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Implementation of 750 m length trains on the Iberian Peninsula

Synthesis

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Introduction

Freight traffic on rail is considered as an efficient modal transport of goods such as steel, manufactured products by containers, wood, automobile, etc., on long distances and especially on the European Corridors designed for this kind of traffic.

The railway undertakings (RUs) strongly wish to run trains up to 750m – hereafter referred to as long trains - on all line sections of the European Corridors as soon as possible to reduce the cost per train. However, there are different reasons that prevent riding long trains today.

European industries have the duties to reduce their carbon impact by finding the best transport solution in the same time as guarantee to their suppliers and customers the best balance between cost and delays. Europe has the chance to inherit of many rail lines, inter-connected between countries. The interoperability system, led by Europe, tends towards the facilitation of the traffic, by setting up the same constraints. The subject of this study is the implementation of the 750 m length trains on the Iberian Peninsula, on the perimeter of the Atlantic Corridor, since France and Germany already allow these long trains. The traffics, from the previous studies, has been analysed more precisely to justify which stations should be improved. The cost of the adaptations has been estimated to have a global idea of the investment amount.

1. Input data

Several input data, from the previous studies made on the Atlantic Corridor, were used in this study. The *assessment impact of the infrastructure constraints on railway undertakings operations*, the *Assessment optimization of capacity management and operational coordination*, and the *traffic and market studies* are the market studies made on the Atlantic Corridor perimeter to improve the freight traffic in Europe, in compliance with the new European policy in terms of environment and transportation. Also, each country made their own studies on the possible adaptations that would be necessary for the long trains traffic (infrastructure studies).

1.1. Existing market studies

The forecasted traffic along the Atlantic Corridor, used for the next calculations, is from the document: “: *Traffic and market research update for the Atlantic Corridor, Phase 4: Traffic forecast*”, *PROGNOS, SETEC, EPYPSA, DELIVERING DISTINCTIVE SOLUTIONS, 2014*. The assumptions are based on the gauge compliance in Iberia, and an operational rolling motorway between France and Spain. Staying focus on the Iberian Peninsula, the work plan used for the modelling of the traffic is the following one.

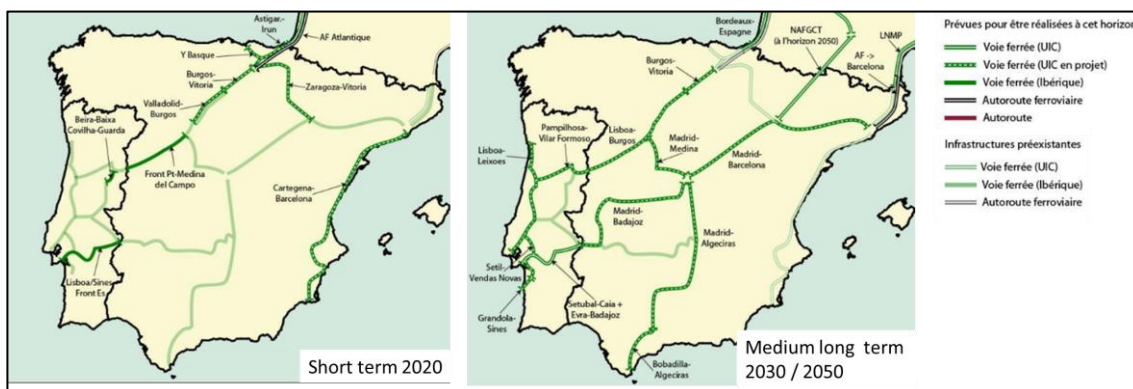


Figure 1 Corridor evolution in Iberia

The raw data, as tons of goods, percentage of the different goods, etc. were the main values used to determine precisely the numbers of train per type of train (direct, combined, automobile) following the type of rolling stock running on the network and the maximum mass due to the coupling resistance (depending on the ramp). The results are shown in the § 7.

