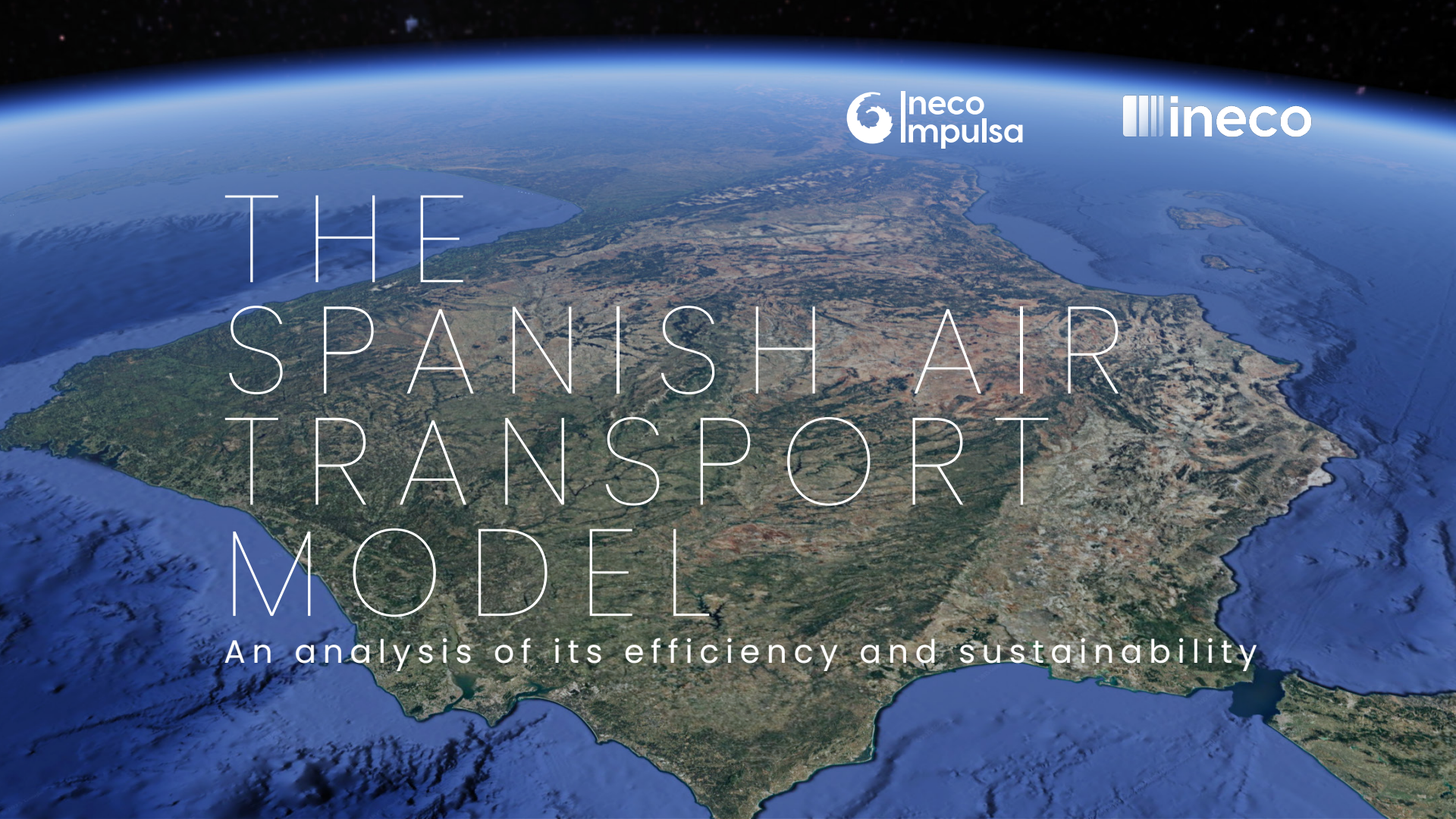

THE SPANISH AIR TRANSPORT MODEL

An analysis of its efficiency and sustainability

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An analysis of its efficiency and sustainability

Contents

01

Introduction and Approach

In 2024, global air transport managed to recover and even surpass pre-pandemic demand levels, with nearly 9.5 billion passengers passing through airports, compared to the 9.2 billion recorded in 2019. Already in 2023, the recovery was showing clear signs, reaching 8.6 billion passengers worldwide.

This recovery occurred much more rapidly in Spain. By 2023, the Spanish airport network was already serving more passengers than in 2019, reaching another record in 2024 with 309.3 million passengers and 2.36 million operations.

The Spanish air market now consistently represents more than 3% of global passenger traffic. This has allowed Spain, for the first time since the pandemic, to consolidate its position as the leading European market and the third largest in the world in terms of international traffic.

The focus on international markets and tourism explains this strong growth, occurring in parallel with the development of the high-speed rail network, which absorbs most domestic (peninsular) traffic.

Despite the many challenges the sector faces, **growth forecasts remain strong**. According to the Airports Council International (ACI World), by 2053 demand could reach 22.3 billion passengers, which would mean multiplying current volumes by 2.4 in just 30 years. The International Civil Aviation Organization (ICAO) is even more optimistic: in its 2026–2050 Strategic Plan, it projects up to 24.8 billion passengers.

Spain maintains a strong position in the global air transport landscape. According to these forecasts, it will continue to be a top-tier origin and destination, **consistently ranking among the world's top five air markets in the coming years.**

This report presents the Spanish air transport model as a success story, through which Spain has reached a leading position in the global industry rankings. To do so, it analyzes key aspects such as the sector's impact on the economy and the main features of its **efficiency, competitiveness, and quality.**

It will explore the reasons behind this success and the key factors that have made it possible. But far from complacency, the focus will be on the future, with a determined approach to addressing the challenges that remain — **especially the need to decarbonize air transport**, a crucial element for ensuring its long-term sustainability.

In the field of sustainability, the report will delve into the importance of providing rigorous data that allows for an accurate assessment of air transport's contribution to greenhouse gas emissions. To this end, it is essential to offer a cumulative calculation from an infrastructure perspective and a comprehensive life-cycle analysis.

02

The Strength of the Spanish Air Sector and Its Significant Impact

2.1 Key economic driver

Air transport plays a relevant role in the global economy, driving key sectors such as trade, industry, and tourism.

In the words of the International Civil Aviation Organization (ICAO), it is one of the pillars of economic development on which States rely, given its effective contribution to commercial exchange and social communication between different nations and States.

This importance takes on a special qualitative and quantitative dimension in Spain. Its condition as a peripheral country, the significant presence of island territories, and the weight of tourism in the GDP make air transport an essential pillar for national connectivity and international competitiveness. In addition to being a key factor for internal mobility, it is the main gateway for tourists and foreign visitors, thus strengthening the economic development and global projection of the country. To assess the relevance of air transport in Spain, two indicators have been considered: its contribution to the Gross Domestic Product (GDP) and its impact on employment. These effects are analyzed at different levels:

- Direct impacts (airlines, airport operators, aircraft manufacturers, and other companies directly linked to air transport).
- Indirect impacts (suppliers of air transport elements such as fuel or aircraft subcomponents, as well as service providers such as consulting or accounting).
- Induced impacts (the impact of spending on goods and services by those employed in the aviation sector and their suppliers).
- Tourism catalyst (air transport generates a positive impact on the number of visitors, thereby influencing employment and the economic development of that sector).

According to the latest ATAG report (2024) with data from 2023, a direct impact of air transport[1] on the Spanish economy of €24 billion has been observed, which is equivalent to 1.7% of the national GDP. When considering the total impact —including direct, indirect, induced, and tourism-related effects— this figure rises to €156 billion, representing 10.8% of GDP. In terms of employment, the direct impact of the sector reaches 305,000 jobs, 1.4% of total employment in Spain, while the total impact exceeds 2 million jobs, representing 9.6% of national employment. In all cases, these values are notably higher than the average of other countries and of Europe as a whole. Spain is thus positioned as the leading country in Europe (ahead of countries like the United Kingdom, Germany, France, or Italy) in terms of the total impact of air transport in both output and employment, as can be seen in the table on the following page.

Spain's good position in air traffic is clearly illustrated when compared with GDP or population. In the graphs that follow, a logical positive relationship can be observed between GDP (above) and population (below), and the demand for air traffic.

Economic Significance of Air Transport in the European Union and Spain

	Territory	Indirect impact	Direct impact	Induced impacts	Catalyst of tourism	Total
GDP contribution (Millions € and %)	European Union	174,000 M€	202,000 M€	147,000M€	239,000 M€	763,000 M€
		1.0%	1.2%	0.9%	1.4%	4.5%
	Spain	24,000 M€	22,000 M€	17,000 M€	91,000 M€	156,000 M€
		1.7%	1.5%	1.2%	6.3%	10.8%
Jobs created (jobs and %)	European Union	2,000,000	2,400,000	1,600,000	3,300,000	9,300,000
		0.9%	1.1%	0.7%	1.5%	4.2%
	Spain	305,000	300,000	230,000	1,200,000	2,035,000
		1.4%	1.4%	1.1%	5.7%	9.6%

Source: Own development based on the report "Aviation benefits beyond borders" prepared by ATAG (2024), Labour Force Survey (LFS) compiled by INE and World Bank database.

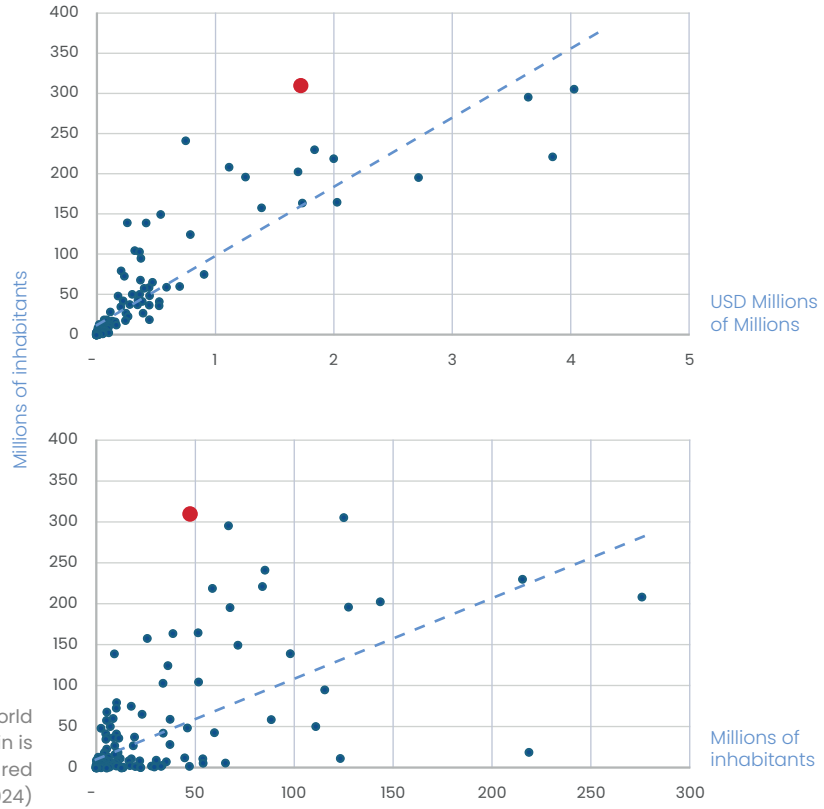
Spain (red dot) is positioned well above the trend line in both cases., this indicates that its passenger volume atypically exceeds what would be expected based on its economy and population. In 2024, Spain received 93.8 million international visitors, of whom 77 million arrived by air, representing 82.1% of the total, according to data from the INE. These figures confirm that the airplane is, by far, the main mode of transport for international tourism in the country.

This predominance is largely due to the high quality and efficiency of the air transport system in Spain, which strengthens its competitiveness as a global tourist destination.

The Travel and Tourism Competitiveness Index of the World Economic Forum analyzes in detail the availability and quality of physical infrastructure and tourism services, placing special emphasis on air transport infrastructure, given its essential role in connectivity and access for travelers both nationally and internationally.

In the 2024 edition, Spain ranked as the second-best country among the 119 analyzed. Furthermore,

Volume in Each Country VS. GDP and Population (2024)



Source: ACI and World Bank. Note: Spain is represented by the red dot (year 2024)

in the sub-index that measures the quality of airports, Spain ranks third globally, only behind the United Arab Emirates and the United States. This recognition highlights the value of the quality of the Spanish air sector in the successful performance of tourism.

2.2 Competitive and High-Quality Sector

Spanish air transport (airports, airlines, and related services) is effective, high-quality, and efficient. To support these statements, a comparative analysis of indicators is conducted across three critical levels of its performance:

- **Demand and connectivity indicators**: based on the volume and resilience of traffic (passengers and operations) at airports.
- **Quality and punctuality indicators**: based on user satisfaction surveys at airports and within the air navigation system, as well as airline punctuality.
- **Cost-efficiency indicators**: based on the cost of operating and constructing infrastructure and the fees charged to airlines.

While there are multiple perspectives and indicators to evaluate the sector's performance, the selected ones allow for a solid and relevant diagnosis, aligned with the objectives of this report.

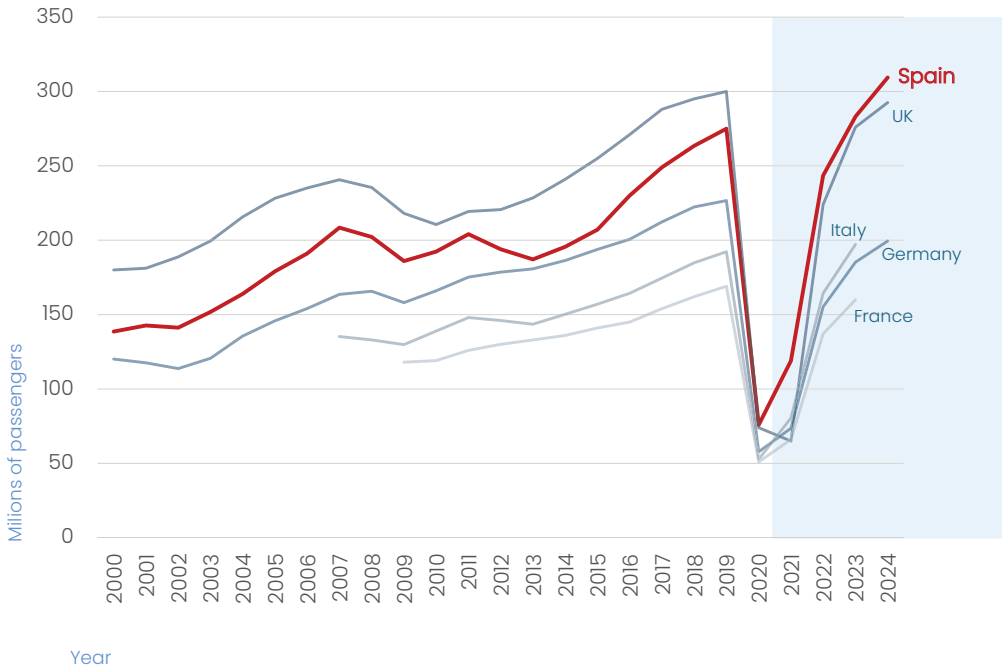
2.2.1 Demand and Connectivity

The Spanish air market reached **309 million passengers and 2.36 million operations in 2024, quickly recovering** and surpassing the sharp decline that occurred in the aviation sector during the pandemic. While some countries have not yet recovered to pre-pandemic levels, Spain has far exceeded its previous figures (275 million passengers and 2.15 million operations in 2019).

This growth has been driven by the boom in tourism, the recovery of international connectivity, and the dynamism of domestic traffic, especially with the islands.

This recovery is highly significant because, during the most difficult moments of the Covid crisis, there was uncertainty about how long it would take for demand to return—and whether travelers had permanently changed their travel habits.

Passenger demand by country (2000-2024)



Source: Aena, Civil Aviation Authority (UK), LBA (Germany), ENAC (Italy), Ministry of Ecological Transition (France)

Spain has now consolidated its position as **the leading air market in Europe** in terms of passenger volume, surpassing the United Kingdom, which had historically led air traffic in the region, thanks to a faster recovery after the pandemic, as can be seen in this graph.

Spain ranks as the fourth-largest air market in the world, behind only countries with much larger populations: the United States (1,870 million passengers in 2023), China (1,144 in 2023), and India (380 in 2023), all of which have massive domestic demand that drives their passenger traffic[2].

It is important to note that this recovery was not a one-off phenomenon. **Already in the past decade, following the financial and fiscal crisis, Spain experienced air traffic growth rates higher than those of its European peers**.

Another key factor in Spain's air traffic recovery has been the remarkable **resilience** of the sector. This is largely because, during the pandemic, the industry managed to preserve both its workforce and operational capacity.

Measures such as the temporary layoff schemes allowed the Spanish system to be ready to handle the strong rebound in demand when passengers were ready to fly again — unlike in other countries.

Two Spanish airports are among the ten busiest in Europe: **Madrid-Barajas (66 million passengers in 2024, ranked 5th) and Barcelona-El Prat (55 million passengers, ranked 7th)**. Both have managed to close the gap with the major European hubs, consolidating Spain as a strategic node both at the continental and global levels.

Expectations for growth in the Spanish air market are high. Passenger numbers are forecast to reach 400 million by 2031, 500 million by 2039, and 600 million by 2048, according to projections by **Airports Council International (ACI)**.

