-Emission Zones (LEZ), cycling infrastructure and public transport.

A. European Level

The European regulatory framework establishes the fundamental basis for transforming the urban mobility system, articulated mainly through the following key instruments:

- 1. European Green Deal:** Serves as the overarching strategic framework, setting out the roadmap to achieve climate neutrality by 2050. In the field of urban mobility, it calls for a 90% emissions reduction in the transport sector, promoting the adoption of zero-emission vehicles and the development of sustainable infrastructure
- 2. Sustainable and Smart Mobility Strategy:** Defines the digital and sustainable transformation of the European transport system, setting measurable milestones such as the introduction of 30 million zero-emission vehicles by 2030 and the doubling of high-speed rail traffic. Ongoing until 2030, it encompasses 82 key initiatives for transforming the transport system and emphasises resilience and digitalisation as central pillars of change.
- 3. Alternative Fuels Infrastructure Directive (AFID):** Establishes the regulatory framework for developing refuelling and recharging infrastructure for alternative fuels, an essential element in facilitating the transition towards low-emission mobility.
- 4. European Climate Law:** Makes climate neutrality by 2050 a legal obligation, setting binding interim targets including a 55% emissions reduction by 2030. This law provides the legal foundation required for transforming the transport setor.
- 5. Revision of the Trans-European Transport Network (TEN-T):** Proposes a comprehensive update of the EU's connectivity and sustainability criteria for transport infra-

structure. It establishes the obligation for “urban nodes” to adopt Sustainable Urban Mobility Plans (SUMPs) by 2025 and reinforces multimodal integration and sustainability in transport networks.

B. National Level

The transposition of European objectives into the Spanish context is articulated through a range of regulatory and strategic instruments:

- 1. Climate Change and Energy Transition Law:** Establishes the fundamental regulatory framework for the decarbonisation of the Spanish economy, including specific measures for the transport sector. It mandates the creation of Low-Emission Zones (LEZ) by 2023 in municipalities with more than 50,000 inhabitants.
- 2. Integrated National Energy and Climate Plan (PNIEC) 2021–2030:** Defines quantifiable targets for emissions reduction, renewable energy deployment and energy efficiency in the transport sector. The measures set out include the electrification of vehicle fleets, the promotion of biofuels and the improvement of public transport efficiency. Following its update in September 2024, the plan incorporates new measures aligned with European guidelines, strengthens the decarbonisation targets for the transport sector and updates implementation and monitoring mechanisms.
- 3. Sustainable Mobility Law:** Adopted in October 2025, it establishes a comprehensive legal framework for promoting more sustainable, safe and connected mobility. It regulates key aspects of transport and urban mobility and introduces coordination mechanisms among administrations.

C. Regional Level

The autonomous communities develop their own regulatory frameworks, adapting national and European guidelines to their specific territorial contexts:

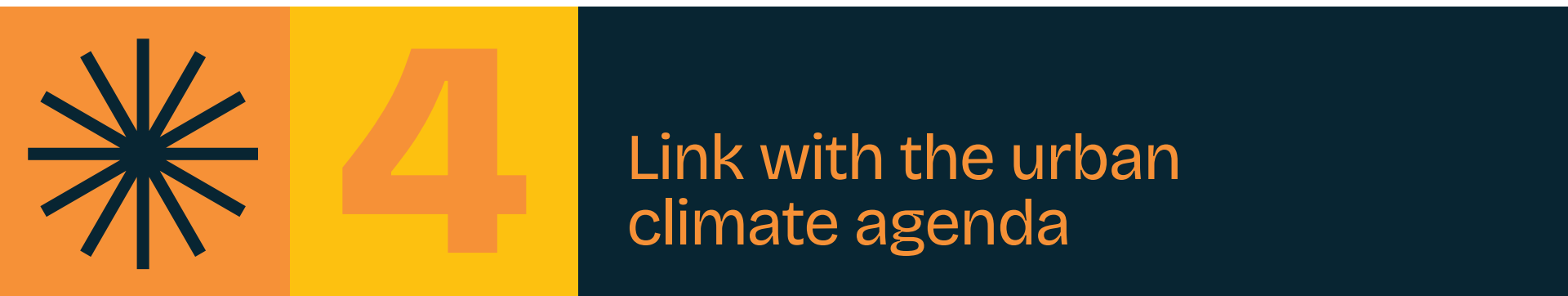
- 1. Regional Sustainable Urban Mobility Plans (SUMP):** The different autonomous communities have developed or are in the process of developing plans that establish guidelines and criteria to draft municipal SUMP, ensuring coherence between local policies and regional objectives. These include developing new Low-Emission Zones (LEZ), implementing mobility systems, and promoting intermodality and active transport.
- 2. Regional climate change strategies:** These incorporate specific measures for the transport sector, setting emissions reduction targets and promoting sustainable mobility at regional level by developing strategic frameworks adapted to the particular characteristics of each territory.

