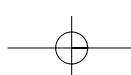
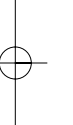
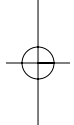
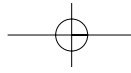


2



DIAGNOSIS OF THE TRANSPORT SYSTEM:
THE NEED FOR A CHANGE OF HEADING



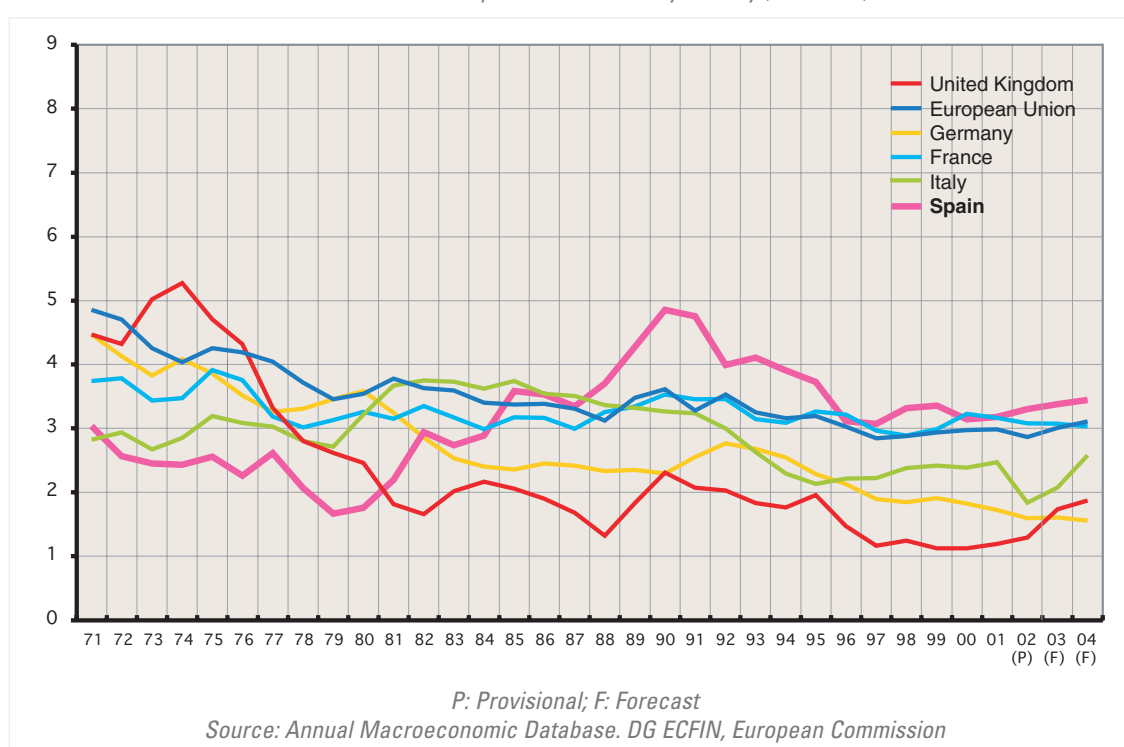


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2.1. THE ANALYTICAL FRAMEWORK

Spain has, since the mid-eighties and with the assistance of European funds, undertaken a significant drive to overcome its deficiencies in transport infrastructures. From the end of the eighties and until the mid-nineties it was, with Germany, in first place in the European Union (EU) in the percentage of GDP allocated to investment in transport infrastructures. From the threshold of 0.5-0.6% of GDP in the mid-eighties it has reached values of around 1.7-1.8% of GDP in recent years, with deviations strongly linked to the economic cycle. As a result, investment in transport infrastructures in Spain is today twice the European Union average (between 1.0 and 0.85% of GDP).

FIGURE 1. Trends in public investment by country (% of GDP)

**2.1.1. The transport infrastructure networks**

This section summarises the main elements of a diagnosis of State-owned infrastructures: roads, rail, ports and airports.

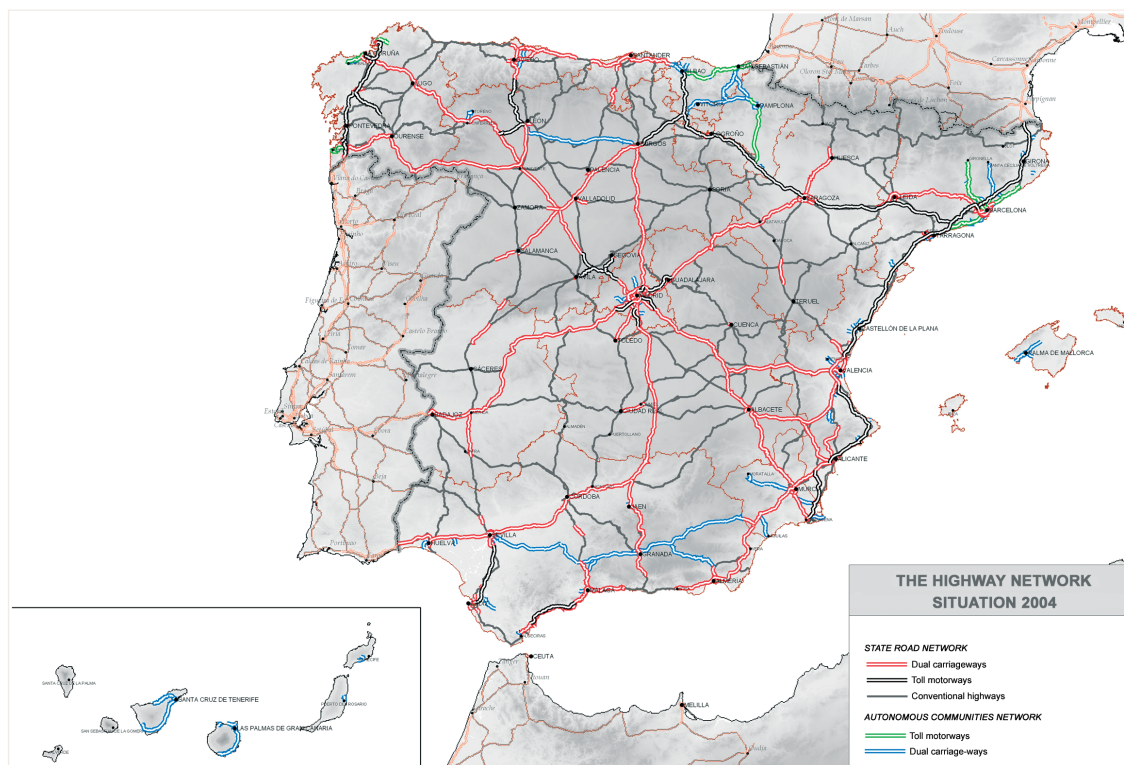
The existing structural road system on the Spanish mainland (Figure 2) comprises the 24,797 km of the State Highway Network, of which 8,700 kilometres (35%) are dual carriageways (6,698 km) and toll motorways (1,951 km). It must also be remembered that this structuring mainland network also includes about another 2,500 kilometres (2,450 km) of the Autonomous Communities' system of dual carriageways and motorways. An analysis of the features of this network must emphasise the following aspects:

- The markedly radial nature of the State system of dual carriageways.
- A mesh system which has begun to be built, but with discontinuities which have to be connected.
- Persistently deficient access from certain regions, which must be corrected.

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- d) The obsolescence and the inadequacy of the security parameters of significant parts of the first-generation dual carriageway network, and of conventional roads, where action is necessary.
- e) A generalisation of "standard" solutions which must be made more flexible in order to better adapt each section to the conditions of its surroundings and users' requirements.

FIGURE 2. The highway network: the current situation



The rail network in service is almost 15,000 kilometres long (Figure 3), of which somewhat more than 1,000 kilometres (1,031) represent the high-performance line in UIC gauge running through the peninsula like a large-scale diagonal axis Seville-Madrid-Zaragoza-Lleida/Huesca, but which is as yet incomplete. The two-track electrified system extends over nearly 3,000 kilometres (2,905), while there are 5,494 kilometres of service on a one-track network which is not electrified.