Additionally, according to ACI's latest connectivity report, Spain ranks third in Europe[3] in terms of total connectivity, and sixth in terms of direct connectivity[4]. Specifically:

- In terms of available seats, Spain would rank third globally in international connectivity, behind only the U.S. and the United Kingdom[5].
- **Madrid-Barajas** is the world's leading airport for direct connectivity to Latin America and the Caribbean, positioning Spain as a key intercontinental hub. Even so, much of Spain's connectivity relies on medium-sized airports.
- **Barcelona-El Prat** stands out for its large number of connections to European cities and is the second airport in Europe for origin-destination traffic, behind only London-Heathrow.

In summary, whereas in other markets the volume is mainly driven by domestic routes, Spain stands out in international traffic, with a network of airports that connects Europe with Latin America, North Africa, and other key destinations.

2.2.2 Perceived Quality and Punctuality

The **growth and traffic volume achieved have not come at the expense of service quality**, despite the pressures faced by the sector in recent years.

To assess this aspect, passenger satisfaction surveys at airports have been analyzed, as well as airline punctuality indicators, allowing a comparison of the performance of Spanish air transport with that of other countries.

First, the most recent passenger satisfaction survey data conducted by ACI (2024) at 114 European airports have been analyzed. [6]These surveys, carried out at the departure gates of pre-selected flights, evaluate the overall user experience within the airport, taking into account all processes from arrival to departure, including check-in, security screening, and boarding gates, among others.

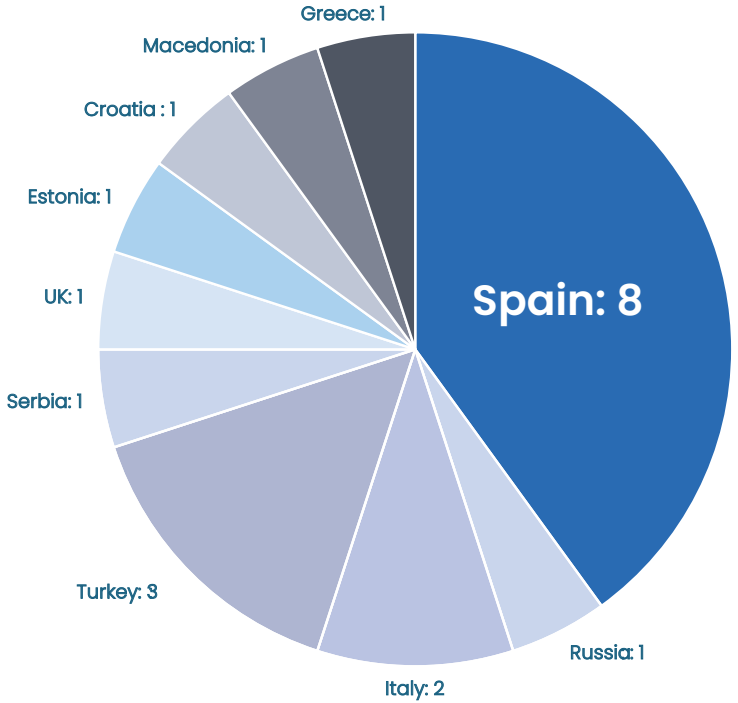
According to this indicator, Spanish airports stand out for their high ratings from passengers.

In fact, Spain is the country with the highest number of airports within the top 20 highest-rated in Europe, as shown in the graph on the right.

When focusing the analysis on Europe's main airports, it becomes evident that user satisfaction tends to be significantly lower at large infrastructures compared to medium- and small-sized airports. However, the Spanish airports of Madrid and Barcelona **stand out for offering passengers** a better overall experience, ranking above other major European airports in terms of satisfaction, such as London-Heathrow (LHR), Istanbul (IST), Charles de Gaulle (CDG), and Amsterdam-Schiphol (AMS).

In general, it is worth noting that the **high ratings of Spanish airports are found across the full range of airport sizes and types, though this advantage is perhaps most noticeable in the larger airports.** And this level of quality is achieved under a regime of strict regulation, financial self-sufficiency, and controlled costs — a context which lends Spain's performance a degree of merit that does not apply as strongly to other airports around the

Top 20 European airports best rated by users according to airport location



Source: Own development based on the report "ASQ Departures. Passenger Satisfaction Report" prepared by ACI (2024). Note: top rated airports by the question "How would you rate your experience today at this airport?"

world, such as those in the Gulf States, where the management model is fundamentally different.

Secondly, **punctuality indicators** for Spanish airlines have also been examined in comparison with other operators. According to the OAG[7] air transport database, in February 2025, Spanish airlines **ranked highly for on-time performance among a total of 109 airlines analysed**. Specifically, Iberia was the most punctual airline in Europe (and fourth globally), while Air Europa ranked third in Europe (and sixth worldwide).

Finally, Spain's air navigation system also assesses levels of perceived quality through **surveys conducted with pilots and airlines**. Over the four years of ENAIRE's Strategic Plan, Plan de Vuelo 2025, **perceived quality has improved by 9.5%**, reflecting rising customer satisfaction and the organisation's strong commitment to continuous improvement.

2.2.3 Cost Efficiency

Maintaining high standards of quality and punctuality has not led to increased costs. Across the entire value chain, the Spanish air sector stands out for keeping costs in check while achieving a high level of efficiency.

In terms of cost indicators, the performance of the Spanish air sector has been assessed with regard to operational costs, capital expenditure, and investment in major airport infrastructure projects. In addition, the level of key charges borne by airlines has also been reviewed.

Airport Operating Costs

First, a comparative analysis has been carried out to evaluate the cost-efficiency of airport operators or infrastructure managers. This was done using operational cost data from the financial accounts of leading operators, divided by the total number of passengers handled[8].

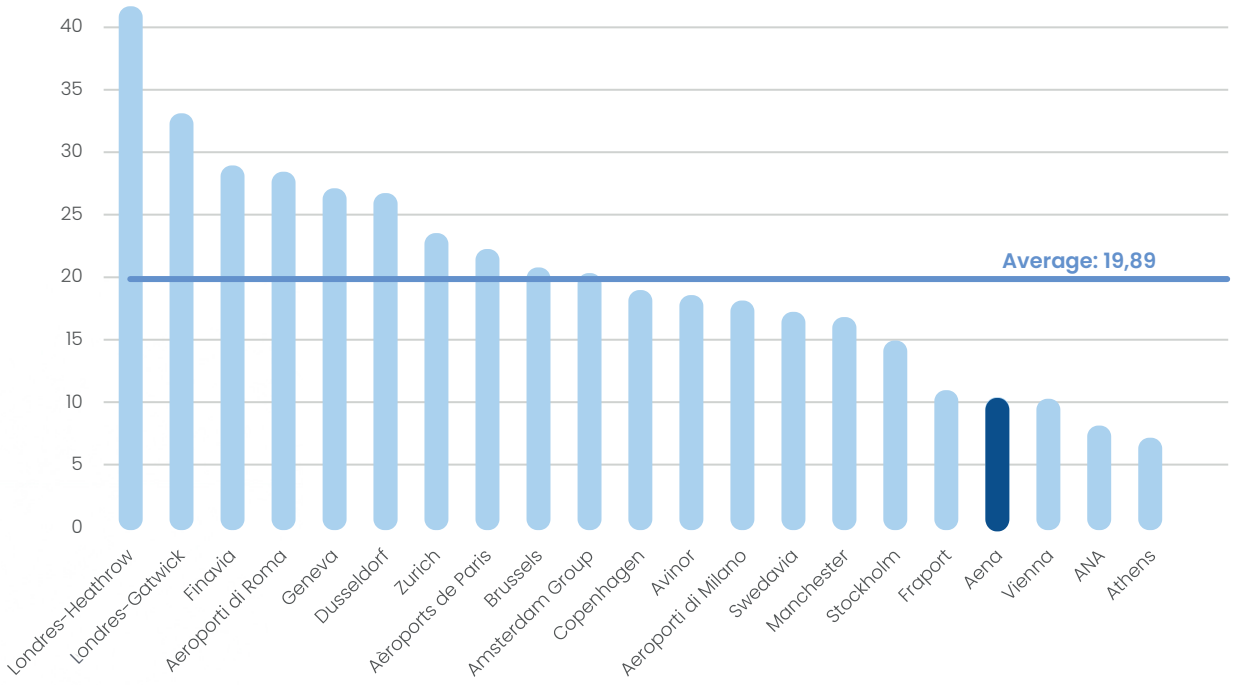
This indicator shows that Aena, the world's largest airport operator by number of passengers, also ranks among the most efficient. Specifically, it is ranked 33rd globally and 18th in Europe in terms of OPEX (operating expenditure) per passenger, outperforming other major European operators such as London Heathrow (3rd globally, 1st in Europe), Aéroports de Paris (11th globally, 8th in Europe), Amsterdam Schiphol Group (13th globally, 10th in Europe), and Fraport (32nd globally, 17th in Europe).

On the following page, you'll find a breakdown of operating costs per passenger among the main European airport operators.

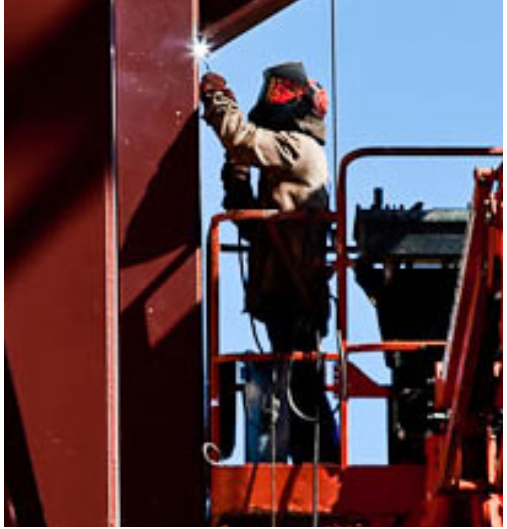
Airport Capital Costs

Aena's leadership in operational cost efficiency across Europe is also reflected in its capital costs, which include, among other items, construction expenditure (CAPEX). According to the 2023 report by Jacobs, Aena ranks 35th globally and 16th in Europe in terms of CAPEX per passenger — once again, placing it ahead of the other major European airport operators in terms of competitiveness.

Operating costs (OPEX) in Euro per passenger by European airport operators (2023)



Source: Airport Performance Indicators 2023 report developed by Jacobs.
Note: Operating costs represent all those costs of operation (personnel costs, supplies, and service costs), excluding amortization costs.



Spanish airports clearly stand out for their cost management efficiency, managing to keep future investments at competitive levels without compromising the ambitious capacity targets that have been set.

In short, the Spanish air sector proves to be both efficient and competitive when it comes to costs. As we will see next, this cost efficiency is passed on directly to the charges borne by airlines — namely, airport and air navigation fees.

Airport Construction Costs

In line with the above, Spain stands out for the comparatively lower costs associated with major airport expansion projects, particularly when compared with similar initiatives in other European countries.

To assess this, budgets for planned expansion, refurbishment, and rail connection projects at major European airports have been reviewed. In the comparative table on the following page,

Budgets for future construction projects at major European airports ($)

Airport	Project Type	Detail	Budget ($ USD)
Adolfo Suárez Madrid-Barajas (MAD)	Expansion and remodeling	T4 expansion and TI23 remodelling. Capacity increase up to 90M people	2,400 M$
Josep Tarradellas Barcelona-El Prat (BCN)	Expansion	Runway extension, new satellite terminal with launcher (APM). Capacity increase up to 70M people	2,000 M$
London Heathrow (LHR)	Expansion	Third runway to the northwest of the terminal: Increase of 18 billion capacity in 260,000 operations	18,000 M$
Paris Charles de Gaulle (CDG)	Rail connection	New rail connection to the terminal (tunnel construction and T2 expansion)	2,600 M$
Amsterdam Schiphol (AMS)	Rehabilitation	Improvements to existing terminals	6,600 M$
Istanbul (IST)	Expansion	New runway	540 M$
Rome Fiumicino (FCO)	Expansion	Terminal expansion, new runway. Capacity increases up to 90M people	10,000 M$
Frankfurt (FRA)	Expansion	New Terminal. Capacity increase up to 85M people	4,800 M$
Sheremetyevo International Airport (SVO)	Expansion	Terminal C expansion	525 M$

Source: Own development based on information from European operators' projects.

Airport Charges

In terms of charges, a comparison has first been made of the fees incurred by airlines when operating at European airports. For this purpose, data from the ATRS (2022) report have been used, specifically covering the following[9]:

- Landing charges cover the use of runways, taxiways, and other aerodrome infrastructure, as well as aircraft parking and the use of air traffic control services during approach, landing, and take-off.

- Terminal charges are calculated based on the number of departing passengers, and occasionally arriving ones, or both. These include fees for the use of jet bridges, baggage systems, and check-in counters.

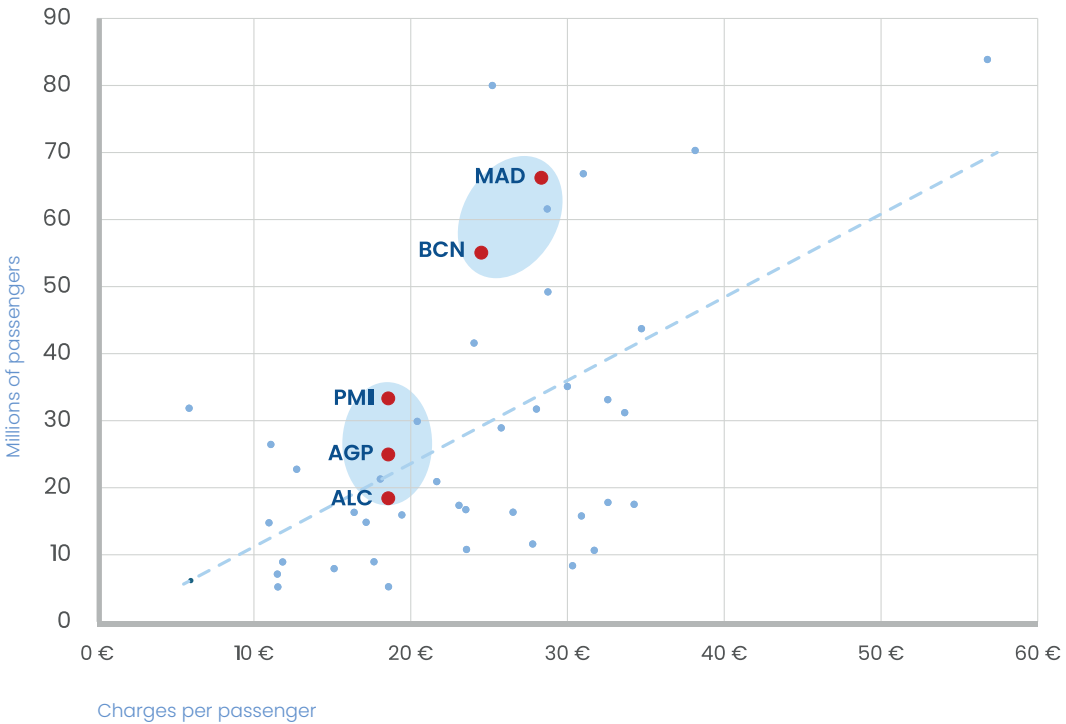
These charges vary depending on the size of the aircraft operating at each airport. For consistency, the Boeing 777-300ER has been used as the reference aircraft in this analysis. The results show that Spanish airports apply competitive rates in comparison with other European airports.

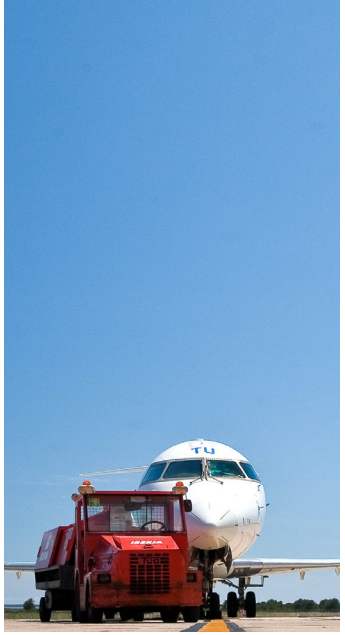
Madrid-Barajas (MAD) and Barcelona-El Prat (BCN), which rank as the 5th and 7th busiest airports in Europe by passenger numbers, are ranked only 24th and 36th respectively in terms of the fees charged to aircraft using their facilities. Meanwhile, Palma de Mallorca (PMI), Málaga (AGP), and Alicante (ALC) — the 14th, 25th, and 31st busiest airports — rank just 53rd, 56th, and 55th in terms of charges.

This clearly shows that aircraft using Spanish airports are subject to lower fees compared to those operating at similarly busy airports across Europe.

The following graph illustrates the per-passenger fees applied at major European airports, highlighting the trend line in relation to the volume of passengers handled. In general, the greater the number of passengers, the higher the per-passenger charge applied.

Landing and terminal charges per passenger per airport





Fuente: Elaboración propia a partir del informe "AIRPORT BENCHMARKING REPORT – 2022. Global Standards for Airport Excellence" elaborado por ATRS (2022) y datos de demanda publicados por cada aeropuerto. Nota: Tasas de aterrizaje y terminal para una aeronave Boeing 777-300ER

Air Navigation Charges

Secondly, air navigation charges applied in Spain (through ENAIRE) have been analysed and compared with those in other European countries. Specifically, this refers to the en-route charge[10], which represents the recovery of costs associated with the provision of en-route air navigation facilities and services[11].