D. Local Level

At the municipal level, sustainable mobility policies are implemented mainly through two key instruments:

- 1. Low-Emission Zones (LEZ):** Their implementation represents one of the most significant measures for improving urban air quality and reducing emissions. The experiences of Madrid and Barcelona have served as a reference for other Spanish municipalities.
- 2. Sustainable Urban Mobility Plans (SUMP):** These constitute the main planning instrument, incorporating measures such as promoting cycling, improving public transport, and developing infrastructure for electric vehicles.

This multi-level regulatory structure establishes a coherent framework for transforming the urban mobility model. However, its effective implementation calls for close coordination among administrations and the removal of a number of barriers, which are examined in subsequent sections.



The interrelationship between sustainable mobility policies and the urban climate agenda is key to the transformation of Spanish cities. This link is reflected in shared objectives to achieve emissions reduction, improve air quality and create more resilient and liveable urban environments.

4.1. Context and priorities of the Urban Climate Agenda

4.1.1. Emissions and air quality targets

Urban mobility is one of the key sectors in achieving the climate objectives set out in the Paris Agreement and European directives. **Law 7/2021 of 20 May on Climate Change and Energy Transition** establishes a specific framework for action that includes:

- Mandatory implementation of Low-Emission Zones (LEZ) in municipalities with more than 50,000 inhabitants by 2023
- Quantifiable emissions reduction targets for urban transport
- Development of air quality indicators and monitoring systems
- Integration of sustainable mobility criteria into urban planning

4.1.2. Climate adaptation and resilience

The intensification of extreme weather events requires specific adaptation of urban mobility systems. The **Climate Change Adaptation Strategies** developed by MITECO establish:

- Resilient design criteria for transport infrastructure
- Implementation of nature-based solutions
- Early warning systems and response protocols
- Specific adaptation measures for public transport

4.1.3. Impact on public health

The transformation of the urban mobility model has direct implications for public health:

- Reduction of respiratory diseases associated with pollution
- Promotion of active modes of transport (cycling and walking)
- Improvement of urban quality of life
- Reduction of noise pollution

4.2. Alignment with other climate action policies

4.2.1. Integration with the Integrated National Energy and Climate Plan (PNIEC)

PNIEC 2021-2030 sets specific targets for the transport sector:

- 39.5% emissions reduction in the sector by 2030
- Progressive electrification of vehicle fleets
- Promotion of advanced biofuels
- Increased use of renewable energy in transport

4.2.2. Synergy with the circular economy

The **Spanish Circular Economy Strategy** incorporates specific criteria for the mobility sector:

- Optimisation of resources in transport infrastructure
- Promotion of shared mobility systems
- Efficient management of vehicle fleets
- Development of circular business models in transport

4.2.3. Coordination with the Covenant of Mayors

The accession of more than 300 Spanish municipalities to the Covenant of Mayors for Climate and Energy entails:

- Specific commitments to emissions reduction in transport
- Implementation of climate adaptation measures
- Development of local action plans
- Monitoring and reporting of progress

4.3. Implementation and monitoring mechanisms

4.3.1. Planning tools

- Sustainable Urban Mobility Plans (SUMPs)
- Low-Emission Strategies
- Air Quality Plans
- Monitoring and evaluation systems

4.3.2. Financial instruments

- Next Generation EU funds
- National incentive programmes
- Local financing mechanisms
- Public–private partnerships

4.3.3. Citizen participation

- Public consultation processes
- Awareness-raising programmes
- Digital participation platforms
- Shared mobility initiatives

This linkage between sustainable mobility and the urban climate agenda requires an integrated, multi-level approach that ensures coherence among the different policies and maximises their impact on the transformation of Spanish cities.



The analysis of the obstacles hindering the implementation of sustainable mobility measures reveals a set of interrelated barriers that must be addressed comprehensively. Identifying and understanding these barriers is essential for developing effective strategies to transform the urban mobility model.

