

# STRATEGIES FOR BETTER RAILWAY LINES

**Daniel Costa Seijas**

Planificación y Economía del Transporte, SENER, España

**José Manuel Cubela**

Planificación y Economía del Transporte, SENER, España

## FOREWORD

This paper summarizes the results obtained by the authors for the UIC (International Union of Railways) in the study “INFRASTRUCTURE SCENARIOS FOR BETTER PASSENGER SERVICES”.

## SUMMARY

The main objectives of investment on railway are improving connectivity and access to services; generate employment and amenities; while delivering cuts in carbon emissions, reductions in traffic noise, pollution and congestion.

Within that general context, the existing options to improve a railway line are the upgrading of the existing line, which is called the brown field option, or to build a brand new line in the corridor, which is called the green field option and which is assumed a state of art line, i.e. a High Speed Line.

There is, nevertheless, a third option that could be followed in which, first the existing line is upgraded and then a new High Speed Line is built in the same corridor.

This latter option is acknowledged as economically inefficient, but it is needed to find out to what extend that assertion is true.

The purpose of this study is, then, to reach a conclusion on that statement through the analyses of actual cases, i.e. not through a theoretical exercise but through an empirical research.

In the first stage of the research two corridors that met the requirements of the study were identified: the Madrid - Valencia Line in Spain and Bordeaux – Spain Line in France.

From the analysis of those corridors it was learnt that, indeed, building a new High Speed Line after upgrading the existing line in that corridor will not be economically efficient unless the new line is built after a number of years.

That delay could be around 10 years, and will depend on the level of investment carried out

for the upgrading and the expected growth of transport demand in the corridor.

## 1. INTRODUCTION

The main objectives of investment on railway are improving connectivity and access to services; generate employment and amenities; while delivering cuts in carbon emissions, reductions in traffic noise, pollution and congestion.

Within that general context, the existing options to improve a railway line are the upgrading of the existing line, which is called the brown field option, or to build a brand new line in the corridor, which is called the green field option and which is assumed a state of art line, i.e. a High Speed Line.

There is, nevertheless, a third option that could be followed in which, first the existing line is upgraded and then a new High Speed Line is built in the same corridor.

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## 2. DEFINITION OF SCENARIOS

This study is called “Scenarios for better passenger services”, so it follows the first question that has to be answer: Which scenarios are going to be analyzed?

The immediate answer comes from the first paragraphs above, where it was talked about Upgrading, New High Speed Line and the third option or scenario of conducting both investment in the same corridor.

The complete answer is, even though, a little bit more specific and defined four not three scenarios to analyze in this study:

**Do Nothing Scenario:** is the scenario where no upgrading is perform in the existing line and no new line is built along the same corridor. It is the base scenario to which the other have to be compared, as it is done in all Cost Benefit Analysis.

**Upgrading Scenario (Brown Field):** is the scenario where the existing line is upgraded to increase its capacity, which will reduce travel times and improve rail service in the corridor.

**New Line Scenario** (Green Field): is the scenario where a New High Speed Line is built in the corridor, which will booster the rail service in the line.

**Upgrading + New Line Scenario** (Brown + Green Field): is the scenario where both investment are carried out: the upgrading of the existing line and the construction of a new high speed line in the corridor, this is the scenario which is expected to be worse than the other two, the statement that this study will show using existing cases.

The main question that this study try answer is, then: Which Scenario will left society better off?

And to answer this question a measure to compare the scenarios is needed.

There are many options for that measure but the most common and the one used in this analysis is the **Economic Net Present Value** of the projects.

Where economic means taken into account **the society as a whole**, i.e. **all market agents**:

- ✓ passengers and shippers using the corridor in all modes of transport,
- ✓ transport operators providing services in the corridor also in all modes,
- ✓ the government and,

**all the rest of society** that will get benefits in an indirect way as the reduction in greenhouse gases emission.

### 3. SEARCH FOR ACTUAL CASES

Once the general framework of the study was set (the former two answers), a research was undertaking in which the actual cases to be analyzed were selected: the Bordeaux – Spain Line in France, and the Madrid – Valencia Line in Spain.

That research stage continue with the analysis of the available data that will be needed to evaluate the different scenarios.