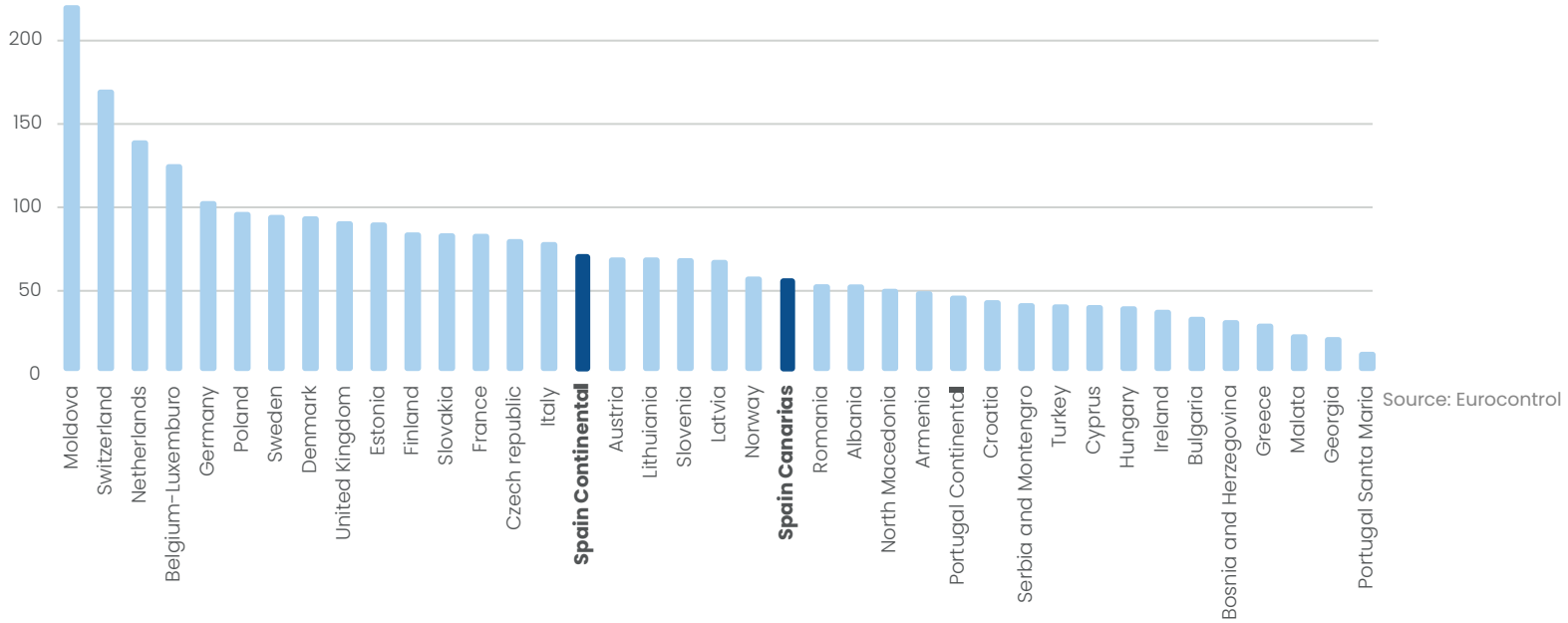
Once again, it is evident that Spain applies highly competitive charges compared to other European states. Spain, which is the leading air market in Europe by passenger volume, ranks 15th (mainland territory, with a unit cost of €62.73) and 20th (Canary Islands, with a cost of €50.38) in terms of en-route navigation charges on the continent — well below countries with significantly higher charges such as the United Kingdom (5th, at €87.30), Germany (6th, €80.14), France (8th, €70.88), and Italy (9th, €68.77).

Furthermore, a historical analysis of en-route charge trends among major European countries (Spain, the UK, France, Germany, and Italy) shows that Spain moved from being the country with the highest en-route charge in 2010 (a weighted calculation of both mainland and island rates), to currently having the lowest.

According to an analysis by the UK CAA (2023)[12], Spain has consistently reduced its en-route charges since 2010 — from over €90, well above the other major European countries at the time — to less than half that value by 2022, followed by a slight increase in the subsequent years.

In contrast, the rest of the major European countries began reducing their en-route charges later, gradually from around 2015 onwards, effectively following the Spanish model.

Route fees by European country (€ 2024)



Source: Eurocontrol

2.3 Conclusion: The Spanish Air Model – Ready to Face Future Challenges

Air transport, across all its phases and sectors, is a strategic pillar for the Spanish economy and society, with an impact that goes beyond mere figures and rankings—surpassing that of many other countries. Factors such as the Iberian Peninsula's peripheral position in Europe, the demographic and economic significance of the island territories, the country's strong reliance on tourism, and its close historical and cultural ties with Latin America reinforce this strategic connection, making air transport a fundamental cornerstone for national connectivity and development.

From the very beginning, authorities, economic sectors, and—more and more—the wider public have recognised this special relationship and the vital importance of a flexible and efficient air sector for Spain's progress.

The data and indicators presented in this chapter show that the Spanish air sector is indeed rising to meet the challenges posed by its strategic relevance. In recent years especially, the sector has proven to be comparatively competitive and efficient. It managed a record-breaking recovery in demand following the Covid-19 crisis, exceeding both historical levels and international benchmarks—perhaps one of the key reasons why Spain is currently leading economic growth in Europe.

This evolution has not come at the expense of quality or punctuality – both of which remain comparatively high—while maintaining strong cost-efficiency across the entire value chain.

The development of Spain's air sector across its various dimensions—demand, quality, and cost—should be understood as a coherent, interconnected trajectory, not a series of isolated or unrelated events. In this sense, we can speak of a "Spanish air model" which, in recent years, has demonstrated a performance that, without losing a critical perspective, can rightly be regarded as a success story.

This conclusion is what drives this report to delve into the deeper reasons behind it. To that end,

this chapter is structured around explanatory pillars that combine data analysis with theoretical perspectives, as well as including first-hand accounts from key industry players, many of whom are part of Ineco.

The analysis is organised around the following themes:

First and foremost, underpinning the entire explanation is a shared awareness among all sector stakeholders of the magnitude and significance of their role.

Secondly, it is important to highlight a measured, well-paced growth—guided by a clear analysis of needs and improvement goals—steering clear of excesses or behaviours lacking in ambition.

Thirdly, the airport sector operates as a network, led by a major national operator that, although it enjoys near-exclusive management, is subject to regulatory and competitive pressures that prevent inefficiencies or complacent monopolistic tendencies.

Fourth, this all takes place within a framework of balanced and rigorous governance, supported by well-structured and capable institutions, measured procedures and regulations, and a coherent and well-articulated distribution of responsibilities.

Fifth, the importance of a dynamic industrial sector across the entire value chain must be recognised—a largely private sector that coexists and collaborates closely with major public stakeholders.

Finally, the human dimension: highly skilled and motivated individuals operating within a system that enables them to realise their ambitions and develop their talents.

Nonetheless, complacency has no place. Analysing and understanding the root causes of a successful model is key to maintaining it. But the future is not assured.

The sector faces many challenges, and its sustainability looms especially large on the horizon. This report aims to contribute valuable insight and reflections to that debate in the final chapter.

03

Keys to the Good Performance of the Spanish Air Model

Having outlined the success of the Spanish model, this chapter explores the underlying causes and factors that help explain it.

This report does not follow a strictly academic format. The approach taken combines rigorous, impartial, and objective analysis with first-hand experiences from a broad group of experts and key figures in the sector. These insights were gathered through a series of meetings held by the drafting team during February and March 2025.

While the narrative could have been structured differently, it has been carefully designed to ensure that all key factors—whether institutional, economic, or technological—are clearly reflected across the five sections that make up the report.

It is important to note that behind all the factors outlined lies a crucial, overarching element: over time, public administrations, the sector itself, and society more broadly have developed a strong awareness of the importance of the aviation industry. It is not just that the data reflect this—it is that the key players know it and understand it.

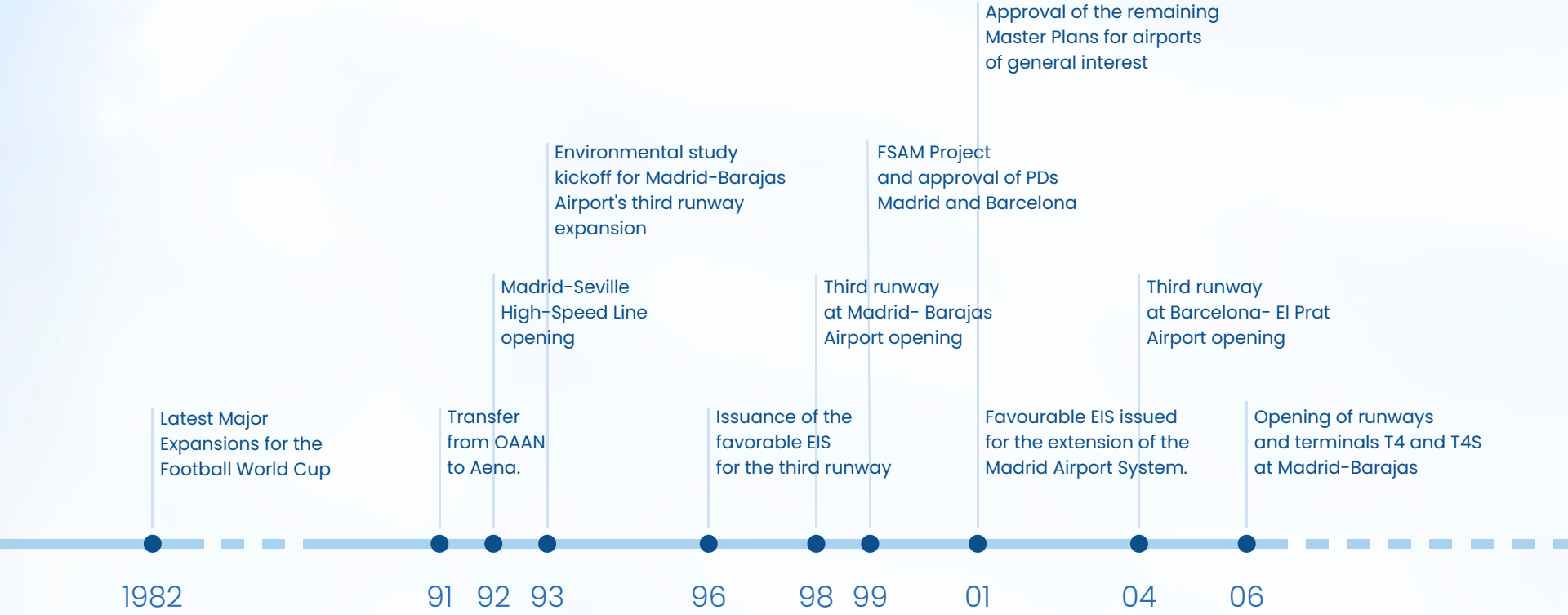
As a result, a high level of technical, political, and social consensus has emerged, encouraging stakeholders to resist opportunistic or predatory behaviours in favour of maintaining a high standard of excellence—one that ultimately benefits both the sector and society as a whole.

3.1 Structured Planning Over Recent Decades

At the beginning of the 1990s, with total passenger demand at around 75 million per year, the operation of airports was transferred from the National Airports Autonomous Agency (Organismo Autónomo de Aeropuertos Nacionales, OAAN) to Spanish Airports and Air Navigation (Aena), which began providing services in November 1991.

At that time, airport development in Spain had largely stalled, with the last major expansions having taken place for the 1982 Football World Cup.

During those same years, two significant developments shaped the future of Spanish infrastructure. First, environmental impact assessments began to be applied to major projects—reflecting a growing awareness that economic and social development could not come at any cost. It rather had to be aligned


Approval of the remaining Master Plans for airports of general interest
Environmental study kickoff for Madrid-Barajas Airport's third runway expansion
FSAM Project and approval of PDs Madrid and Barcelona
Madrid-Seville High-Speed Line opening
Third runway at Madrid- Barajas Airport opening
Third runway at Barcelona- El Prat Airport opening
Latest Major Expansions for the Football World Cup
Transfer from OAAN to Aena.
Issuance of the favorable EIS for the third runway
Favourable EIS issued for the extension of the Madrid Airport System.
Opening of runways and terminals T4 and T4S at Madrid-Barajas
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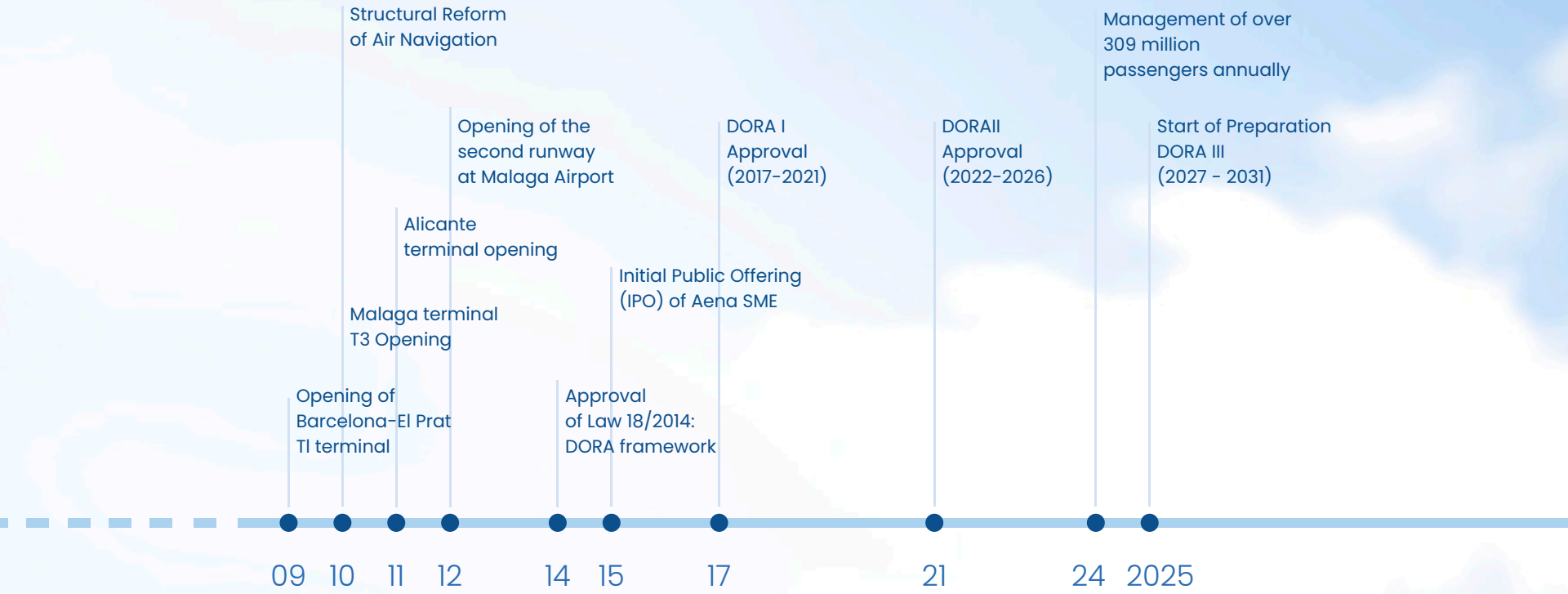


with environmental objectives reflecting a more conscious and better-prepared society.

Secondly, development began on the high-speed rail network, with the inauguration of the Madrid–Seville line in 1992 drawing great attention and expectations. It would go on to become a fundamental pillar of Spain's transport system.

First Major Expansions

The first major project to undergo an environmental evaluation in the aviation sector was the expansion of Madrid-Barajas Airport, involving the construction of a third runway (18R-36L), with the environmental assessment beginning in 1993. A favourable Environmental Impact Statement (EIS) was issued in 1996, allowing construction to proceed, albeit under strict conditions for future developments, even including the consideration of a potential airport relocation.

This process led to the FSAM project (Future Airport System of Madrid) and a new Master Plan approved in 1999, which culminated in environmental clearance in 2001 and the inauguration of two new runways along with Terminals T4 and T4S in 2006.

Learning Curve

The process launched in 1991—although partially halted until 1999 and finally executed in 2006—represented a major learning experience for Spain's airport and air navigation sector. This structured planning model made it possible to develop a network capable of efficiently and effectively managing over 309 million passengers annually by 2024, representing a 350% increase over 30 years, despite various economic and health crises.

A similar model to Madrid's—incorporating many of the lessons learned—was applied to later expansions in locations such as Barcelona, Málaga, and others. The master plans largely guided and shaped this balanced development. Spain avoided the kind of maximalist—almost showy—expansions seen elsewhere in the world, yet without forgoing a confident and optimistic ambition in terms of capacity, quality, and safety.

Evolution of the Regulatory Framework

The first three decades since the 1990s allowed for large-scale development of the airport network—essential to overcoming the historical delays Spain faced at the time. The outcome of this period is, without a doubt, a positive one: a significant expansion was achieved, enabling the system to absorb the surge in demand that followed.

Nonetheless, this process also generated certain tensions that needed to be addressed. The system's level of debt and the high proportion of investment resources it absorbed (up to 80%) required the introduction of mechanisms and institutions to optimise capacity use and to structure future investments more effectively. A calm and orderly evolution of the regulatory and institutional framework was needed.

A major qualitative turning point in the development of Spain's airport network came with the separation of Aena Aeropuertos from ENAIRE, the introduction of private capital into Aena Aeropuertos, and, most importantly, the implementation of Law 18/2014,

which introduced urgent measures to promote growth, competitiveness, and efficiency.

This new regulatory framework has enabled orderly development and a decision-making process based on rigorous technical studies and objective criteria. It has ensured efficient coordination between the various areas involved, encouraged the participation of airlines and future fee-payers, and established a balanced institutional structure with independent bodies and mechanisms for oversight in decision-making.

