

# Planning and network design

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# Planning and network design

1. Strategic Planning
2. Railway infrastructure development
3. Previous studies
4. Informative study
5. Evaluation of a railway project
6. Financial Analysis
7. Economic Analysis (CBA)
8. Making decisions
9. Planning results
10. Effects
11. Experiences
12. Key Issues
13. Conclusions
14. International connections



# 1. Strategic Planning

## Main railway plans in Spain

Since the 50s, some of the main railway plans that have been developed in Spain are shown below. Some of them are more specific and others are more general:

- **General Plan for the Reconstruction of 1949**, subsequently amended in 1952 by the **General Plan for Modernization** which was never fully realized.
- **Decennial Modernization Plan 1964-1973**, which included the renovation 7,500 km, 1,100 km of electrification and acquisition of modern equipment and mobile engine.
- **RENFE Strategic Plan 1972-1975**.
- **Electrification Plan 1974-1977**.
- **Master Plan of 1977 and General Plan of Railways (PGF)**, this plan was not very effective.
- **Railway Transport Plan (PTF) 1987**.
- **Commuter Transportation Plan 1990-1993**.
- **Infrastructure Master Plan (PDI) 1993-2007**.
- **Transport Infrastructure Programme (PIT) 2000-2007**
- **Strategic Infrastructure and Transport Plan (PEIT) 2005-2020**
- **Plan for Infrastructure, Transport and Housing (PITVI), 2012-2024**

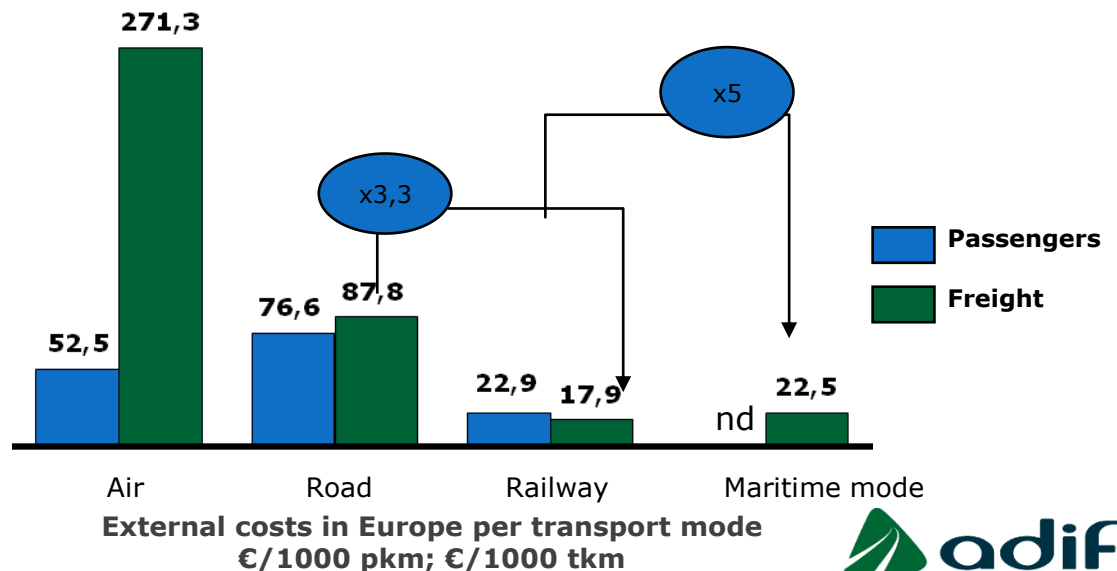
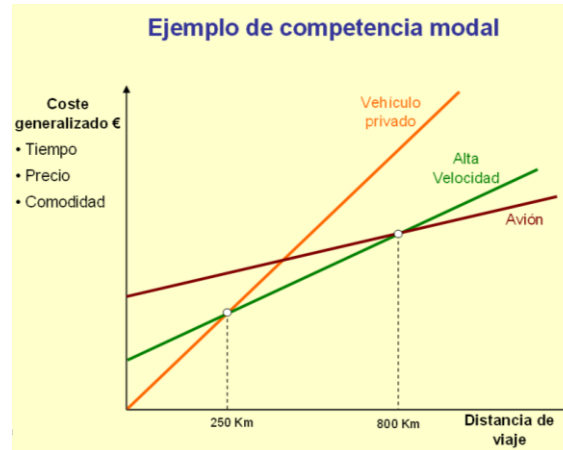
# 1. Strategic Planning

## Main railway plans in Spain

These general plans are **betting heavily** on the railway for several reasons:

- **Greatly competitive** for distances between the main centers of activity in Spain
- **Most efficient mode** of transport from an environmental point of view

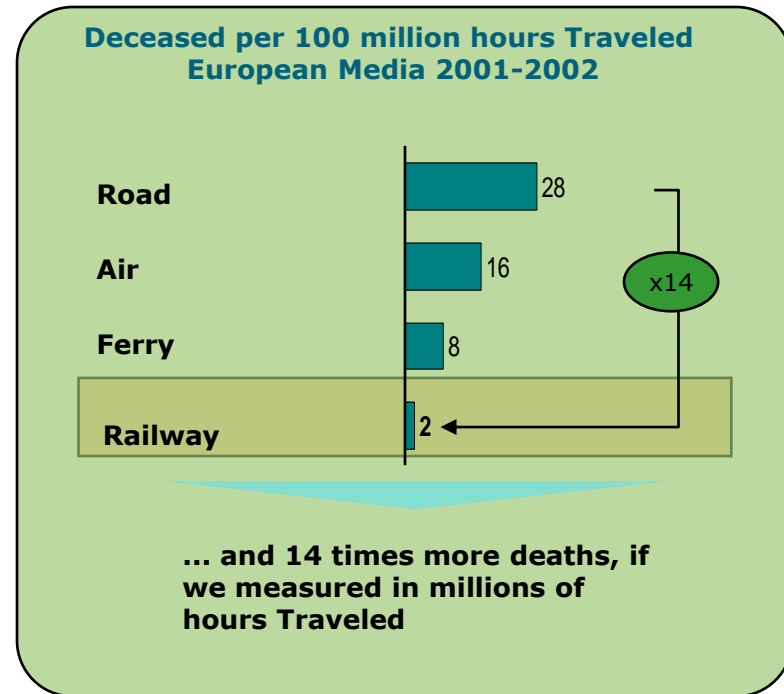
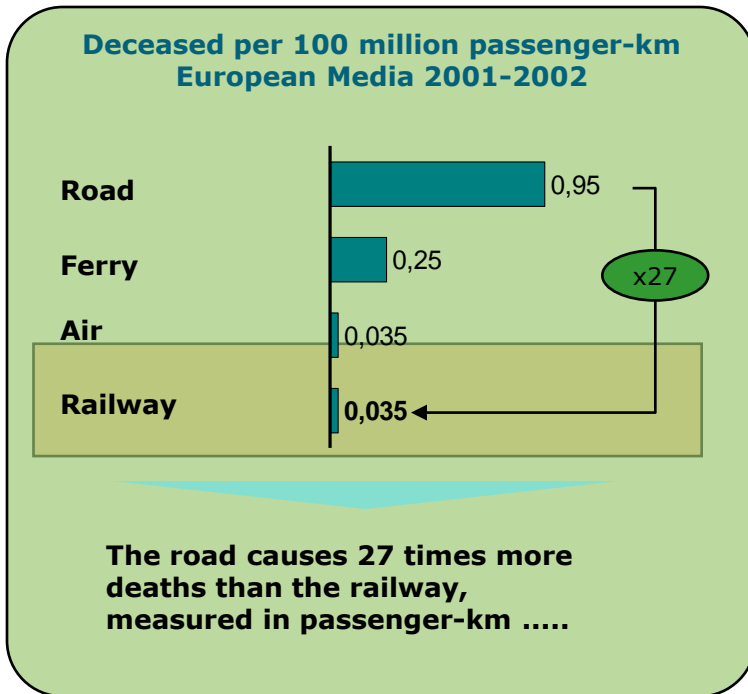
The external costs of road are 3.3 times higher than the external costs of rail transport for the movement of passengers and almost 5 times more for freight transport



# 1. Strategic Planning

## Main railway plans in Spain

- High levels of safety



Definitely the configuration of a strong and competitive rail network is economically advantageous for a country, and that **puts the main centers of economic activity connected to Madrid in less than 3 hours.**

# 1. Strategic Planning

## Plan for Infrastructure, Transport and Housing PITVI (2012-2024)

- This plan establishes **two phases**: 2012-2018 and 2018-2024, and **three scenarios of economic development**:
  - **Optimistic** scenario (base) average GDP growth 1.76% per year
  - **Conservative** scenario: average GDP growth 1.02%
  - **Unfavorable** scenario: average GDP growth 0.21%
- Investment in transport will be between 120 and 145 thousand Mill € (0.89-0.94% of GDP).

# 1. Strategic Planning

Plan for Infrastructure, Transport and Housing PITVI (2012-2024)

## Investment prioritization criteria

- For railway, 3 main criteria:
  - **Potential:** Demand uptake versus profitability of the level of execution, also analyzing partial openings with adding value.
  - **Degree of definition**, incorporating strategic aspects or functionalities not "closed".
  - By analyzing thoroughly the possibility of **receiving European funds:** Level and impact on the pending investment, the deadlines and criteria for obtaining, among others.

# 1. Strategic Planning

## Plan for Infrastructure, Transport and Housing PITVI (2012-2024)

- Network Long-Term objective : Final image for **HS network**, which is the proposal for the Trans-European Transport Network TEN-T





# 1. Strategic Planning

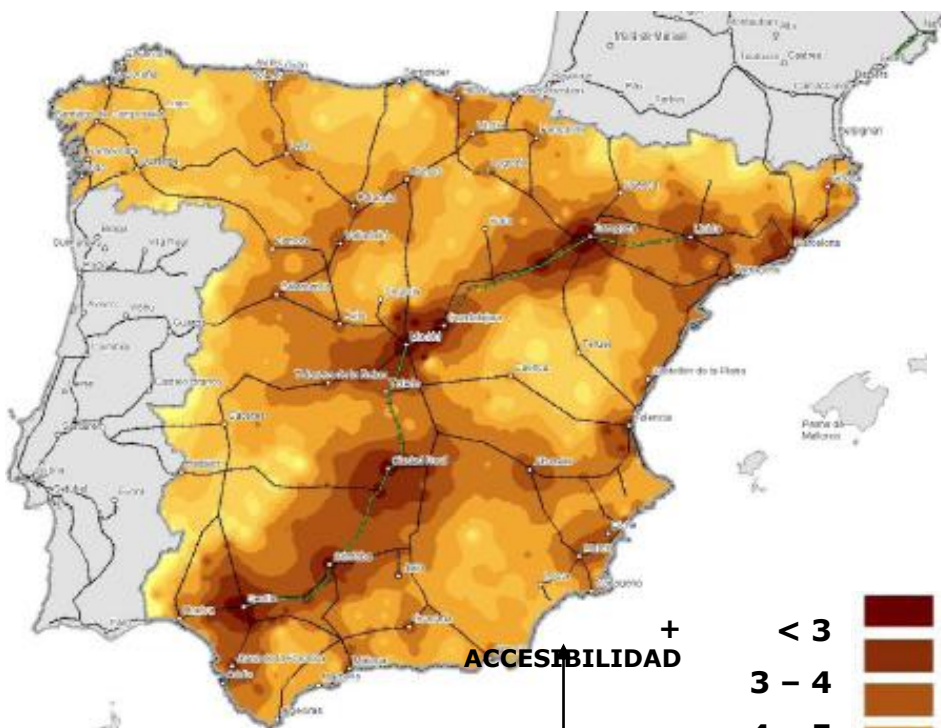
## Plan for Infrastructure, Transport and Housing PITVI (2012-2024)

- Network Long-Term objective: Final image for **freight rail network**, which is the proposal for the Trans-European Transport Network TEN-T



# 1. Strategic Planning

Evolution of interurban accesibility expected by the new Plan

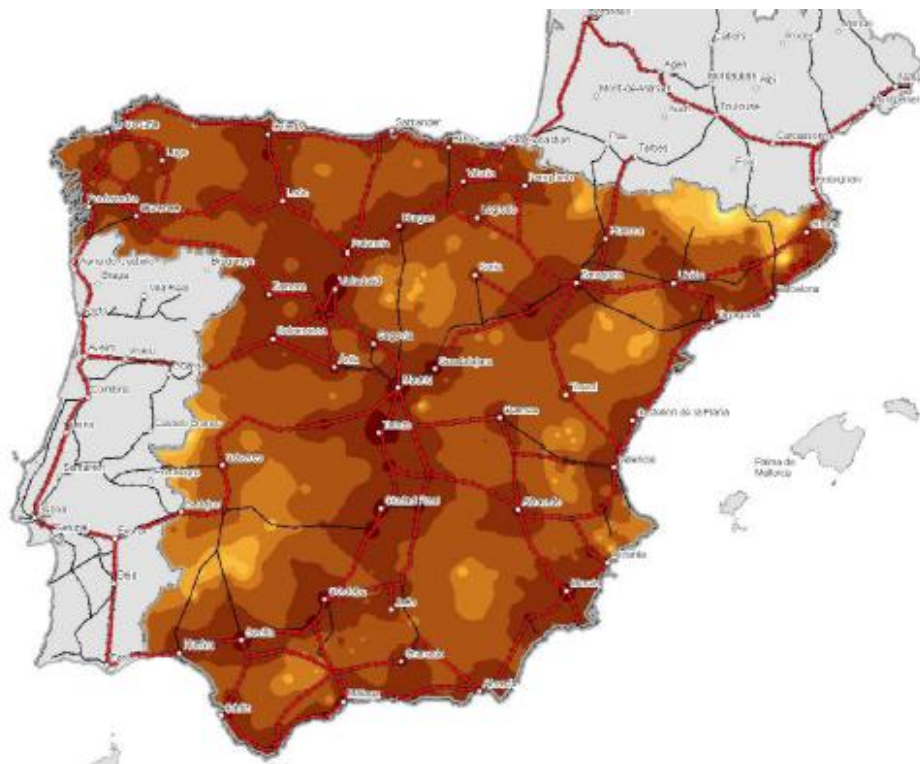
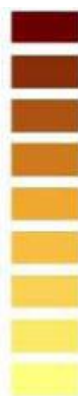