And it was found, as it was expected, that there is not enough information to carry out a **Cost Benefit Analysis** from scratch but there is enough information to carry out a **Meta-Analysis**, i.e. an analysis done over results rather than over actual detailed data.

This result of the research stage is not a disadvantage but a good solution to avoid any controversies that will arrive if an ex – post or a re-evaluation of the projects were have been done.

This was not anticipated before the research but produces a statement that has to be highlighted:

*The analysis carried out here **IS NOT** an Ex Post Analysis **NOR** a re-evaluation of the lines made from scratch.*

*What have been done was just introducing new alternatives in already finished studies, i.e. using the data and the assumptions of the original study.*

Once the research has set the methodology to follow in the study both actual cases were analyzed which results are the following.

### **3. FINDINGS IN THE BORDEAUX – SPAIN LINE**

The first analyzed case was an existing and well documented project: the **Bordeaux – Spain Line** (235 km).

For this project, three scenarios were studied and documented:

- ✓ **Upgrading** the existing two tracks line to a four tracks line (Scenario 1).
- ✓ Building a **New High Speed Line** to the West of the Landes (Scenario 2).
- ✓ Building a **New High Speed Line** to the East of the Landes (Scenario 3).

### Bordeaux – Spain Line Scenarios

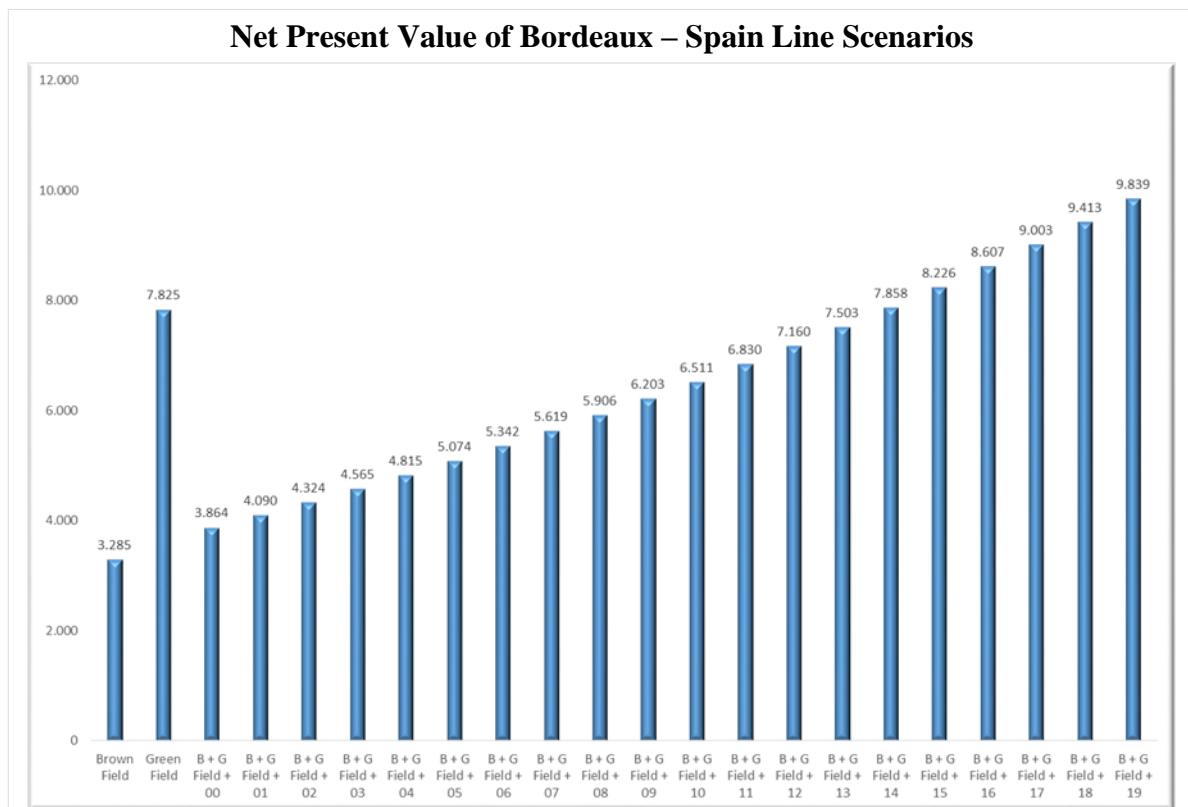


Source: *Projet ferroviaire Bordeaux Espagne*

Using the existing data for this line and a series of assumptions it was possible to estimate the benefits and costs for the three Scenarios that has to be analyzed in this study, which are:

- ✓ **Upgrading** (Brown Field), this is the scenario 1 in the Bordeaux – Spain line study.
- ✓ **New Line** (Green Field), for which the scenario 2 of the above study were chosen (because it was the better scenario in that study).
- ✓ **Upgrading + New Line** (Brown + Green Field), which has to be synthetically evaluated using the estimations of benefits and costs of the other two scenarios and which actually is a series of scenarios:
  - the first one doing the upgrading and building the new line simultaneously (no delay).
  - delaying the new line one year, two years, etc., up, in this case, to 19 years of delay, i.e. 20 scenarios.

The most important finding of this exercise was that in order to obtain for the society the same net benefits that the New Line Scenario, the building of a new high speed line after finishing the upgrading has to be done 15 years after the first improvement of the line.



Source: SENER, INGENIERÍA Y SISTEMAS, S.A.

*After upgrading a line, the building of a new line has to be done after a long period of time to achieve the same level of benefit that the best single solution.*

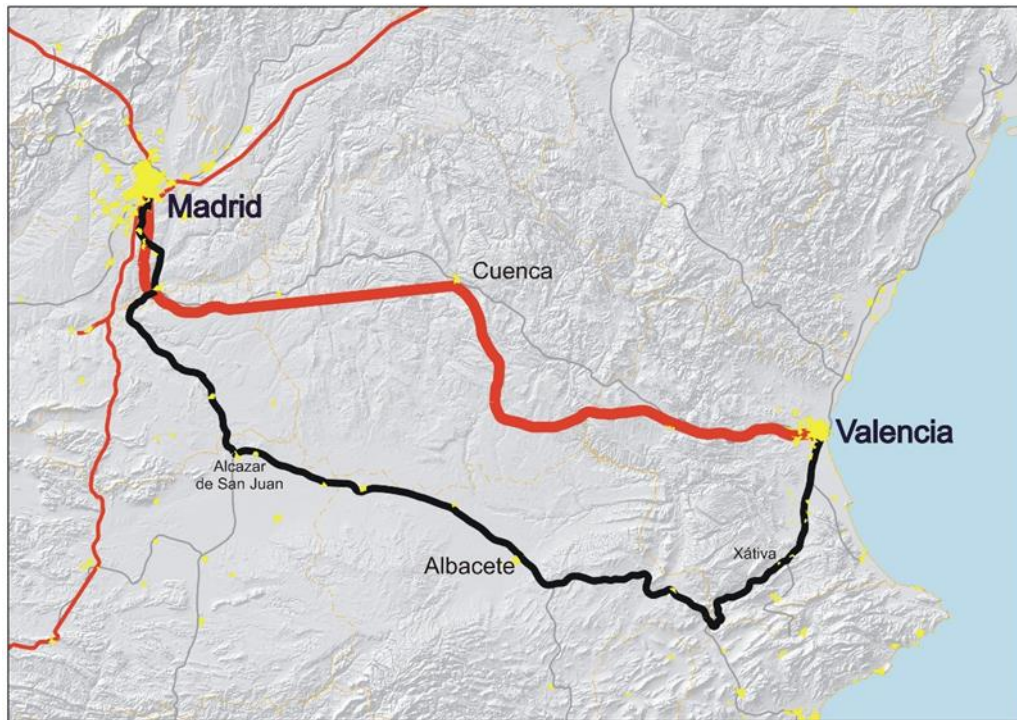
#### 4. FINDINGS IN THE MADRID – VALENCIA LINE

The second case of analysis was not a project but an actual case: the **Madrid – Valencia Line**.

In this line two improvements were already done:

- ✓ **Upgrading** of the conventional line in the 1990's up to 220km/h.
- ✓ Building a **New High Speed Line** in the 2000's which was put into service in 2010.