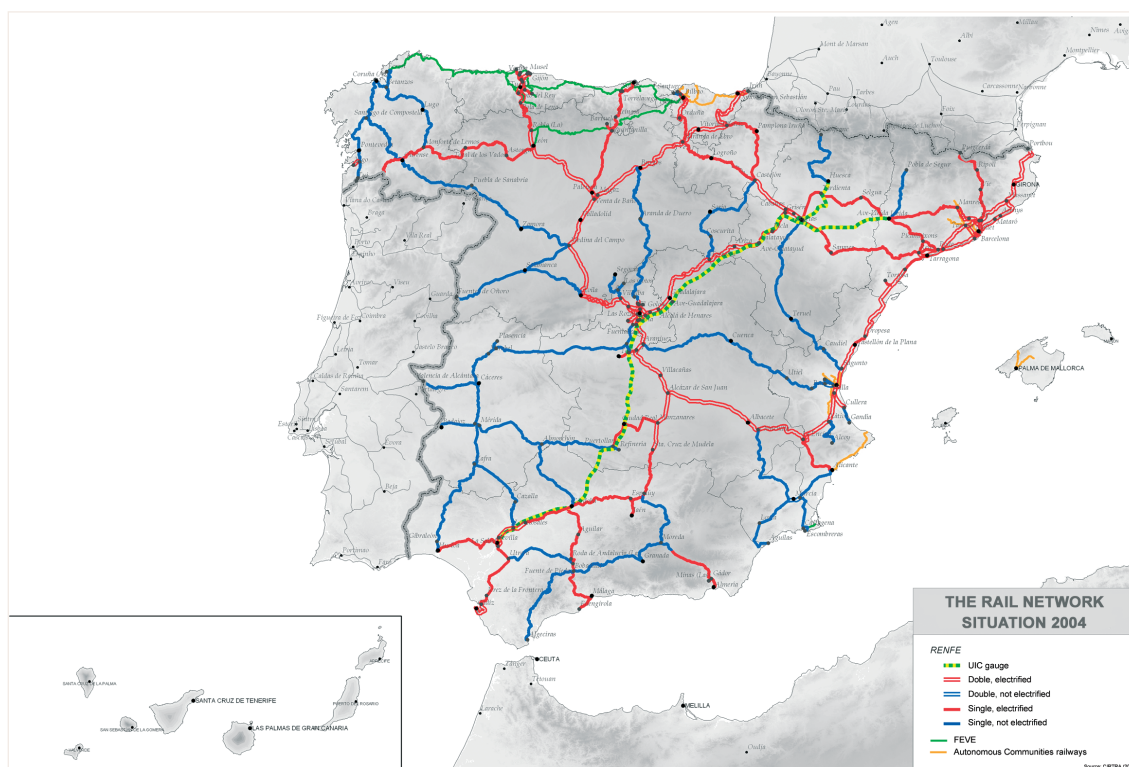
The following are some of the most significant aspects of the current state of the system:

- a) Significant differences of both quality and safety levels from one network line to another.
- b) The existence of sectors and lines where traffic is light.
- c) Difficulties in integrating the network into the international framework (*interoperability*), where the gauge difference is one major conditioning factor, albeit not the only one.
- d) The existence of tensions, along with aspects related to suitability, between urban development and the rail networks. In the main urban areas, the major developments in commuter networks and services must be added in.

The network of State Ports of general interest is made up of 28 Port Authorities (Figure 4) which enjoy considerable operational and financial independence, coordinated by the Public Corporation *Puertos del Estado* (EPPE) which was set up in 1992. The port system

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FIGURE 3. The rail network: the current situation



comprises the main entry and exit point of this country's imports and exports, accounting for around 70% of the total. The last decade has seen a continuing rise in port traffic which, in 2003, reached a total aggregate volume of 380 million tons. This demand is to some extent concentrated in the largest ports (particularly Algeciras with more than 60 million tons, Barcelona and Valencia, with more than 35 million), although in general each port has its own specific market.

More than the capacity of the maritime infrastructures, the main conditioning factors for the development of port activity are the need to adapt installations and services to the changing circumstances of demand, and the provision of land access (road and rail) which, as suggested with rail, points to the need to deal specifically with a better urban integration of ports.

There are 48 airports of general interest, managed by Aeropuertos Españoles y Navegación Aérea (AENA) including the military air bases open to civilian traffic and the Ceuta heliport, but activity is concentrated in a small number of airports. According to 2003 figures, Madrid-Barajas accounts for almost a quarter of all passenger traffic in Spain (23.3%), and it, Barcelona and Palma de Mallorca airports take more than 50% of all passenger traffic in this country, a figure which is tending to rise. The networked operation of air transport services favours this trend, while making it possible to increase access to air transport by the majority of the population.

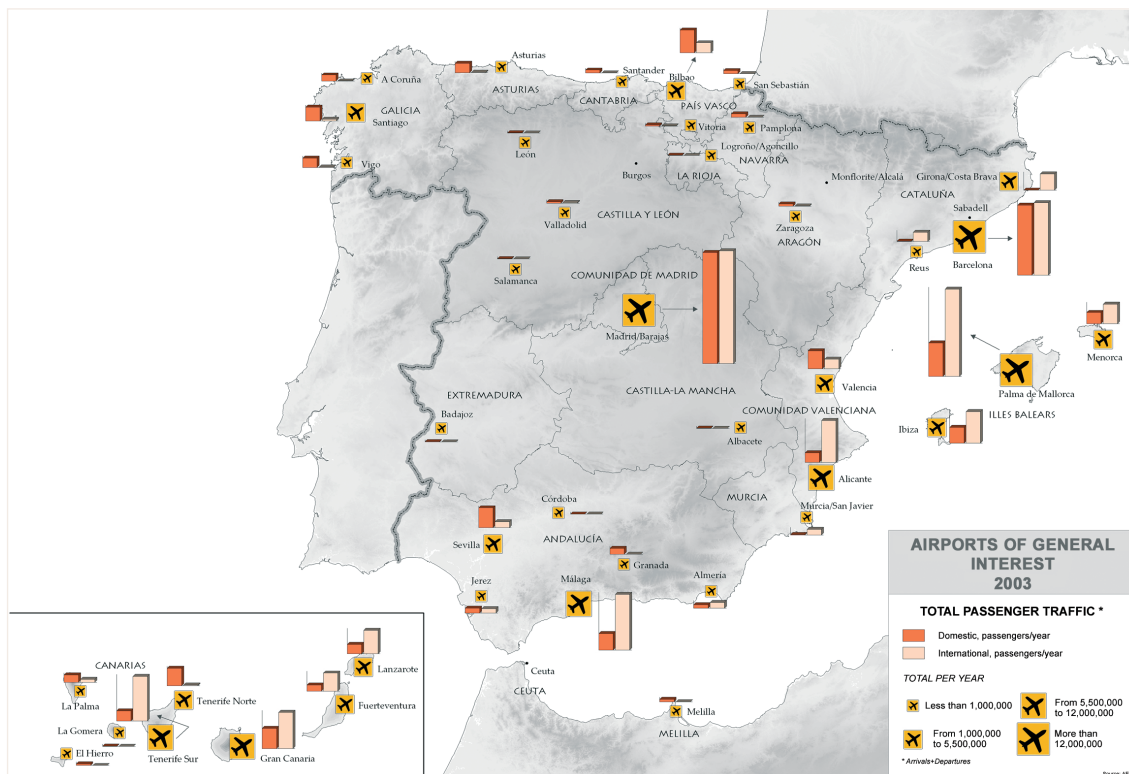
Airport infrastructures are the main means of inward and outward access for passenger transport, but air transport is also domestically significant medium- and long-distance and (like sea transport particularly for goods) essential for communications with the territories away from the mainland, and for the links between them.