An analysis of the capacity and the possible optimizations along the Atlantic Corridor, including in the nodes and the borders, is made in the document: *“Assessment optimization of capacity management and operational coordination – Final report”, IDOM, ARCADIS, 2015.*

For a freight train using the corridor, it will be necessary to manage the path by taking into account the border, the maintenance windows and the traffic within the node. This aspect is important for the global capacity of the Atlantic corridor. The analysis highlights the fact that there is a lack of coordination between the different networks involved, regarding the travel time to cross the country, the maintenance of tracks and the way to pass the border. Some operational aspects are considered for the cross-border sections. The train length is considered but no technical proposal is done relating to the length homogenisation. There are some proposals within the study to manage the maintenance windows and to improve the way and the procedures to cross the border.

An analysis of the operational constraints has been realised in the document: *“Assessment impact of the infrastructure constraints on railway undertakings operations – deliverable 4: International transport plan along the corridor”, BG and MCRIT, 2016.*

Solutions have been found on the following issues:

- The management of the cross-border, in terms of rolling stock (electrification and gauge)
- The management of the driver’s rotation, with a limit of 8-hours of driving per day and the “go back to home” of the drivers (maximum of roundtrip per driver)
- The management of the composition of the trains, considering the maximum length accepted per section and the mechanical constraints such as maximum load per axles, stress limit per couplings

From this last issue, we used in our calculation the gradient of the ramp as input data to determine the maximum mass per train per section to have the number of trains per day. The results can be shown in the § 7.

An analysis of the investment effect has been done in the document: *“Assessment impact of the infrastructure constraints on railway undertakings operations – deliverable 5: effects of investments”, BG and MCRIT, 2016.* Indeed, the conclusion highlights, among other things, on the benefits for the international relation of the long train adaptation investments

Increased rail traffic compared to the base scenario in %	France - Europe flows	Transpyrenean flows	Iberian flows	TOTAL along the Atlantic corridor
SCN 9 : all investments	1%	154%	77%	54%
SCN 7 : Extension UIC gauge	0%	83%	0%	26%
SCN 5 : 750m	0%	20%	25%	8%
SCN 2 : Y Basque	0%	24%	1%	8%
SCN 8 : ERTMS	1%	7%	6%	3%
SCN 3 : Lisboa - Madrid	0%	4%	22%	3%
SCN 4 : Electrification	0%	2%	8%	1%
SCN 6: Gradient	0%	1%	3%	1%

Table 1 increased traffic compared to the base scenario in % - source: BG and MCRIT table

1.2. Existing infrastructures studies

The Spanish studies from ADIF were used to define a part of the reference scenario, fully exposed in the § 4, and also the financial estimation.

Madrid-Irún corridor is one of the main lines of the Spanish railroad network in Iberian track gauge. The main constrains are the capacity limit due to traffic congestion in Madrid-Villalba section (more than 80%). The medium-long term start-up of new high-speed lines in the surroundings of this corridor, could lead to the transfer of passenger traffic from the Madrid-Irún conventional line. It will mean the release of potentially rows for freight trains operation. The functional study proposed the construction of new sidings and the expansion of existing ones in 8 stations, as well as the quadrupling of road between Pinar de las Rozas and Villalba and Bujedo station for the rearrangement of the traffic coming from Ebro corridor.

The traffic capacity is available on the Madrid-Sevilla-Málaga corridor, although it's worth mentioning Linares-Espeluy section with an occupancy rate close to 70%. There will be an evolution of traffics according to the type of goods transported, which will be greater in containers and multimodal. One of the solutions proposed is to act in Manzanares due to its status as interconnection point with the Ciudad Real line and in Santa Cruz de Mudela y Lora del Río because the double to single track transition. All the actuaciones are focused on reducing the station distances in those sections where the speed is higher than 40 km/h.

In the Madrid-Albacete-Valencia corridor, the main capacity constrains due to traffic congestions are between Madrid-Aranjuez and Xátiva-Valencia (50-80% occupancy). It's possible that intermodal transport increases, being able to circulate up to 6 trains/day in each direction, all of them with interoperable length. The construction of two 750 m sidings in Villasequilla will be supported to regulate in-traffics in Aranjuez. In addition, a siding in the up direction in Alcira and in the down direction in Algemesí will allow the 750 m siding without capacity network problems.

The entire corridor is at a medium-high saturation level. It is estimated that the evolution of traffic distribution according to the type of goods transported, establishes a greater growth in intermodal traffic. The works to be highlighted are: At the station of Campillos with the extension of 250 m of track, 400 m in the station of Setenil and extension of the Alcázar de San Juan station, allowing the service of section of the trains of the Alcázar line -Córdoba-Seville.