### Madrid – Valencia Line Improvements



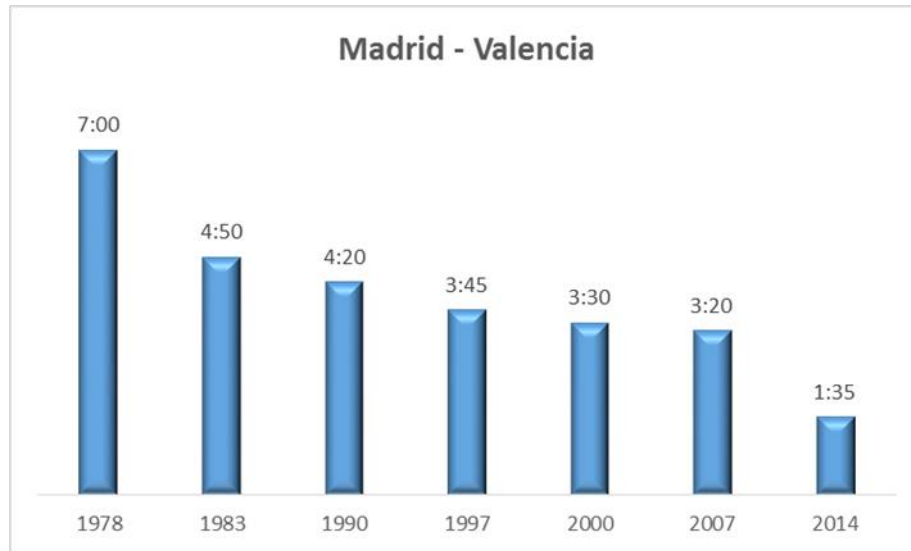
Source: SENER, INGENIERÍA Y SISTEMAS, S.A.

In Red the New High Speed Line and in Black the Existing Conventional Line upgraded in the 1990's.

As this is an actual case, the main characteristics of the improvements are observed not estimated data:

- ✓ **Travel Time Reduction:** the evolution of Travel Time by train between Madrid and Valencia has been the following.

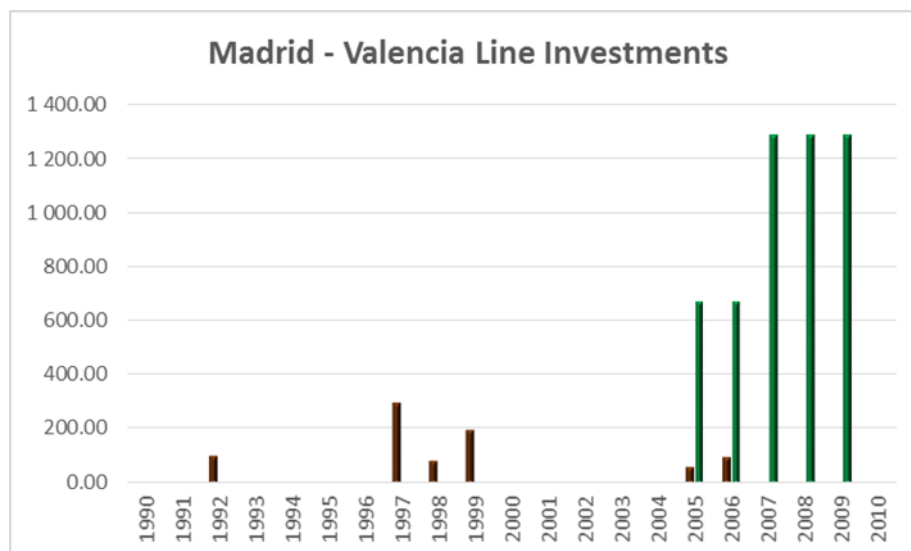
### Madrid – Valencia Travel Time Evolution



Source: SENER, INGENIERÍA Y SISTEMAS, S.A.

- ✓ **Investment:** the investment carried out in the Madrid – Valencia Line were 830 M€ for the 1990's Upgrading and 5,200 M€ for the 2000's New Line (only the Madrid – Valencia section)

### Madrid – Valencia Line Investments



Source: SENER, INGENIERÍA Y SISTEMAS, S.A.

With these actual data is not possible (nor desire as it was explained before) to carried out a new Cost Benefit Analysis from scratch, but there is a Cost Benefit Analysis already done by ADIF in 2007, which results could be used to estimate the benefits of the new scenarios.