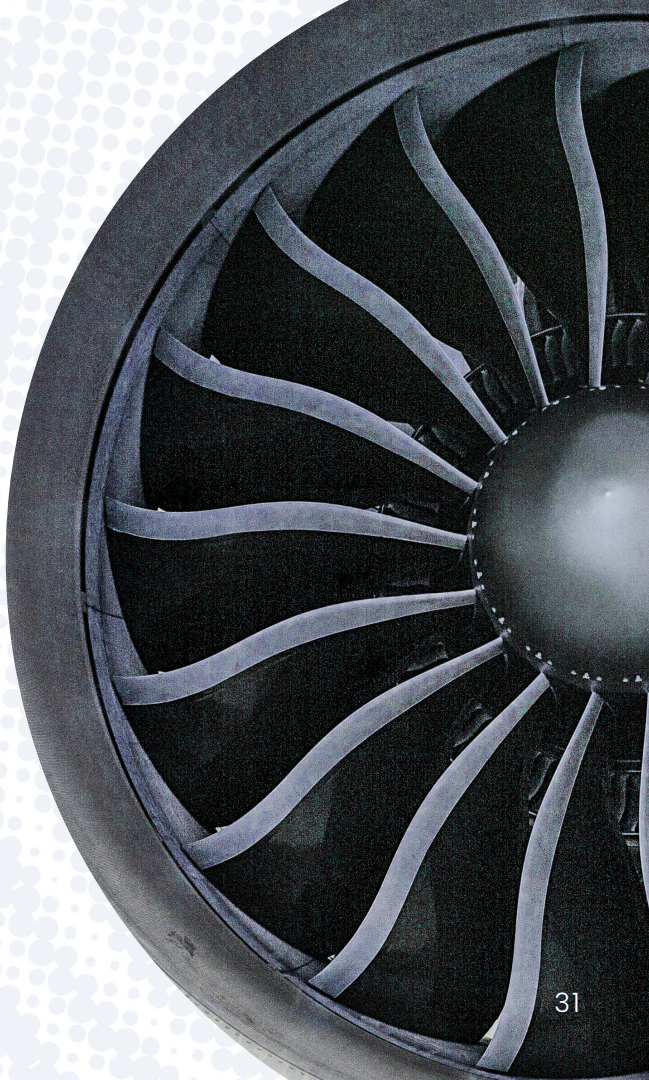
The Environment at the Heart of Planning

Another key aspect of this development has been the attention paid to the surrounding environment and society. Since the 1990s, the approach has evolved from a "blank canvas" model of planning to one that is adapted to the territory and its people. Citizens have been placed at the centre of the strategy, with mitigating and compensatory measures introduced to minimise environmental impact and ensure sustainable integration of airport infrastructure into its surroundings. This includes optimised air navigation manoeuvres designed to reduce noise pollution.

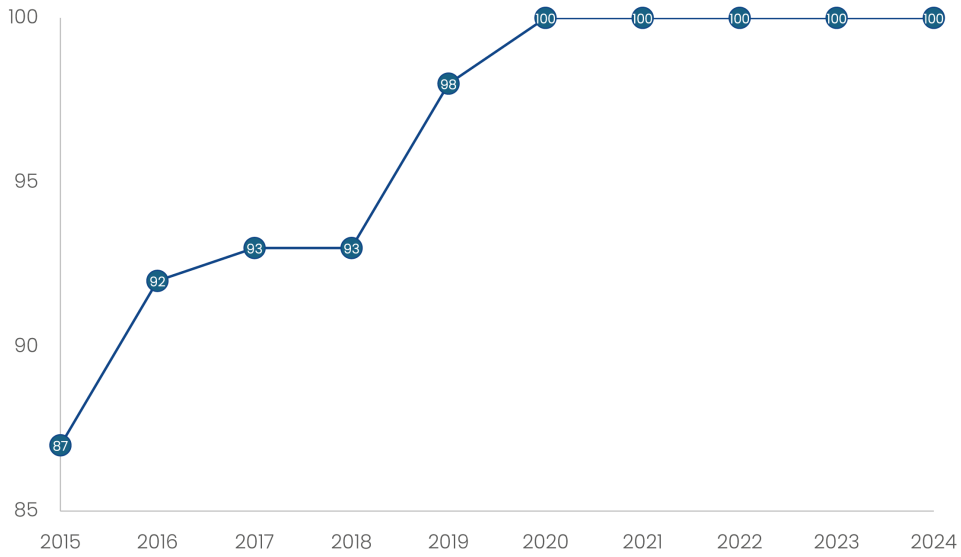
Without Compromising Safety

Finally, it is important to emphasise that this structured development—designed to meet the constant growth in demand—has never compromised one of the fundamental principles of air transport: SAFETY FIRST! A clear example of this commitment is ENAIRE, which was one of the first organisations to establish a monthly Executive Safety Committee dedicated exclusively to safety matters. This sends a strong and unambiguous message to its professionals—and, by extension, to the entire sector—about the absolute priority given to safety.

Over the same period in which air traffic has grown significantly, safety levels have continued to improve. According to the European EoSM (Effectiveness of Safety Management) standard, ENAIRE has led the way since 2019, when it achieved 98% maturity—reaching 100% in 2020 and maintaining that level through to 2024.



Evolution of ENAIRE's Effectiveness of Safety Management (EoSM) indicator.



Source: EUROCONTROL

Continuing to Learn and Grow

Thanks to this orderly evolution, institutional alignment, and continuous learning, Spain now has a robust, efficient airport network and air navigation system—capable of supporting the fourfold increase in air traffic since the 1990s.

At present, work is underway on a new investment cycle aimed at accommodating the significant growth in traffic anticipated over the coming years, while maintaining high standards of quality, safety, and efficiency. All of this is being pursued alongside a vital commitment to improving the environmental performance of air transport and reducing its emissions.

Significant investment will be required—both in volume and boldness—an effort that must be channelled through the regulatory and institutional framework introduced with the DORA (Documento de Regulación Aeroportuaria), in contrast to the approach taken during the first major capacity expansion.

This may well be the system's greatest current challenge in terms of its future development.

3.2 Balanced and Rigorous Governance

The sector is supported by solid institutions, well-equipped and with clearly defined roles, operating professionally and independently under a stable regulatory framework adapted to emerging demands. This structure has achieved balanced governance with effective oversight mechanisms, earning the Spanish air system strong international recognition for its technical competence, commitment, and regulatory stability.

3.2.1 Institutional Framework

Aviation Authority: DGAC and AESA

Since 2008, the Spanish model of aviation administration has been characterised by a separation of responsibilities within the aviation authority. On one hand, the Directorate-General for Civil Aviation (DGAC) is responsible for formulating sectoral proposals, defining strategic policies, and coordinating with other administrations and the European Union on matters of air transport. On the other hand, the Spanish Aviation Safety and Security Agency (AESA) is tasked with carrying out executive, inspection, and enforcement functions.

Since the entry into force of Law 18/2014, the roles of both DGAC and AESA have been significantly strengthened and evolved—consolidating their status as guarantors of discipline, stability, and transparency within the air system. Furthermore, both institutions have led a shift in culture, fostering dialogue, trust, and teamwork between the sector and the administration, with the aim of safeguarding the right to air mobility while aligning infrastructure development with citizens' rights.

Aena and ENAIRE

Since its establishment in 1991, Aena initially operated as a single, public entity responsible for both airport management and air navigation, effectively acting as a central authority. This initial model was crucial in laying the foundation for cooperation between the two systems.
Over time, a gradual transformation took place, leading to the separation of airport management (Aena Aeropuertos EPE) from air navigation services (ENAIRE EPE), the introduction of private capital into Aena SME SA, and the creation of a strong regulatory framework via the DORA (Documento de Regulación Aeroportuaria) under Law 18/2014. This evolution consolidated the model of a unified airport network of general interest.

During this period, Aena has become the world's largest airport operator, managing the highest volume of passengers across its national and international airports. Its network model—supported by competitive operating costs and high levels of perceived quality—has earned it unprecedented global prestige. The model enables Aena to efficiently manage all types of airports, from major hubs and high-traffic airports to smaller facilities focused on general aviation, leveraging strong centralised services and a highly qualified workforce.

ENAIRE, for its part, has made significant strides in the professionalisation of air navigation management, with strong support from the aviation authority.

Prior to the establishment of ENAIRE, one fundamental milestone in consolidating the competitiveness of Spain's air sector was **the structural reform of air navigation services**, enacted through Royal Decree-Law 1/2010 of 5 February. This legislation regulated the provision of air traffic services, established the obligations of civil service providers, and set certain employment conditions for civil air traffic controllers. **This reform significantly improved the efficiency of the Spanish aviation sector** by curbing the unsustainable growth in air traffic controllers' salaries, which had previously made Spain's air navigation costs the highest in Europe. It also enabled the gradual entry of alternative air traffic service (ATC) providers.

As a result, ENAIRE now offers competitive air navigation charges and has a clear customer-oriented approach, reflected in the high level of perceived quality among pilots and airlines. In 2025, en-route charges for the Spanish mainland and the Canary Islands are 23% and 40% lower, respectively, than the average in comparable European countries (the UK, Germany, France, and Italy).

During the 2020–2021 crisis, ENAIRE applied reduced charges to support the sector's recovery, committing not to raise them above 2019 levels until traffic had returned—an objective reached in 2023. Adjusted for inflation, 2025 charges in the mainland and Canary Islands are 11% and 14% lower than in 2019, while approach charges have remained frozen since 2024.

CNMC

The entry of the National Commission for Markets and Competition (CNMC) into the air transport sector came as part of broader European regulatory developments, coinciding with the shift towards private participation in airport management.

Since 2014, the CNMC has established itself as a key player in the Spanish airport model, acting as a counterbalance and guardian of market efficiency. It oversees airport charges and ensures transparency in consultations between the airport operator and the airlines.

Its role includes issuing reports on Master Plans and playing an essential part in the five-year definition of the Airport Regulation Document (DORA), assessing traffic forecasts, service quality, airport capacity, and planned investments.

Moreover, the CNMC monitors Aena's annual charge updates to ensure they comply with the Adjusted Maximum Annual Revenue per Passenger (IMAAJ), as stipulated by Law 18/2014—thus guaranteeing the system's efficiency, transparency, and long-term sustainability.

Coordination Among the Various Stakeholders

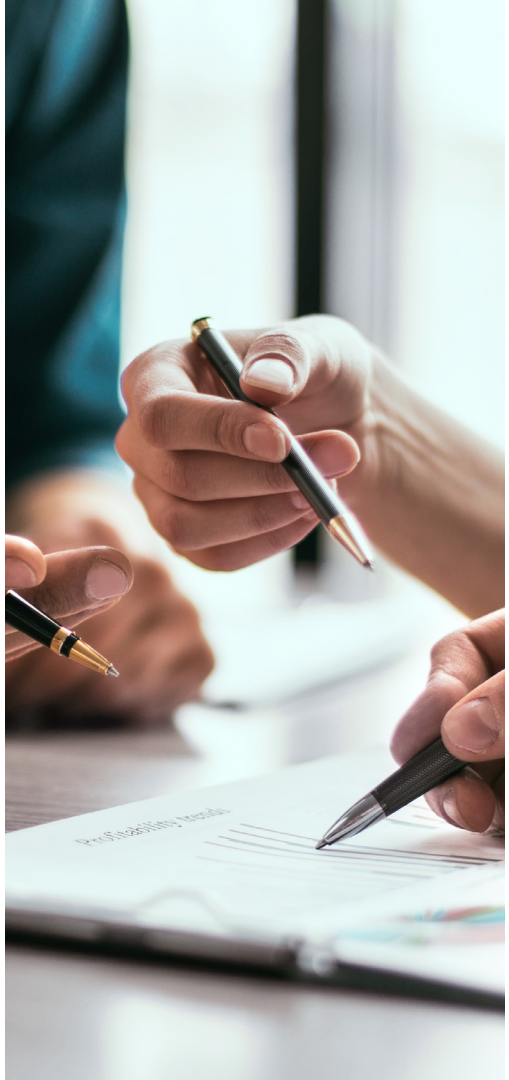
This institutional and regulatory framework has evolved in an orderly and gradual fashion—not as a top-down imposition, but by adapting to European regulations and, above all, to market conditions, private initiatives, and contributions from the air sector itself. It is a technically robust system, free from protectionism or artifice, characterised by strict regulation, rigorous oversight, and a high degree of transparency and predictability, ensuring its effective operation.

3.2.2 Regulatory and Management Instruments

The Concept of General Interest

In the Spanish regulatory framework, the concept of general interest refers to activities, infrastructure, or services that are essential to society, and whose provision must be guaranteed due to their economic, social, or strategic importance. This principle justifies State intervention to ensure their proper functioning and accessibility.

In the airport sector, the Spanish Constitution already includes the notion of airports of general interest, outlining the scope of the State's (exclusive) powers over such infrastructure. Since 1981, the application of this concept has evolved, developed further through Law 21/2003 on Air Safety and Law 18/2014. It applies to airports that ensure national and international connectivity, drive economic growth and tourism, support territorial cohesion, and contribute to national security and defence.



Airports declared to be of general interest are centrally managed by Aena, are subject to specific regulations in terms of safety, quality, and access, and have regulated charges to ensure equitable access.

The fulfilment of these general interest objectives is ensured through several mechanisms: by maintaining the integrity of the airport network, through the Master Plans of each airport, and by defining the framework governing basic airport services. Accordingly, the closure or sale, in whole or in part, of any airport facilities or infrastructure essential to the provision of airport services is prohibited—unless expressly authorised by the Council of Ministers or the Ministry of Transport and Sustainable Mobility.

Furthermore, the expropriation of land included within the General Airport System, as defined in each airport's Master Plan, is permitted when necessary.

SERVICE QUALITY STANDARDS

Monitoring and supervision of service quality for each airport in the Aena network, implemented through a series of indicators related to Airport and Aerodrome Traffic Services.

- Perceived satisfaction of the passengers
- W aiting times at process points
- Availability of facilities in Building
- Availability of airside facilities
- Other key areas

ENVIRONMENTAL STANDARDS

Monitoring of environmental standards for each airport in the Aena network, instrumented through a series of sustainability indicators:

- Absolute emissions of CO2
- Energy efficiency
- Carbon Neutrality
- Water consumed
- N oise levels
- Recovered non-hazardous waste

Monitoring of the Capacity standards of the different subsystems of the Aena network airports: Airfields and Terminals.

AIRPORT CAPACITY STANDARDS

Monitoring and supervision of the Regulated Investment Plan, mostly focused on implementing the applicable regulations, proper maintenance of the airport network and contributing to the improvement of environmental sustainability.

- Strategic investments
- Regulatory investments
- Relevant investments

INVESTMENTS AND REGULATED ASSET BASES

Planning and Development Instruments

Although there is no high-level codified sector-specific regulation, a number of clear instruments are in place to enable structured planning and orderly development.

Master Plans

The Master Plans for airports of general interest are long-term strategic planning tools (covering over 15 years), designed to guide the development of each airport based on projected demand, rather than fixed timelines. They serve to reserve land through its designation as part of the General Airport System and inform urban planning and surrounding territorial strategies.

The process for approving Master Plans includes consultations with public authorities and public participation as part of the Strategic Environmental Assessment framework. These plans represent the first step in the development of airport infrastructure. While they include indicative estimates of investment, these do not constitute financial commitments, which are defined later in more detailed five-year planning cycles.

DORA

The Airport Regulation Document (DORA), established under Law 18/2014, defines the conditions that Aena must meet to ensure quality service provision with sufficient capacity to meet demand throughout each five-year regulatory period.

This framework provides predictability to the sector, promoting long-term efficiency, competitiveness, and sustainability. DORA sets out specific obligations for Aena regarding airport capacity, service quality, environmental standards, planned investments, and minimum service levels.

In line with European regulatory models, the airport operator's revenue from basic services is subject to a maximum annual revenue per passenger (price cap), based on the recovery of efficient costs recognised by the regulator. This system complies with the European framework on transparency, consultation, non-discrimination, and oversight of airport charges, aligned with Directive 2009/12/EC.

Compliance with quality and investment standards may lead to incentives or penalties that affect these permitted revenue limits, and any deviations from planned values must be absorbed by the operator through other income streams, such as commercial activities, international operations, or real estate management.

By contrast, the management of non-essential services and commercial or real estate activities is governed by free market principles.

3.3 Competitive Pressure on the Airport Network

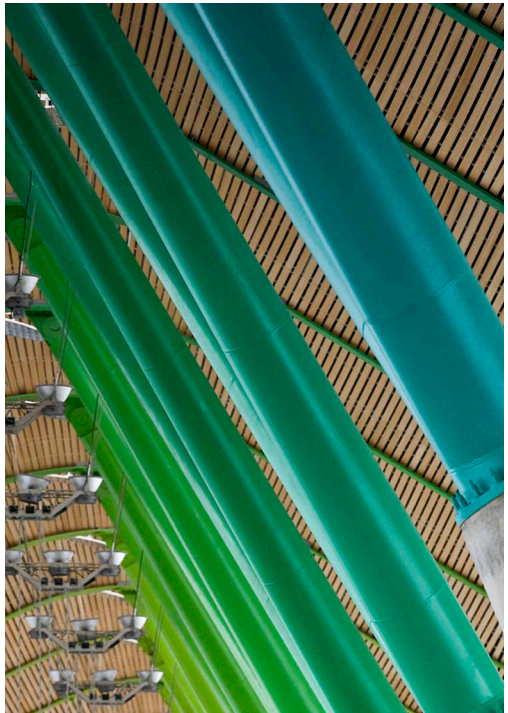
Air transport in Spain has established itself as a successful sector largely thanks to the airport network model managed primarily by Aena, which has remained stable since its inception. The integration of most airports into this network has generated synergies and network effects that enhance both efficiency and economic performance—particularly in an increasingly interconnected environment. This model also promotes balanced development across the national territory. A similar approach is applied to air traffic control services in certain phases of flight.