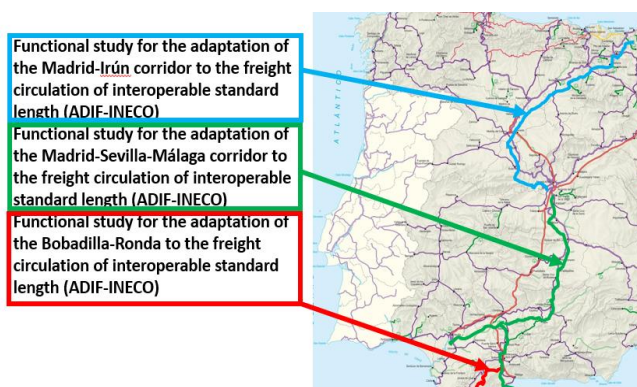


Figure 3 Infrastructure data in Spain

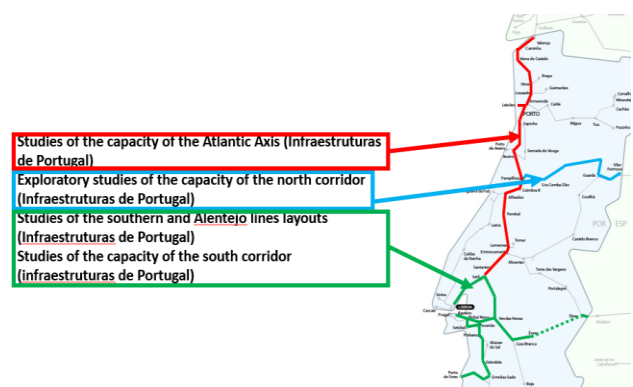


Figure 2 Infrastructure data in Portugal

The Portuguese studies, with the layouts of each station involved in the implementation of long train, were used to define the reference scenario of the Portuguese part and the financial estimation.

The exploratory studies on the North Corridor (Beira Alta line) concluded that 12 stations will need to be adapted in term of siding length, from Pampilhosa (included) to Vilar Formoso.

The capacity increase on the Leixões Line involve the modification of 2 stations, the construction of a new logistic area and a re-organizing of the layout of the Leixões Port.

The first investments on the Ovar-Gaia section won't increase the capacity but only improve the traffic conditions. The real investments having a positive impact on the section will be the construction of a new double track.

The expected investments in the south corridor are located in 3 freight terminals (Elvas, Bobadela and Setúbal), will concern the new sections Evora-Elvas and Sines-Ermidas variant and 14 stations. At this time, the Evora-Caia-Elvas-Border section are already underway and so financed.

2. General methodology of the study

2.1. Progression of the study

The methodology for this study is based on the fact that previous market studies has been already performed.

Phases	Activities
Phase A Mapping of the present situation in terms of infrastructure conditions and capacity, identifying the restrictive sections	Analysis of other european corridors
	Analysis of data provided by IMs. Construction of the reference scenario
	Functional analysis on the determined perimeter
Phase B Proposal of solutions to solve the identified constraints, in order to meet future capacity demand;	Identification of the critical points of the existing infrastructures
	Functional detailed analysis on each section of the perimeter
	Analysis of the signaling system: actual and future with ERTMS development
Phase C Estimation of costs for the works required	proposals of actions in two phases of investments
	Economic estimation of the proposed actions on line, stations and freight terminals

Figure 4 Methodology of the study

The study has been divided in 3 phases:

- Phase A: Collection of the existing data on current and future market demand for long trains based on the results of the existing market studies provided by the GEIE Atlantic Corridor. The existing situation of the corridor is detailed and compared to other corridors. Train and traction aspects are also treated.
- Phase B: Collection of current infrastructure data with hindering for long trains on the considered perimeter. Each section is analyzed for their functional aspects. A proposal of actions is done in two phases of investments according to the needs per section.
- Phase C: Estimation of the cost of all the investments, including the underway projects, based on the infrastructure needs proposed in phase B.