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FIGURE 4. Network of State Ports of general interest



FIGURE 5. Network of airports of general interest



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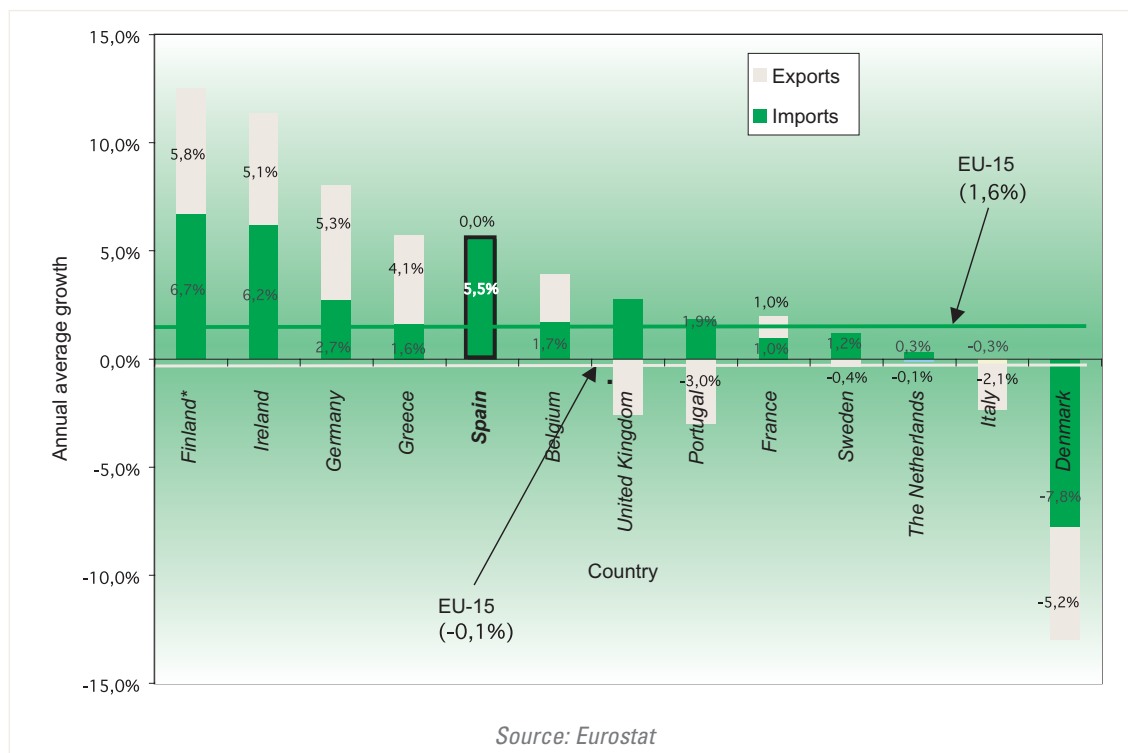
2.1.2. Transport demand and services

Despite the fact that, comparatively speaking, in quantitative terms domestic transport is far more important, the dynamic of the Spanish transport system is greatly influenced by the international context, for two reasons:

- the effect of European integration and world economic trends, which are raising overseas flows very quickly, and
- the existence of a common European frame of reference for transport policies.

International trade guidelines have gone hand-in-hand with a considerable growth of transport flows between Spain and the rest of the world, in both goods and passengers. Between 1993 and 2002, annual average growth in goods transport was 5.5%. Sea was the most-used means of international transport (236 million tons in 2002 and 5% average annual growth), followed well behind by road (with 87 million tons and annual growth of 6%). There are still major expectations of growth, the Spanish economy being relatively closed in comparison with that of most European Union countries. On the other hand, most of these new flows originate in or are destined for other European countries. Between 1997 and 2001, Spanish growth in international sea traffic was one of the largest in Europe, although with a notable imbalance in trends in imports and exports (Figure 6), and Spain was among the countries with greatest market share in the European Union (Figure 7).

FIGURE 6. Annual average growth 1997-2001 in international sea transport (tons) in the European Union



In passenger terms, Spain is a major tourist destination, to which the country's transport system has contributed decisively. Tourists represented 68.5% of all travellers from overseas in 1995, rising to 70.4% in 2003. During that time, the number of passengers entering Spain rose an annual average of 4.4%. In order, the categories used were air (70%

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in 2003) and road (23%, mostly in private vehicles). The former experienced strong annual average growth, of 8.8%, slightly above the European average (Figure 8).

FIGURE 7. Spain's market share in European Union international sea transport (arrivals + departures). 2001

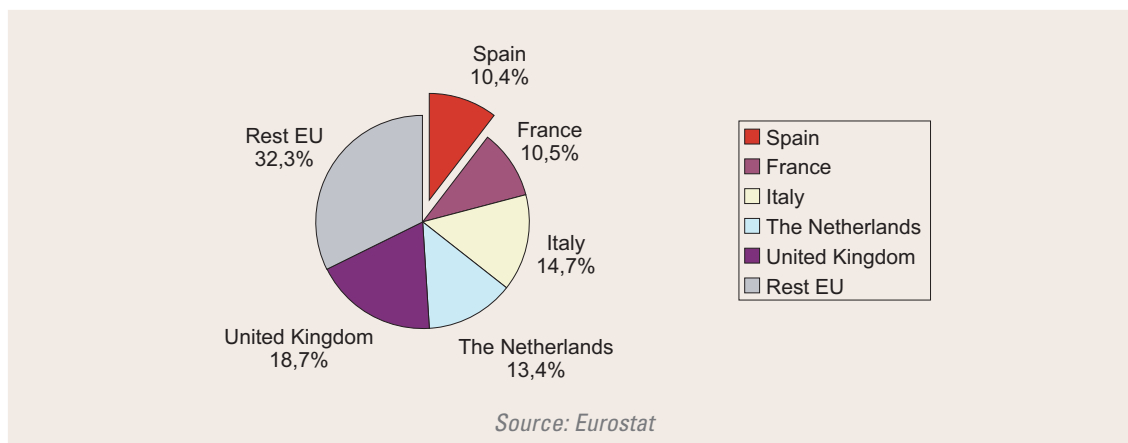
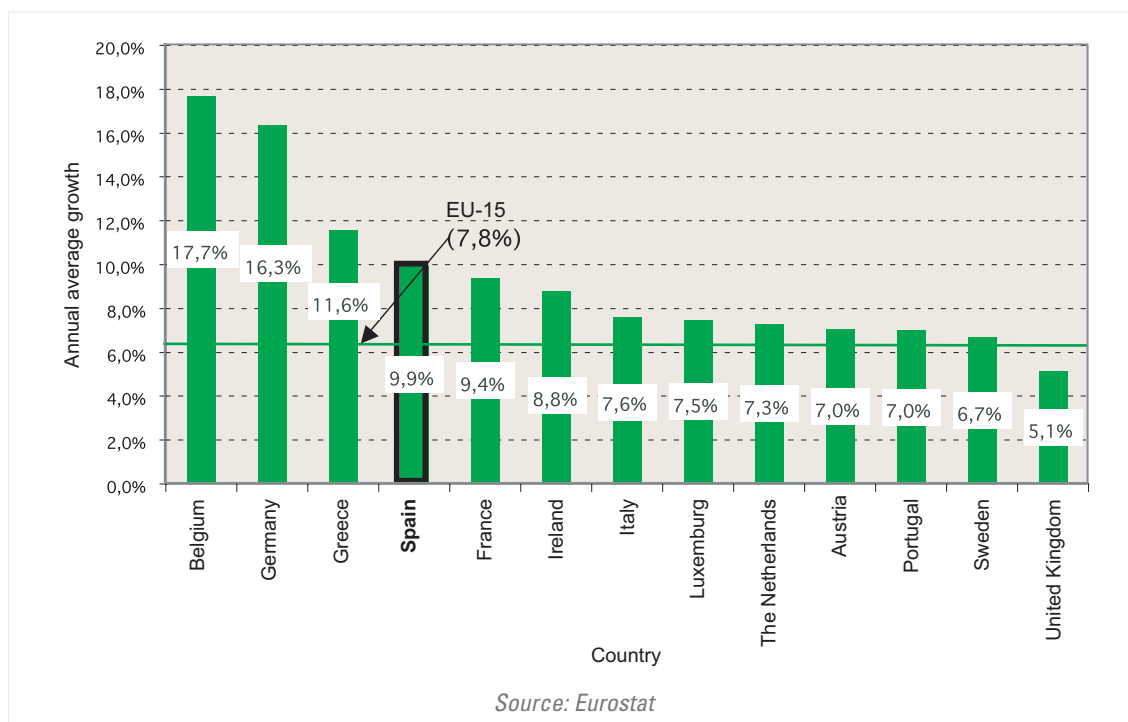