**Before**

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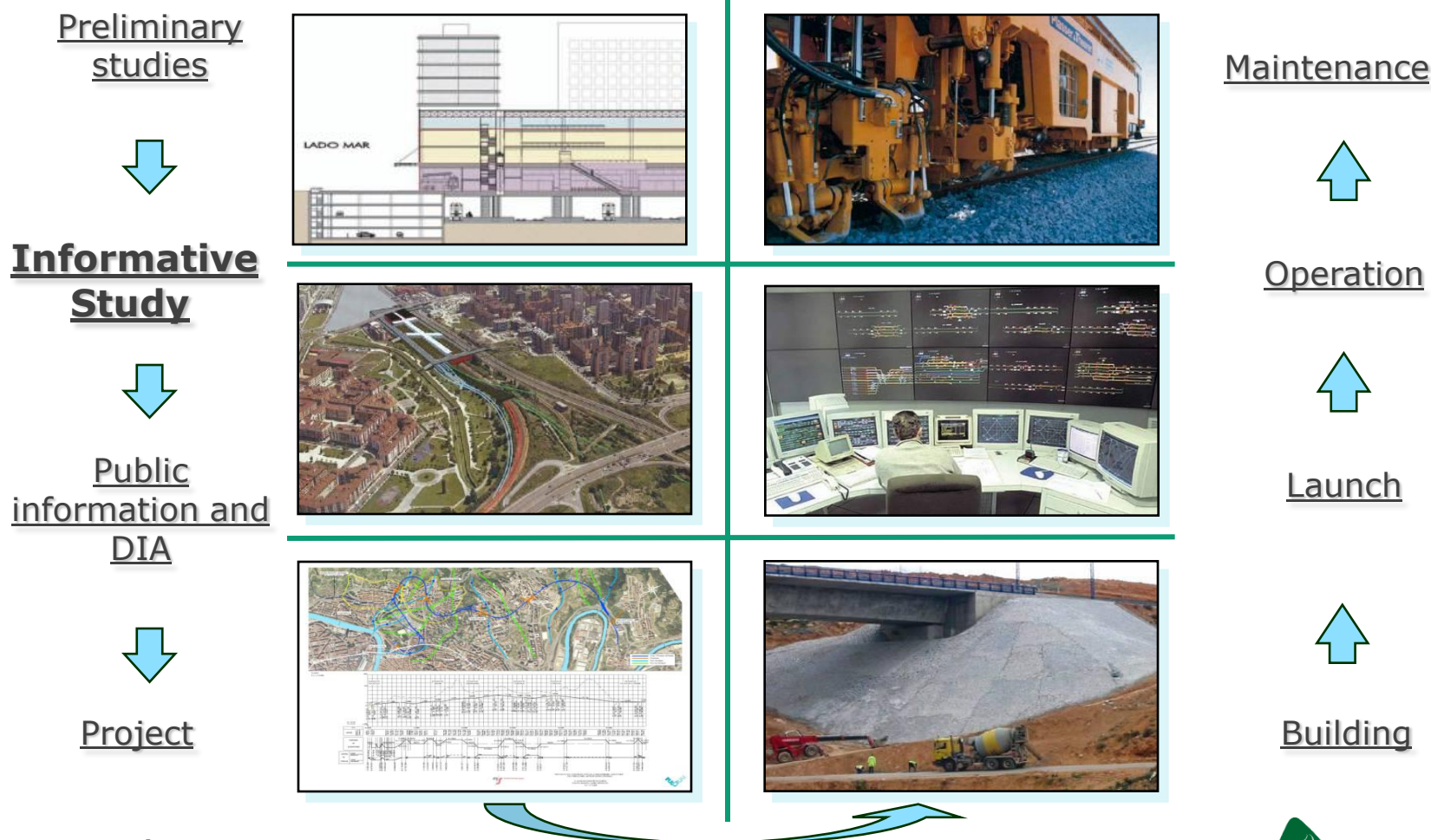
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**After**

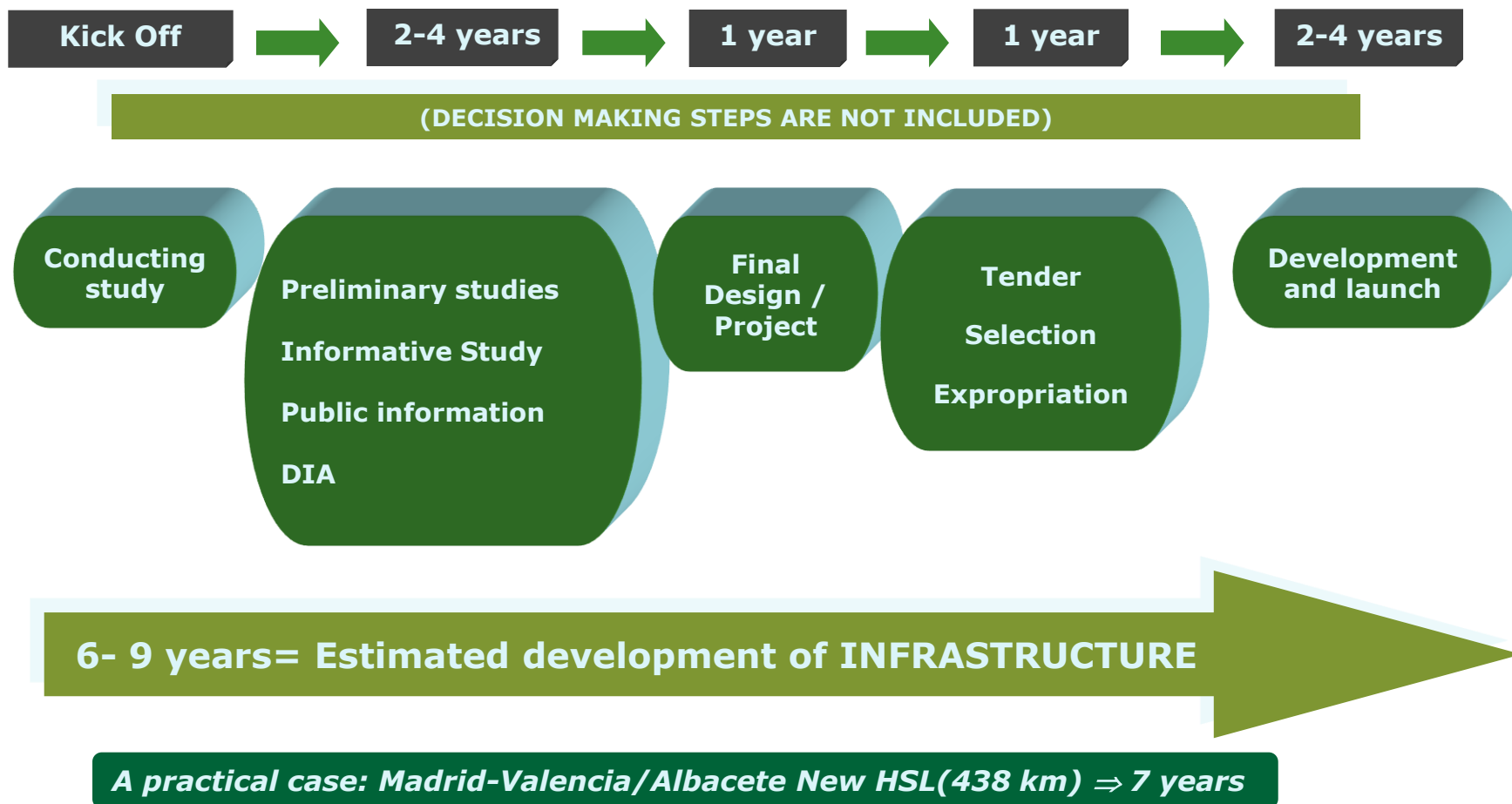
## 2. Railway infrastructure development

From strategic planning and definition of the master plan, **each corridor takes shape in Spain** through the following steps



## 2. Railway infrastructure development

The approximate periods for the development of a railway infrastructure are:



### 3. Preliminary studies

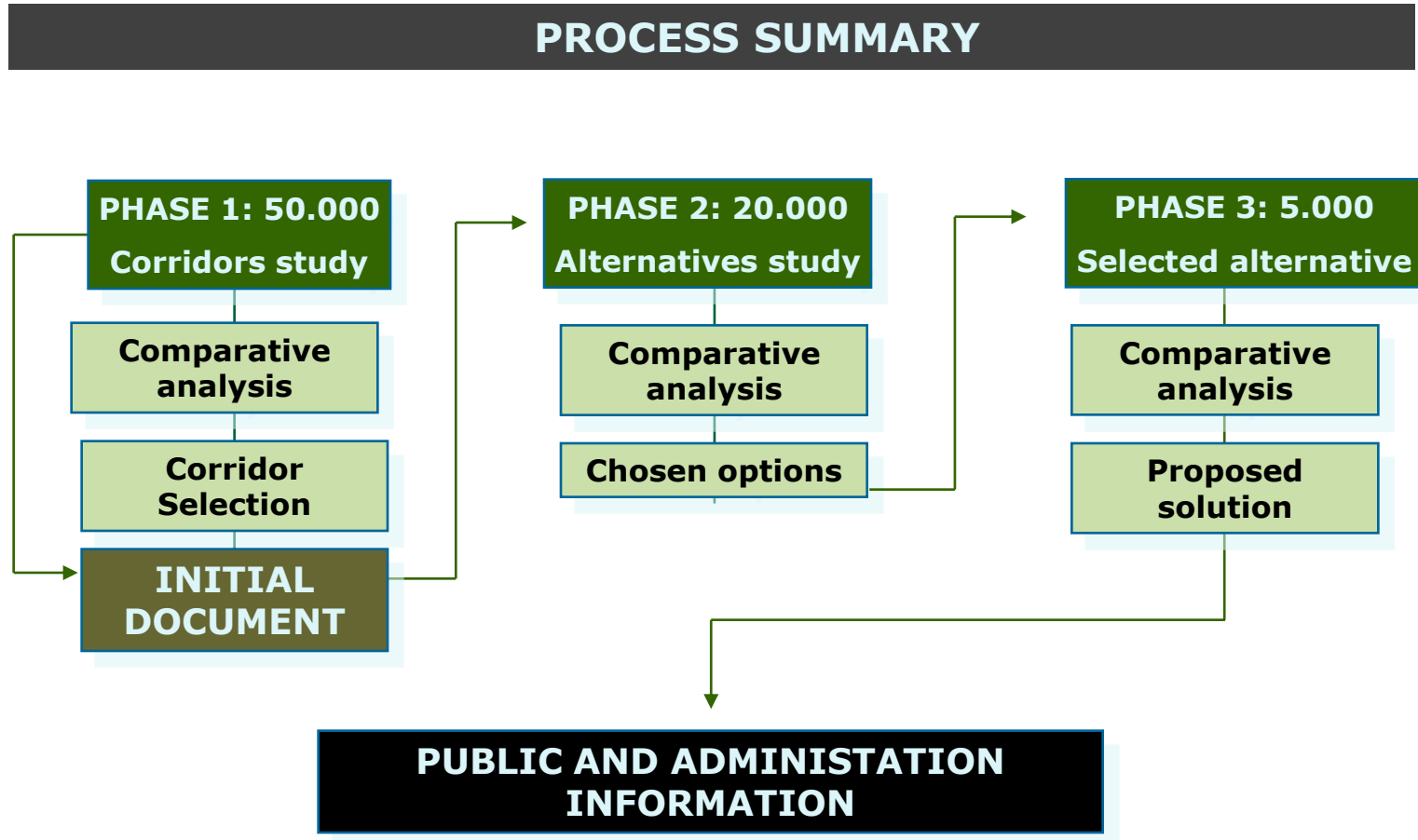
As a result of the Strategic Planning and the Master Plan and prior to any railway performance, the Authority must develop different Preliminary studies in order to define and justify the actions to perform.

- Functional studies
- Feasibility corridors study
- Demand study
- Financial and economic studies

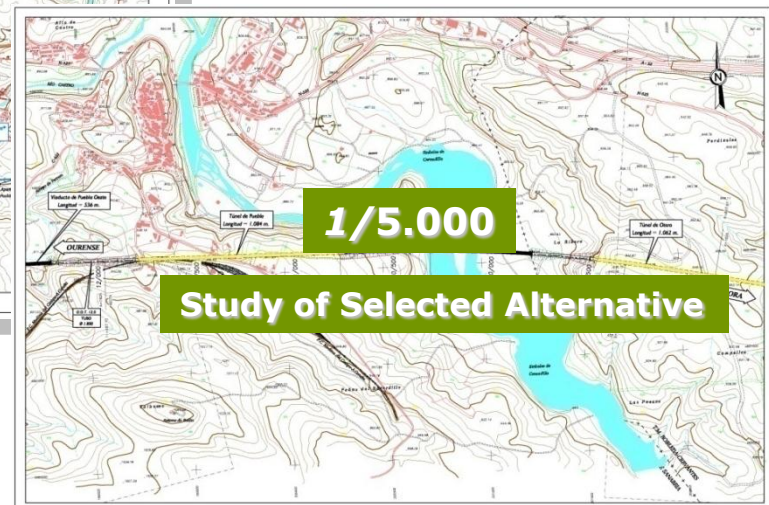
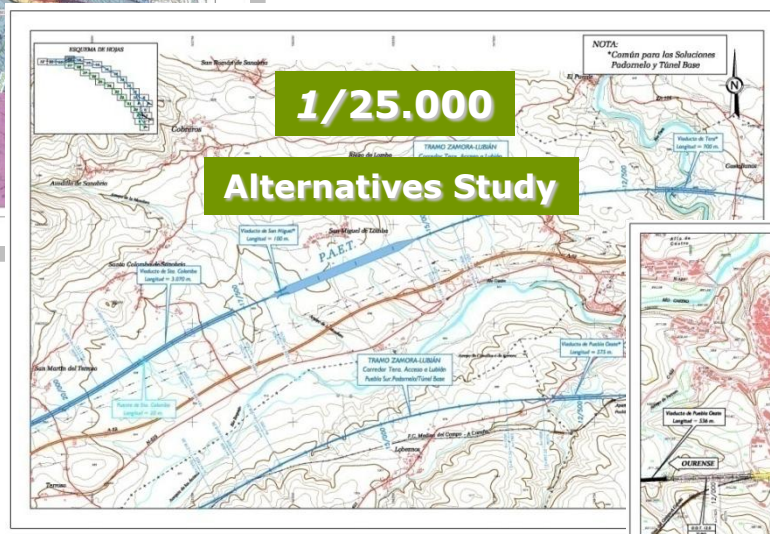
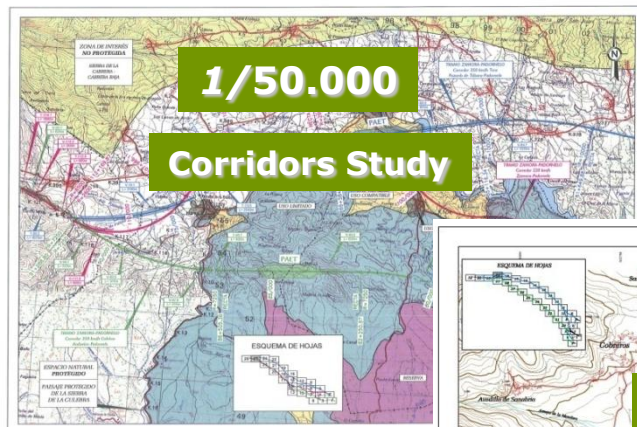
The **conclusions extracted** from these previous studies, if they are favorable, **will be the basis for the decision to develop an informative study**, by which analyze and report potential affected of the action to be executed.