5.1. Technical barriers

5.1.1. Insufficient infrastructure for electric vehicles

- Spain faces a significant deficit in charging points per kilometre of road compared with the European average.
- The lack of charging infrastructure limits the widespread adoption of electric vehicles in urban environments.
- This situation contrasts with the objectives set out in the **EU's Sustainable and Smart Mobility Strategy** and in the **PNIEC**.
- The uneven geographical distribution of charging points has created “infrastructure deserts” in certain urban areas.

5.1.2. Transport integration and digitalisation

- Lack of interoperability between different public transport systems.
- Need to improve the integration of transport modes (rail, bus, bicycle).
- Shortcomings in the implementation of unified digital systems.
- Difficulties in data management and user information systems.

5.2. Financial barriers

5.2.1. Initial cost of sustainable infrastructure

- High initial investment required for the implementation of Low-Emission Zones (LEZ).
- Budgetary constraints faced by municipalities in developing sustainable infrastructure.
- Insufficient Next Generation EU funds to cover all needs.
- High costs associated with transforming public transport fleets.

5.2.2. Access to financing

- Complexity of the application and management procedures for schemes such as the **MOVES III Plan**.
- Bureaucratic barriers to accessing subsidies.
- Specific difficulties for citizens and small businesses.
- Need for specialised personnel to process applications for aid.

5.3. Regulatory barriers

5.3.1. Fragmentation and overlap of regulations

- Coexistence of regulations at European, national, regional and local levels.
- Overlaps and contradictions among different administrative levels.
- Complexity in interpreting and applying regulations.
- Need for alignment with the principles of the **Climate Change and Energy Transition Law**.

5.3.2. Rigidity of regulatory requirements

- The existing regulatory framework is poorly adapted to new mobility technologies.
- Difficulties in regulating micromobility systems.
- Need for regulatory updates to address autonomous vehicles.
- Limitations in adapting to specific urban contexts.

5.4. Social barriers

5.4.1. Resistance to change

- Cultural predominance of private vehicle use.
- Negative perceptions regarding the safety and convenience of public transport.
- Resistance to the implementation of Low-Emission Zones.
- Lack of awareness of the benefits of sustainable mobility.
- Pressure from the automotive industry and from Member States with a strong automotive presence to delay previously agreed commitments (e.g. opposition to the 2035 ban on the sale of petrol cars or postponement of emissions standards from 2025 to 2027).
- An unfavourable social climate, amplified by reactionary and denialist networks opposed to the European Green Deal.

5.4.2. Skills and training gap

- Shortage of qualified personnel in new mobility technologies.
- Need for training in sustainable mobility management systems.
- Insufficient training in infrastructure maintenance.
- Lack of specific knowledge about shared mobility systems.

5.5. Impacts and consequences

5.5.1. Effects on implementation

- Delays in meeting climate targets.
- Difficulties in transforming the urban mobility model.
- Adverse impacts on air quality and public health.
- Obstacles to the decarbonisation of transport.

5.5.2. Implications for planning

- Need to review existing strategies and plans.
- Adjustments to implementation timelines.
- Additional resource requirements.
- Adaptation of objectives and targets

Identifying and understanding these barriers constitutes the first step in developing effective strategies to overcome them. The following sections of this report address specific approaches to overcoming these challenges



Possible areas of action

This section proposes specific strategies to overcome the barriers identified in the sustainable urban mobility sector. The areas of action presented are aligned with the objectives set out in European and national policies, taking into account the 2030- and 2050-time horizons.

6.1. Development of sustainable mobility infrastructure

6.1.1. Expansion of the charging network for electric vehicles

- Development of a strategic plan for the deployment of charging points.
- Promotion of public-private partnerships for installation and management.
- Use of Next Generation EU funds for infrastructure development.
- Prioritisation of areas with coverage deficits.
- Integration with the existing electricity grid and renewable energy systems.

6.1.2. Implementation of Low-Emission Zones (LEZ)

- Acceleration of LEZ implementation in cities with more than 50,000 inhabitants.
- Development of effective monitoring and control systems.
- Establishment of uniform access and restriction criteria.
- Coordination with parking and public transport policies.
- Continuous assessment of the impact on air quality.

6.2. Financing mechanisms and incentives

6.2.1. Incentives for sustainable vehicle adoption

- Review and expansion of programmes such as MOVES III.
- Establishment of specific tax incentives (VAT reduction, rebates).
- Development of fleet renewal programmes.
- Creation of preferential financing schemes.
- Simplification of administrative processes for accessing aid.