FIGURE 8. Annual average growth of international air transport in Europe (Passengers, 1993-2001)



Although at levels well below those of other European countries, international transit traffic has begun to rise significantly in recent years. Added to that originating or with destination in Portugal are the flows between the Maghreb and Europe, where there is also major potential for expansion, in both passengers and goods. Here the PEIT deals with and foment the promotion of the technical studies and work begun by Spain and Morocco in connection with the Fixed-Link project across the Straits of Gibraltar. This is in any event a long-term project, implementation of which may exceed the PEIT horizon.

Spanish transport with the rest of the EU follows lines similar to those of other Member States, influenced by the growing integration of European economies. For international goods transport, movement is by sea or road (50% and 43% respectively). Development of cabotage offsets the scant possibilities for river transport and the extremely limited

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advance of rail (4.5% of the modal distribution compared with a European average of 8%). Transport flows run mainly to France, the United Kingdom, Italy and Germany, and the choice of the mode of transport depends to a large extent on the type of merchandise: while rail and sea transport concentrate on a limited number of products –such as some bulk items or motor vehicles– road transport provides a “universal” category.

In passenger transport inside the EU, more than 80% of Spanish international air transport users fly on intra-Community routes (a percentage equalled only by Ireland and Luxemburg), a pointer to the lack of modal alternatives for most displacements within Europe. In terms of the number of travellers originating or with a destination outside the EU, Barajas, with more than 6 million, heads medium-sized European airports such as Milan (Malpensa), Brussels or Copenhagen, although considerably behind the group of most important airports (London-Heathrow, Amsterdam-Schipol, Paris-Charles de Gaulle, Frankfurt and London-Gatwick).

The merit of placing a diagnosis of the Spanish system in the European context is confirmed with analysis of some data on internal transport demand, showing how the findings put forward by the European Commission for the EU as a whole in its 2001 White Paper turn out to be substantially adequate for this country too, despite its peripheral location.

Nationally, road continues to be the only means of transport which is able to meet almost any type of demand, so it is hardly surprising that it accounts for 86% of land transport of goods and 88% of passengers (the sum of the 78% in private vehicles and the 10% covered by group transport by bus). In goods, cabotage is, despite its importance, highly specialised in certain types of cargoes and connections (such as transport with Spain's non-mainland territories). This is similar to the situation of rail which, as already pointed out in dealing with international traffic, is becoming progressively more specialised in certain connections and demands. The dominance of road transport of goods, and its competitiveness in terms of service quality and price is, despite the advances made to enhance the transparency of the market and the business structure, associated with a worrying fragility of the sector, and weakness in its relation with loaders.

For passengers, the importance of air transport for domestic traffic (substantially linked to connections with areas of the country away from the mainland) is reflected in the fact that Barajas is, with a figure similar to that of Paris-Orly, the number one European Union airport in domestic passenger numbers, and Barcelona-El Prat is fourth, not far behind Rome-Fiumicino. Rail transport of passengers rose 30% in 1990-2000, although the annual average distance (traveller-kms per capita and year) by rail remains considerably lower in Spain (510 km) than the European average (810 km), and less half that in France (1,149 km). Use of rail in Spain is clearly concentrated along the trunks which offer high-quality service, such as the high-speed routes or the Mediterranean Corridor.

Urban mobility trends also make clear the relevance of a European diagnosis. Dispersed urban development has multiplied in this country, boosted by substantial improvements to metropolitan route networks (enhanced accesses and new ring-routes) aggravating dependence on the car despite major investments in many cities' public transport systems: private vehicles continue to grow in terms of vehicle-kms travelled and, on many occasions, even in terms of distribution by mode. The flexibility offered by new technologies (e-commerce, urban logistics management) does not appear at present to be translating into reduced transport demand, and even points in many cases in the opposite direction: greater consumption in terms of vehicle-kms.

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2.1.3. The strengths and uncertainties of the existing Spanish transport model

It can thus be said as a general balance that the Spanish network is mature, and has virtually converged with Europe in terms of the country's resources in major transport infrastructures, particularly in dual carriageways and motorways. With nearly 18 kilometres of high-capacity routes for every 1,000 km² of area, Spain was as early as 2000 at the same level as France, and significantly ahead of the EU-15 average (15.9 km/1,000 km²). The same can be said of high-speed rail lines (over 250 km/h): with the recent inauguration of the Madrid-Lleida line, only France has longer high-performance rail routes. In terms of numbers of inhabitants, Spain has the second-highest density in Europe of dual carriageways and motorways, exceeded only by Luxemburg. On the other hand, mid-range infrastructures continue to reveal a substantial difference, in particular in rail: 28.3 of conventional rail line for every 1,000 km² compared with a Community mean of 48.3 km/1,000 km² (Table 1).

TABLE 1. Length of transport networks: Key Indicators. 2000

	Rail				High-capacity roads		
	Km	% Electrified	Km/100,000 Inhabitants	Km/1,000 Km ²	Km	Km/100,000 Inhabitants	Km/1,000 Km ²
Belgium	3.471	78	34	113,8	1.702	16,6	55,8
Denmark	2.047	31	38,3	47,5	922	17,3	21,4
Germany	36.652	52	44,6	102,7	11.712	14,3	32,8
Greece	2.299	0	21,8	17,4	707	6,7	5,4
Spain	14.303	54	36,2	28,3	9.049	22,9	17,9
France	32.515	43	53,7	59,8	9.766	16,1	18
Ireland	1.919	2	50,7	27,3	103	2,7	1,5
Italy	16.499	66	28,6	54,8	6.478	11,2	21,5
Luxemburg	274	95	62,5	105,4	115	26,2	44,2
The Netherlands	2.802	74	17,6	67,5	2.289	14,4	55,2
Austria	6.281	60	77,5	74,9	633	20,2	19,5
Portugal	2.814	32	28,1	30,6	1.482	14,8	16,1
Finland	5.854	41	113,1	17,3	549	10,6	1,6
Sweden	11.560	75	130,5	25,7	1.506	17	3,3
United Kingdom	17.067	30	28,6	69,9	3.546	5,9	14,5
EU-15	156.357	50	41,4	48,3	51.559	13,6	15,9

Source: Eurostat (2003) Panorama of Transport

In relation to demand, infrastructure indicators also point to relatively high resources, particularly in road transport. Spain is in first place in terms of the length of high-capacity routes in relation to passenger kilometres (23.7 km/million traveller-kms), almost twice the European average (12.2). In goods transport, it is in third place with 84.6 km/1,000 ton-kms, albeit well above the European average (52.5). In rail, the length of the network in relation to demand is also significantly higher than the EU average, for both passengers (686 km/1,000 passenger-kms compared with 482) and goods (1,170 km/1,000 ton-kms compared with 612).

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This transport system has facilitated Spain's integration into the European economy and has considerably palliated the effects of its peripheral location. It has also allowed the strengthening of certain corridors and city systems (the Atlantic axis, the Mediterranean corridor).