## 4. Informative Study



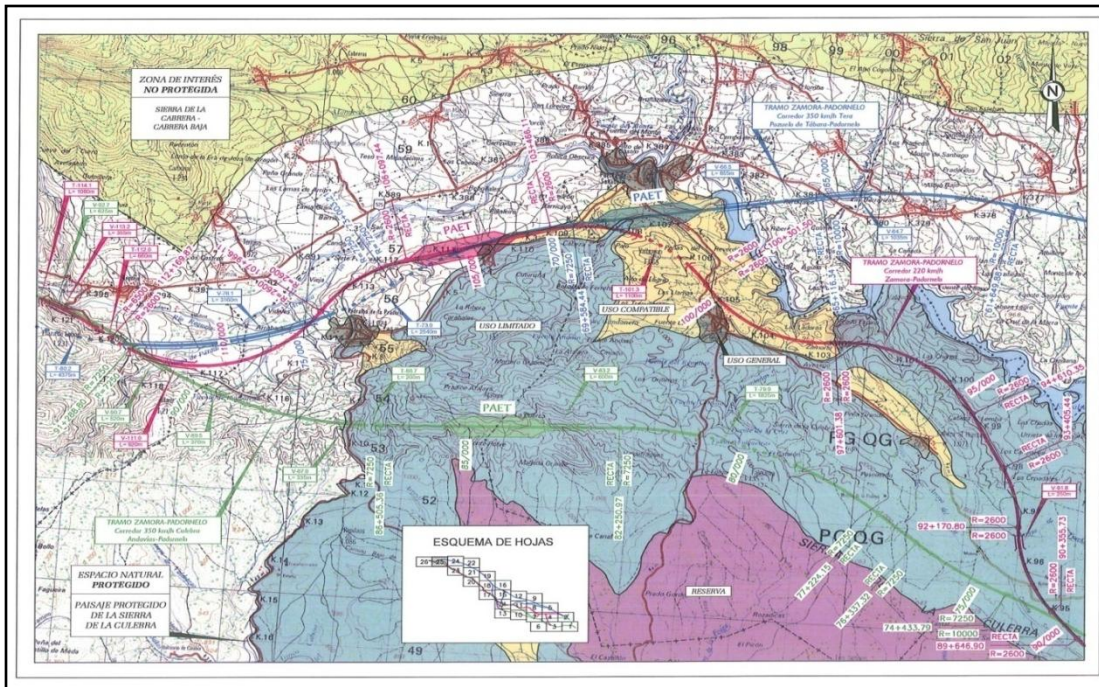
## 4. Informative Study



## 4. Informative Study

### ■ Corridors Study

**1/50.000**



**Main specific studies  
(geological, hydraulic ...)**

**Environmental impact**

**Demand**

**Financial and Economic  
Analysis (CBA)**

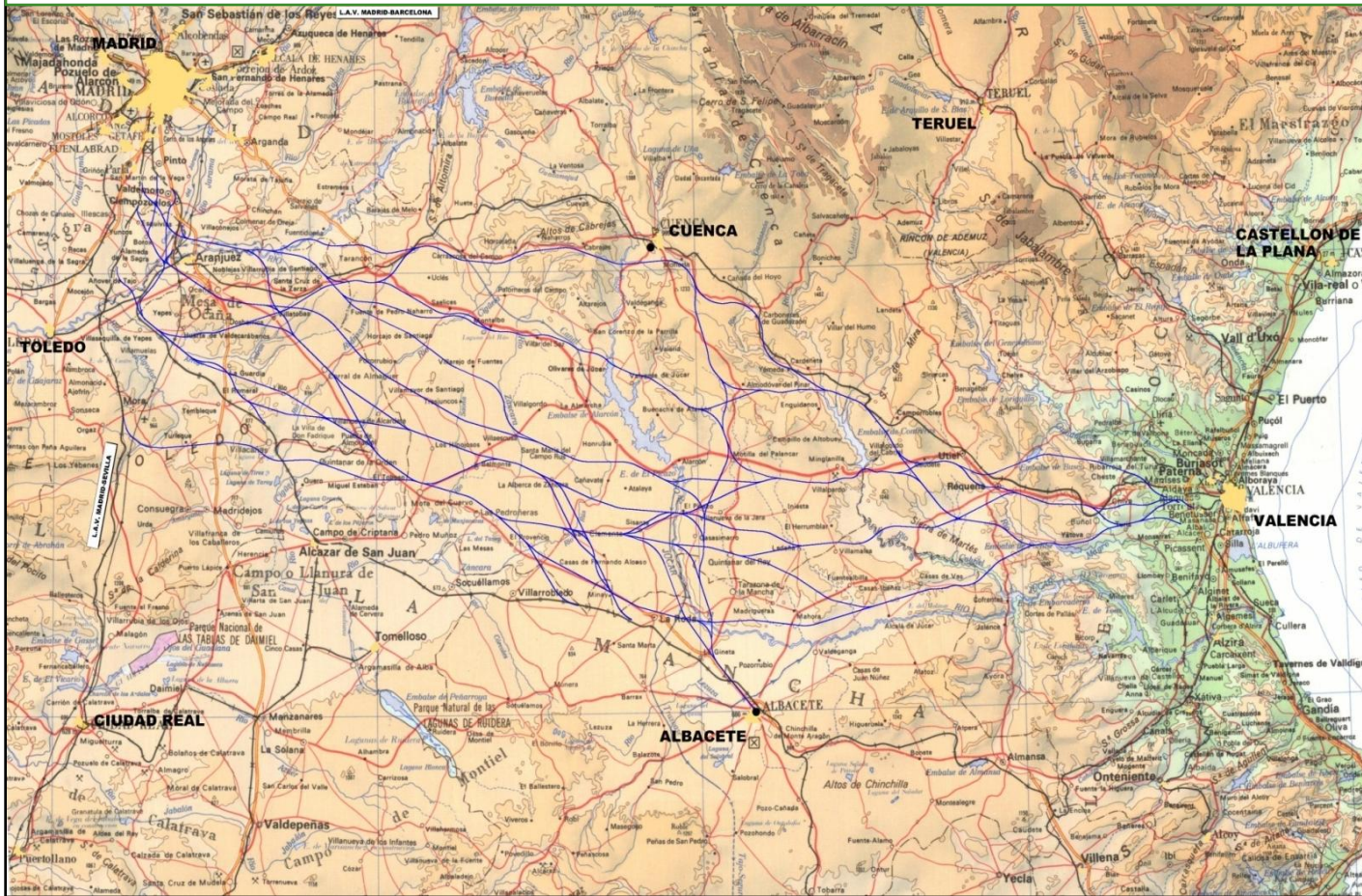
**Corridors Comparison**

**Selection of the corridor**



## Corridors Study 1:50.000

**MADRID-CASTILLA LA MANCHA-COMUNIDAD VALENCIANA-  
REGION OF MURCIA HSL  
SECTION MADRID-ALBACETE/VALENCIA**



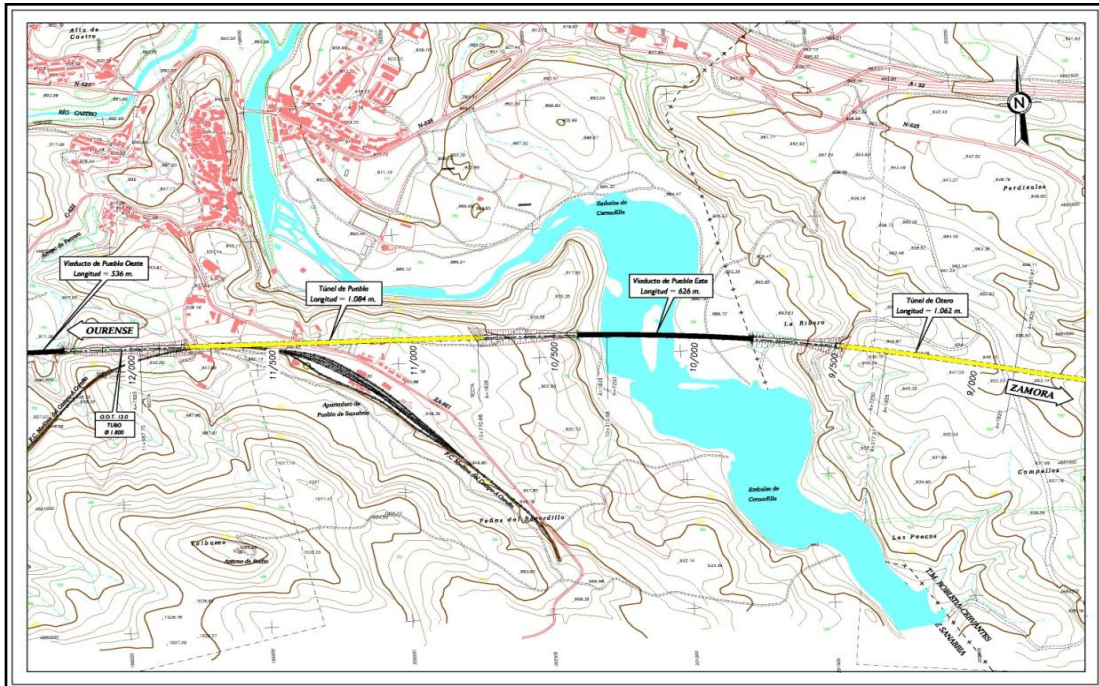




## 4. Informative Study

### ▪ Study of Selected Alternative

**1/5.000**



**Complete specific studies**

**Environmental impact**

**Demand**

**Financial and Economic  
Analysis (CBA)**

**Proposed Solution**

## 4. Informative Study

### Selecting indicators for comparing alternatives.

The most common are:

- Design
- Traffic and travel times
- Geology and Geotechnics
- Hydrology and drainage
- Structures and tunnels
- Stations and interchanges
- Urban planning
- Electrification
- Environmental impact
- Budget
- Plan works
- Demand and financial and economic analysis (CBA)

## 5. Evaluation of a railway project

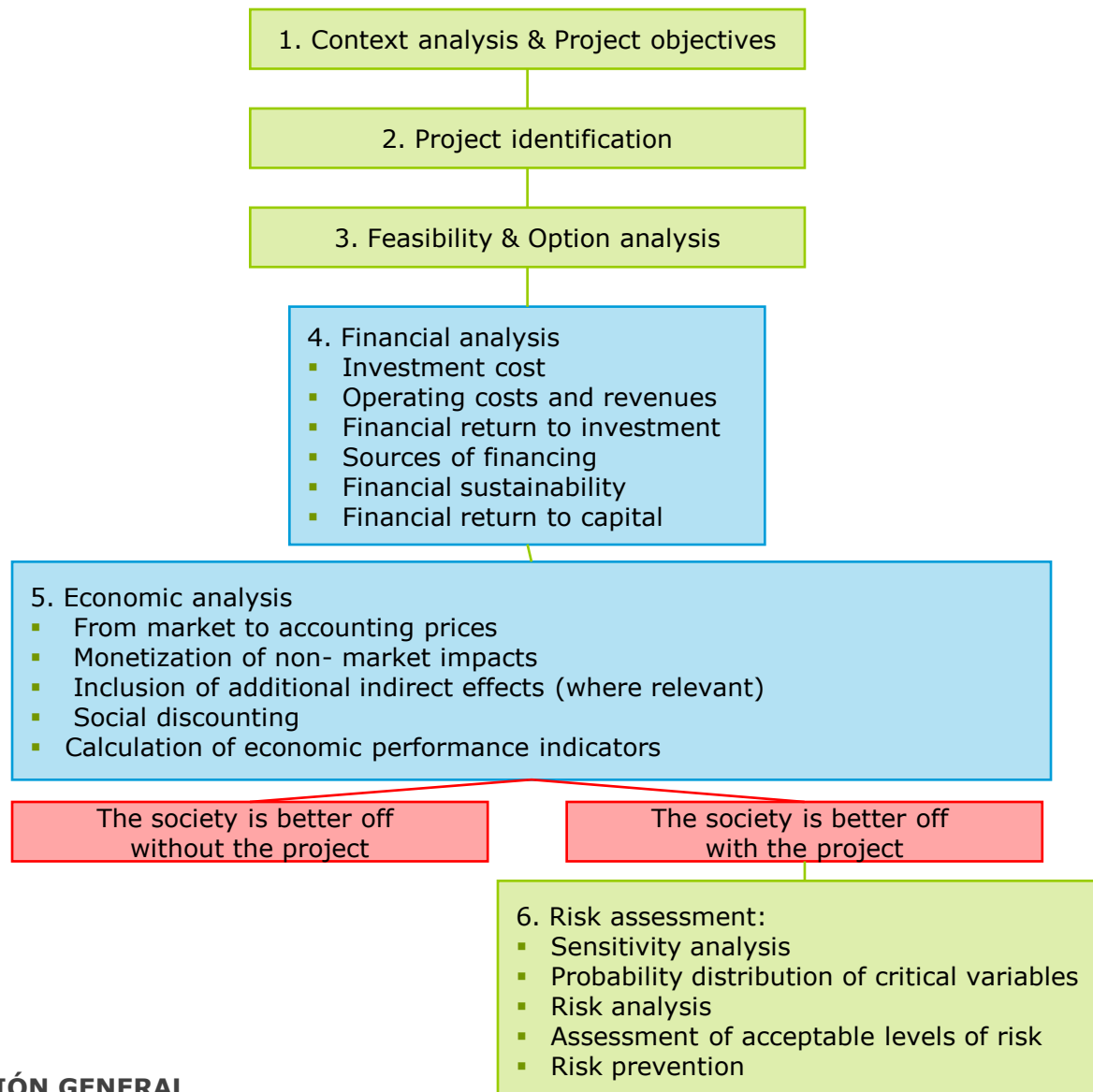
The **evaluation of a railway project** can be approached from two different perspectives:

- A **financial analysis** focused on the **costs and revenues** generated by the project.
- An **economic analysis** that considers the **benefits and costs** it generates to society.

The **financial analysis** is related to the viability of the project, funding amount and it is asking: **private participation is possible?**, or **what is the margin of a Manager?**

The **economic analysis** responds to the contribution of social welfare: **Does the project take place?**, requested by the society through the Public Administration.