6.2.2. Promotion of private investment

- Creation of favourable frameworks for investment in sustainable infrastructure.
- Development of innovative financial instruments (green bonds).
- Establishment of public guarantees for strategic projects.
- Promotion of sustainable business models in mobility.
- Incentives for private sector participation.

6.3. Regulatory simplification and coordination

6.3.1. One-stop shop for administrative procedures

- Centralisation of licensing and aid application processes.
- Digitalisation of administrative procedures.
- Coordination among different administrative levels.

- Establishment of maximum resolution timeframes.
- Creation of a file-tracking system.

6.3.2. Harmonisation of regulations

- Coordination among local, regional and national regulations.
- Development of flexible and adaptable regulatory frameworks.
- Establishment of common implementation criteria.
- Improvement of communication among administrations.
- Creation of inter-administrative working groups.

6.4. Training and awareness

6.4.1. Programas de capacitación

- Development of specialised training programmes.
- Collaboration with educational centres and universities.
- Continuing education for professionals in the sector.
- Professional certification programmes.
- Exchange of best practices.

6.4.2. Public awareness and advocacy

- Information campaigns on the benefits of sustainable mobility.
- Educational programmes in schools.

- Citizen participation initiatives.
- Demonstration of innovative technologies and solutions.
- Effective communication of results and benefits.
- Advocacy at European level to counter attempts by the automotive industry to slow down or weaken decarbonisation targets.

6.5. Monitoring and evaluation

6.5.1. Monitoring systems

- Development of key performance indicators (KPIs).
- Implementation of real-time monitoring systems.
- Periodic evaluation of the measures' impact.
- Cost-benefit analysis.
- Continuous adjustment of strategies.

6.5.2. Adaptive management

- Periodic review of objectives and targets.
- Adaptation to new technologies and solutions.
- Response to changing mobility patterns.
- Incorporation of lessons learned.
- Updating of plans and programmes.

These areas of work require a coordinated approach and the active participation of all stakeholders involved in transforming the urban mobility model.



Key stakeholders in the public, private and social sectors influencing each barrier

This section identifies and analyses the main stakeholders involved in the transformation towards sustainable urban mobility, outlining their specific roles and capacities to address the barriers previously identified.

7.1. Public sector

7.1.1. European Union

European Commission, in particular DG Mobility and Transport (DG MOVE) and DG Climate Action (DG CLIMA)

- Under the European Green Deal, responsible for promoting efficient, safe and environmentally friendly mobility across Europe (DG MOVE).
- Leads the Commission's efforts to combat climate change and make the EU a resilient and climate-neutral society by 2050 through a just and socially fair transition (DG CLIMA)

European Parliament, notably its Committee on Transport and Tourism (TRAN) and Committee on the Environment, Public Health and Food Safety (ENVI)

- Legislation on transport within the Union (rail, road, inland waterways, maritime and air), as well as trans-European transport networks (TEN-T) (TRAN Committee).
- Legislation, implementation and oversight of the European Green Deal, including the circular economy and air quality (ENVI Committee)

7.1.2. Central government

Ministry for the Ecological Transition and the Demographic Challenge (MITECO)

- Development and coordination of national sustainable mobility policies.
- Management of European funds and grant programmes.
- Coordination with climate and energy policies.
- Supervision of compliance with national objectives.

Ministry of Transport, Mobility and Urban Agenda (MITMA)

- Strategic planning of transport infrastructure.
- Development of technical regulations.
- Coordination of urban and territorial policies.
- Management of specific aid programmes.

7.1.3. Regional and local governments

Autonomous Communities

- Adaptation of national policies to the regional context.
- Management of funds and aid programmes.
- Development of regional mobility plans.
- Inter-municipal coordination.

City Councils

- Direct implementation of sustainable mobility measures.
- Management of Low-Emission Zones (LEZ).

- Development and implementation of Sustainable Urban Mobility Plans (SUMPs).
- Citizen participation and awareness-raising activities.

7.2. Private sector

7.2.1. Mobility and transport companies

- Public transport operators.
- Shared mobility companies.
- Micromobility service providers.
- Charging infrastructure managers.
- Developers of innovative technological solutions.

7.2.2. Industrial and technology sector

- Electric vehicle manufacturers.
- Mobility management system developers.
- Charging infrastructure providers.
- Information technology companies.
- Start-ups specialising in sustainable mobility.

7.2.3. Financial sector

- Banks.
- Specialised investment funds.
- Insurance companies.
- Energy service companies.
- Specialised consulting firms.