It is also true that, overall, the system has become more centralised, increasing the disparities between areas depending on whether or not they are reached by one of these major infrastructures, and facilitating the concentration and centralisation of economic activity in a reduced number of main centres (according to some studies of the effects of the Madrid-Seville AVE or the Paris-Lyon TGV, weakening areas of less force, to the benefit of those dominating). Such effects have also been noted, to a lesser extent, in the development of the radial structure of the high-capacity routes, or with the organisation of air services into a *hub-feeder* hierarchy. At the same time, these networks prove "impermeable" for a substantial part of the territory, aggravating spatial segregation. In short, while improvements to the transport system through radial structures organised in an extremely hierarchical form have assisted in economic progress and integration into Europe, they have gone hand-in-hand with greater regional disparities which, on the other hand, cannot be attributed exclusively to the transport infrastructures.

Recent years have thus seen major development of the different modes of transport in Spain, but this has happened independently in each, creating a system in which infrastructures and services compete progressively among themselves (and, in the first instance, for the allocation of resources), rather than collaborating to offer better service to users and society. Investment programming has too often ignored the functionality of each action, leading to heterogeneous networks and routes, where sectors with a capacity and performance out of proportion to true demand coexist with others which are obsolete, or out of step with the current requirements of quality and safety parameters.

The level of resources which has been achieved means that transport policy can be tackled from a new perspective: with major defects and bottlenecks overcome, the conditions exist where an attempt can be made to influence negative tendencies and impacts, very like those in the rest of the EU, more than clearly identified in the Community sphere (see the 2001 White Paper, or the Strategy for the Objectives of Sustainable Development in Transport Policy, October 1999): the huge increase in the mobility of persons and goods, particularly in urban and metropolitan areas; imbalances in access to the country as a whole, above all in the non-mainland and cross-border regions; the impact of transport on health and the environment; the volume and source of financial resources destined for infrastructures; and the challenges of a transport system which is increasingly integrated internationally and which demands greater competitiveness in the sector and greater attention to safety.

Transport safety and transport security are a challenge of particular importance in its three dimensions: risk of accident to users and others (including the environment), work risks to workers in the sector and risks to persons, installations and property which may arise from illicit actions of all sorts. More homogeneous action is essential in terms of objectives for the various categories of transport, on the grounds that ambitious objectives must be put in place to enable these risks to society as a whole to be reduced.

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2.2. FACTORS CONDITIONING TRANSPORT POLICY

The Spanish transport system is decisively influenced by the principles of the Common Transport Policy. Re-establishing the balance of the types of transport, eliminating bottlenecks, the user as reference in decision-making (safety, quality, charges, ...) and the sustainable management of the process of globalisation in transport are priority questions not just for the actions of the Community institutions but also for all Member States.

Following the Treaty's remit¹, transport must include the principles of sustainable development: the Sectorial Strategy for integration adopted by the Council of Transport Ministers in October 1999, following the directives of the European Council Cardiff Meeting (1998) and the European Strategy for Sustainable Development (the Council of Europe Göteborg meeting, 2001), provides that *"A sustainable transport policy should tackle rising volumes of traffic and levels of congestion, noise and pollution and encourage the use of environment-friendly modes of transport as well as the full internalisation of social and environmental costs. Action is needed to bring about a significant decoupling of transport growth and GDP growth, in particular by a shift from road to rail, water and public passenger transport"*.

The *sustainable mobility* strategy undertaken by the EU targets in short the de-coupling of growth in transport from economic growth, the development of alternatives to transport in private vehicles and the road transport of goods, and correct cost-allocation. It also insists on the need for strict monitoring of the sector's environmental performance, consolidating the TERM monitoring system (*Transport and Environment Reporting Mechanism*) and, where possible, fixes quantified objectives in transport policy: for example, in the distribution of goods transport categories (to be the same in 2010 as in 1998) or in road safety (halving the number of road deaths by 2010).

This country's geography and positioning in world trade and its transport flows provide a second point of reference for the PEIT: if in the context of the continent of Europe, Spain's location is peripheral, the same is not the case in the global situation, where this country occupies a key position in international movements of sea transport, and in relations between Europe and North Africa, while in air transport there is by no means negligible potential for it to enhance its position in trans-Atlantic traffic.

Economic growth, social trends and the outlook for territorial development place growing pressure on transport, demanding constant improvements to the quality of services and infrastructures. Increasing population, the development of the tourist sector, the reorganisation of productive processes or peripheral urban sprawl explain the growth of demand, but that growth is also accompanied by a demand for quality which has to be met, while observing three conditioning factors: financial efficiency, the energy framework and environmental compatibility.

The financial framework calls for consistency with the general objectives of budgetary balance, in a context of a significant reduction in European Funds which, for more than ten years, have contributed an average of some 20%-30% of the Ministry of Public Works and Transport infrastructure expenditure. Private enterprise must discover the right channels by which to continue cooperating with the public sector in the provision of infrastructures and services, although the natural concern to attract investment to the sector must respect

¹ Article 6 of the European Community constituent Treaty.

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the principles and priorities defined in the PEIT. It is not a question of directing public action to maximise the volume of investments but rather to guarantee the stability and continuity of investment, tempering previous cycles.

The energy framework also imposes some conditions on transport policy, since the sector consumes 36% of the country's final energy resources, most of which comes from oil the main source (99%). A clear aim of Spanish economic policy is the challenge of reducing energy dependence: 77% of the energy consumed in this country is imported, compared with 50% in the EU-15, while net crude imports account for 2.1% of Spanish GDP, against 1% in most European countries. The energy requirements of transport have trebled in the last 30 years, and transport policy must take on a clear commitment to the aim of cutting energy dependence and guaranteeing secure energy supplies for this country, because of their significant weight in the final total of oil product consumption.

Environmental compatibility responds to growing demand and concern of the public and the social agents about sustainable development. This question is particularly sensitive in this country because of the wealth of its natural heritage and the existence of many areas (whether or not protected) which are vulnerable to the environmental impact of transport. Spain has to confront its commitments in the environmental sphere and must in future actively foment the international community's action.

Finally, there has to be a more detailed analysis of the risks of transport to health (air quality, noise, healthy mobility habits ...) and firm action must begin to inform citizens and to promote urgent action plans which provide them with adequate levels of protection and prevention policies.

2.3. DIAGNOSIS: KEY QUESTIONS

2.3.1. Forecast trends in the mobility of persons and goods

Studies of trends based on developments in recent years suggest very significant growth rates in future transport demands in this country, of between 3% and 6% annual average in products and services and between 4.5% and 6% in goods. Variations in the results of these forecasts depend basically on the initial econometric hypotheses and, very substantially, on GDP growth and population tendencies. In any event, this country is above the forecast growth rates for the whole EU-15.

In a scenario of economic growth, it is reasonable to expect a turning point to appear, at which the high elasticity between the demand for transport and economic growth (at present in the region of 1.2-1.5) begins to reduce, as has happened in other developed countries; however, it would be risky to predict an exact time horizon. Other countries' experience does suggest that there is a ceiling: in passenger transport linked it is linked at the very least to the existence of a maximum limit to the time people use to travel and, in goods transport, it derives from evolution towards a more de-materialised economy. Here on this last point, the Spanish economy is at present especially intensive in transport consumption (Figure 9).