# 5. Evaluation of a railway project



# 5. Evaluation of a railway project

## Decision criteria

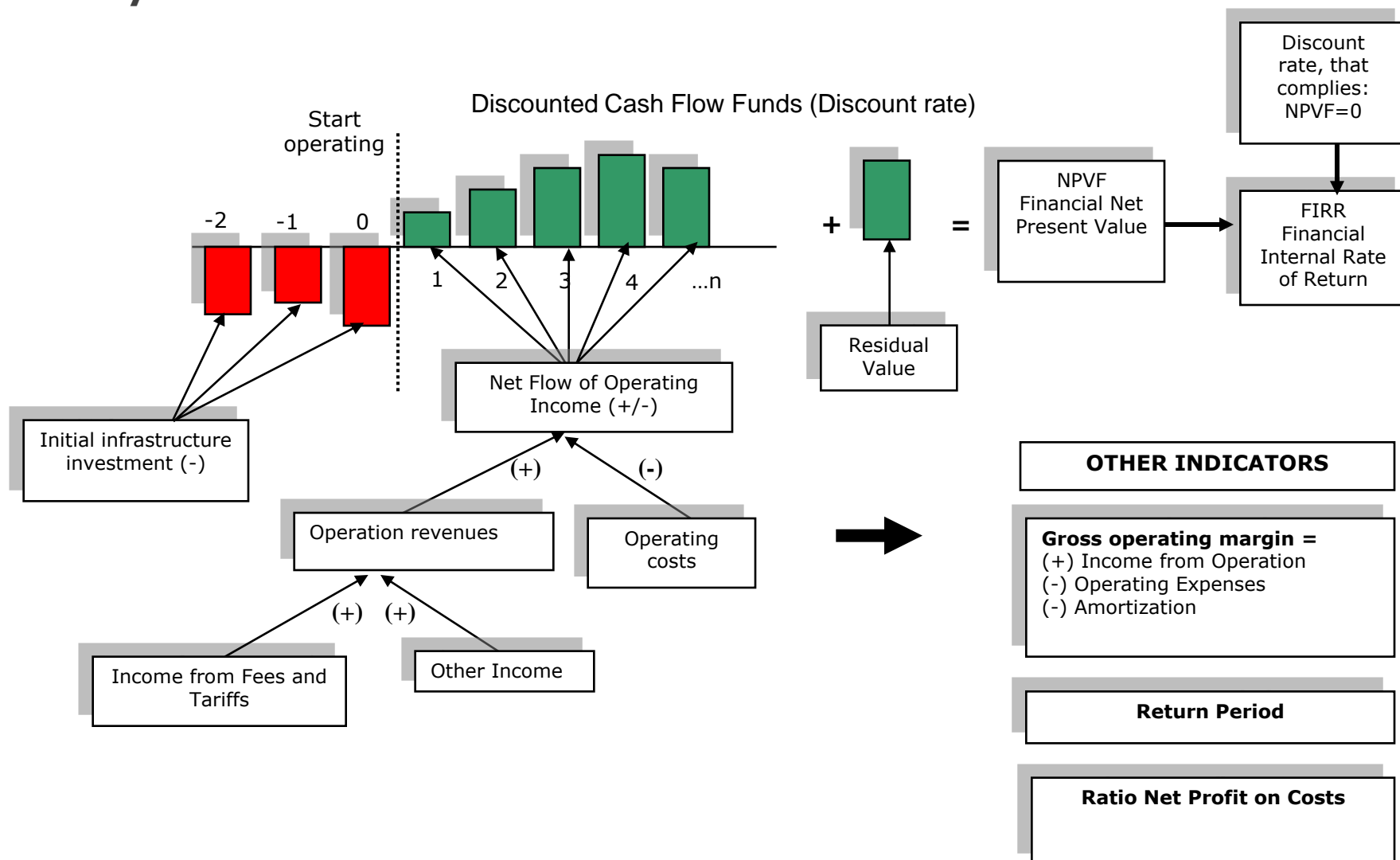
The decision criteria refer to the calculation of a series of economic indicators that measure the results of the project and allow a comparison with other projects. These ratios are:

- The **Net Present Value**, NPV, flows of benefits and costs start date to the period of exploitation. It is a unique numeric value that summarizes the flow of benefits and costs of the entire project life allowing easy comparison.
- The Internal **Rate of Return**, IRR, as the rate that makes the NPV equal to zero.
- **Capital deficit**, which consists in calculating that part of the investment is amortized cash flow (income - expenses, including investment), which normally flow in AV projects is negative.

**Capital deficit (%)** =  $100 * \text{NPV of cash flow} / \text{investment to date to the period of commencement of operation}$

# 6. Financial Analysis

## Railway Infrastructure Administrator





# 7. Economic Analysis

## Cost - Benefit Analysis (CBA)

In monetary terms, measures **the net contribution of the project to society** as a whole, measuring the difference between the situation with and without the project. Includes:

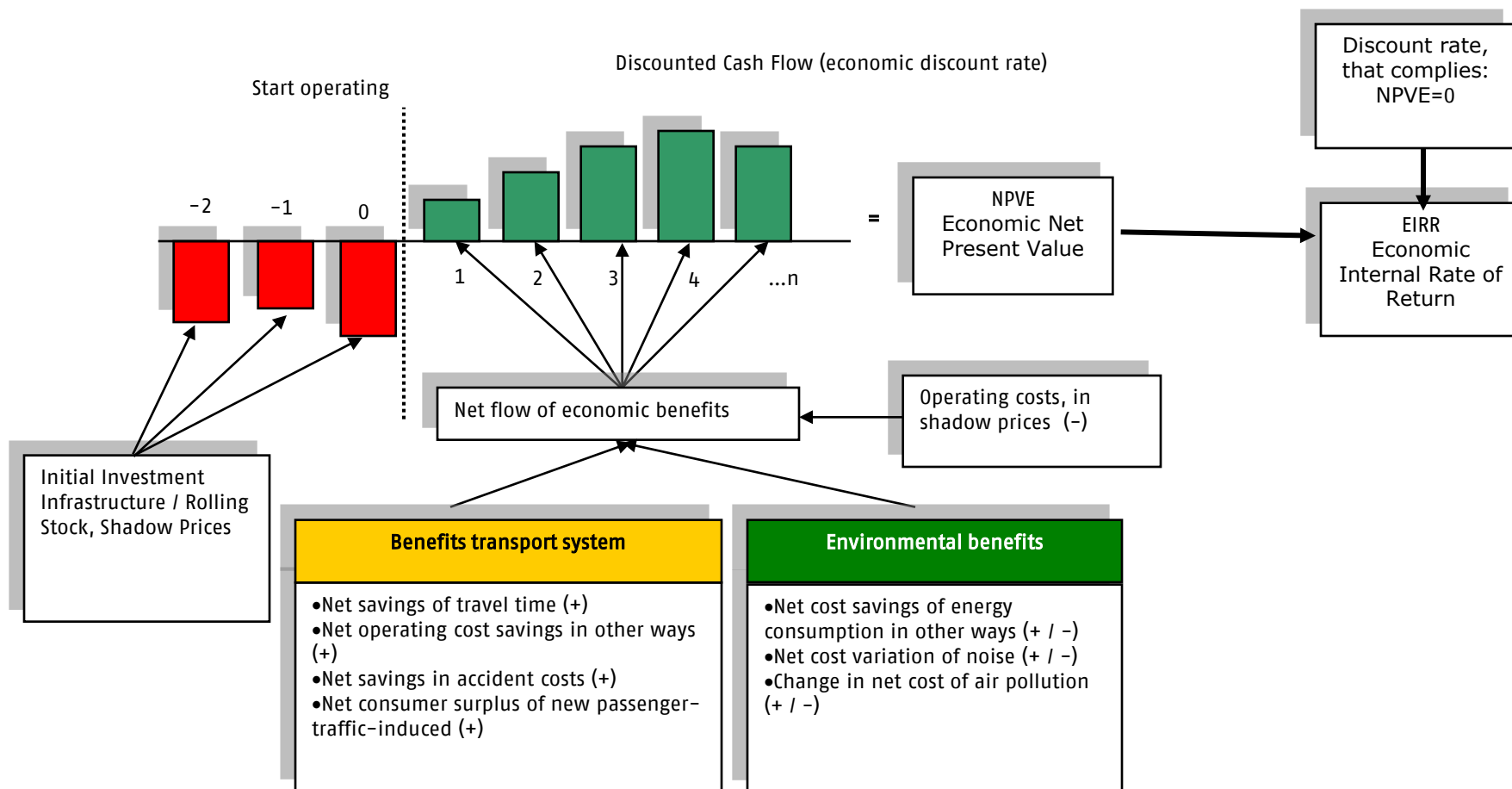
**Net income RUs and infrastructure manager**, discounting all cash flows represent cash transfers between agents.

All **updated relevant externalities**, direct and indirect, in "money" units that can be classified into:

- **Effects on the functionality and efficiency** of the transport system
- **Effects on competitiveness and economic integration** and land use planning
- **Effects on environment**

# 7. Economic Analysis

## COST - BENEFIT ANALYSIS (CBA)



## 8. Making decisions

Once the evaluation is finished, we must explicitly determine **how we want to internalize the uncertainty**, and for that we have 3 ways:

- **Completely ignore** the existence of uncertainty. Decision criteria based on deterministic. **NPV values or other variables are formulated**
- **Incorporating uncertainty** through **sensitivity analysis**. It is an intermediate option widely used in cost-effectiveness studies until recently. The decision is made with deterministic criteria but **considered the possibility that the results vary when modifying individually some parameters**. The system ignores the possibility that the changes happen simultaneously. ("False security")
- **Incorporating uncertainty into decision tools**. It is the most complete alternative but requires more information. It is considered that the **indicators are distributed under a probabilistic law. (Risk Analysis)**

## 8. Making decisions

### Risk Analysis

The way to "evaluate" this uncertainty is to analyze the **probability distribution** that can take the different parameters.

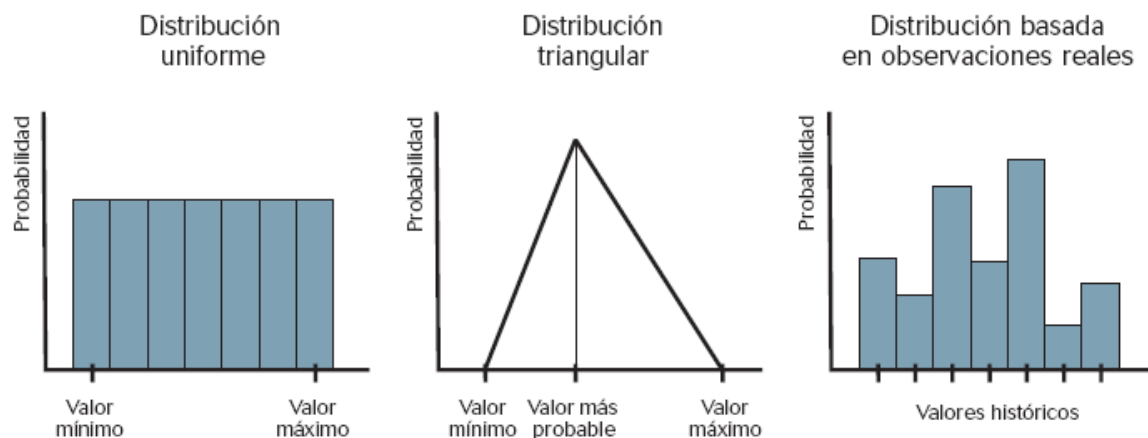
If probability distributions appropriate to the **critical variables** (identified in the sensitivity analysis) are assigned, we can assess the probability distributions of indicators of financial and economic performance, being then transformed into "**random variables**".

The decision maker has a **probability distribution of NPV**, ie, it has a range of **possible values** and **their corresponding probabilities** facing the traditional deterministic value.

This risk assessment is carried out by Monte Carlo simulations, assigning different probabilities to different scenarios.

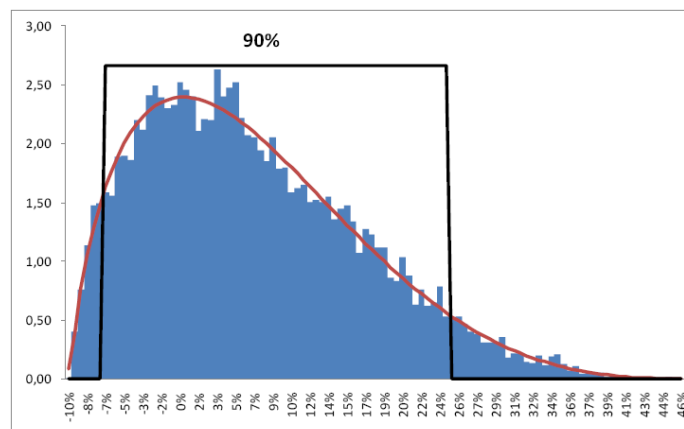
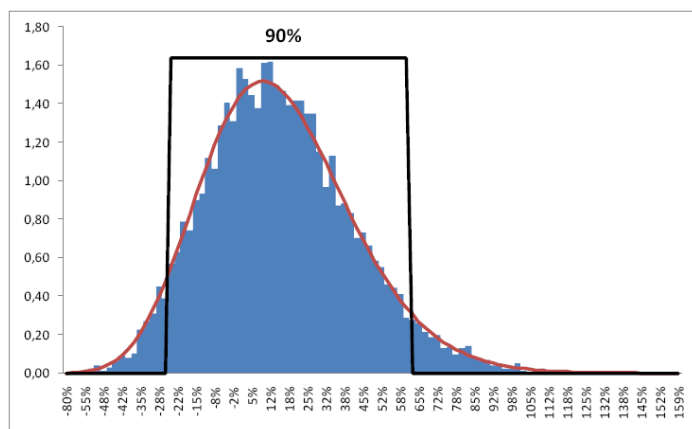
# 8. Making decisions

## Risk Analysis



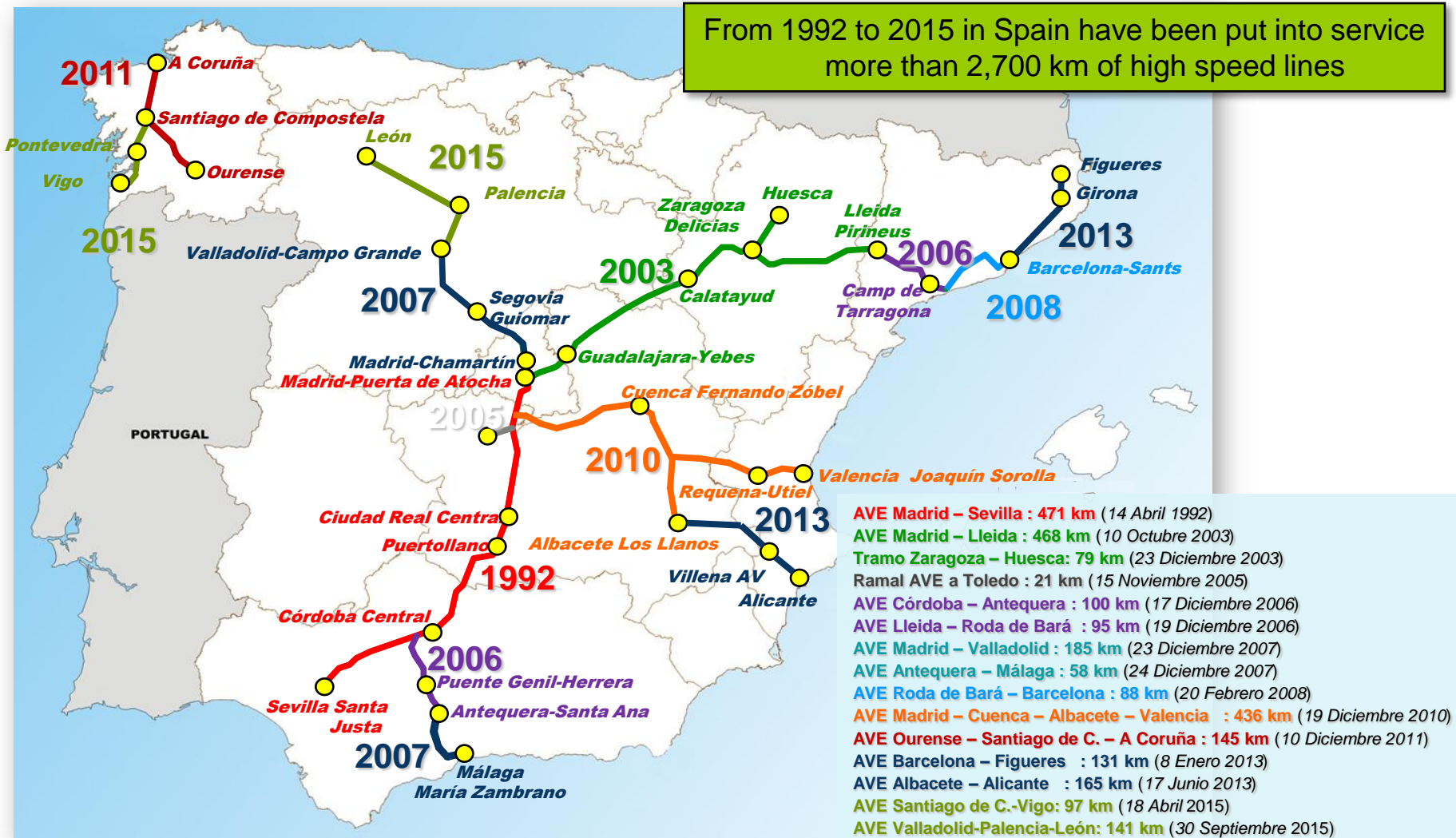
Posibles valores de la variable aleatoria