Spain is not the only country to adopt a network model, though it is the largest in terms of scale and traffic. Some critics view this model as a direct legacy of the state monopolies of the 1970s, and therefore suggest it reflects a lack of the reformist spirit that drove the evolution of other airport systems (and other sectors) during the 1980s.

Without delving into the motivations behind the current model in Spain, it is clear that this is not an inefficient or outdated monopoly. As demonstrated in the previous chapter, the results reflect a system at the forefront of efficiency and quality. This success is no accident, but rather the product of competitive and institutional pressures that create effective incentives—driving operational efficiency and boosting the international competitiveness of Spain's airports.

The growing importance of network effects in the modern economy has reaffirmed the advantages of operating in a network model—one that now has few detractors. These effects tend to concentrate activity around a small number of operators, or even a single operator, a trend not limited to the airport sector.

Although debate continues around the appropriate regulation of such scenarios, Aena's model demonstrates how it is possible to combine the advantages of a network with a regulatory framework that ensures efficiency and encourages innovation. This model can serve as a valuable reference in that broader discussion.



Strengths of the network model: Size, volume, network effects and inter-airport support[13]

According to Law 18/2014, "network management guarantees the economic sustainability of the airports integrated within it by enabling, under conditions of transparency, objectivity, and non-discrimination, the support of loss-making infrastructure."

The network model offers significant advantages in terms of operational, managerial, and administrative efficiencies, especially when compared to models based on the management of individual airports. It allows airports that may not be independently profitable to acquire not only funding, but also strategic purpose, by being part of a network that performs better than the sum of its parts[14].

It is also important to recall that the air transport sector is self-financing—meaning that these infrastructures do not cost the taxpayer, but are funded by users (airlines and passengers), as well as through commercial activity and space usage generated by aviation operations. The size of the operator is also an asset when accessing financial markets, instilling confidence in the banking sector—especially in the current context, where the European Investment Bank no longer finances projects solely aimed at increasing capacity.

In short, this approach guarantees connectivity across the country and reinforces Spain's position as a leading international air transport market. Operating within a unified structure enables the use of economies of scale, the harnessing of network effects, and more efficient resource use—while also strengthening bargaining power with suppliers and financial institutions.

Technical Value of Centralised Services

Aena and ENAIRE possess highly developed infrastructure and technical resources, distributed between centralised services and each airport or control centre. This enables enhanced coordination and continuous service improvement. Progress in digitalisation, operations, and safety has allowed the network to function efficiently and competitively, in line with the most demanding international standards.

The use of integrated and redundant systems across all airports and control centres—open to all users and fully coordinated—is one of the key success factors and major distinctions of Spain's network model when compared to others in Europe.

Disaggregation and Competition: Previous Experiences

In discussions about the possibility of breaking up the network to promote greater competition, past experience has produced mixed results. In Spain, most new airport initiatives outside the network have not been successful—some have even ended up being absorbed into it.

Disaggregation could lead to duplication and inefficient allocation of resources, undermine the viability of smaller airports, and jeopardise the cohesion of the national airport system.

In the international context, given the greater resilience of the Spanish model and its swift recovery after the pandemic, the question arises as to whether the disaggregation and individualised management of airports in other countries may

have contributed to several European airports being forced to cut resources—resources which later proved difficult to recover in time to respond effectively to the rebound in demand.

This challenge highlights the importance of resilience in the sector and reinforces the benefits of maintaining a cohesive model, always under appropriate regulation and supervision.

Regulatory Evolution: From the Pre-DORA Era to the Current Model

Before the introduction of the Airport Regulation Document (DORA), Aena faced high levels of debt and a significant share of resources devoted to investment. While Master Plans and the organisation's culture enabled intense and efficient development of the network, greater order and structure were needed to continue advancing into the future.

The introduction of DORA marked a turning point, establishing an incentive-based economic regulatory framework focused on efficiency.

Since its implementation nearly a decade ago, the DORA model has delivered significant progress in airport management in Spain by providing greater predictability in investment planning, prioritising investment based on actual demand, incentivising the reduction of operating costs and competitiveness of charges and promoting transparency and the involvement of stakeholders.

This regulatory framework has enabled Aena to optimise its resources and consolidate its position as a globally efficient operator. Moreover, the application of the European Directive on Airport Charges in Spain has successfully integrated and adapted best regulatory practices from countries such as the United Kingdom, Germany, and France, while tailoring them to the specific characteristics of a large airport network.

For instance, the Spanish model includes numerous checks and balances and control mechanisms to ensure that the interests of the airport operator or its shareholders do not override efficiency criteria, striking a balance between necessary investments and the competitiveness of the charges used to fund them.

Nonetheless, the regulator—by monitoring efficiency indicators, assessing justifications for capacity expansions linked to demand growth, and ensuring compliance with quality and environmental standards—together with the airlines involved in the consultation process for tariff-setting, ensures that no unjustified investments are made.

In addition, the model encourages the operator to optimise operational costs, thereby improving its competitiveness in a constantly evolving market.

The transfer of the risk of deviations to the airport operator acts as an incentive to make accurate forecasts and manage spending efficiently. But it is not only the regulatory framework that drives this

efficient behaviour. Aena is also subject to market-based competitive pressures from several fronts:

- Competition from other modes of transport. The growing presence of High-Speed Rail and its liberalisation places pressure on part of Aena's operations within mainland Spain.
- Pressure from investors seeking returns. The introduction of private shareholders into Aena means attention must be paid to profitability—something that, in part, depends on cost efficiency.
- Strong competitive pressure from airlines. Airlines retain a certain level of choice regarding which airports to operate from and where to carry out other activities.
- Within that pressure, the competition to be chosen as a hub airport or network is particularly intense.
- Pressure from sectors heavily dependent on air transport. Currently this includes tourism, but also services and even industry—which may threaten to shift their activities or locations if airport costs become excessive.

Ability to Expand Successfully into Other Countries

Aena's scale, operational cost efficiency, and the technical strength of its centralised network management services are key advantages that enable it to offer similar services in other markets. Aena is a case in point, with an international presence in recent years notably through its management of another major airport network in Brazil and at Luton Airport in the United Kingdom.

Debates Surrounding the Current Model

Despite its successes, the model is not without its critics.

In tariff-setting processes, differences often arise around the methodologies used to estimate traffic levels and determine capital costs.

In general, airport charges remain a key point of discussion within the sector's regulatory framework, with varying views held by the different stakeholders involved.

As for the determination of capital costs, methodologies are often borrowed from other economic sectors, raising questions about their relevance or suitability for the airport industry.

Nevertheless, considering the results in terms of improved cost efficiency and the establishment of highly competitive airport charges at the European level, it seems clear that none of these concerns have impeded the sector's progress.

3.4 Dynamic Industrial Sector Across the Entire Value Chain

The learning curve achieved by organisations and companies within the sector has not only resulted in a network of airports in excellent condition — capable of absorbing significant increases in demand — but has also enabled Spanish airport and air navigation stakeholders to position themselves among the international leaders in various fields.

Throughout the entire life cycle of an airport infrastructure — from needs assessment, planning, design and construction, to commissioning and operation — there are Spanish firms that stand out as global benchmarks in each of these stages.

Engineering, Architecture and Airport Construction

The high level of detail achieved in design allows for highly accurate construction budgets, reducing the need for modifications and facilitating the work of project management offices. In addition, the Spanish market is extremely competitive, with contracts awarded under the Public Sector Procurement Law, which requires cost optimisation in construction without compromising quality.

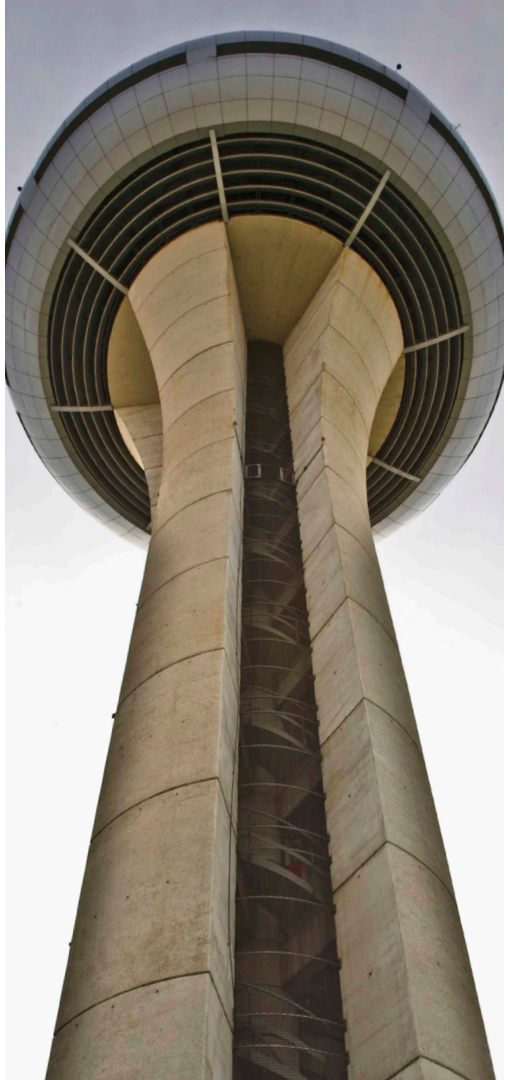
In the case of engineering and design firms, according to the 2024 ranking published by Engineering News-Record (ENR), four Spanish companies are ranked among the top 50 globally by international revenue from engineering and design services (AYESA, IDOM, TYPSA and SENER). Narrowing the list down to engineering and design firms with over 50% of their business in the transport sector, three Spanish firms feature in the global top 10.

As for ENR's construction company rankings, three Spanish companies are in the global top 20 (Grupo ACS/Hochtief, Ferrovial and Acciona). Grupo ACS/Hochtief has participated in the construction of new airport infrastructure projects in the United States (San Diego, Orlando, John F. Kennedy in New York), India (New Delhi and Bangalore), Australia (Brisbane), and Saudi Arabia (Riyadh). Meanwhile, Sacyr is part of the consortium responsible for building the new terminal and runway at Jorge Chávez International Airport in Lima, Peru.

Moreover, the construction sector benefits from the significant contribution of small construction firms, both directly and as subcontractors for major builders. These SMEs go a step further in their use of technology and innovation — "bringing intelligence to concrete".

When it comes to the design of new passenger terminal buildings, several Spanish architectural practices are involved in major international projects of considerable significance. Thus, Estudio Lamela Arquitectos is part of the consortium designing the new terminal at Amsterdam Schiphol Airport, alongside Ineco, in the Netherlands.

In Mexico, the firm has worked in partnership with LAM Arquitectos on the expansion of the terminal



building at Tijuana Airport. In Spain, in a joint venture with AYESA, it is currently involved in the design of the expansion of terminals T4 and T4S at Adolfo Suárez Madrid-Barajas Airport.

Meanwhile, Luis Vidal + Arquitectos, through various consortiums, has participated in several modernisation and expansion projects at airports across the United States: Terminal E at Boston Logan International Airport, Terminal D at Dallas Fort Worth International Airport, and the terminal at Pittsburgh International Airport.

Finally, Spanish involvement in the management of major airport projects and in supporting the commissioning of new infrastructure (ORAT – Operational Readiness and Transfer projects) should also be highlighted. The knowledge and expertise gained from Spain's major infrastructure investments over recent decades have enabled these services to be exported internationally. Notable examples include the Project Management Offices for the expansions of Lima and Kuwait airports, and ORAT support for the terminals in Abu Dhabi and Kuwait, all carried out by Ineco.

Airport Operations

When it comes to airport operators, Aena stands out as a global leader, with total traffic exceeding 369 million passengers across its airports in 2024. In addition to the 46 airports and two heliports it operates in Spain, Aena holds a 51% stake in the operating company of London Luton Airport, and owns 100% of two concessionaire companies operating 17 airports in Brazil. Furthermore, Aena is involved in the management of 15 additional airports in countries such as Mexico, Jamaica, and Colombia, leveraging its extensive aeronautical experience and know-how.

With a market capitalisation of around €33 billion, Aena once again ranks as the world's leading airport operator in this regard.

In recent years, Ferrovial was the principal shareholder of the former BAA, having controlled all the airports around the London area. Since 2022, it has been part of the consortium responsible for designing, constructing, and operating the new Terminal One at New York's John F. Kennedy

International Airport in the United States. That same year, it also acquired a 60% stake in the company managing the concession of Dalaman International Airport in Turkey.

Air Navigation

The Spanish aviation sector also features a major player in the field of air navigation. ENAIRE is Spain's provider of air navigation and aeronautical information services. It ranks as the fourth largest in Europe by traffic volume and is among the most important globally. For instance, it holds the highest rating in the European Safety Management effectiveness indicator (EoSM – Effectiveness of Safety Management), with a score more than 12 points above the European average among service providers.

ENAIRE leads Europe in the implementation of sustainable procedure enhancements in air transport. It is the Air Navigation Service Provider (ANSP) with the highest use of continuous climb and descent operations (37% compared to the European average of 13%), and in PBN (Performance-Based Navigation) routes that follow optimal flight paths — resulting in a saving in flight miles equivalent to 91 laps around the Earth in 2024.

The field of Air Navigation Systems, traditionally at the forefront of technological innovation, is now progressing towards more efficient models for communication, navigation, and surveillance, with interoperable systems that provide high latency, integrity, and reliability to ensure safe air operations. These technologies, based on GNSS rather than traditional radar systems — which have a greater environmental impact and energy consumption — are crucial for enhancing in-flight efficiency and airspace management, allowing more flights to be handled safely.

A standout example in the field is the Automated Air Traffic Control System (SACTA), which integrates all Spanish control centres — en-route, terminal area (TMA), and tower — and allows for automated communication with international centres. This system reduces manual interventions, detects potential conflicts, and provides flexibility to reconfigure operational airspace. Since its inception, SACTA has continuously evolved to meet operational needs, establishing ENAIRE and Indra as international benchmarks in the sector.

Ineco also plays a key role as a service provider to ENAIRE, producing flight procedures and being certified to carry out these tasks across the EU. Additionally, Isdefe contributes significantly to the management of Air Navigation, as well as to the operation and maintenance of space stations for NASA, ESA, and INTA within Spain.

Technology Companies

Indra is a world leader in air traffic management. More than 25% of the world's total airspace is managed with Indra's automation systems, including systems equivalent to SACTA in the United Kingdom, Germany, and the Netherlands, and with traffic management facilities in more than 160 countries. Additionally, it is the main technology provider for EUROCONTROL's digital transformation, one of the most influential companies in the SESAR program, the technological pillar of the Single European Sky, and also a world leader in air navigation aids, with more than 8,000 navigation systems installed worldwide. Thanks to the experience of these companies and their positioning as benchmarks, Spain is involved in cutting-edge projects. A clear example of this is the iTEC SkyNex project, known as the new generation of traffic management, where Spain, Germany, the UK, the Netherlands, Norway, Poland, Lithuania, and Canada collaborate. In this consortium, ENAIRE is a founding member and Spain is the majority partner with 33% thanks to ENAIRE and Indra.

iTEC SkyNex

27 control centers

12 Millons of flights per year

26 Millions of Km_2 controlled

8 Air traffic service providers

Airlines and Manufacturers

Spanish airlines are also important players in our sector globally and are a crucial part of the necessary machinery to provide good air transport service. They bring indispensable value to the country and benefit from the good condition of Spanish airports and efficient air navigation service, achieving very notable punctuality levels: Iberia and Air Europa rank 4th and 6th in the world in the On-Time Performance rankings in February 2025. For its part, Airbus has a historic and solid position in Spain that dates back to the origin of the group, resulting from the convergence of companies of French, German, British, and Spanish origin. Airbus began as a consortium of aircraft manufacturers called Airbus Industrie GIE, as a collaboration between Aérospatiale of France, Messerschmitt-Bölkow-Blohm (MBB) of Germany, and British Aircraft Corporation (BAC) of the United Kingdom, to which Construcciones Aeronáuticas (CASA) of Spain later joined.

Commitment to Innovation and Research

The Spanish aerospace sector shows a strong commitment to research and innovation through multiple initiatives driven together with its main actors. The Spanish Space Agency seeks to position science, innovation, and space technology at the European and international excellence level, promoting collaboration between industry and research organizations, encouraging participation in international programs, and ensuring adequate scientific, technological, and industrial returns.

In the field of R&D&I, one standout initiative is the Strategic Project for Economic Recovery and Transformation (PERTE) for the aerospace sector, which aims to establish the Spanish industry as a key reference point in response to the sector's emerging challenges and opportunities. This project supports the strengthening of capabilities and the development of solutions to address economic, social, technical, and regulatory challenges, as well as to overcome the economic impact of the COVID-19 crisis, all based on public-private collaboration.

The specific objectives of the aerospace PERTE are structured around three main pillars, one of which is the Aeronautical pillar. This focuses on the development of zero-emission technologies and systems, the creation of demonstrators for multipurpose aircraft and UAVs, and the enhancement of aeronautical infrastructure to meet the requirements of the Single European Sky, thus promoting the decarbonisation of air transport.

3.5 Human Capital

The success of the air transport sector in Spain is not only the result of strategic planning or infrastructure investment, but above all, of the excellence and continuous development of its human capital. The combination of high-level academic training and the hands-on experience gained through the development of a robust airport network and an advanced air navigation system has enabled professionals in the sector to lead and drive the growth of the institutions and companies managing it.