Increased mobility is one of the major challenges to the sustainability of the transport system. Although its negative effects can be mitigated by adequate distribution among the various

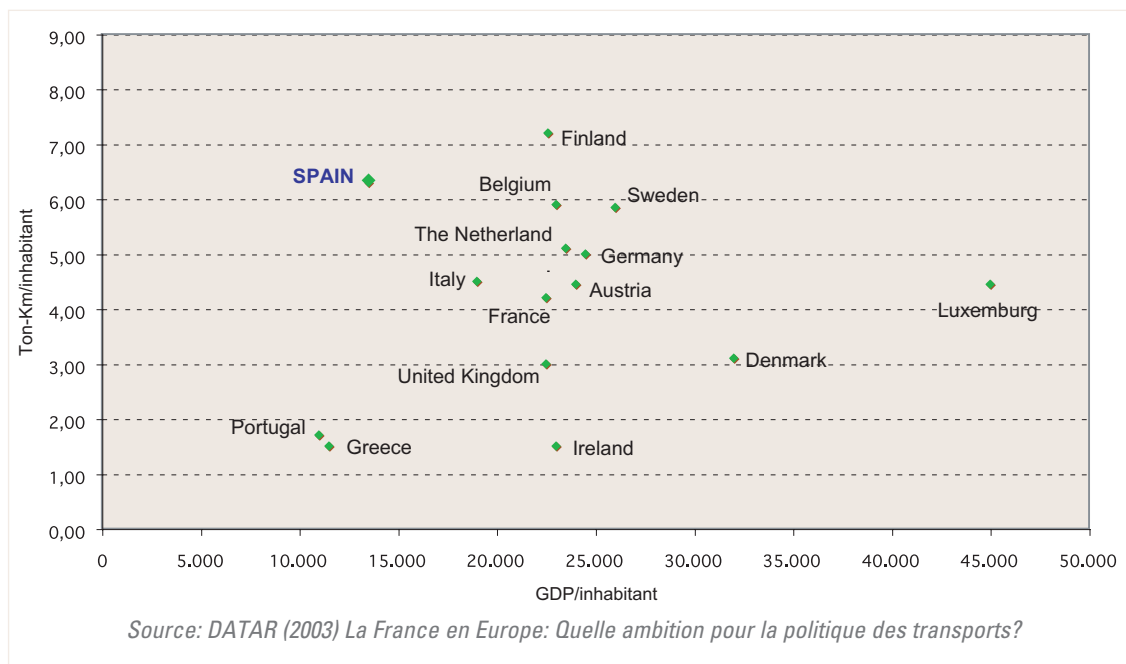
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categories of transport, and operational and technological improvements in each of them, these palliative actions would seem to be insufficient, given the scale of growth forecast and the strong conditioning factor raised by environmental objectives. Thus the question arises as to the viability of future growth with lower transport demand (the *de-coupling* of economic growth and growth in transport) and the feasibility of promoting it through suitable mobility management measures. This de-coupling can be understood as follows:

- In relative terms, as an active policy to direct the rise in the demand for transport towards categories with less impact.
- In absolute terms, as an active policy which, in addition to the above, reduces the mobility of persons and goods without affecting economic growth or the needs for accessibility and social interaction.

Despite the scepticism dominating some sectors about the possibilities for such de-coupling, an examination of mobility in a number of countries suggests that there is no determining factor governing the degree of mobility linked to a certain degree of development. It is true that there is a relation between the demand for transport and the standard of living, but this relation differs from one country to another, so that states with high income levels may yield per capita levels of demand which are significantly lower than others. On the other hand, because the relative mobility of persons and goods has a physical limit and cannot grow indefinitely, it can be concluded that each situation is more the result of criteria or lifestyle and a degree of organisation of the productive system than of geographical and economic conditioning factors, so that the possibilities for intervention need to be explored.

FIGURE 9. Goods transport (t/km) according to per capita income



2.3.2. Urban mobility

It is a feature of the data available that they are diffuse and heterogeneous. They do however coincide in indicating that motorised urban mobility is growing faster than its inter-urban counterpart. The portion of this travel provided by public transport scarcely holds against the advance of the private vehicle. Non-motorised transport –also described

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as *healthy* because of its effects on health— is falling back in the distribution of the transport types. This tendency is especially marked in medium-sized cities and on the peripheries of the large metropolitan areas. It is estimated that close to 40% of transport-generated CO₂ emissions come from urban and metropolitan movements where, within the sector, emissions are rising fastest.

While action is still largely focused on the provision of new public transport infrastructures, it is beginning to move in other directions: 10 years ago, only Madrid had a Transport Authority offering an integrated system of charges, but there are now eight metropolitan areas which, to a greater or lesser extent, have a structure of institutions and charges. The efficacy of such actions is however often counteracted by contradictory measures for traffic management and increased route capacity, or by problems in funding the system. When compared with other European countries, there are few Spanish cities which have medium- or long-term Urban Mobility Plans and, of those in place, few include explicit sustainability objectives.

There has been a considerable financial drive in dealing with the urban transport system; with no specific competences in the field, the contribution of the State Administration (AGE) in its backing for urban and metropolitan public transport—in terms both of investment in infrastructure and of direct input into the system's operation—stands at some 650 million euros a year. In a framework of institutional coordination based on that sustainable mobility planning approach, such contributions could be channelled more efficiently and with better coordination, and be defined in greater proportion to the seriousness of the problems raised. Ministry of Public Works and Transport action in urban areas, in the construction of infrastructures and in the organisation and management of services, could also be more effective in terms of functionality and the contribution to sustainability, within this general framework.

Mobility requirements are not the same in all urban environments, and the response strategies must adjust to each situation. Each type of urban space (metropolitan areas, medium-sized more compact cities, multi-focus or dispersed systems) requires different approaches and priorities, and the combination of the appropriate measures must adapt to the features of each particular case.

2.3.3. Accessibility imbalances, especially in areas away from the mainland, and cross-border regions

On the Spanish mainland, the development of high-performance transport infrastructures has led to an apparent homogenisation in terms of the territory, which conceals appreciable imbalances (Figure 10):

- These high-performance infrastructures are less permeable for the territory as a whole: access is restricted to a few nodes, thus defining a dual territory, and the source of growing tension between the functional access standards of these infrastructures (few links or stations) and local demands.
- It also leads to an undervaluation of infrastructures with lower levels of performance, even where they may be more appropriate to capillary access in that region, and to the local development expectations. The conventional infrastructures are wrongly seen as incompatible with the region's development expectations.

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- The infrastructure does not *per se* ensure accessibility: for that, in addition the goods and passenger transport service operators must decide to provide the service effectively, with adequate levels of frequency and quality.

In short, the growing creation in the country as a whole of high-performance infrastructures coexists with the centralised network structure, with problems of *capillarity* or access to these networks outside the access nodes, and the scarcity of services away from the direct connections, so aggravating the difference between those who are or who are not served by the new networks, and preventing the system's efficient hierarchical organisation.

The airport network model, which operates in domestic services on the basis of the connecting point at Barajas, creates an accessibility distribution which clearly differentiates Madrid on the one hand, the large coastal cities on the other, headed by Barcelona, with sufficient critical mass to justify direct services without the airlines going through Barajas, and the rest of the peripheral cities, leaving a significant domestic peninsula vacuum.

These effects are particularly clear in cross-border areas, where development opportunities are intense, and where the infrastructures have traditionally responded to the strict logic of national links, so that resources prove deficient. There is at present a risk of replacing the original logic with others, of international connections based on service to large flows, of an overridingly transit nature, large arteries which have little to do with the dense network and that for mid-range capacity and performance which is characteristic of a cohesively organised territory.

The imbalances in accessibility in areas away from the Spanish mainland are on the other hand the upshot of geographical factors and the resulting dependence on sea and air links for communication, both with the mainland and among these territories themselves, particularly on inter-island routes. This, even more than on the mainland, makes the adequate organisation and management of the transport services the main factor for integration and to minimise the negative effects on accessibility arising from geographical isolation.

2.3.4. The impact of transport on the environment and health

Transport sector emissions, most of which are the result of road transport (both interurban and urban) account for 22.6% of carbon dioxide emissions (CO₂), and 37% of nitrogen oxides (NO_x). The best technological resources mean that a significant reduction can be foreseen in pollutant emissions, specifically in NO_x, to levels which are compatible with the limits in the National Emission Ceilings Directive 2001/81/CE, before the end of the decade. However, technological development cannot correct the increase in CO₂ emissions. Road transport contributes approximately 90% of the transport sector's emissions. Between 1990 and 2001, these emissions rose by 57%, an annual rate of more than 4%, much greater than GDP growth in that period. The Ministry of the Environment estimates that emissions could be 110,000 tons in 2010 and 140,000 tons in 2020 (100% and 155% more than the 1990 figures). Unlike pollutant emissions which are being confronted relatively successfully with technological measures to improve engines and fuels, CO₂ emissions are linked to fossil fuel consumption² and require other forms of strategy, associated with energy efficiency and the management of demand.