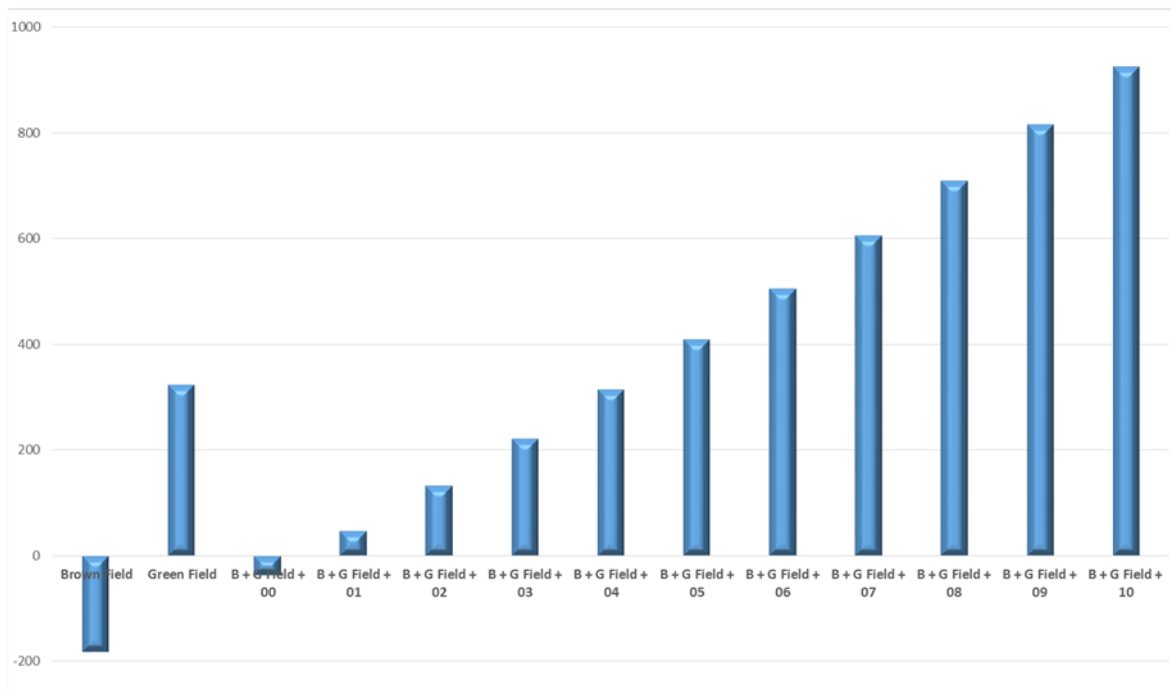
Those new scenarios are, then, two actual improvements and one hypothetic case defined as follow:



- ✓ The New High Speed Line scenario studied by ADIF in 2007, which will be our base case, is in fact the **Upgrading + New Line** scenario.
- ✓ The **Upgrading** scenario will be the actual upgrading of the line carried out in the 1990's, whose benefits were estimated in this study based in the ADIF's Cost Benefit Analysis of 2007.
- ✓ Finally, the hypothetical case will be the **New Line** scenario, which will be defined as **what could have been** the benefits if instead of upgrading the line in the 1990's a New High Speed Line were built.

The most important finding here was, again, that in order to obtain for the society the same net benefits that the New Line Scenario the building of a new high speed line after finishing the upgrading has to be done 5 years after the first improvement of the line. (It actually was done 10 years after that upgrading)

### Net Present Value of Madrid - Valencia Line Scenarios



Source: SENER, INGENIERÍA Y SISTEMAS, S.A.

*After upgrading a line, the building of a new line has to be done after a period of time to achieve the same level of benefit that the best single solution.*

## 5. CONCLUSION

From those analysis it was learnt that, indeed, building a new High Speed Line after upgrading the existing line in that corridor will not be economically efficient unless the new line is built after a number of years.

That delay could be around 10 years, and will depend on the level of investment carried out for the upgrading and the expected growth of transport demand in the corridor.

### **ACKNOWLEDGEMENT**

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### **REFERENCES**

UIC (2015). *Infrastructure Scenarios for Better Passenger Services*.