### Examples of distribution



# 9. Planning results

## ■ Corridors in service



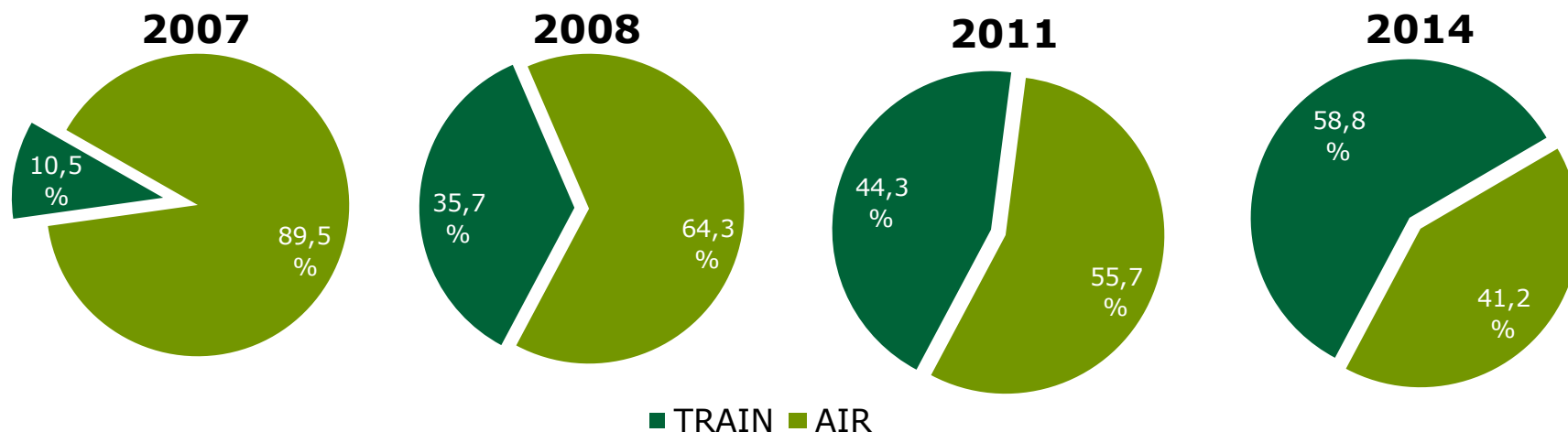
## 9. Planning results

All these actions in New High Speed lines mean:

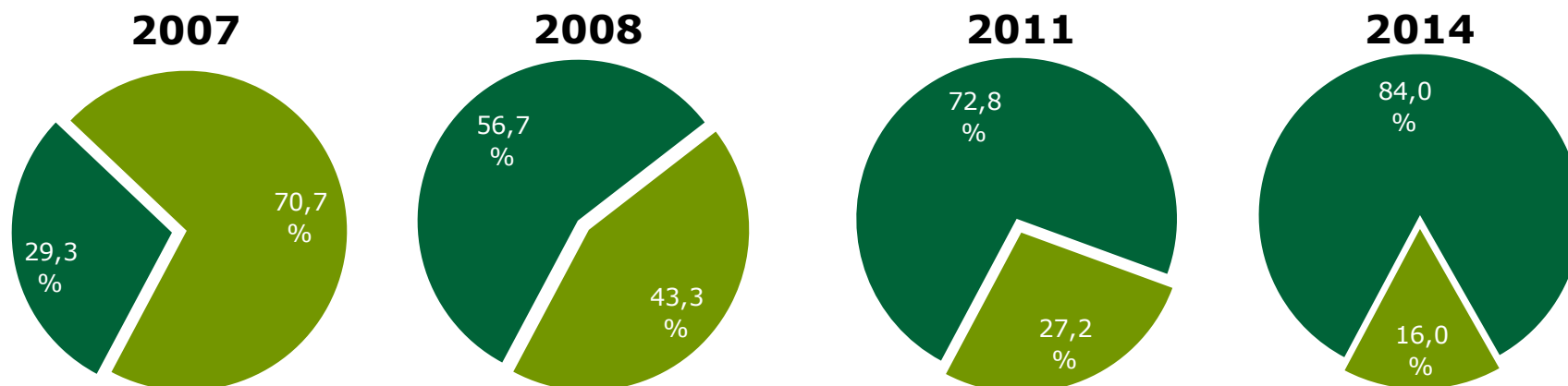
- **26 years of experience** for the complete development of the high speed
- **More than 2.700 km “in service” and 1.700 km in work** (and more network in project/study)
- **27 cities connected** by the high speed, extending through another 44 by gauge changers (50% of the national population)
- Lines allowing 300 km / h in 90% of its length
- **Safety and Comfort** > 96% customer satisfaction
- Protection of Environment and Cultural Heritage. Sustainability
- Costs and efficiency > 15 M € / km, **lower cost per line in Europe**
- Technology and innovative solutions

## 9. Planning results

### Competitiveness RAIL-AIR in Madrid - Barcelona

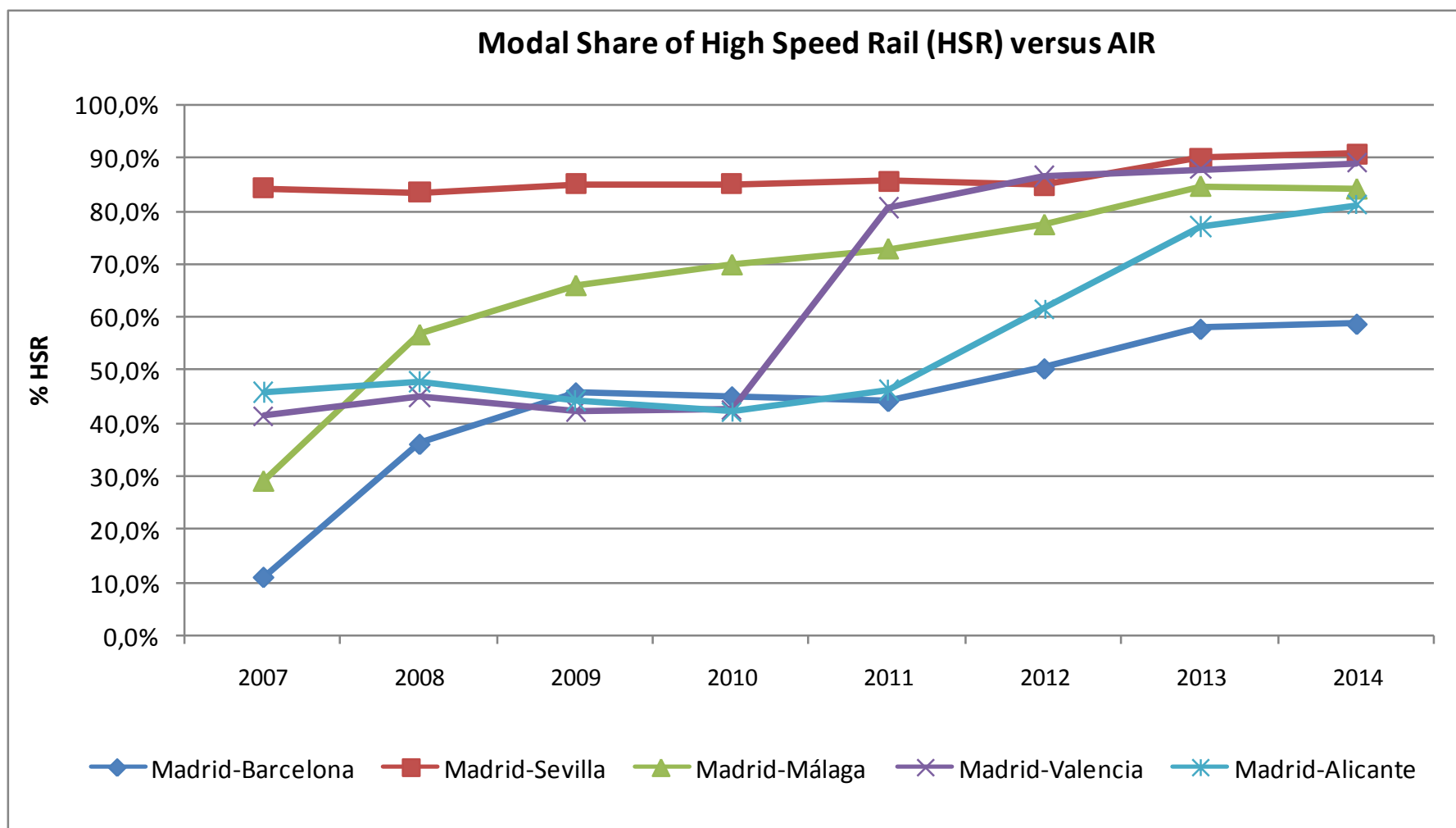


### Competitiveness RAIL-AIR in Madrid - Málaga



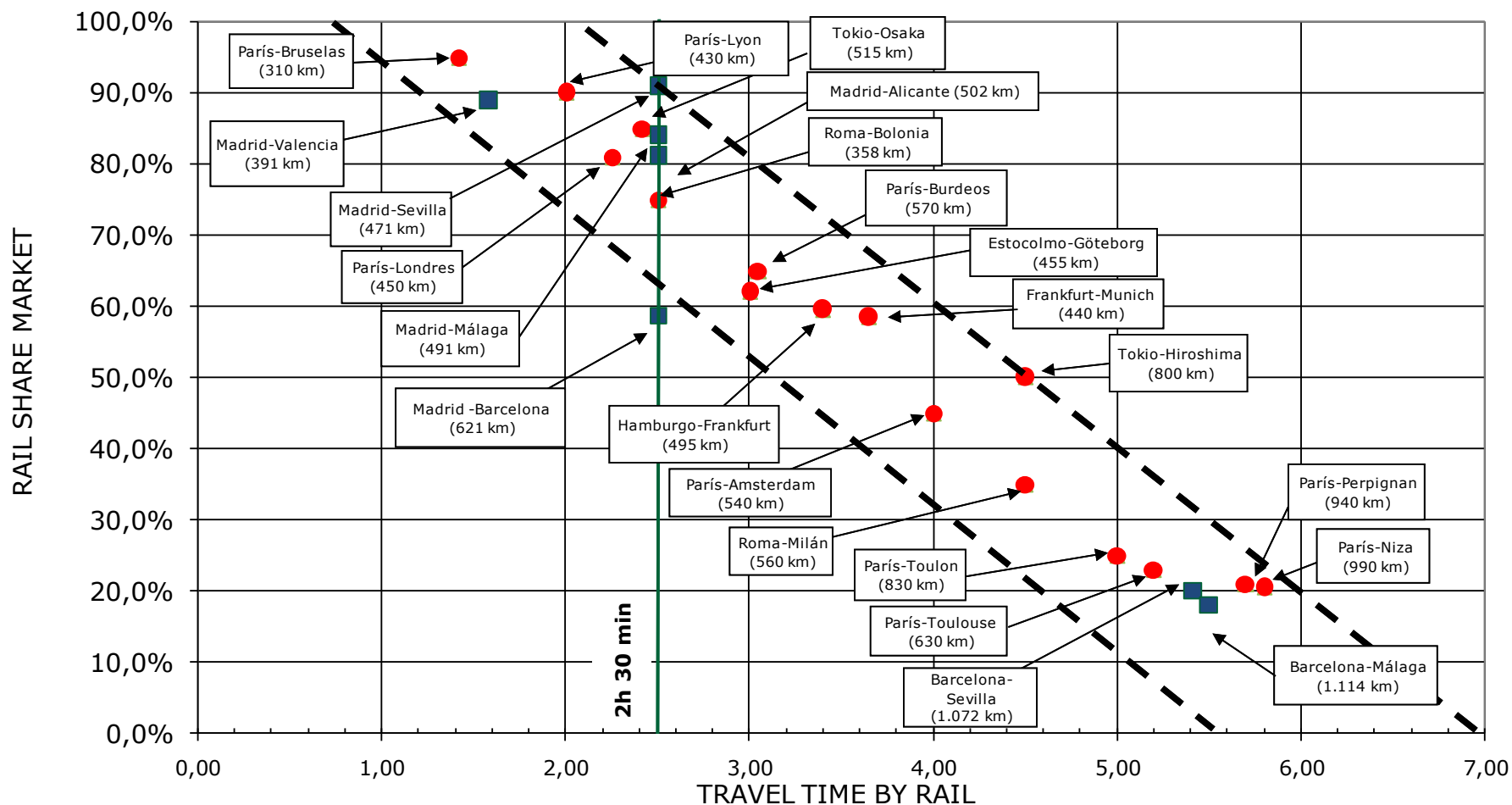


## 9. Planning results



# 9. Planning results

**AIR-RAIL MODAL SHARE**



## 9. Other results: Effects of HS on mobility

- High Speed captures in most cases more than 70% of the rail-plane demand.
- Only in the Madrid – Barcelona Line case the competitiveness with air transport is maintained.
- Regarding all transport modes, HS market share is around 30-35%.
- Price differences with private vehicle transport is the main obstacle to increasing the HS transport demand.



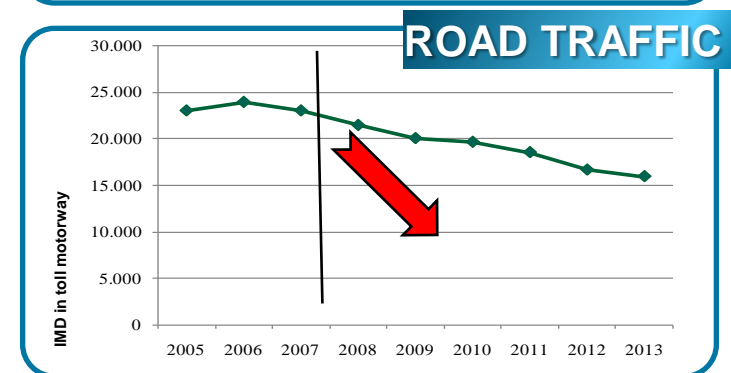
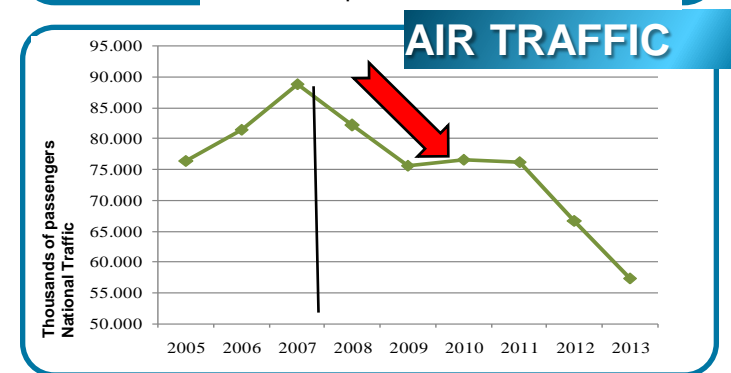
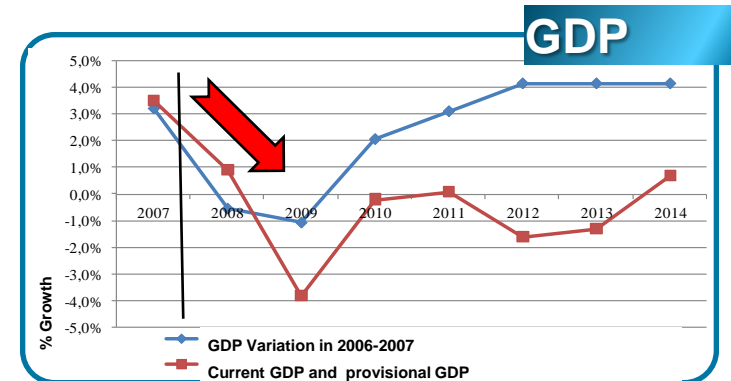
Achieved objective



Next Challenge

## 9. Other results: The impact of the “crisis”

- Consequences:
  - **Decline of the explanatory variables** on the evolution of transport demand: GDP and employment.
  - Mobility reduction in all motorized modes.
  - Reduction of public investment in infrastructure.
  - Large number of projects under construction.
  - **Need to fit the investments** to the real growth of transport demand.