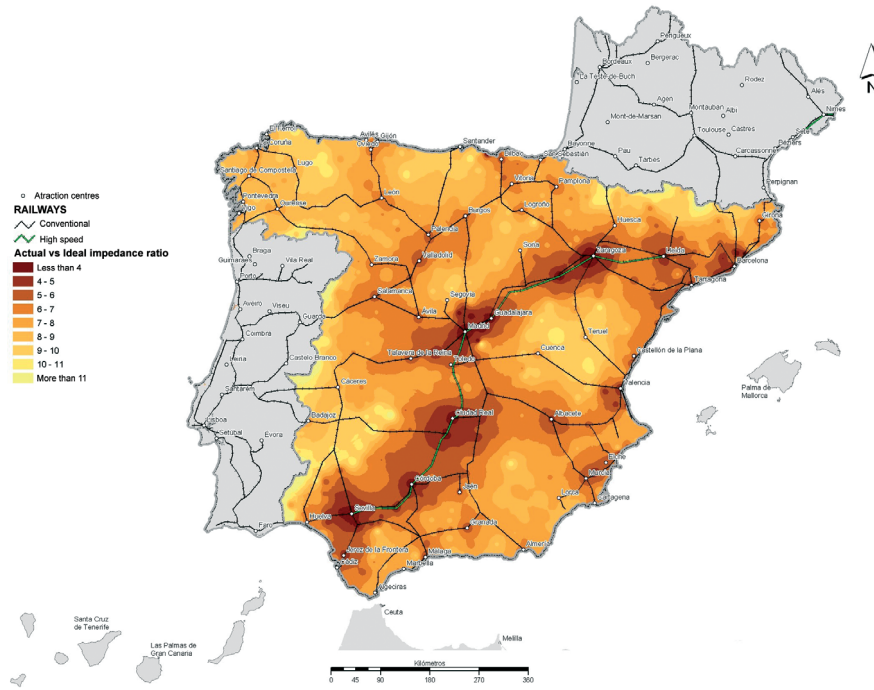
² Hydrocarbon combustion produces approximately 2 kg of CO₂ per litre of petrol or diesel consumed.

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FIGURE 10. Land transport accessibility

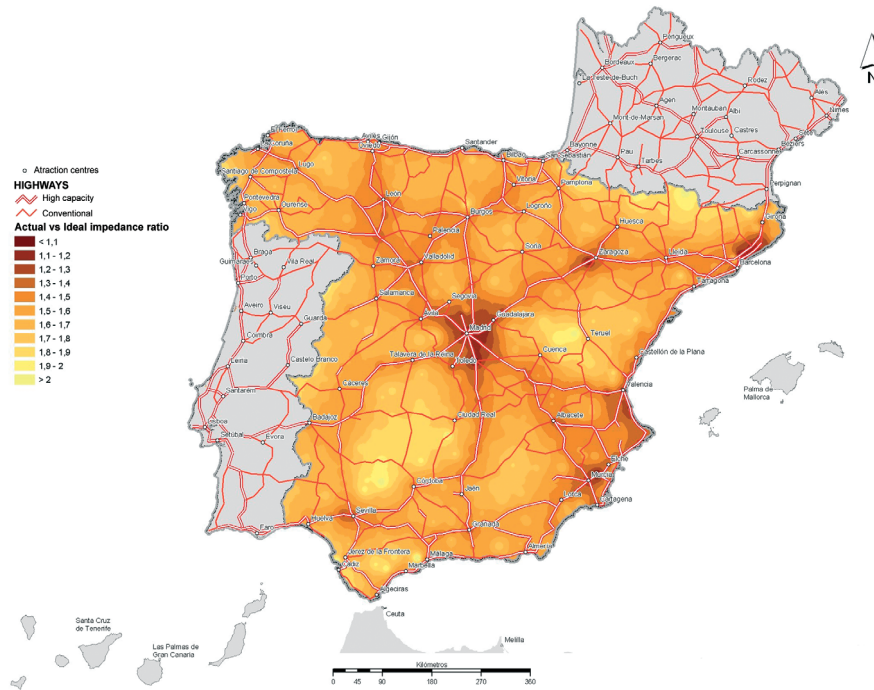
A) RAIL ACCESSIBILITY

The effects of the radial nature of the system and the lack of cross-border permeability become clear particularly in rail. The map shows rail access time, weighted according to the destination locality for each provincial capital, disclosing the marked imbalances between the centre (black, maximum accessibility) and these cross-border areas (yellow, minimum accessibility).



B) ROAD ACCESSIBILITY

Accessibility in the road network is considerably greater and more homogeneous than for rail (the indicator value varies between 1 and 1.5 for provincial capitals, while this value for rail moves between 1 and 5). The radial nature of both networks causes better accessibility concentration in radial corridors.



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Pollutant emissions have a notable effect on air quality in cities. The massive introduction of catalysers and leadless petrol has led to a progressive reduction of some contaminant emissions, particularly SO₂, COV, benzene, lead and CO, whose concentrations have dropped in recent years at most metering stations affected by traffic. The same cannot be said in connection with the concentration of particles in suspension of less than 10 microns (PM₁₀), tropospheric ozone, NO₂ and CO₂, where increases have not yet been slowed. At present, virtually all large cities experience periods in which air-quality limits set in the European and national provisions for PM₁₀, NO₂ or ozone are exceeded to a greater or lesser extent. The data offered by the European projects APHEA, APHEIS, and the Spanish EMECAS program, plus information from the WHO point to a high correlation between mortality, morbidity, some cancers, and cardiovascular and respiratory conditions. Specifically, the impact on certain groups at risk or which are especially vulnerable, such as children and the elderly, are clear and hard to avoid.

Traffic noise, above all in urban environments, has increased in this country in recent years. It is considered that 74% of the Spanish population is subjected to high sound levels. The relation between noise and health is clear: nuisance, disrupted communications and increased aggressive conduct, in sleep and rest, in children's development, high blood pressure and influence in cardiovascular disease.

Against the deterioration caused in the environment by the construction of infrastructures, the corrective measures introduced in Environmental Impact Declarations seek to alleviate some of the negative effects, although it is difficult for them to eliminate the progressive occupation of land and its fragmentation, with extremely negative effects on biodiversity. While the rate of territorial fragmentation as a result of infrastructures is lower in Spain (250 km²) than in the rest of the EU-15 (130 km²), sight must not however be lost of the large number of environmentally protected areas in this country, which are therefore more vulnerable to any activity which divides them and breaks them up. It is emphasised that Spain has declared 38 Ramsar zones, 70% of which have at least one transport infrastructure less than 5 km from their centre. These figures do not reflect the entire impact of the ecological barrier created by linear infrastructures, in particular high-performance systems or those with high traffic densities. The country's natural wealth and the existence of many spaces which, while not receiving special protection, can be classified as environmentally "sensitive" (coastal zones, mountain massifs, urban areas) create increasing conditioning factors for future development and the concentration of high-performance transport infrastructures.