2.2. The challenge for running longer trains

The challenge of running long trains (total length 740m, always including all wagons and locos – plus 10m for visibility gives 750 m track length) asks for train-side and track-side elements to be coordinated. Therefore, considering the following train parameters is mandatory:

- Speed: 90 – 100 km/h.
- Traction: One multisystem loco (6 MW) running through.
- Braking regime: P up to 1'600t (5GP, long loco – loco and 5 first wagons G, rest P) allows faster train path. All RU prefer the P braking mode. Every change of braking mode during train run is a loss of 30 – 60 minutes.
- Last mile: Train must fit into handover points and terminals regarding track length.
- Operating program: Complete trains or train parts with forming/joining and splitting up.
- Train weight: Depending mainly on gradients of line sections used.

To better understand the requirements of the RU, three potential long trains (750m) were set up and verified by the RU ADIF and CP in two workshops:

- Light long train, max. 1'200t, max 100 km/h, P braking mode
- Medium long train, max. 1'600t, max 100 km/h, P braking mode (5GP, long loco)
- Normal long train, over 1'600t, max 90 km/h (some 100 km/h), G braking mode

Trains (direct train) with heavy goods (coal, ore, steel) are limited by the maximum train load and not by their length. For example, the daily coal trains Rotterdam – Ruhr (with double traction) weight 4'800t but are only 550m long. For another example, the mass of a direct freight train in the most constraint environment in Spain reach 2'010t for a length of 482 m (calculation made only for the study).

The potential for long trains depends on the type of freight.

Due to the rather low weight, freight trains with empty wagons, automotive or combined traffic have the biggest potential for long trains.

Clearly, not all trains on Atlantic Corridor will ever be 750m long. The RU plan for the longest realistic value that a train might have and some trains reach this limit. Economically, it is interesting to have any train as long as possible to make the best use of train path and traction with the same cost.

By increasing the train length from today's 600/650m to 740m, the benefit for the RU would be 10% to 25% per train.

3. Actual limitations of the length of the trains on Atlantic Corridor

The train length is limited with given train parameters by:

- national regulations
- gradients on the line sections
- track length limitations combined with operational guidelines of the IM.

The weakest part on the entire run defines the maximal train length.

3.1. National regulations

Generally, the national regulations of all countries involved in the Atlantic Corridor allow long trains up to 740 m except in the Iberian Peninsula, where the installations are not adapted. The mass limit, most of the time the highest constraint, is defined in the network statement for Spain and in a specific documentation for Portugal, depending on the gradients.

3.2. Gradients

Due to the inclination, the following sections are critical for traction today:

- Avila – Aranjuez: 17 ‰
- Aranjuez – Bobadilla: 17 ‰
- Bobadilla – Algeciras: 24 ‰
- Medina del campo – Fuentes de Oñoro: 17 ‰
- Manzanares – Badajoz: 16 ‰
- Alsasua – Castejón de Ebro: 17 ‰
- Castejón de Ebro – Zaragoza: 16 ‰
- Miranda de Ebro – Bilbao: 18 ‰
- Alfarelos – Entroncamento: 18 ‰
- Pampilhosa – Vilar Formoso: 18 ‰
- Ermidas Sado – Porto de Sines: 21 ‰

These critical sections represent almost all the Iberian part of the Atlantic Corridor.