Within this context, there has been a remarkable transformation in professional profiles: the traditional concept of the airport engineer has evolved into that of the airport and air navigation systems engineer. This new profile brings a more holistic, multidisciplinary, and innovation-oriented perspective, which is essential to successfully address the current and future challenges of a constantly evolving sector.

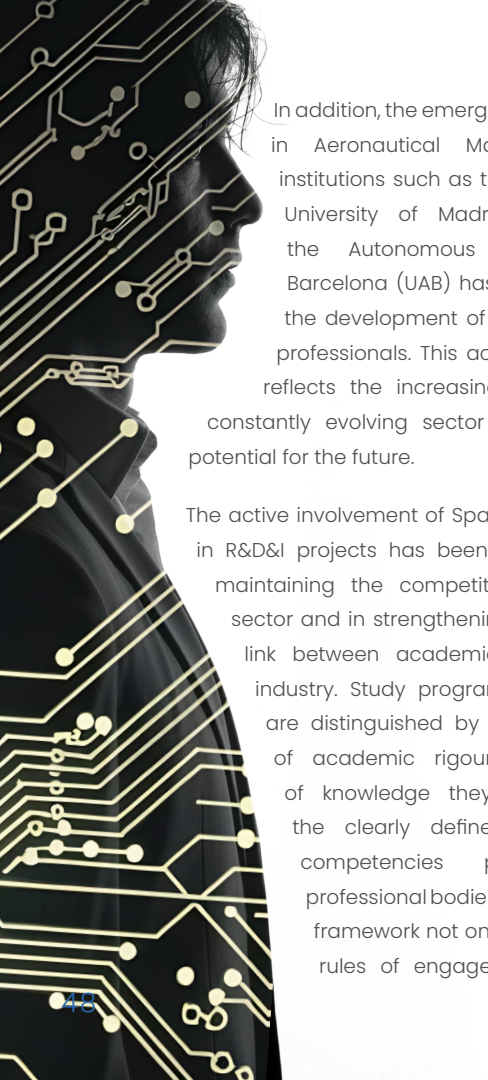
One of the distinguishing features of Spain compared to other countries is the historical

inclusion of specialisations in Airports and Air Navigation within the Aeronautical Engineering degree, rather than incorporating them into disciplines such as Civil Engineering or Telecommunications, as is common in most other nations. This unique approach has provided Spanish aeronautical engineers with a comprehensive and in-depth understanding of the sector, covering everything from aircraft performance to operational needs and efficient integration into the overall system.

Thanks to this integrated vision, Spain has been able to develop more efficient planning, design, and operational models, both in airport management and in the air navigation system.

Over recent decades, university education in aeronautical engineering in Spain has undergone significant development. While it was initially concentrated at the Polytechnic University of Madrid (UPM), the academic offering has expanded considerably with the inclusion of other leading universities such as the University of Seville, the Polytechnic University of Catalonia, the University of León, the Polytechnic University of Valencia, and Carlos III University of Madrid, among others.

We were able to do it because we had the technical and professional capacity – and the courage – to achieve everything we dreamed of



In addition, the emergence of degrees in Aeronautical Management at institutions such as the Autonomous University of Madrid (UAM) and the Autonomous University of Barcelona (UAB) has contributed to the development of highly qualified professionals. This academic growth reflects the increasing interest in a constantly evolving sector with immense potential for the future.

The active involvement of Spanish universities in R&D&I projects has been a key pillar in maintaining the competitiveness of the sector and in strengthening the strategic link between academic training and industry. Study programmes in Spain are distinguished by their high level of academic rigour, the breadth of knowledge they provide, and the clearly defined professional competencies protected by professional bodies. This regulatory framework not only sets out clear rules of engagement but also promotes aeronautical specialisation, which in turn drives excellence within the business ecosystem.

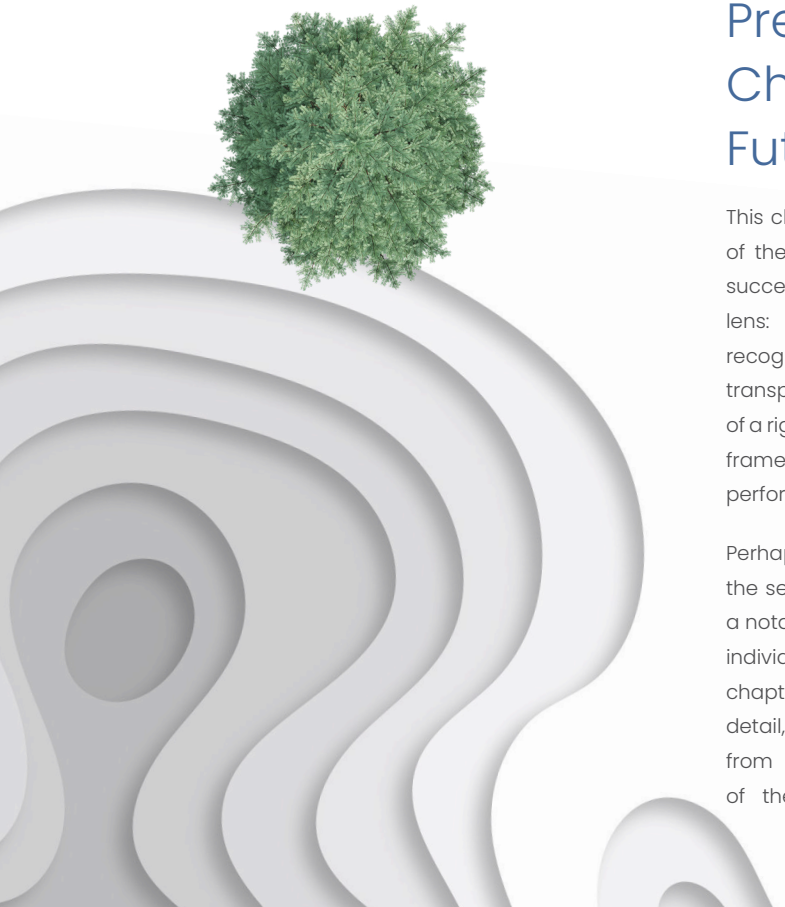
Despite the growing demand for professionals in the sector, Spain does not face a shortage of engineers. On the contrary, the high employability and strong reputation of aeronautical engineering education in Spain continue to attract new students eager to develop careers in a field with promising long-term prospects.

Moreover, the internationalisation of the sector has opened new opportunities for Spanish companies and professionals, allowing them to export their expertise and knowledge to foreign markets. This process of global expansion not only reflects the quality and strength of the training provided in Spain, but also its capacity for adaptation and leadership in a constantly transforming sector.

An illustrative example of the efficiency of Spanish talent in airport management is the case of the Barajas Plan. While the development of Terminal 5 at London Heathrow required three times as many human resources to manage a similar volume of investment, in Spain, just 120 versatile professionals from Aena and INECO were sufficient to manage an investment of €4 billion. The video shown during the inauguration of Terminal 4, which has remained in people's memory and continues to be quoted in meetings, sums up this reality with a powerful phrase:

"We were able to do it because we had the technical and professional capacity – and the courage – to achieve everything we dreamed of."

A capability built over decades, thanks to the strength and resilience of the sector's human capital.



3.6 Conclusions: Prepared to Face the Challenges of the Future

This chapter has outlined the key success factors of the Spanish air transport model. Much of this success can be explained through an institutional lens: a political and social environment that recognises the strategic importance of air transport for the country has fostered the creation of a rigorous and stable institutional and regulatory framework, which in turn supports strong performance across all phases of the sector.

Perhaps as a reflection of this shared awareness of the sector's significance to Spain, there has been a notable convergence of views among the many individuals consulted during the drafting of this chapter. While opinions may differ in emphasis or detail, the interviewees — including senior officials from the Directorate General of Civil Aviation of the Ministry of Transport and Sustainable Mobility, the Spanish Aviation Safety and Security Agency, the Official Association of Aeronautical Engineers of Spain, the National Commission on Markets and Competition, Aena SME SA, ENAIRE, the Airlines Association (ALA), and various experts and managers at Ineco — consistently expressed broad agreement in describing the Spanish sector as a success, and in identifying the factors underpinning it, as outlined in this chapter.

There is also a shared recognition that self-congratulatory attitudes are unwarranted, as recent success does not in itself guarantee future achievements. While the sector faces the future with clear strengths, it also faces real threats and challenges.

Several of these future challenges were identified: the growing geopolitical and economic tensions on the international stage, which affect a sector that fundamentally depends on a world that seeks to connect, engage, and trade; and the structural difficulties and constraints that limit growth across the sector's various stages — such as aircraft production capacity, availability of specialised personnel, and airspace and airport congestion.

In relation to this last point, the Spanish aviation sector faces the challenge of managing a new investment cycle in the coming years, in order to adapt capacity to forecasted growth and to meet environmental and quality demands.

From an efficiency improvement perspective, it is worth noting that although the sector does not receive public funding — on the contrary, it contributes financially to the public treasury — some users and air transport services do benefit from support via funds allocated to regional policy objectives that impact the sector. Examples include subsidies for island residents and Public Service Obligation (PSO) support for certain routes.

The overall impact of these funds on the air transport sector has been analysed by various bodies, which have highlighted the potential to increase their effectiveness without raising — and potentially even reducing — their total amount.

Improving their design, in order to minimise distortions within the air transport mode, should enhance the sector's performance without undermining their intended policy objectives.

However, the most frequently cited issue, and the one representing the most pressing challenge for the sector, is sustainability: the reduction of greenhouse gas emissions to meet medium- and long-term commitments on the path to climate neutrality — both for the aviation sector and the economy as a whole.

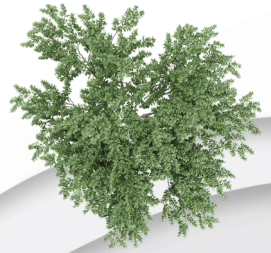
This challenge, of course, affects all sectors and all modes of transport, but perhaps in aviation, the road ahead presents greater uncertainty, which will need to be clarified over the coming years. The challenge for the air sector, therefore, lies not only in intensifying decarbonisation, but in defining how it is to be achieved. It is a challenge that involves international organisations and the industry as a whole, across all its phases — with different degrees of intensity, but present throughout.

There is a general consensus that the sustainability battle in aviation must be fought on four main fronts.

- First, the technological front, which applies not only to aircraft but also to related sectors such as air traffic control and airports.
- Second, the operational front, involving the organisation of operations to improve the use of airspace or increase flight occupancy, for example.
- Third, the use of SAFs (Sustainable Aviation Fuels) — a front where promising initiatives are emerging, albeit at a more preliminary stage than in other transport modes. Spain holds comparative advantages in this area that it should leverage.
- Fourth, the market and regulatory front, with measures related to mobility management, intermodality, or the internalisation of external costs. These are tools that may need to be employed — but they must be bold and well-designed, to avoid unintended or counterproductive effects that could ultimately harm the environment rather than protect it. While this report does not go into detail on such measures, it is important to acknowledge their relevance.

The future success of the Spanish air transport sector, in all its phases, will also depend on this arena: on the ability to design and implement effective solutions to improve the sector's sustainability, and, once in place, on the actual reduction of emissions achieved.

This is a challenge that calls on the entire Spanish aviation sector, including Ineco, which — as a transport engineering and consultancy firm — must contribute to a better understanding of the current situation: where the environmental and climate efficiency thresholds lie for each mode, which levers of improvement should be prioritised by each, and how, where, and how much investment is needed.



04

The Global Challenge: Sustainability

4.1 Transport and Climate: A 360° Vision to Measure Real Impact

To make genuine progress towards climate neutrality, we must fundamentally rethink how we measure and understand the impact of transport. It is no longer sufficient to focus solely on greenhouse gas (GHG) emissions during the operational phase — it is time to adopt a 360-degree perspective, one that encompasses the entire life cycle of transport and enables informed, evidence-based action.

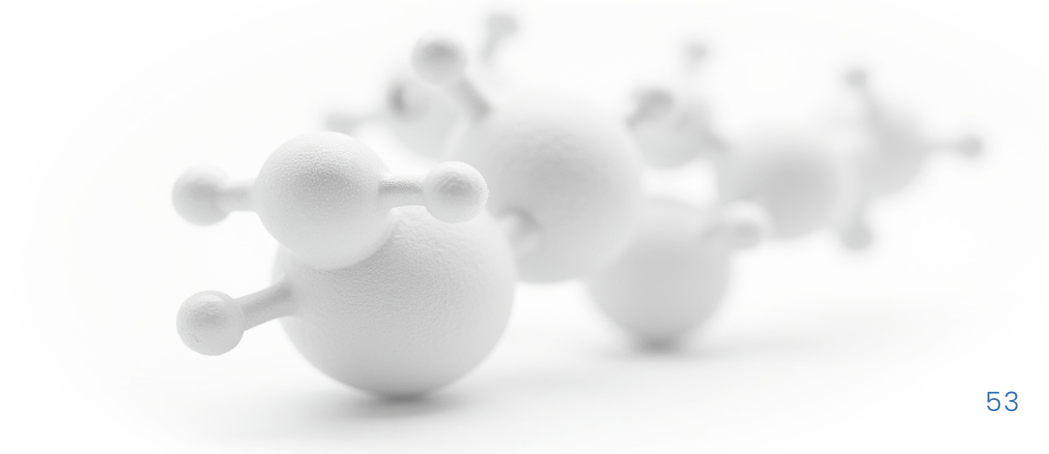
Transport is one of the largest contributors to GHG emissions and poses a major challenge to sustainability. In Spain, the transport sector accounted for no less than **32.5% of all GHG emissions in 2023**. Of that total, road transport represented **30.1%,** while domestic air transport also left its mark, contributing **1.2%**.

But these figures only tell part of the story. They reflect emissions during the operational phase alone, overlooking other critical stages in the life cycle of infrastructure and vehicle development: **construction, maintenance, renewal, or decommissioning**. All of this impact is spread across other economic sectors, masking the true scale of the problem.

A comprehensive approach is needed — one that can accurately identify which activities and technologies can effectively reduce transport emissions. This holistic and realistic vision is essential for designing effective strategies that genuinely make a difference.

Moreover, we must move beyond the comfort of annual statistics, embracing **cumulative accounting** that aggregates emissions year after year. Only then can we understand the full climate impact from a global perspective and design solutions that truly address the scale of the challenge.

Decarbonising transport requires rigour and a life-cycle perspective. Without complete data and cumulative analysis, any strategy will remain incomplete. True sustainability depends on understanding everything: **every emission, every impact, and every opportunity for improvement**.



4.2 A Retrospective View

To better understand the relationship between transport and climate, this section presents an analysis comparing two key modes: **domestic air travel within mainland Spain and high-speed rail.** This exercise covers not only the operational phase, but also the construction and maintenance stages, offering a more complete picture of their greenhouse gas (GHG) impact.

Air transport, traditionally seen as one of the largest emitters, shows a much lower impact during the construction phase. High-speed rail, on the other hand, **which has recorded zero emissions during operation since 2019** thanks to its use of clean energy, faces a significant carbon footprint challenge in the construction of infrastructure.

These two modes have been natural competitors on the mainland Spain corridor, offering comparable collective transport solutions aimed at similar types of journeys and passengers. This comparison is particularly relevant for identifying where action can be most effective in reducing overall emissions.

For methodological reasons, road transport has been excluded from this analysis — despite being the largest contributor to GHG emissions. Road infrastructure is regarded as a fundamental asset for accessibility and territorial cohesion, which makes direct comparison with air or rail transport modes inappropriate.

The analysis is primarily based on the **"Recommendations for estimating GHG emissions in the environmental assessment of transport plans and projects",** published by the Directorate General for Environmental Quality and Assessment and Natural Environment of the Ministry for the Ecological Transition and the Demographic Challenge.

The challenge is clear: to move towards a sustainable future, we must evaluate with rigour, compare with realism, and make decisions based on complete and accurate data.

4.4.1 Across the Network as a Whole

Over the past three decades, Spain has undergone an impressive modernisation of its transport infrastructure. The opening of **key airport terminals,** alongside the development of **high-speed rail,** has helped to consolidate a modern network that began its transformation with the construction of the motorway system in the 1980s.

This modernisation has brought numerous benefits, but it also presents new challenges in terms of sustainability. Gaining a clear understanding of its impact from a broad and rigorous perspective is essential for designing effective strategies towards a truly sustainable transport future.

This analysis focuses specifically on GHG emissions generated by domestic air transport within mainland Spain and high-speed rail, deliberately excluding other transport modes and activity segments in order to produce more accurate and comparable results.

In the case of **air transport,** all domestic mainland traffic is included, regardless of whether a high-speed rail alternative exists (these route pairs account for **63% of mainland demand**). Emissions from non-mainland and international air traffic are excluded, as they cannot be substituted by rail and, in any case, account for the majority of air traffic in Spain.

For rail transport, the analysis excludes other uses of the high-speed network, such as medium-distance AVANT services (which carried 24% of high-speed rail passengers in 2023) and Alvia, Altaria, and Euromed services (14%). In addition, the study **does not consider the infrastructure renewal phase at the end of asset life**, due to a lack of reliable data. This is particularly significant in the case of high-speed rail, where construction accounts for a large proportion of total emissions. Similarly, **vehicle manufacturing, maintenance and decommissioning are not included** — factors which also influence the overall environmental impact.

This analysis does not aim to provide an exhaustive comparison or an absolute judgement on past or present policies. Rather, it seeks to shed light on **the relative magnitudes between transport modes and to demystify preconceived ideas,** thereby contributing to a better-informed and more rigorous debate on how to achieve a more sustainable transport future.