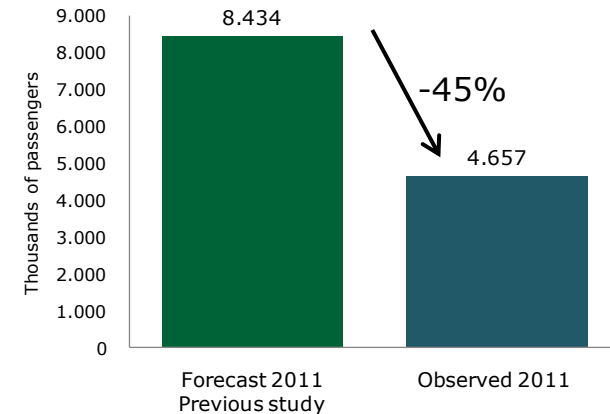
## 10. Effects: Comparison forecast / observed demand

### Analysis by relations: Madrid-Valencia (2011)

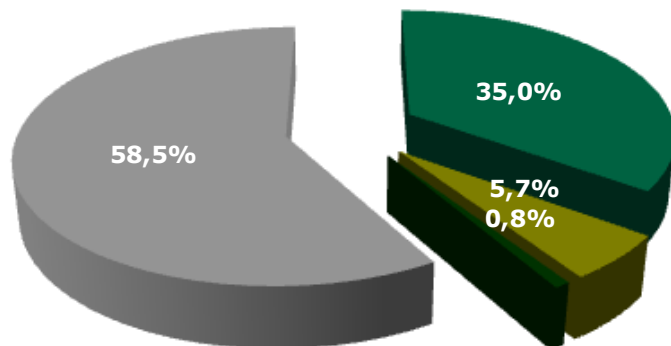
In 2007 study, the growth patterns of mobility were estimated based on models with economic variables. Due to the **economic crisis** the evolution of these variables, as GDP, has been much lower than the estimated

The **travel demand in 2011** between the provinces of Madrid and Valencia was 4.7 million passengers a year, **45% lower than estimated in the former study**

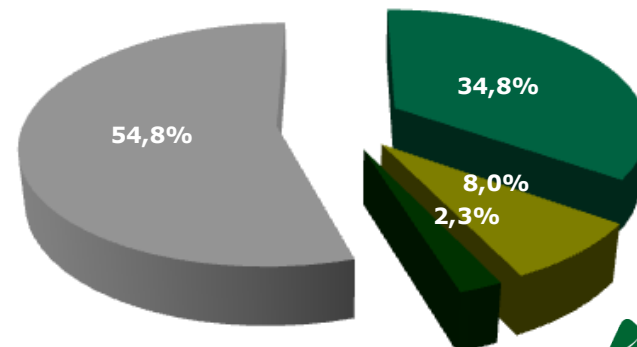
However, the **modal distribution** is **very similar** **than the estimated** in the previous study



PREVIOUS STUDY FORECAST FOR 2011



OBSERVED (2011)



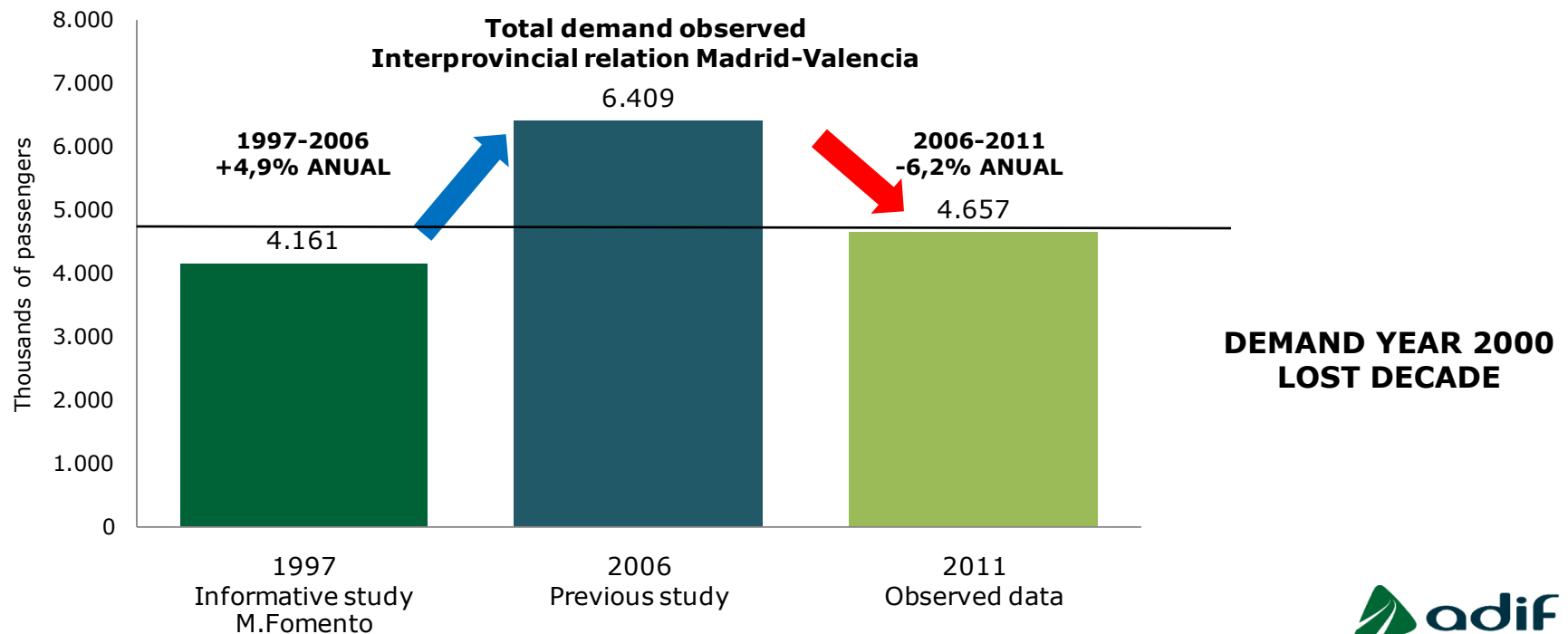
■ Rail ■ Bus ■ Airplane ■ Car

## 10. Effects: Comparison forecast / observed demand (II)

### Analysis by relations : Madrid-Valencia (2011)

Besides the previous study, conducted in 2007, the Ministry of Public Works in 1999 elaborated the informative study of the high-speed line Madrid-Castilla La Mancha – Comunidad Valenciana – Región de Murcia, where the observed demand in 1997 was obtained by the corresponding field work

The following chart shows the evolution of the current demand compared to the years 1997, 2006 and 2011. It is noted that the **current demand is at 2000 levels**, what is known in economics as the "lost decade"

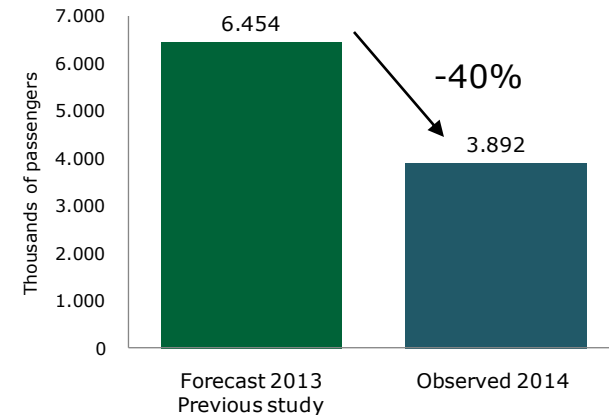


## 10. Effects: Comparison forecast / observed demand (III)

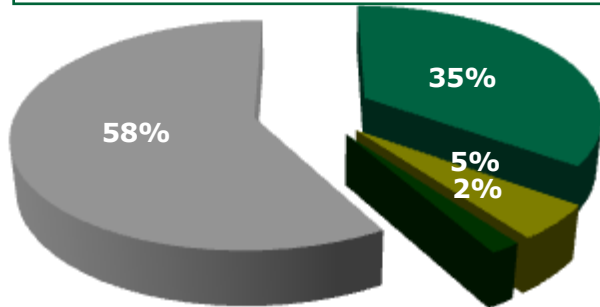
### Analysis by relations : Madrid-Alicante (2013)

**Travel demand in 2014** between the provinces of Madrid and Alicante was 3.9 million passengers, **40% lower than estimated in the former study**

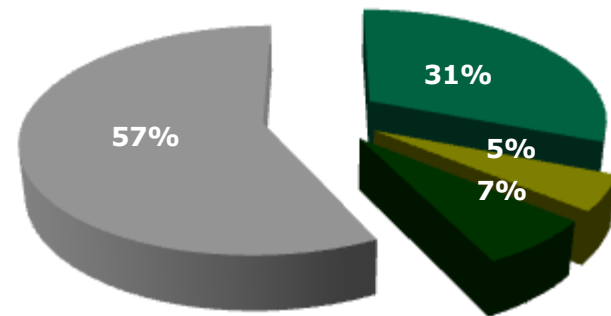
However, the **modal distribution** is **very similar** **than the estimated** in the previous study, though in this relationship the airplane seems to have weathered railway competition



PREVIOUS STUDY FORECAST FOR 2013



OBSERVED (2014)

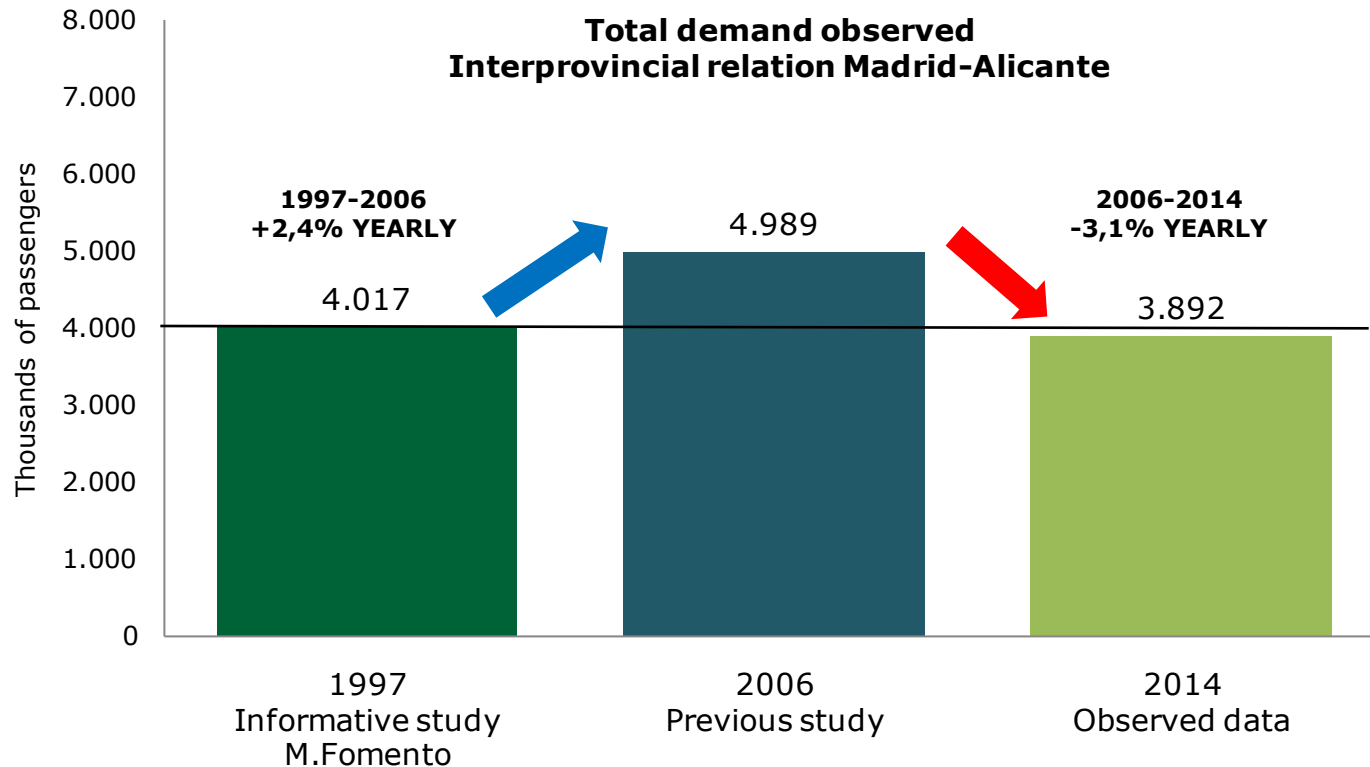


■ Rail ■ Bus ■ Airplane ■ Car

## 10. Effects: Comparison forecast / observed demand (IV)

### Analysis by relations : Madrid-Alicante (2013)

The following chart shows the evolution of the observed demand in 1997, 2006 and 2014 in the relation Madrid-Alicante. It is observed that the current demand is at levels below 1997