3.3. Track length

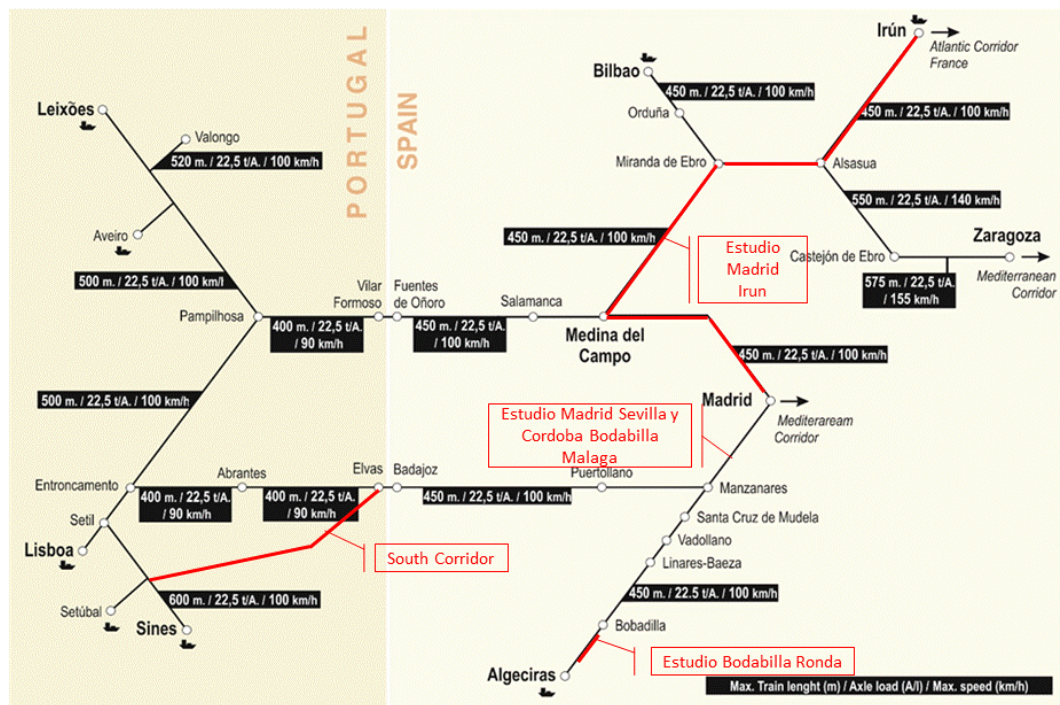


Figure 5 Maximum train length

Today it is impossible to run long trains on the Iberic part of Atlantic Corridor. The main hinderings today are the following:

- The Irún – Madrid section accepts lengths of only 450m.
- The Madrid – Bobadilla section accepts lengths of 450 m
- The Bobadilla – Algeciras section accepts lengths of 500 m
- The Alsasua – Zaragoza section accepts lengths of 550 m
- The Miranda de Ebro – Bilbao section accepts lengths of 450 m
- The Medina del Campo – Pampilhosa section accepts lengths of 400 m
- The Porto – Lisbon section accepts lengths of 500 m

It can be clearly seen in Figure 5 that **this not possible today** with good quality.

4. Perimeter of the study

The perimeter of the study is the Iberian part of the Atlantic Corridor. The map below represents the number and the location of the stations allowing nowadays 750 m long freight trains. This map shows that there is a lack of installations allowing this type of traffic.



Figure 6 – Map of the infrastructures that form the Atlantic Corridor in Spain and Portugal - Source: FFE

For the purpose of the study, the perimeter has been divided in several sections, that define the reference scenario. Also, the sections Madrid-Badajoz via Cáceres in Spain, and Evora-Caia in Portugal have been added compared to the initial Atlantic Corridor, to consider the needs of the both countries.

The reference scenario for Spain and Portugal can be seen on the maps below. Eight sections composed the Spanish network involved in the Corridor, and seven sections composed the Portuguese network involved.



- Section 1: Irún – Ávila
- Section 2: Ávila – Aranjuez
- Section 3: Aranjuez – Algeciras
- Section 4: Medina del Campo – Fuentes de Oñoro
- Section 5: Manzanares – Badajoz
- Section 6: Altsasu – Zaragoza
- Section 7: Miranda de Ebro – Bilbao
- Section 8: Aljucén - Castillejo



- Section 1: Alcántra Terra (Lisboa) - Porto Campanhã
- Section 2: Vilar Formoso – Pampilhosa
- Section 3: Vendas Novas – Elvas
- Section 4: Setúbal – Poceirão – Sines
- Section 5: Setil – Vendas Novas
- Section 6: Entroncamento – Elvas
- Section 7: Connection to the ports of Aveiro, Leixões and Alcaer variant

5. Capacity

A functional analysis has been realized per section to consider the type of signaling system, the forecasted traffics for the next years and the maintenance windows of all the stations involved. The signaling systems defines the theoretical capacity of the section. The capacity data, provided by the both country Spain and Portugal, reflect the real capacity of each section.

In Spain, the results show that there is an available sufficient capacity regarding only the actual percentage of saturation. A contrario, in Portugal, the results show that parts of the section 1 between Porto and Lisbon are saturated. Knowing that, a general plan of 750 m long train implementation has already been studied and some project are already underway.