7.3. Social sector

7.3.1. Non-governmental organisations (NGOs)

Environmental organisations

- Ecologistas en Acción
- Greenpeace Spain
- WWF Spain
- The Spanish Network for Sustainable Development (REDS-SDSN Spain)

7.3.2. Citizen associations

- Neighbourhood associations.
- Cycling groups.
- Public transport user groups.
- Citizen platforms.
- Consumer associations.

7.3.3. Academic and research institutions

- Universities.
- Research centres.
- Specialised think tanks.
- Mobility observatories.
- Vocational training centres.

7.4. Collaboration mechanisms

7.4.1. Coordination platforms

- Mobility roundtables.
- Intersectoral working groups.
- Citizen participation forums.
- Sustainable City networks.
- Public–private partnerships.

7.4.2. Cooperation instruments

- Collaboration agreements.
- Framework agreements.
- Joint pilot projects.
- Open innovation programmes.
- Public–private participation initiatives.

The effectiveness of the urban mobility model transformation depends largely on coordination and collaboration among these stakeholders, as well as on their capacity to align objectives and resources in pursuit of common goals.



8

Urban structure and transformative best practices

The relationship between urban structure, population density and sustainable mobility is a determining factor in the success of urban transport transformation policies. This section analyses how urban morphology and territorial development patterns condition the effective implementation of sustainable mobility strategies and presents success stories that have adapted their solutions to different urban contexts.

8.1. Determinants of urban structure

High-density urban areas offer significantly more favourable conditions for the implementation of sustainable mobility systems. In such environments, the concentration of popula-

tion and economic activity makes public transport more viable, thanks to a critical mass of users that ensures the profitability of services. Shorter distances between origins and destinations also facilitate active mobility, enabling many journeys to be made on foot or by bicycle. This compact urban configuration allows for more efficient use of infrastructure and a substantial reduction in per capita costs for transport service provision.

In contrast, low-density areas face considerable challenges in implementing sustainable mobility systems. Urban sprawl creates a strong dependence on private vehicles, as long distances and low population density make it difficult to maintain frequent and economically viable public transport services. Infrastructure costs per inhabitant increase signifi-

cantly, while the energy efficiency of transport is reduced due to more dispersed mobility patterns.

The centre–periphery relationship poses particular challenges for sustainable mobility. The territorial dynamics of contemporary metropolitan areas are characterised by complex commuting patterns that place considerable pressure on transport infrastructure. Discontinuous urban expansion, with low-density residential developments on the periphery, generates a strong functional dependence on the urban centre, leading to congestion at city access points and high emissions associated with long commutes.

8.2. Success stories in Spain

The transformation of urban mobility in Spain offers notable examples that have successfully adapted their strategies to different urban contexts.

Vitoria-Gasteiz stands out as an international benchmark in sustainable mobility thanks to its compact and polycentric city model. Its Sustainable Mobility Plan has achieved a comprehensive transformation of the transport system through the implementation of an innovative superblock system, which reorganises traffic by prioritising pedestrians and cyclists. The city has managed to increase the modal share of sustainable travel (public transport, walking or cycling) to 59% of total journeys (mainly walking), while cars are used for 29% of trips³. The system is complemented by an efficient public transport network connecting all neighbourhoods to the centre and a network of urban paths integrated with the peri-urban green belt. The success of the model lies in its ability to guarantee access to basic services within a 15-minute walk from anywhere in the city.

Barcelona has shown how a dense, traditional urban fabric can be transformed through the Superblocks programme, which goes beyond simple traffic-calming measures to create new shared public spaces. The initiative has reduced motorised traffic by 26% in the areas concerned and has significantly expanded the space allocated to pedestrians and cyclists. The city’s micromobility strategy complements this transformation with an extensive network of cycle lanes and a successful bike-sharing system that carries more than 50,000 trips per day. The integration of micromobility services under a public–private management model has further diversified sustainable transport options.

Madrid has implemented one of the most ambitious low-emission zones in Europe with Madrid Central, later expanded as Madrid 360. According to the Transport & Environment report cited by the European Commission, Madrid Central achieved “a 32% reduction in NO₂ emission levels”, making it “one of the most effective low-emission zones in the EU”⁴. The control and monitoring system, based on cameras and licence plate readers, has proved effective in ensuring compliance with restrictions. Madrid’s experience has served as a model for other Spanish cities that must implement low-emission zones under the Climate Change Law.