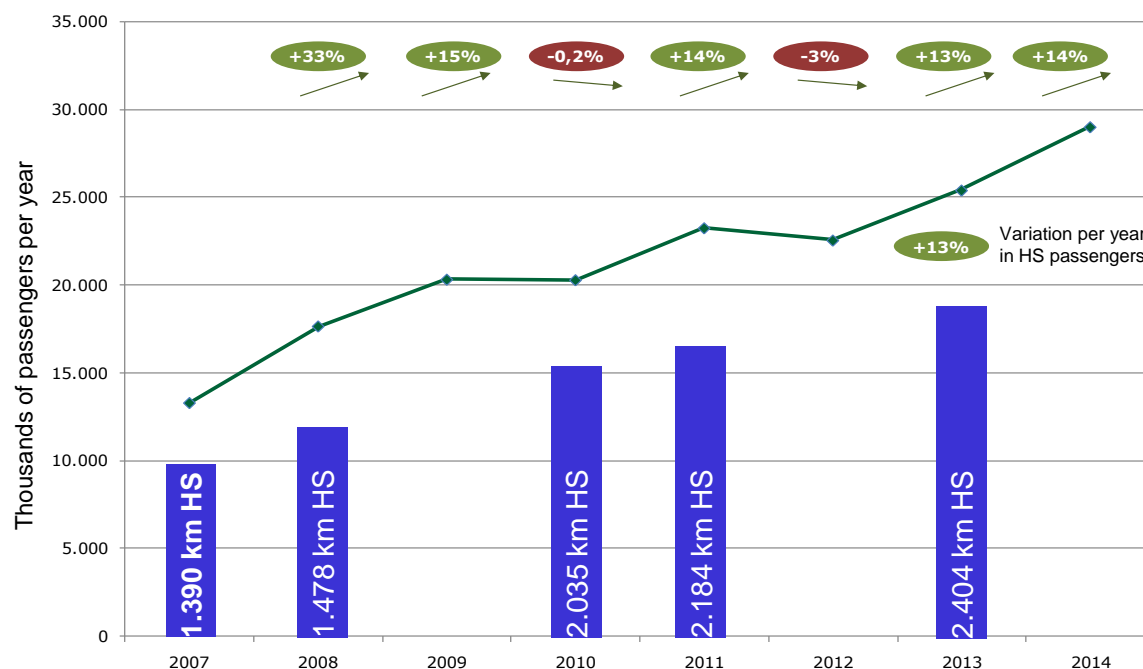
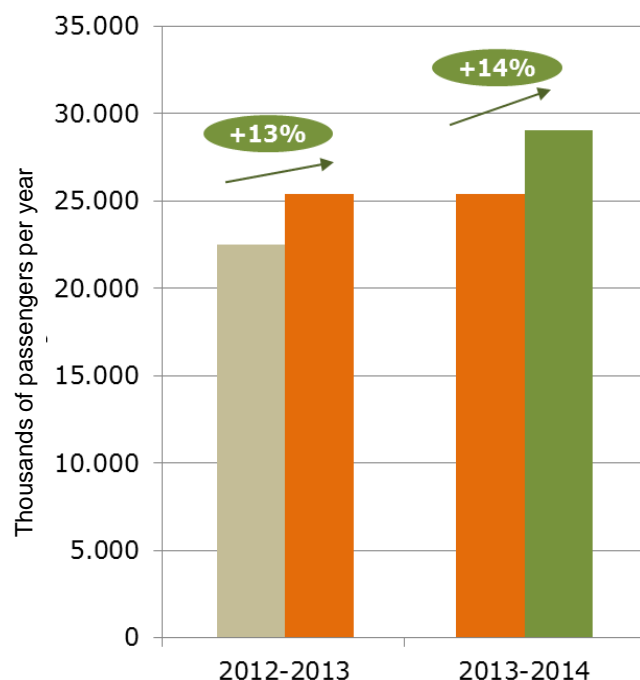


## 11.The experience: New criteria in short/medium term

- **Complete the sections** with advanced stage of execution.
- Design solutions **integrating and connecting the new HS sections with the existing network.**
- Establish line equipment depending on traffic **expectations:** single track VS double track.
- Commissioning a **phasing approach for the new sections.**

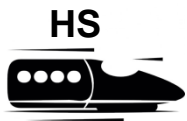
# 11.The experience: Passenger demand evolution

- Despite the ongoing economic crisis, since 2007 there has been a **continued increase** of the High Speed market.
- The key factor has been the **reduction of ticket prices** by the railway operator.
- In 2013-2014 there has been a strong recovery up to a total of 30 M passengers in 2014.



## 12. Key issues: Increasing HS competition

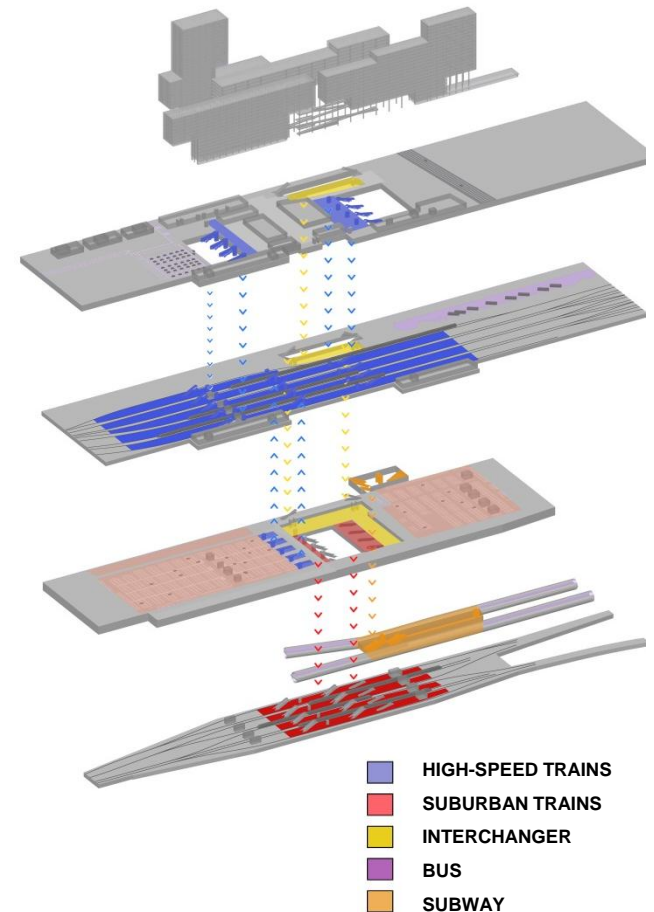
- Key competition issues for HS
  - **HS market liberalization.**
  - **Attractive fare structures** (yield management).
  - Customer and quality oriented approach to the operations.
  - **Promotion of intermodality** in stations/other transport hubs:



- Conventional Rail
- Subway.
- Buses and Taxis.
- Cars.
- Airplane.



BARCELONA SAGRERA HS HUB



## 13. Conclusions

- The HS network has undergone a significant development in the past seven years.
- The **effect of the economic crisis has forced to review and adapt** projects under construction **by introducing new criteria** of development that have enabled in 2015 the commissioning of 1.000 new kilometers of high speed lines.
- **Competitiveness of the Spanish HS network with air transport is an achieved goal.**
- **Economic, environmental and social benefits of the travelers that can be grasped from private vehicle to HS point out the objective** to be achieved in the near future.

# 14. International Connections



## 14. International Connections: financing the HSR

- For the development of **trans-European rail connections** across France and Portugal, **4 European Economic Interest Grouping (EEIG)** have been created and which studies and works are financed by Member States and EU subsidies.
- The aim is to define the project and, if necessary, develop a contest of concession:
  - **AEIE Sud-Europa-Mediterráneo** (**Figuera-Perpiñán** concession, running from december 2010)
  - **AEIE Sud-Atlántico** for the development of **Vitoria-Dax line**.
  - **AEIE Alta Velocidad España-Portugal** (AVEP) for the development of :
    - **Madrid-Lisboa/Oporto**
    - **Oporto-Vigo**
    - **Faro-Huelva**
  - **AEIE TGC-Pirineos** for the development of Great Cross of Central Pirineos Range, oriented towards freights.

# EEIG Vitoria-Dax

## Background

11/2003

- In the **Franco-Spanish Summit of Carcassonne**, the Spanish Minister of Public Works and the French Minister of Equipment, Transport, Housing, Tourism and Sea discussed about the development of railway infrastructure between the two countries, agreeing the creation of an **European Economic Interest Grouping** for the development of studies for **the new high speed railway connection between Vitoria and Dax**

03/2005

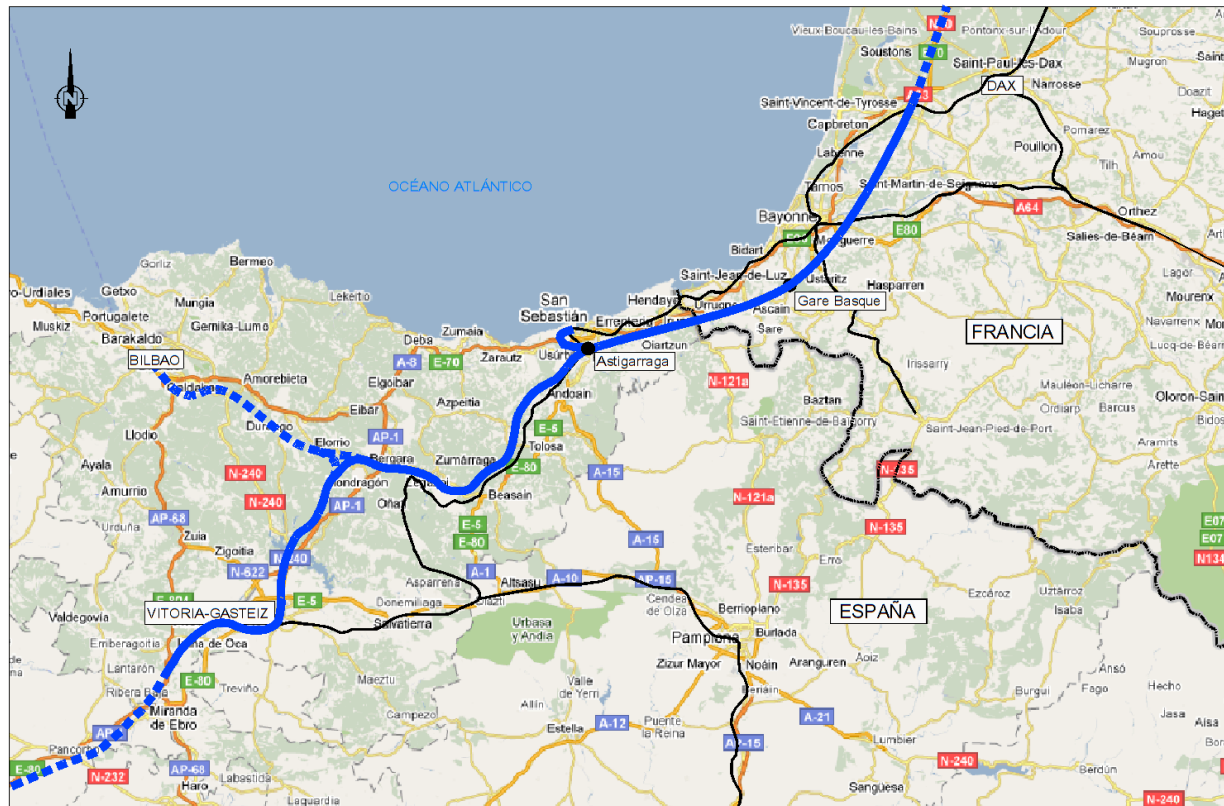
- Public entities Réseau Ferré de France (RFF), now SNCF Réseau, and ADIF **created the European Economic Interest Grouping South Europe Atlantic-Section Vitoria-Dax (EEIG SEA Vitoria-Dax)**.



# EEIG Vitoria-Dax

## Object

Develop **studies and projects** necessary for the definition, construction and putting into service of an international section in the area of **railway connection Vitoria-Dax.**



# EEIG Vitoria-Dax

## Organization

### GENERAL ASSEMBLY

- It is **composed of representatives of the members of the EEIG** or their designated substitutes.
- It is the **highest decision-making body** grouping.
- Attended by representatives of the services of economic and financial control of public authorities and their subsidiaries of Spanish and French States.

### MANAGERS AND OTHER POSITIONS

- **President, proposed by ADIF. His mandate is for three years renewable.**
- Director, appointed by the President upon the proposal of SNCF Réseau). It is responsible for the direction of grouping, including staff and budget management.
- Deputy Director appointed by the President upon the proposal of ADIF. Oversees the conduct of studies.
- Management Inspector appointed by the General Assembly on the proposal of ADIF, oversees staff and budget management, and prepares the annual management report.
- Management Deputy Inspector appointed by the General Assembly on the proposal of SNCF Réseau.

### STATUTORY DOCUMENTS

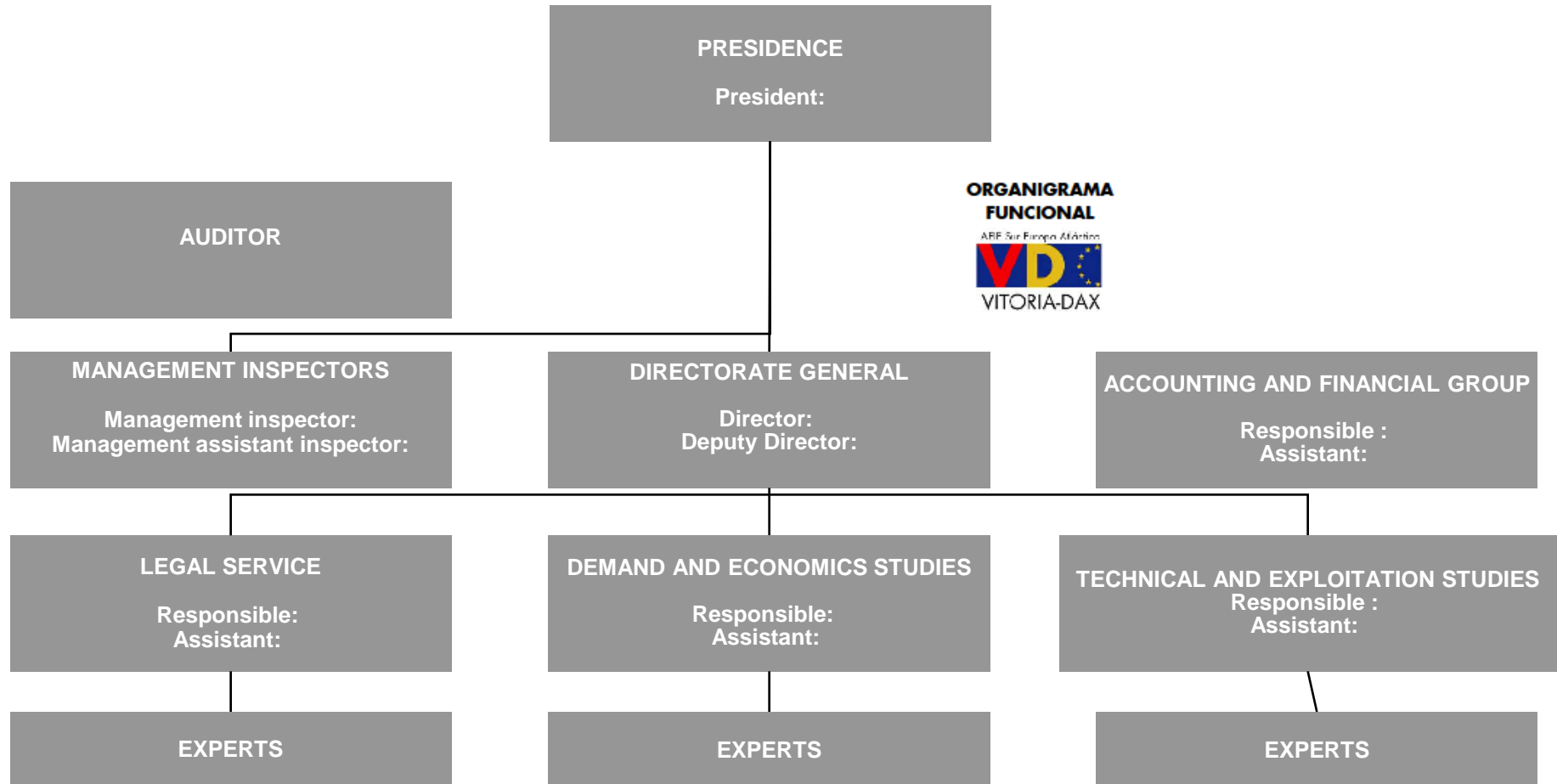
- Constitutive Agreement grouping
- Regulation of Internal Affairs and Internal prestations
- Treasury Convention