About the maintenance periods coordination, some improvements are possible to increase the capacity, especially in the border between Spain and Portugal. The periods could be moved of some hours to avoid the stabling of the trains. An example of diagram is presented below, representing some path close to the maintenance periods.

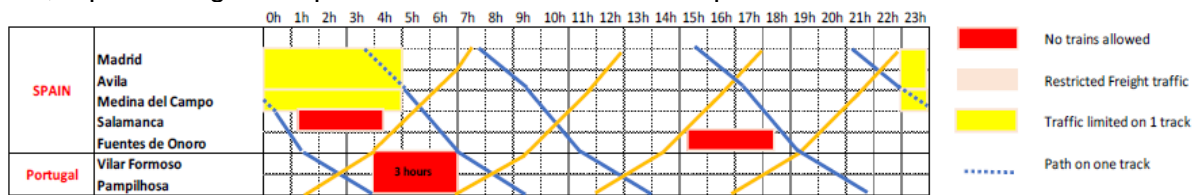


Figure 7 Example of available path considering maintenance windows

6. ERTMS

The ERTMS subject has been mentioned during the study about the minimal safe distance to respect after the stopping signal. There are some differences between France and Portugal about the definition and the methodology of calculation of this distance. It has been acted that for a 750 m long train, the minimal length of a siding will be 820 m, to consider the future signaling system ERTMS.

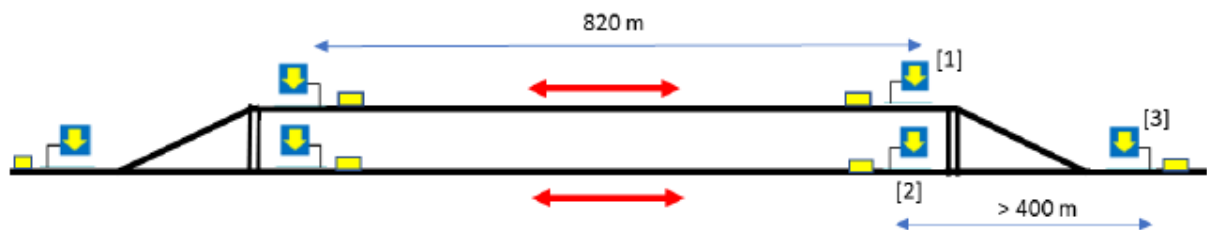


Figure 8 Minimal length of a siding

7. Forecasted traffic analysis

The forecasted freight traffic, represented in the figure hereunder, consider the traffic on the conventional lines from the year 2020 and on the rolling motorway only from the year 2030.

The increase traffic, from the double to the triple, justify the number of station that need to be improved, in order to allow long train for the crossing of other trains on single tracks, and for the passing of faster trains on double tracks.