Valencia has developed a comprehensive sustainable mobility model that combines an extensive public transport network with significant interventions to promote active mobility. The development of the MetroValencia network, complemented by a bus network and an orbital tram system, has significantly reduced private vehicle use. The city has created more than 156 kilometres of cycle lanes and implemented a successful public bicycle system that registers more than 20,000 uses per day. The pedestrianisation of the

historic centre and the creation of “green rings” have significantly improved the quality of public space and reduced CO₂ emissions by 30% in the areas involved⁵.

8.3. International cases

8.3.1. Comprehensive transformation of urban centres

Oslo is a prime example of a city that has transformed its centre into a car-free zone. Since 2019, the Norwegian capital has progressively eliminated motorised traffic from its centre through a gradual process that began with the removal of parking spaces and continued with the pedestrianisation of increasingly larger areas. The programme has converted former parking spaces into public areas, parks and cycle lanes, while reducing emissions from municipal agencies by 70%⁶. The effective prioritisation of public transport, with dedicated lanes and high frequency, has made it possible to maintain accessibility to the centre without relying on private vehicles.

Paris has revolutionised urban planning with its 15-Minute City concept, which reorganises the city into neighbourhoods where all essential services are accessible within a 15-minute walk or cycle ride. The Comprehensive Mobility Plan includes the creation of 1,000 kilometres of cycle lanes, the removal of 70,000 surface parking spaces and the transformation of major avenues into green corridors. The results show a 45% reduction in car use since 2001 and a 54% increase in cycling. The creation of “school streets” and the redistribution of public space have significantly improved the quality of urban life.⁷

8.3.2. Active mobility and cycle lanes

Amsterdam has developed a comprehensive cycling mobility system over decades that serves as a global benchmark. The cycling infrastructure network includes more than 767 kilometres of segregated lanes, secure parking at all public transport stations and specific signage for bicycles. This infrastructure has led to a scenario where 36% of all journeys in the city are made by bicycle, therein significantly reducing emissions and improving public health⁸. Urban design consistently prioritises cycling, with safe intersections, synchronised traffic lights for cyclists and direct connections between neighbourhoods.

The capital region of Denmark has implemented an innovative network of *cycle superhighways*⁹ that connects the suburbs with central Copenhagen. The system, which covers more than 850 kilometres planned to link 30 municipalities, has demonstrated that high-quality cycle lanes can be a viable alternative for medium-distance trips (5–30 kilometres). The investment of €295 million is justified by an estimated socio-economic benefit of €765 million, derived from improved public health and reduced emissions. Use of these routes has increased by 23% since their implementation.

8.3.3. Innovation in mobility services

Finland has revolutionised the concept of urban mobility with its Mobility as a Service (MaaS) system¹⁰. The 2017 Transport Services Act established the regulatory framework for integrating all modes of transport into a single digital platform. Users can plan, book and pay for multimodal journeys through a single app, combining public transport, taxis, shared bicycles and rental vehicles. The system has reduced private vehicle use by 38% among its users and increased public transport use by 25%.

3. <https://www.polisnetwork.eu/member/vitoria-gasteiz/>

4. https://urban-mobility-observatory.transport.ec.europa.eu/news-events/news/madrids-low-emission-zone-identified-one-most-effective-eu-2019-09-30_en

5. <https://safety4sea.com/port-of-valencia-achieved-30-reduction-in-co2-emissions/>

6. <https://www.oslo.kommune.no/politics-and-administration/statistics/environment-status/climate-and-energy-statistics/>

7. <https://www.peopleforbikes.org/news/how-paris-raised-bike-ridership-54-percent-in-one-year>

8. <https://americas.uli.org/wp-content/uploads/ULI-Documents/Amsterdam-Bicycling.pdf>

9. <https://supercykelstier.dk/english/about/>

10. https://www.nordicpolicycentre.org.au/mobility_as_a_service_legislation_in_finland?

Rotterdam has developed an innovative solution for low-density areas with its PTFlex system. This on-demand transport service connects peripheral areas with major transport hubs using a diversified fleet ranging from minibuses to electric vehicles. The flexible booking system allows real-time requests and is fully integrated with regular public transport pricing. The results show user satisfaction above 4.4/5 and a 35% reduction in operating costs compared with regular bus services in low-density areas¹¹.