### HEADQUARTERS

- It is established in **France**

# EEIG Vitoria-Dax

## Organization chart



## STUDIES

### DEMAND STUDIES

MARKET STUDY AND FREIGHT TRAFFIC IN ATLANTIC CORRIDOR

MARKET STUDY AND PASSENGERS TRAFFIC IN ATLANTIC CORRIDOR

SURVEYS OF REGIONAL AND TRANSBORDER PASSENGER TRAFFIC

STUDY OF PASSENGER TRANSPORT IN ATLANTIC CORRIDOR. HORIZON 2020 AND 2030

MARKET AND TRAFFIC STUDIES OF A LONG-TERM DEVELOPMENT OF A HIGHWAY RAILWAY NETWORK IN SPANISH SIDE

FREIGHT MARKET AND TRAFFIC STUDY IN THE SHORT, MEDIUM AND LONG TERM OF THE EUROPEAN FREIGHT CORRIDOR No.4 (ATLANTIC CORRIDOR)

### PLANNING STUDIES

DEFINITION STUDY OF THE INTERNATIONAL SECTION IN THE BINATIONAL RAILWAY CONNECTION VITORIA-DAX

PRIORITY IMPROVEMENTS OF HENDAYA-IRÚN RAILWAY COMPLEX (HENDAYA STATION)

COMPLEMENTARY STUDIES OF THE DEFINITION STUDY OF THE INTERNATIONAL SECTION IN THE BINATIONAL RAILWAY CONNECTION VITORIA-DAX

TECHNICAL STUDIES OF THE ADAPTATION OF HENDAYE-IRUN RAILWAY COMPLEX ON THE HORIZON OF PUTTING IN SERVICE THE Y BASQUE

### ECONOMIC AND ENVIRONMENTAL STUDIES

ECONOMIC STUDY AND BALANCE OF CARBON PROJECT VITORIA-DAX

# EEIG Vitoria-Dax

## STUDIES

### EXPLOITATION STUDIES

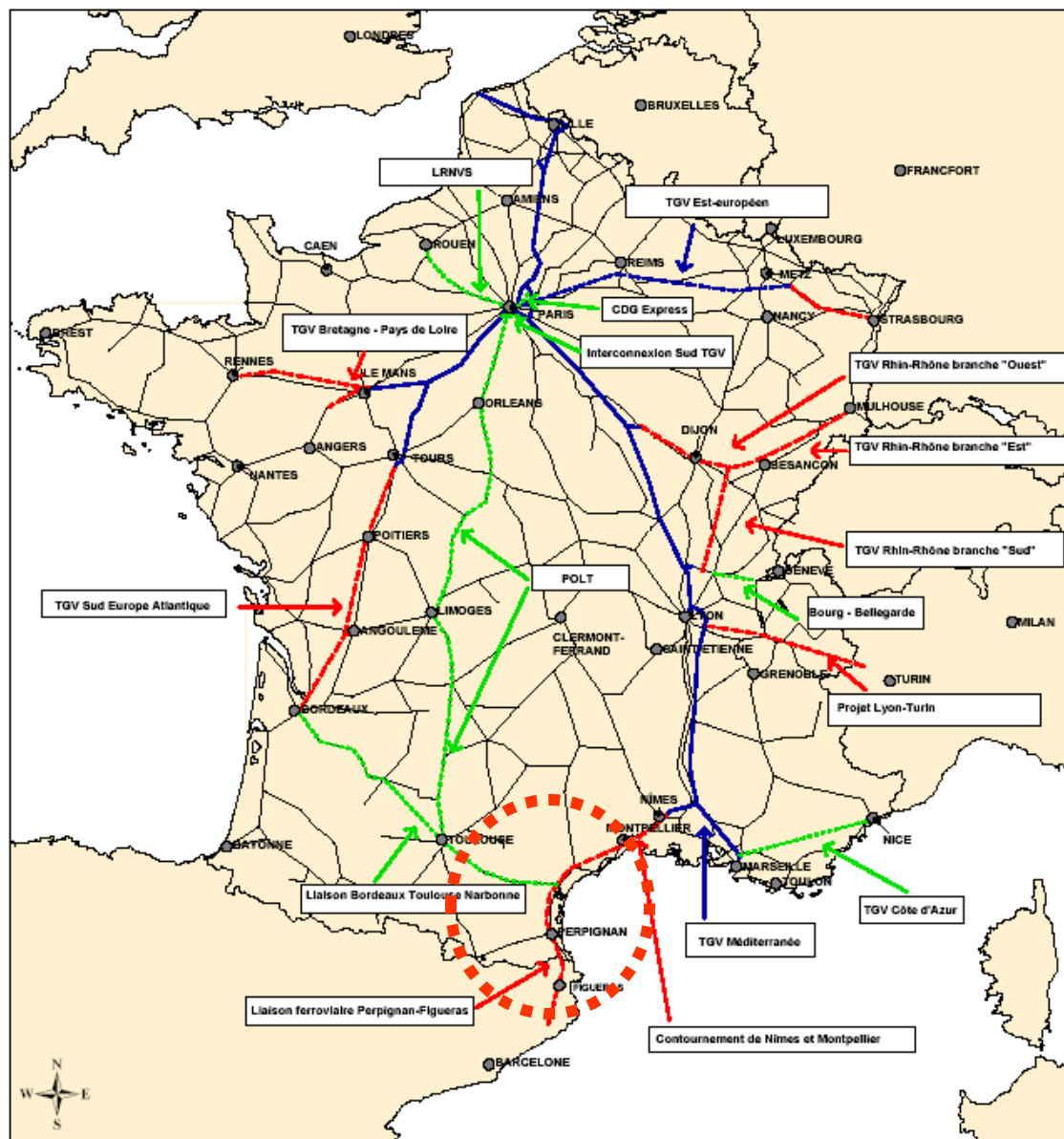
STUDY OF EXPLOITATION CONDITIONS IN THE RAILWAY COMPLEX IRUN-HENDAYA. HORIZON 2020

DIRECTOR SCHEME OF BINATIONAL RAIL SERVICES IN VITORIA-DAX. HORIZON 2020

INFRASTRUCTURE AND EXPLOITATION STUDIES OF EUROPEAN FREIGHT CORRIDOR 4 (ATLANTIC CORRIDOR)

CAPACITY STUDIES OF VITORIA-DAX RAILWAY CONNECTION AT SHORT, MEDIUM AND LONG TERM

## 14. International Connections: Figueras-Perpignan



# 14. International Connections: Figueras-Perpignan

## Project



- Spain and France have different gauge track (1.435 mm in France, 1.668 mm in Spain)
- In 1989 the spanish Ministry decided the development of UIC gauge for HSR
- Figueras-Perpignan is a « maillon-clé » and a priority project inside TEN-T Network
- **Great improvement:**
  - 10 hours for freights
  - 2 hours for passengers
- Studies started in 1992

**1995 International agreement: The Connection will be a Concession regime**



# 14. International Connections: Figueras-Perpignan

## Project (cont.)

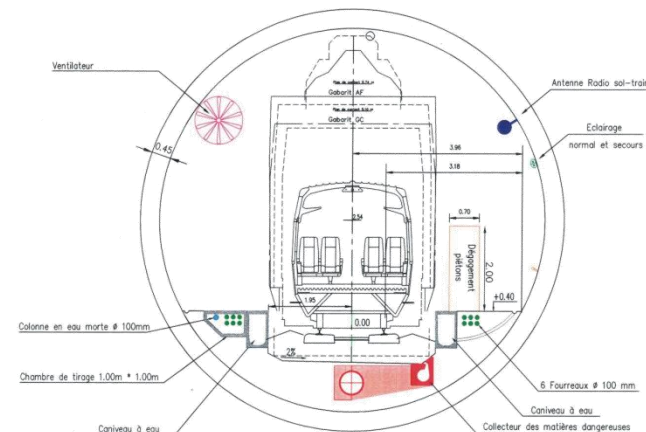
**45 km lenght**

- Freight trains: 100-120 km/h
- Passenger trains : 300-350 km/h

***Tunnel 8,2 km lenght***

- bitube

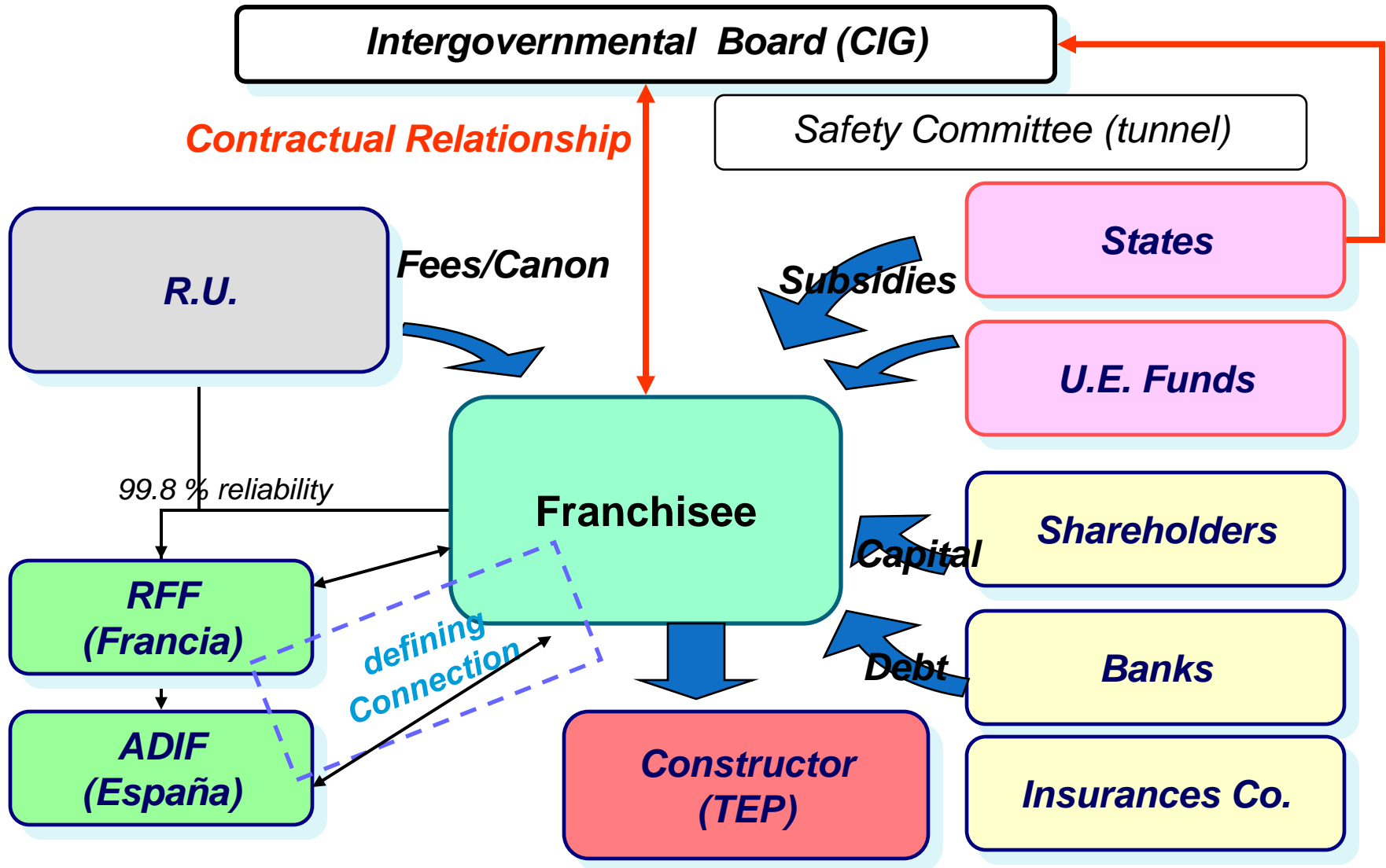
**up to 950 M€ of investment**



COUPE D'UN TUBE



## 14. International Connections: Figueras-Perpignan. Concession



## 14. International Connections: Figueras-Perpignan. Concession (II)

1. The grant was **awarded after an international tender** to EEC directive - 93/37. Under the leadership of the Spanish and French States
2. Concession for **the design, construction, maintenance and operation**. Once ended the concession, it is transferred to the States
  - States have designed a preliminary study
  - Dealer builds and finances the project at his own risk
  - Dealer obtain a subsidy from the member States
  - Dealer will receive from RU the fees/canon adopted

## 14. International Connections: Figueras-Perpignan. Concession (III)

### *The tendering process*

*April 16th 2003: the negotiations with Boygues.-Dragados were cancelled*  
*May 8th 2003 : New tender is published in the DOCE*

#### 1. The new tender is « closer »

- They have the experience coming from the first tender
- **More innovation:** The selected candidates will be invited to tender, according to a draft statement and non-negotiable contract (except a limited number of clauses), with reference to the model contract reached at the end of the first negotiation
- **No technical modifications** are allowed
- **Objective** : to finalize quickly the process

#### 2. July 2003 : 4 tenders presented

- RFF-GIF, ACS-Dragados-Eiffage , Bouygues-FCC, Ferrovial-Vinci
- All the tenders are accepted. Bids received October 7th
- November 13 th 2003 started negotiations with bidders

## 14. International Connections: Figueras-Perpignan. Concession (IV)

- The tender is won by TP Ferro

***The concession contract was signed in february 17th 2004***

- **Construction cost**= 952 M€ (January 03). Tunnel is 32% of costs
- **Term of works**= 60 months from february 17th
- **Fees**= 1.350€ pass/train, 550€ freight/train
- **Subsidy** = 57% of construction costs
- **Shareholders equity**= 102,9 M€
- **No guarantees**

## 14. International Connections: Figueras-Perpignan. Concession (V)

### *Selection process*

Spain

France

**(CIG) Intergovernmental Board**

#### **Selection Committee**

- Evaluation & proposal of Candidates and winner
- Experts from both countries

- Representatives of both countries

- Advisor for the governments in preparation and selection

#### **Negotiating Committee**

- Contract's Negotiation
- Experts from both countries

#### **Technical group**

*Construction  
Operation*

Technical support

#### **Legal group**

*Contract issues*

Legal support

#### **Financial group**

*Fees  
Financing*

Financial experts

## 14. International Connections: Figueras-Perpignan. Concession (VI)

### ***Main Conclusions***

- Excellent collaboration between the Spanish and French governments for the cross border project
- A groundbreaking project for the railway sector:
  - Application of highway Concession concepts to railway
  - New coordination scenario with infrastructure managers (RFF and ADIF)
  - Relation and cooperation with railway operators (RENFE, SNCF)
- CPP is possible in the railway sector with a proper transfer of risk to the Concessionaire:
  - Risks during Construction
  - Traffic/operation risks



**ADIF EXPERIENCES**  
VISIT OF CHEQUIA  
*Madrid. November 2015*



**Thank you very much for your attention**