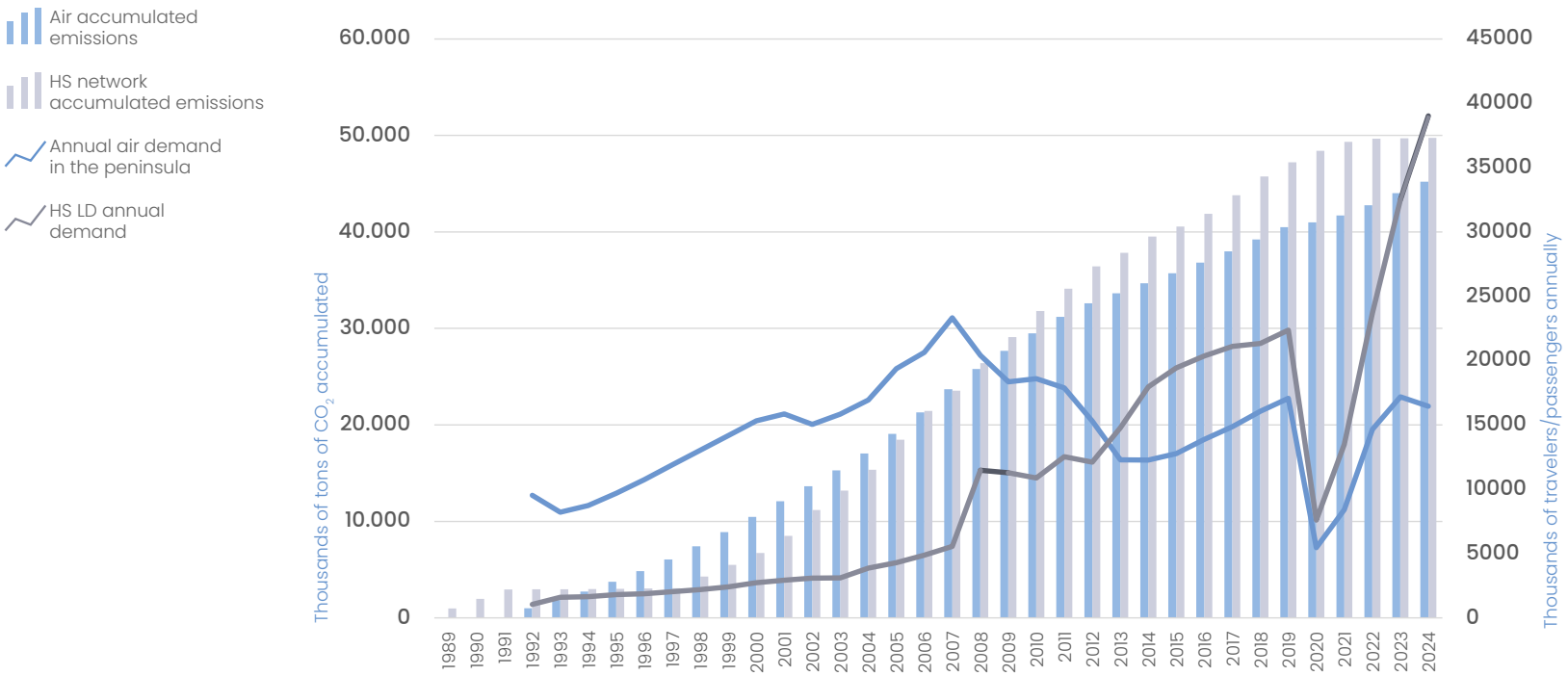
Since 1989, Spain has constructed and expanded key airports such as **Madrid (1998 and 2006), Barcelona (2004 and 2009), and Málaga (2010 and 2012)**. In total, **2.4 million m² of terminal buildings and 9.2 million m² of runways have been built.** These expansions serve all air traffic; therefore, 11.5% of the construction-related emissions are proportionally allocated to mainland domestic traffic, based on its share of total traffic.

On the other hand, the roll-out of **high-speed rail** has resulted in around **4,000 km of track entering service** during the same period. Simplified assumptions have been made regarding the distribution of construction-related GHG emissions over time. Emissions from infrastructure maintenance are also included and increase as new segments come into operation.

As a result, over the past three decades, mainland air transport has generated **45 Mt CO_2e**, while high-speed rail has emitted **50 Mt CO_2e**. Emissions from rail have begun to stabilise in recent years, owing to the completion of major projects and the exclusive use of renewable energy since 2019.

This analysis highlights the importance of considering **the full life cycle of infrastructure** — and not just the operational phase — in order to truly understand the climate impact of each mode of transport.

Cumulative emissions from the mainland air transport vs. high-speed rail network



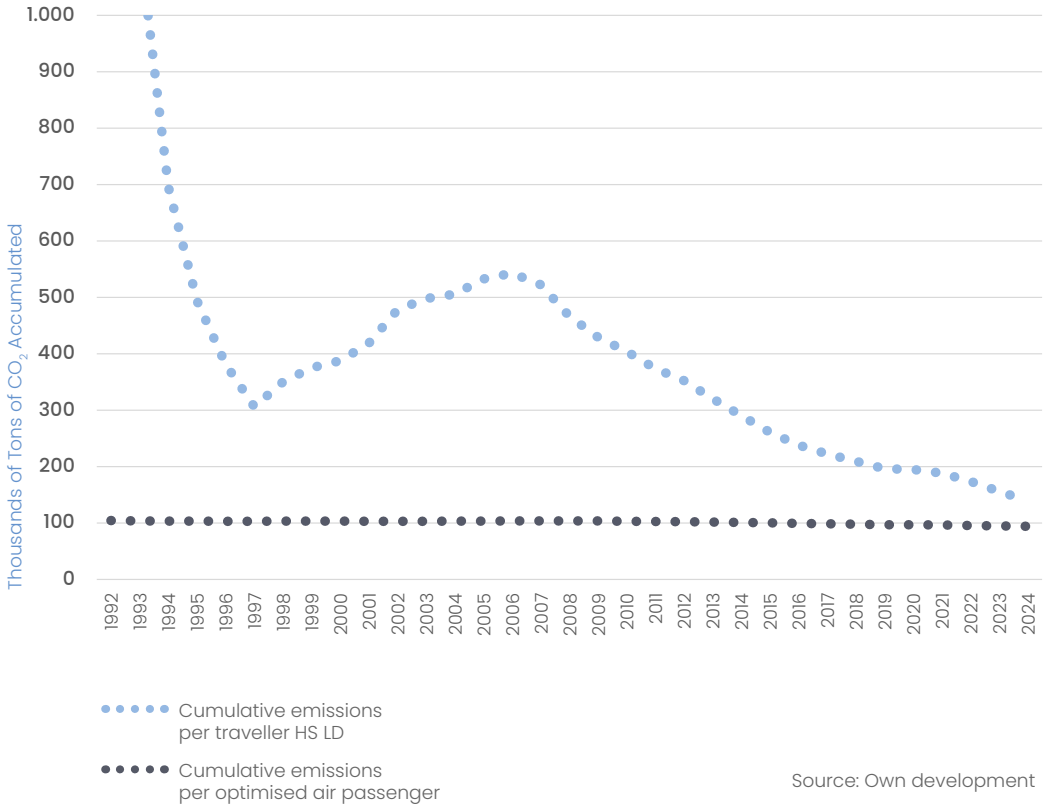
Source: Own development

During this period, demand for long-distance domestic mainland travel has experienced strong growth (+162%), alongside a significant shift in trends as the high-speed rail network expanded and was further boosted by the liberalisation of rail services in recent years. In 2024, long-distance high-speed rail demand approached 40 million passengers, compared to 16 million for mainland domestic air travel, which has not surpassed its 2007 peak and has shown a declining trend ever since.

The construction of the high-speed rail network has required substantial investment — both in financial terms and in emissions. However, the success in attracting demand means that cumulative emissions per high-speed rail passenger have fallen sharply in recent years, reaching 139 kg CO_2e per passenger by 2024.

Air travel, meanwhile, has already achieved significant reductions in GHG emissions thanks to advancements in aircraft and engine technology, bringing cumulative emissions per passenger down to 94 kg CO_2e.

Cumulative emissions per passenger/traveler for each mode



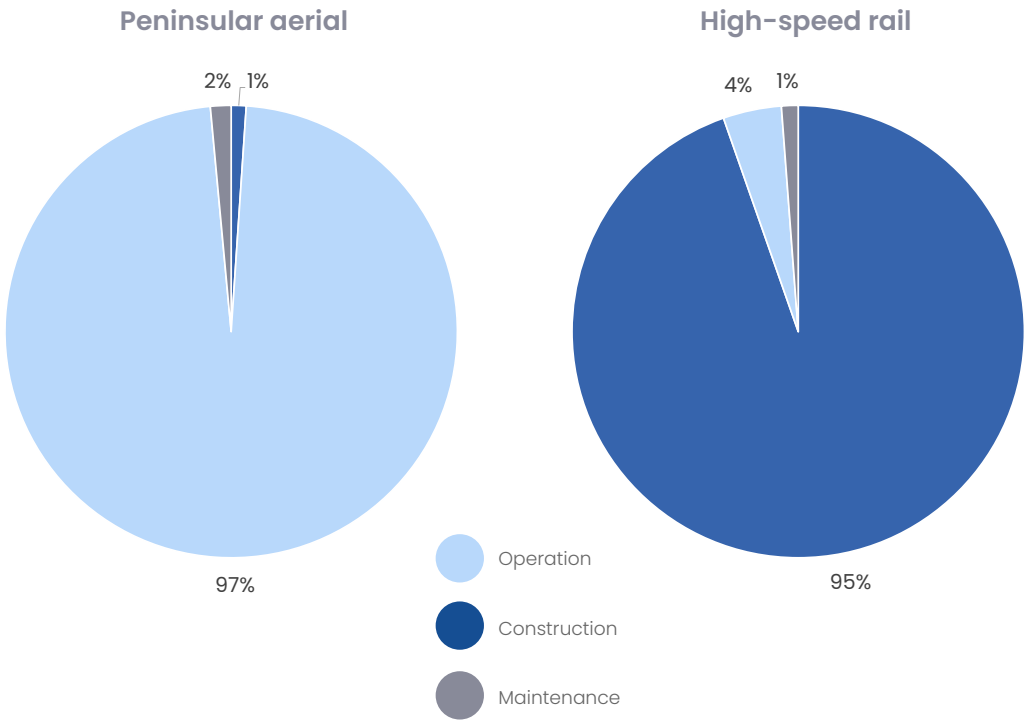
Source: Own development

A key finding of the analysis is that emissions for each mode of transport are generated at very different stages. For **air travel, 97% of emissions** come from the operational phase, whereas **for high-speed rail, a striking 95% of emissions** are linked to infrastructure construction.

This is a revealing insight, as it clearly highlights **where each mode should focus its efforts** to reduce emissions going forward: air transport must continue to optimise its operations, while rail should prioritise efficient and sustainable construction, particularly when it comes to future network expansions and renewals.

Identifying these priorities is essential to ensure that decarbonisation strategies are effective and capable of delivering a real and lasting impact on greenhouse gas reduction.

Cumulative emissions distribution per phase in each mode



Source: Own development

4.4.2 Focusing on Specific Corridors

Taking a corridor-based approach allows for a more detailed understanding of the results obtained for the network as a whole, by focusing on key long-distance connections. This approach includes both emissions generated during infrastructure construction and those from the operational phase.

However, in the case of rail, this type of analysis does not account for the valuable "network effect" — the ability of a single piece of infrastructure to support multiple additional connections across the mainland. It also excludes Alvia services, which partially use the high-speed network, as well as AVANT services between intermediate points, which have no direct equivalent in air transport.

Understanding these differences is essential for developing effective strategies that maximise both efficiency and sustainability in the transport system.

The analysis includes three corridors:

Madrid – Córdoba – Seville / Málaga

This corridor offers the longest timeframe for analysis. The construction of the high-speed rail infrastructure is estimated to have generated 5.2 million tonnes of CO_2e, with a total of 6.1 million tonnes of CO_2e, including 11% from operational emissions (up to 2019).

Air travel on the same route has generated 3.4 million tonnes of CO_2e over the same period. Thanks to the accumulated rail demand, bolstered by strong growth in recent years, cumulative emissions per rail passenger (48 kg CO_2e) are lower than those per air passenger (90 kg CO_2e).

Madrid – Zaragoza – Barcelona

For the Madrid – Barcelona corridor, construction emissions for the high-speed line are estimated at around 8 million tonnes of CO_2e. Including operational emissions (up to 2019) and infrastructure maintenance, the total amounts to 8.7 million tonnes of CO_2e.

Over the same period, air transport on this route has generated 5 million tonnes of CO_2e, 97% of which came from the operational phase. In this case, cumulative emissions per air passenger (80 kg CO_2e/pax) remain lower than those of rail passengers (88 kg CO_2e/pax).

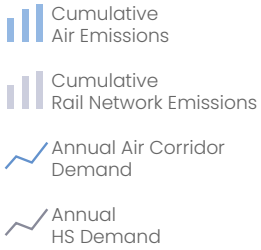
Madrid – Valencia / Alicante - Murcia.

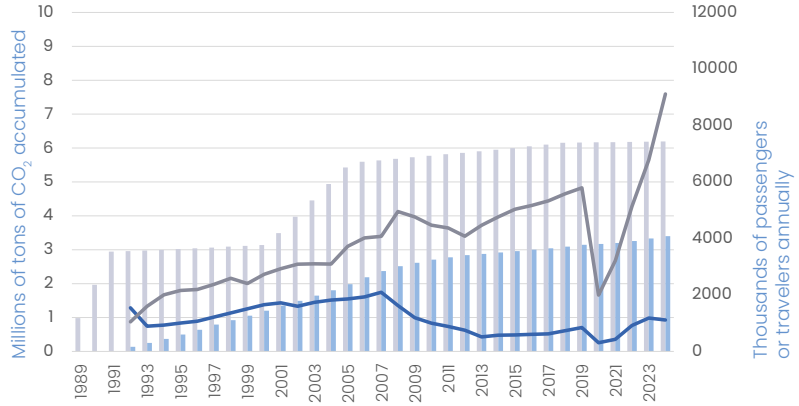
The Madrid – Levante corridor is the most recent of the three analysed. Estimated construction emissions amount to 6.9 million tonnes of CO_2e, with total rail emissions over the period reaching 7.1 million tonnes of CO_2e.

Air demand has dropped significantly since the introduction of high-speed rail, resulting in just 0.8 million tonnes of CO_2e from air transport during the analysed period.

For now, cumulative emissions per air passenger (85 kg CO_2e/pax) remain lower than those for rail passengers (112 kg CO_2e/pax).

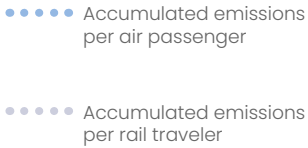
Total accumulated emissions in each mode by corridors

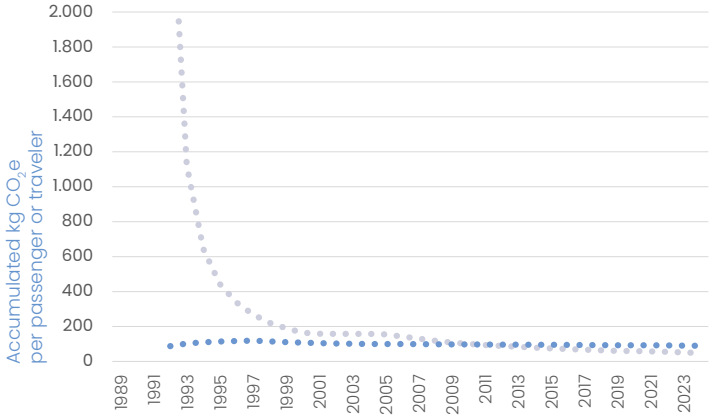




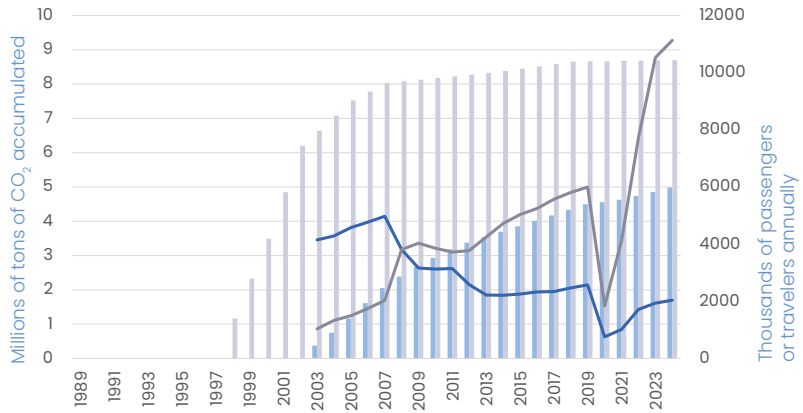
Madrid - Córdoba - Sevilla / Málaga

Total accumulated emissions and per passenger/traveler emissions accumulated in each mode by corridors