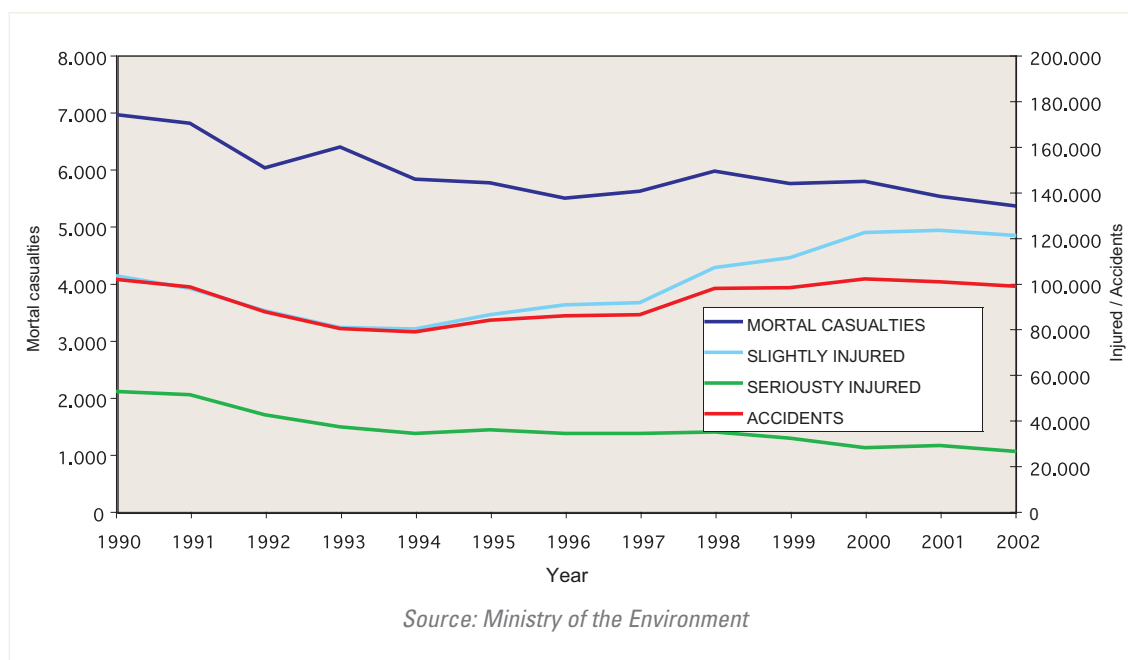
The safety record of various modes of transport turns out to be very disparate, even in relative terms: throughout the EU³ (2001) and per thousand passenger-kms, the number of deaths was 0.2 for rail (2.3 with the addition of victims who were not travelling by rail), 0.4 in the air sector and 8.7 on roads. Traffic accidents are the main cause of death in the population aged between 6 and 25. In Spain, the number of deaths in interurban accidents has dropped since 1990, when the figure was 5,936, to the 4,032 recorded in 2003. In the last 7 years, the high annual rate of deaths from road accidents has remained stable. The Spanish accident rate in relation to the vehicle fleet and existing mobility remains high: 14 deaths per thousand traveller-kms.

³ European Community Commission (2003). *Transport in Figures 2001*.

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Overall, environmental and health conditioning factors can do no more than increase over the coming years, in line with the progressive implementation of international commitments and European provisions in the field, and with increasing public awareness of these questions.

FIGURE 11. Trends in the number of road accidents, deaths and injured in Spain since 1990



2.3.5. Competitiveness in the international context

Expansion in the goods transport sector in the European Union in the last ten years has been accompanied by a degree of *Europeanisation*, which is perhaps more marked in central states rather than in those on the periphery. Road transport of goods has been pioneering, but Spanish carriers are, despite continuing to lead in terms of bilateral exchange (Spain with France, Germany or Italy), hardly present in land cabotage in other EU countries, or in the relations between them. This process is still at an incipient stage in rail: some national companies have established alliances and have applied for the first licences for new operators with an international transport vocation. This tendency is accompanied by the consolidation of a small number of large logistic operators, the first of which, Deutsche Post, posts a business figure virtually twice that of the number two, La Poste; there are no Spanish firms in the list of the 15 top European operators.

The possibilities for national transport operators to *internationalise* and convert to intermodality (not just those attached to the Ministry of Public Works and Transport –RENFE Operadora and Post– but also operators carrying goods by road or by sea) are dragged down by an absence of incentives comparable to those in place in other countries, and by the relative lack of an international strategy on the part of the main national operators. There have been no nation-wide initiatives which might, as in other countries, enhance the effects of the European policy of support for intermodality, such as the Marco Polo Program.

This trend is also patent in the field of air transport of passengers, with the consolidation of the three large international alliances which, in turn, dominate the European space. The full potential of the effects of liberalisation have not yet become manifest in terms of the

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advent of new operators and increased competition in the European market which can be passed on to consumers, and for the time being affects principally those connections with greatest traffic demand. To a lesser extent, the appearance of international operators is beginning to emerge in the rail sector, with the arrival of the first international high-speed services (Thalys).

While not able to offer the openings inherent to a transit country (market proximity, development as an international logistic platform), Spain's peripheral location has on the other hand allowed greater flexibility and autonomy in the choice of the transport policy model: thus the country has in the past been able to select its priorities to some degree independently of European strategies, for example giving priority development to the high-capacity road network over conventional rail, or creating new airport facilities based even on demand forecasts significantly below those considered in other countries. However, the foreseeable continuation of trends toward economic integration and the likely new increase in intra-European movement associated with EU enlargement make it advisable to align national priorities more unequivocally with those of other Member States and, in particular, Spain's main countries of destination or of necessary transit (France and Germany), to facilitate the access of the European intermodal transport chains which are appearing.

In short, transport trends in Spain are increasingly converging with those of the rest of the EU. Notwithstanding its relative peripheral situation, Spain cannot pursue a transport infrastructures and services policy based solely on domestic considerations. This is not just because of the potential decisiveness to the sector of the Community's regulatory framework, but also because of the consolidation of trans-national operators and the scale of the problems transport raises for sustainable development, which are similar in all countries and which, in many cases, cannot be tackled without convergent response.

2.3.6. Transport costs: charges and taxes

The cost borne by users in travelling or in transporting goods in a given mode depends on a multiplicity of factors such as tax, subsidies, public and private investment, fuel charges, and vehicle or insurance prices. In other words, it is the upshot of a complex set of public and private decisions on regulation, investment and markets. Added to these internal costs are the so-called external costs charges, which are the losses users of one mode of transport cause to others, and which the market cannot assign without prior public regulation, such as accidents, atmospheric pollution, noise, climate change, or congestion. The internal and external costs differ depending on the transport mode, and users may not be able to cover them in full. For example, studies carried out in the EU-15 show that, during recent years, the cost of transport (at constant prices) by private car has been reduced an average of 15%. Every time a user decides to use a particular mode of transport, someone else may be suffering a loss, whether in the tax realm with the costing of infrastructure they do not use, and its maintenance, or related to the environment and health, by meeting external costs arising from noise or from pollution or accidents.

The system for transport charges and taxation must send the right signals in relation to the PEIT's strategic objectives, otherwise it will distort the system's operation. The current tax burden on transport offers no incentive for conduct which is compatible with transport policy, nor does it penalise contrary behaviour; it does not favour increased

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demand for public transport aimed at cutting the accident-rate, congestion and pollution; there are no mechanisms to adequately compensate citizens who suffer loss from accidents and other effects, nor does it ensure an equitable distribution, without regressive impact on income, of the benefits and disadvantages produced by public decisions related to transport.

2.3.7. Action by the institutions

The transport system must be in a position to offer users an integrated service, irrespective of who owns a given infrastructure or service. Institutional cooperation remains very partial, limited to very specific objectives, such as investment in certain infrastructures, coordination in certain regulatory aspects, or the financing of certain services. This type of cooperation, which is effective in that it allows certain actions to be coordinated, makes it difficult to identify objectives, and to plan over a longer time horizon. Actions in a certain territory, and most particularly in urban surroundings, environmentally sensitive areas or corridors with high infrastructure densities, has to be rationalised on the basis of a joint definition by the Administrations involved of objectives which are compatible with the principles of sustainability.

If it is to be effective and stable, institutional action demands an appropriate legal framework which delimits the scope of the cooperation between Administrations. And concerted action means that the Administrations have to go beyond an identification of specific actions, in order to incorporate objectives into their arrangements. The challenge posed to transport by objectives such as those established in the PEIT –of economic efficiency and the social returns from the actions, of social cohesion and territorial equilibrium, and sustainable development, particularly in the realm of climate change– cannot be confronted without creating a system of joint responsibility whereby actions are associated with specific policies which make it possible to achieve all the expected benefits, and which link future investment to the previous fulfilment of those objectives.