8.3.4. Modal exchange systems

The United Kingdom has developed an extensive network of Park & Ride facilities that facilitate the transition between low- and high-density areas. With more than 92 facilities in 40 locations, the system has proven particularly effective in historic cities with dense centres. Oxford, a pioneer in its implementation since the 1970s, has reduced traffic in the city centre by 40% thanks to this system¹². Express bus services connect the parking facilities with city centres and integrated pricing encourages the use of public transport. The model has been particularly successful in cities such as Cambridge, York and Bath, where historic centres cannot absorb large volumes of traffic.

8.4. Lessons learned and success factors

These case studies demonstrate that the transition towards sustainable mobility requires a comprehensive approach that takes into account the existing urban structure. Key success factors include long-term planning, sustained political commitment and active community engagement. The gradual implementation of measures, combined with clear and effective communication, has been essential to overcoming initial resistance.

Integrating different modes of transport and leveraging digital technologies have enabled the development of solutions adapted to varying urban densities. Ongoing monitoring and evaluation have, in turn, facilitated the adjustment of strategies to the specific needs of each context.

Ultimately, success depends on offering attractive alternatives to private vehicles, tailored to the characteristics of each area: on-demand services in low-density zones, cycling infrastructure for medium-distance travel, and efficient modal interchange systems for transitions between different urban densities.



Conclusions

The analysis carried out in this report shows that the transformation of the urban mobility model in Spain is at a critical stage in its evolution. The research demonstrates the existence of a robust, multi-level regulatory framework which, although setting ambitious targets in line with European guidelines, still presents **significant challenges for effective implementation**.

The study of existing barriers reveals that the main obstacles lie not so much in the absence of regulatory instruments as in the technical, financial and social difficulties involved in their application. Insufficient electric-vehicle charging infrastructure, budgetary constraints on local governments and social resistance to change are the main obstacles identified in achieving the established objectives.

Analysis of the relationship between urban structure and sustainable mobility shows that **solutions must be adapted to different urban contexts**. Successful experiences, both in Spain and internationally, demonstrate that **it is possible to implement effective strategies in high-density contexts** — as shown by the superblocks in Barcelona and Vitoria-Gasteiz — as well as in low-density environments, as illustrated by the PTFlex system in Rotterdam or the British Park & Ride model. Innovation in mobility services, such as Finland's MaaS system, and the development of regional-connection infrastructure, such as Copenhagen's Cycle Superhighway network, show that the barriers imposed by urban sprawl and dependence on private vehicles can be overcome. The most successful transformations have been characterised by a **comprehensive approach** combining demand-management measures, improvements in public transport provision and the promotion of active mobility, always adapted to the specific characteristics of each urban fabric.

The research finds that achieving the targets set for 2030 and 2050 will require a significant acceleration in the implementation of planned measures. This acceleration must rest on three fundamental pillars: improving coordination among administrations, developing innovative financing mechanisms and strengthening citizen-participation processes.

The transition towards a sustainable urban-mobility model in Spain is technically feasible and socially necessary. However, its success will depend on the ability to mobilise the necessary resources and to maintain long-term political and social commitment. The coming years will be decisive in consolidating the progress achieved and in laying the foundations for a comprehensive transformation of the urban mobility system, in line with the objectives of decarbonisation and improved quality of life in Spanish cities.

11. https://tda-mobility.org/wp-content/uploads/2018/11/Rotterdam_Urban-Traffic_Plan.pdf?

12. https://www.interregeurope.eu/good-practices/the-use-of-park-and-ride-as-a-strategy-for-tourist-arrivals-to-the-destination?utm_source=chatgpt.com



References to relevant publications on the subject

The transition towards sustainable urban mobility is supported by a broad body of documentation encompassing regulations, strategies and studies developed by various institutions and organisations. This section presents the most relevant sources supporting the analysis conducted.

10.1. European Union documents and strategies

10.1.1. European Green Deal

- Framework document establishing the pathway to European climate neutrality
- Date of publication: December 2019
- Sets out the main objectives
 - Climate neutrality by 2050
 - 90% reduction in transport emissions
 - Comprehensive transformation of the mobility system

10.1.2. Sustainable and Smart Mobility

- Published: December 2020
- Specific objectives:
 - 30 million zero-emission vehicles by 2030
 - Doubling of high-speed rail traffic
 - Digital transformation of transport
- Alignment with decarbonisation objectives
- Definition of 82 key initiatives

10.1.3. Alternative Fuels Infrastructure Directive (AFID)

- Establishes the regulatory framework for recharging infrastructure
- Promotes the development of alternative fuels
- Establishes common technical standards
- Plans the development of a European recharging network