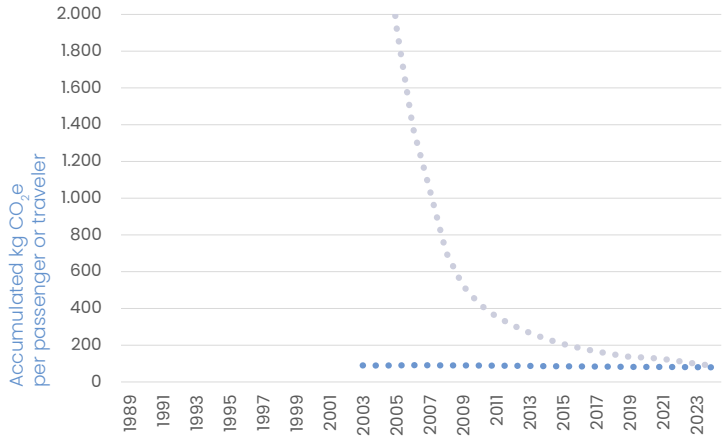


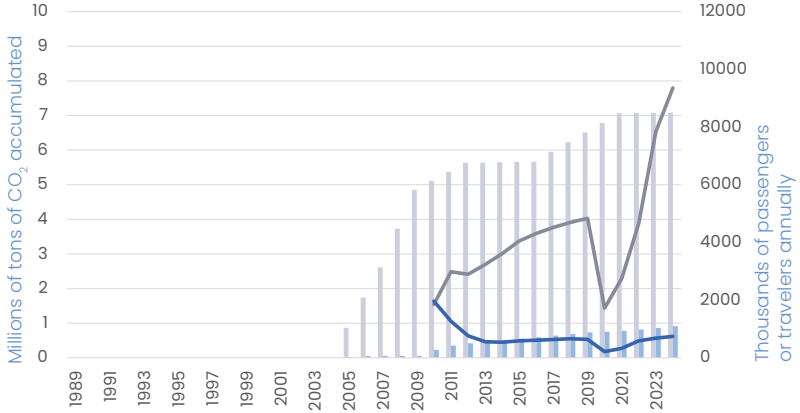


Source: Own development

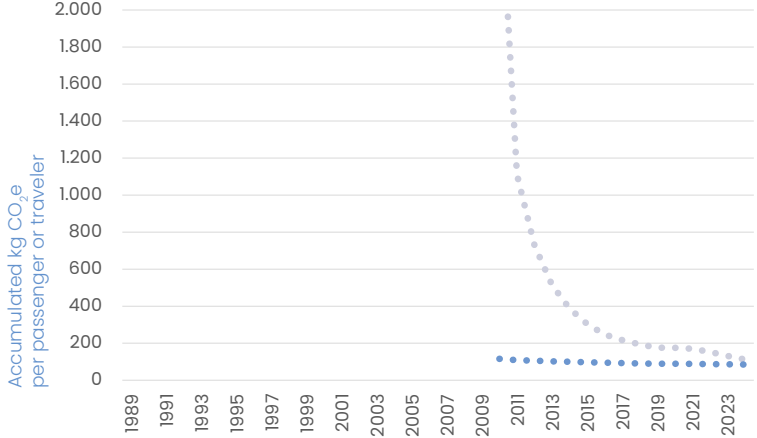


Madrid – Zaragoza - Barcelona





Madrid – Valencia / Alicante - Murcia



4.3 Innovation and Intelligence to Tackle the Climate Challenge

Climate goals must be addressed from a holistic perspective, ensuring an efficient balance between different modes of transport. It is essential that each mode contributes within its natural sphere of demand, while minimising total emissions across the system.

The key principle is clear: **avoid greenhouse gas emissions unless demand justifies** them, always taking into account the specific characteristics of each case. Specialising transport modes according to their optimal areas of use is crucial for maximising efficiency and reducing climate impact.

To achieve a significant reduction in transport-related emissions in Spain, efforts must focus on the most emission-intensive phases of each mode. In air transport, the main challenge remains the operational phase, while for high-speed rail, the greatest issue lies in infrastructure construction — which will also be a factor in future network upgrades and renewals.

The aviation sector has multiple opportunities to continue reducing its emissions, including:

- Implementing technological improvements in aircraft and engines
- Developing and scaling up the use of more efficient, lower-emission fuels
- Optimising airspace management
- Improving load factors to maximise flight efficiency

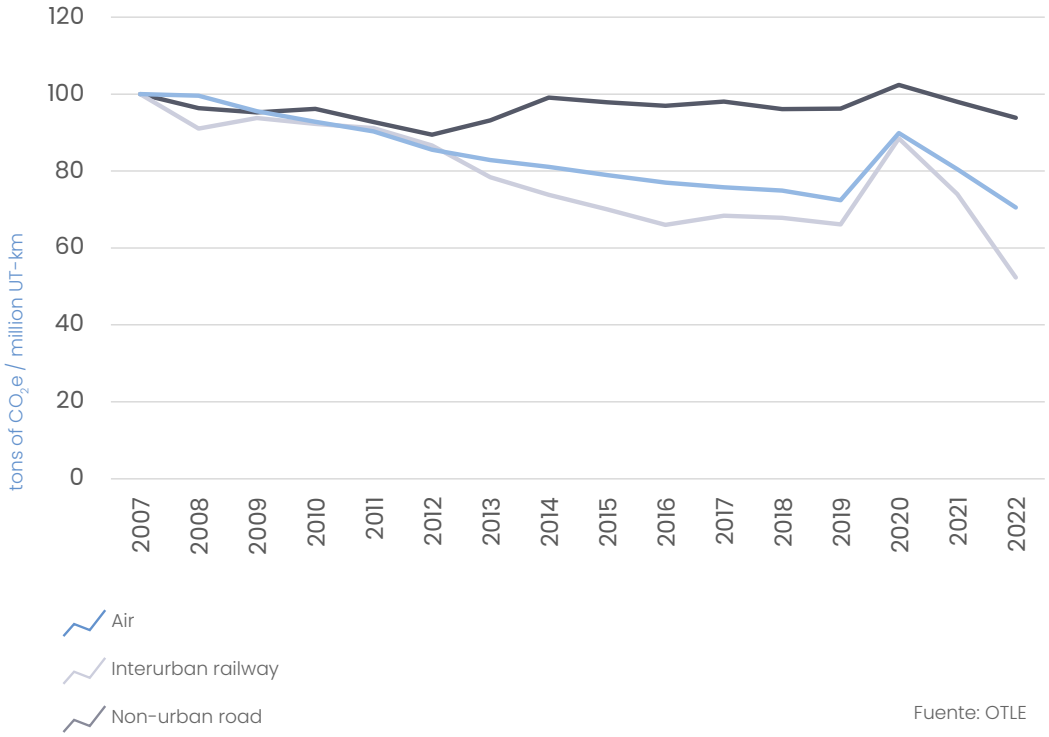
The sector has been applying emission reduction strategies for years, achieving **a 30% decrease in emissions per passenger-kilometre for domestic air transport since 2007**.

Identifying and applying effective strategies in each area is the only way to achieve real and sustainable climate targets.

The challenge of reducing GHG emissions in transport cannot be met with outdated tools. If we are to truly transform the system, we must embrace innovation — with forward-looking solutions that offer rigorous and practical insights.

In this spirit, **Ineco** is developing **CarbonTrack360:** an innovative tool designed to provide comprehensive tracking of cumulative emissions across various scenarios. Its purpose goes beyond simply measuring — it aims to anticipate, enabling accurate assessments of the impact of technological and operational improvements across the entire transport life cycle.

GHG emissions evolution (t of CO_2e) per unit of transport (million TU-km) by mode. Index 2007=100



Fuente: OTLE

CarbonTrack360 will make it possible to incorporate improvements across all phases of the transport life cycle — enabling the inclusion of more sustainable construction materials or the adoption of new fuels, such as **Sustainable Aviation Fuel (SAF)**. These fuels, which already have ambitious rollout targets for the coming years, are a crucial component in efforts to reduce emissions from air transport.

Far from seeking to close the debate, **CarbonTrack360** aims to broaden and enrich it. Its objective is to provide a robust and fair foundation for comparing transport modes that differ significantly in their development and operation, thereby supporting informed and climate-aligned decision-making.

05

Conclusions

Over the past decade, Spain has emerged as the most successful air transport model in Europe — performing best in terms of demand, quality, and efficiency. That is the first key conclusion of this report by Ineco. It is a success built over years of steady progress, punctuated by setbacks and periods of turbulence, such as the fluctuations in demand during the Spanish housing and fiscal crisis (2008–2013) or the COVID-19 pandemic (2020–2022) — to name just two major events that tested the sector's resilience.

Nonetheless, it is a success that might be described as quiet — in the sense that the aviation sector often receives less public recognition than other transport modes or infrastructure achievements. Yet it is a success born of decades of strategic decisions and sustained effort, which have culminated in a Spanish air transport model that is clear in its identity, robust, mature, and efficient, as set out in the pages that follow.

This report aims to tell the story of that model — to outline its key components and explain how it works. To do so, we have drawn on a series of in-depth interviews with a broad range of sector leaders, exploring the elements they consider fundamental to its success. The objective was to understand where and how those directly involved perceive and interpret the drivers of performance.

It has not been a difficult task, as there is a notable level of consensus across the sector. Despite differing interests, responsibilities, and perspectives, a common set of explanatory themes emerges. The role of this report is to convey those themes clearly and faithfully.

Spain has emerged as **the most successful air transport model** in Europe — performing best in terms of demand, quality, and efficiency. That is the first key conclusion of this report by Ineco

A model of **robust governance**, with institutions that are technically and financially capable of fulfilling their roles

Training and Foundations of the Spanish Air Transport Model

In the early 1990s, aviation in Europe entered a new era with the liberalisation of air transport. In Spain — newly integrated into the European project — the first steps were being taken towards the major expansion of transport infrastructure (motorways, high-speed rail, and airports), driven by the country's strong desire for openness and growth. These were the years of airport expansion plans, which would come to fruition in the 2000s. The projects were ambitious but not ostentatious, well-executed, and efficient — planned and delivered under a centralised model, led strongly by the public sector, quite distinct from the one in place today.

The result is the airport network we see today: fully capable of handling the largest air travel market in Europe, offering high quality at very competitive prices. This was the phase of major expansion, which continued until the early 2010s.

During the 2010s, the focus shifted from infrastructure development to management and optimisation. Key milestones in this new phase included the DORA (Airport Regulation Document), the structural reform of air traffic control in 2010, and the partial privatisation of AENA in 2014. These developments marked a new era of capitalising on past investments, delivering remarkable levels of quality and economic efficiency.

This strong performance in management has been the result of a combination of traditional institutions and instruments, adapted to a changing landscape, and enhanced by newer mechanisms — such as DORA, and the involvement of bodies external to the traditional aviation ecosystem, like the National Commission on Markets and Competition (CNMC).

What has emerged is a model of robust governance, with institutions that are technically and financially capable of fulfilling their roles, operating within a framework of independence and professionalism. It is a system supported by instruments that encourage consensus, balance of powers, and well-judged decision-making.

The result is a model in which stakeholders feel represented and confident, and whose performance is validated by objective metrics.

However, the success of the Spanish air transport model cannot be attributed solely to vertical "institutional or regulatory design". A key strength lies in the model's responsiveness to the needs and expectations of its user and beneficiary community. The fact that all airports of general interest in Spain form part of a single network does not shield Aena from scrutiny; on the contrary, its performance is held accountable to the demands of highly competitive sectors, such as aviation and tourism, to name just two of the most directly affected. It is also subject to the expectations of private investors (not only in Aena itself) and, ultimately, to those of increasingly well-informed and demanding passengers, who care about everything from service quality to delays and airport experience.

While airports play a central role, the aviation sector is far broader than airport infrastructure alone. This report highlights the importance of the air navigation system — including ENAIRE and other providers — as well as the many technology and service companies operating across the entire air transport value chain. Special mention must also go to the people behind the system — their training, commitment, and in particular, the prestigious Spanish aeronautical engineering sector, which enjoys widespread international recognition.

From Today's Success to Tomorrow's

But success today does not guarantee success tomorrow. What worked in the past may not be enough for the future. The real test for the Spanish model will be how it responds to the challenges ahead.

Air transport currently faces several risks. One is the possibility that ongoing geopolitical tensions could place a brake on air travel — an activity that is, by nature, international. Meanwhile, in Spain, the current focus on management and optimisation will need to evolve into a new phase of investment, both to maintain quality amid growing demand and to meet the increasing sustainability requirements of the airport system.

In this context, it is notable that Aena has announced plans to strengthen its financial structure and workforce in preparation for €7 billion in infrastructure works. Investment will also be needed in new technologies, especially those linked to emerging forms of air mobility and technological development — including next-generation aircraft, sustainable fuels, and drones.

But without doubt, the most pressing challenge facing air transport is sustainability. This major global issue requires a response on multiple fronts,

Without doubt, the most pressing challenge facing air transport faces is **sustainability**

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and if the Spanish model is to remain successful, it must capitalise on Spain's current strong position and adapt swiftly to meet this defining challenge.

On one front, there is the technological dimension, where aircraft and engine manufacturers around the world continue to achieve performance improvements that translate into lower fuel consumption and emissions. On another, the operational front, where the efficient organisation of air traffic is a key factor — an area in which ENAIRE already demonstrates outstanding performance.

The third front is that of Sustainable Aviation Fuels (SAF). According to several studies, Spain enjoys a competitive advantage in this area thanks to its transport infrastructure and its renewable energy production capacity. Finally, there is the regulatory and market-based front, which increasingly involves the internalisation of external costs, as is happening in other transport modes.

The Decarbonisation Challenge

But the battle for sustainability demands transparency and high-quality data. It is essential to have rigorous information that enables accurate diagnoses, the development of sound investment strategies and transport policies, and clear guidance for decision-makers on where to focus their efforts.

To support this, Ineco is developing the CarbonTrack360 tool, designed to provide a

comprehensive assessment of emissions from air transport and other modes, using a life-cycle approach. This means accounting for not only emissions during the operational phase, but also those arising from the construction and maintenance of the infrastructure required for transport to take place.

The idea itself is not new, but with this tool — conceived as a project of continuous improvement — we can begin to put figures to the discussion and set the parameters for a productive dialogue.

Although the tool is still under development, it is possible to share some early but enlightening findings. First and foremost, when construction emissions are included in the analysis, the importance of assessing each case individually becomes clear in order to understand the relative environmental efficiency of different transport modes.

Demand levels and the environmental costs embedded in infrastructure construction are critical for defining the efficiency thresholds of each mode. As might be expected, air transport is not always the least environmentally friendly option — rather, its impact depends on a variety of factors that must be assessed in detail. This is precisely where CarbonTrack360 proves valuable.

It is important to stress that the goal is not to defend air transport per se, but to support the fight against climate change. The aim is not to rely on clichés or stigma, but to move beyond them through rigour and evidence-based analysis.

In any case, the environmental improvement and decarbonisation of air transport remains the greatest challenge facing both the Spanish and global aviation sectors. The path to improvement is considerable, but the fact that the Spanish sector is aware, engaged, and prepared to design and implement meaningful change is essential if today's success is to be translated into success for the future.

NOTES

1 ATAG (2024) " aVIATION BENEFITS BEYOND BORDERS" with Oxford Economic Analysis data. https:// aviationbenefits.org/downloads/aviation-benefits-beyond-borders-2024\

2 Bureau of Transportation Startics (USA), Civil Aviation Administration of China, Ministry of Civil Aviation (India). The year 2024 for India corresponds to the fiscal year (April-March).

3 Airport Industry Conectivity Report 2024. ACI Europe

4 Total connectivity measures the total number of air connections available from a country, including both direct flights and those with stopovers, while direct connectivity refers only to direct air connections, i.e. non-stop flights between two destinations.

5 10 countries with the best international air connectivity. Mabrian TRavel Intelligence.

6 ACI (2024). " ASQ Departures. Passenger Satisfaction Report"

7 Official Airline Guide (OAG) https:// www.oag.com/

8 Jacobs (2023) " Airport Performance Indicators 2023"

9 Air Transport Research Society (ATRS) (2022) " AIRPORT BENCHMARKING REPORT-2022. Global Standars for Airport Excellence.

10 The en-route charge is a monetary cost to be multiplied by the number of kilometres flown in the sovereign airspace of each country and the weight of the aircraft performing the route.

11 Spain participates in Eurocontrol's en route charges system, whereby Eurocontrol is delegated the invoicing and collection of these charges, although the amount is not standardised.

12 UK Civil Aviation Authority (2023). " Economic Regulation of NATS (En Route) plc: Final Decision for the NR23 (2023 tu 2027)price control review".

13 Strengths of the network model: Size, volume, network effects and inter-airport support.

14 Network effects can be described as the positive impact that the entry of a new user of a product or service, or a new participant in an interaction, has on the value of other users or participants (Belleflamme & Peitz, 2021). They gained relevance in the framework of two-sided digital platforms. But in the field of transport analytics are particulary important.

PROJECT DIRECTOR

Sergio Vázquez Torrón

AUTHORS

Miguel de Bernardo

Javier Anibarro

María López-Mateos

COLLABORATORS

María Cifuentes

Carlos Cobos

Elena Curto

Sergio Garrido

Javier González

Juan Hungría

Ana Lorenzo

Antonio Martín

Marta Martínez

Carlos Rubio

Alicia Ruiz

VALUABLE CONTRIBUTIONS

(INTERVIEWS):

CNMC: Paloma Gilmartín, Eduardo Martínez y Luis Felipe Montero

COIAE: José Manuel Hesse y Santiago Carmona

ALA: Javier Gándara

AENA: Javier Marín y Angel L. Sanz

ENAIRE: Estíbaliz Salazar, Santiago Cortés, Javier Cámara y Mónica Mansilla

AESA: Montserrat Mestres

DGAC: David Benito, Andrés López Morales, Verónica Elvira y Pablo Prados

AND THE SUPPORT OF:

Marta Gabaldón

Elpidio González

José Angel Higueras

Rafael Molina

Francisco Olmedo

Laura Serrano

Rafael Torres

Map data:
Google, Maxar Technologies

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