10.2. National strategies and plans in Spain

10.2.1. Law 7/2021 on Climate Change and Energy Transition

- National legal framework for decarbonization
- Binding targets for 2030 and 2050
- Specific regulation for urban mobility
- Mandatory establishment of Low Emission Zones

10.2.2. Integrated National Energy and Climate Plan (PNIEC) 2021–2030

- National strategic framework
- Specific measures for the transport sector
- Quantifiable emissions-reduction targets
- Strategies for electrification and renewable energy

10.2.3. Spanish Circular Economy Strategy

- Framework for waste reduction
- Promotion of reuse and recycling
- Application to the transport sector
- Promotion of shared mobility

10.3. International Organisations and Agreements

10.3.1. Covenant of Mayors for Climate and Energy

- Network of cities committed to climate action
- Specific targets for sustainable urban mobility
- Exchange of best practices
- Monitoring and reporting of results

10.3.2. International Association of Public Transport (UITP)

- Technical publications and case studies
- Implementation guides
- Analysis of best practices
- Resources for transport operators

10.4. Academic and Technical Publications

10.4.1. Impact Studies

- Evaluations of Low Emission Zones
- Analyses of mobility policies
- Air-quality assessments
- Research on modal shift

10.4.2. Technical Guides

- Implementation manuals
- Methodological documents
- Technical standards
- Evaluation protocols

This body of publications provides the essential framework for developing and implementing sustainable mobility policies, ensuring their alignment with the climate and sustainability objectives set at European and national levels.



Madrid City Council (2019). Plan de Sostenibilidad Ambiental Madrid 360 [Madrid 360 Environmental Sustainability Plan], https://www.madrid360.es/wp-content/uploads/2021/09/Avance-Estrategia-Sostenibilidad-Ambiental-Madrid-360_baja.pdf

European Commission (2020). Strategy for Sustainable and Smart Mobility: Steering European Transport Towards the Future. https://eur-lex.europa.eu/resource.html?uri=cellar:5e601657-3b06-11eb-b27b-01aa75ed71a1.0009.02/DOC_1&format=PDF

Community of Madrid (2024). Estrategia de Economía Circular de la Comunidad de Madrid [Circular Economy Strategy of the Community of Madrid] https://www.comunidad.madrid/transparencia/sites/defaultfiles/regulation/documents/20250721_estrategia_eccm_-_version_inicial.pdf

IDAE (2021) Plan MOVES III, <https://www.idae.es/ayudas-y-financiacion/para-movilidad-y-vehiculos/programa-moves-iii>
Regional Government of Andalusia (2021). Plan Andaluz de Acción por el Clima [Andalusian Climate Action Plan 2021–2030]: https://www.juntadeandalucia.es/medioambiente/portal/land-ing-page-%C3%ADndice/-/asset_publisher/zX2ouZa4r1Rf/content/el-plan-andaluz-de-acci-c3-b3n-por-el-clima-2021-2030-20151

Law 7/2021, of 20 May, on Climate Change and Energy Transition. https://www.boe.es/diario_boe/txt.php?id=BOE-A-2021-8447

Law 1/2024, of 17 April, on the Circular Economy of the Community of Madrid. <https://www.boe.es/buscar/act.php?id=BOE-A-2024-14999>

MITECO – Ministry for the Ecological Transition and the Demographic Challenge (2020). Estrategia Española de Economía Circular: España Circular 2030 [Spanish Circular Economy Strategy: Circular Spain 2030]: <https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/economia-circular/estrategia.html>

MITECO – Ministry for the Ecological Transition and the Demographic Challenge (2024). Plan Nacional Integrado de Energía y Clima (PNIEC) 2023–2030. [Integrated National Energy and Climate Plan (PNIEC) 2023–2030]. https://www.miteco.gob.es/content/dam/miteco/es/energia/files-1/pniec-2023-2030/PNIEC_2024_240924.pdf

Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment and amending Regulation (EU) 2019/2088 (Text with EEA relevance) <https://eur-lex.europa.eu/legal-content/ES/ALL/?uri=CELEX:32020R0852>

Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (“European Climate Law”) <https://eur-lex.europa.eu/legal-content/ES/TXT/HTML/?uri=CELEX:32021R1119>

Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure and repealing Directive 2014/94/EU (Text with EEA relevance). <https://eur-lex.europa.eu/ES/legal-content/summary/deployment-of-alternative-fuels-infrastructure.html>

European Union (2019). European Green Deal: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en



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