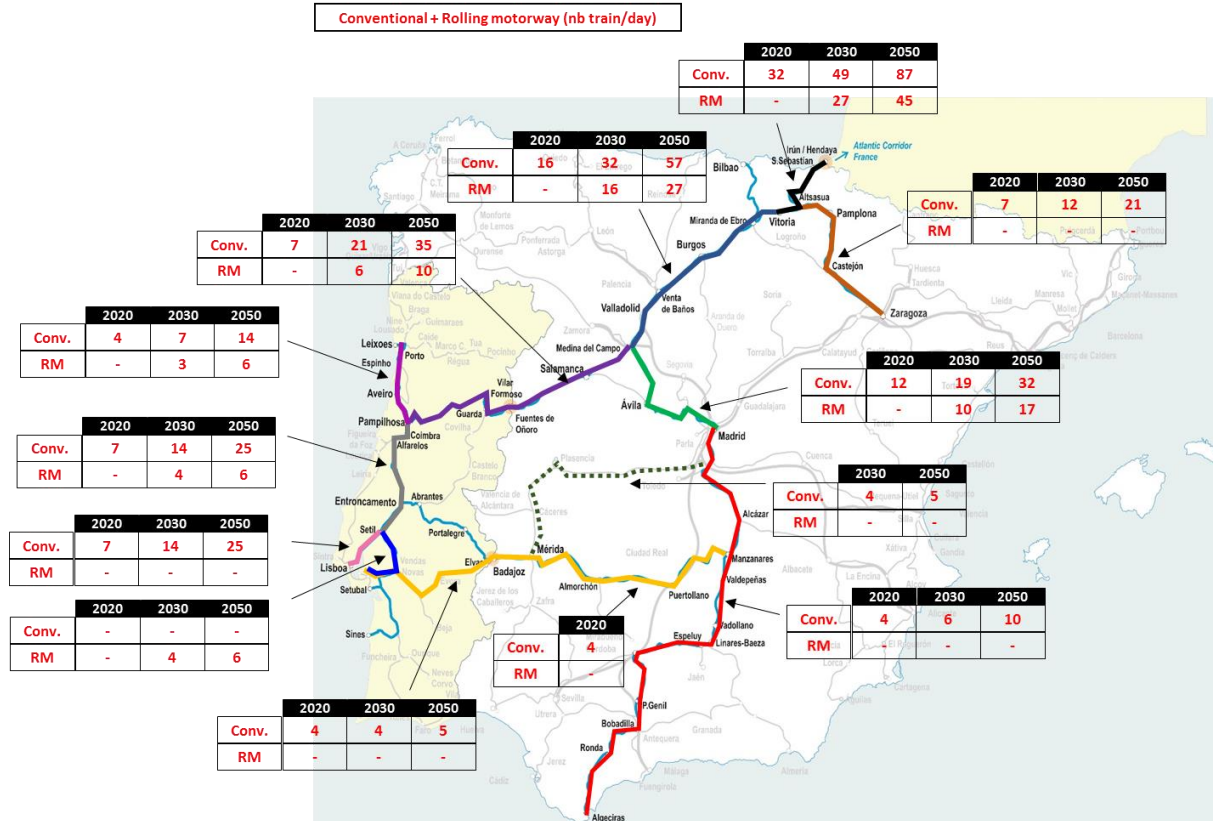


Figure 9 Forecast of the freight traffic

According to real capacity and the forecasted traffic, an estimation of the minimal distance between two stations allowing the 750 m long freight train has been made, in order to define the best optimization of the location of these types of station.

The analysis demonstrates that a siding every 30/40 km is the minimum improvement for the year 2020, but for the future, a siding every 25 km and sometime less will be needed. Of course, this analysis is a general one and was adapted to the situation (double or single track, project underway, etc.).

In Portugal, the future adaptations are already planned, with the exact number of station to improve. In Spain, previous studies proposed solutions for the Irún-Madrid section. We considered every input data and compared to our proposal.

8. Implementation in Spain and Portugal

The implementation has been divided in two phases, for the short/medium terms and the long terms, in order to distribute the investments following the increase of traffic and the approach of each country. The plan of Portugal is to improve the lines in three stages:

- To lengthen existing siding or to create new one to be able to park the slowest trains to get an optimal transport plan
- To increase the capacity by constructing a new line double track (ex.: Aveiro-Gaia)
- To construct a second double track line to guarantee the future traffic (Ex.: Alfarelos-Pampilhosa)

The plan of Spain is to invest in new (mixed) high speed lines (underway projects) and in the lengthening or creation of long sidings in two phases to respond to the traffic increase.

8.1. Methodology

The methodology used to determine which station should be adapted for the long trains was in two phases.

Firstly, the forecasted traffics is re-calculated from the input data in order to consider the new constraints (new stress limit in the coupling). The remaining capacity is defined per each section, in order to understand where this will be difficulties with the actual installations and where the adaptation can be postponed in a second phase. Then, this traffics, per years, is added to the actual traffic of each section, defining the minimal number of 750 m siding.

Secondly, our estimation of the minimal distance between each 750 m siding was compared to the previous studied, to confirm or not the previous choices. Finally, only few differences were found and applied for Spain in the sections 1 to 3.

Quintana del Puente is replaced by Villodrigo. Guimorcondo, O'Donnell, Huerta de Valdecarabanos, Andújar, Fernan Nuñez, Gaucín and San Roque-La Linea are added. Herradón-La Cañada and Bobadilla are moved to the phase 1. Manzanares, Santa Cruz de Mudela and Campillos are moved to the phase 2. Almargen-Cañete La Real is removed.

The few differences we found with the Portuguese proposals were just indicative, since we had to consider all the previous studies.

8.2. Results

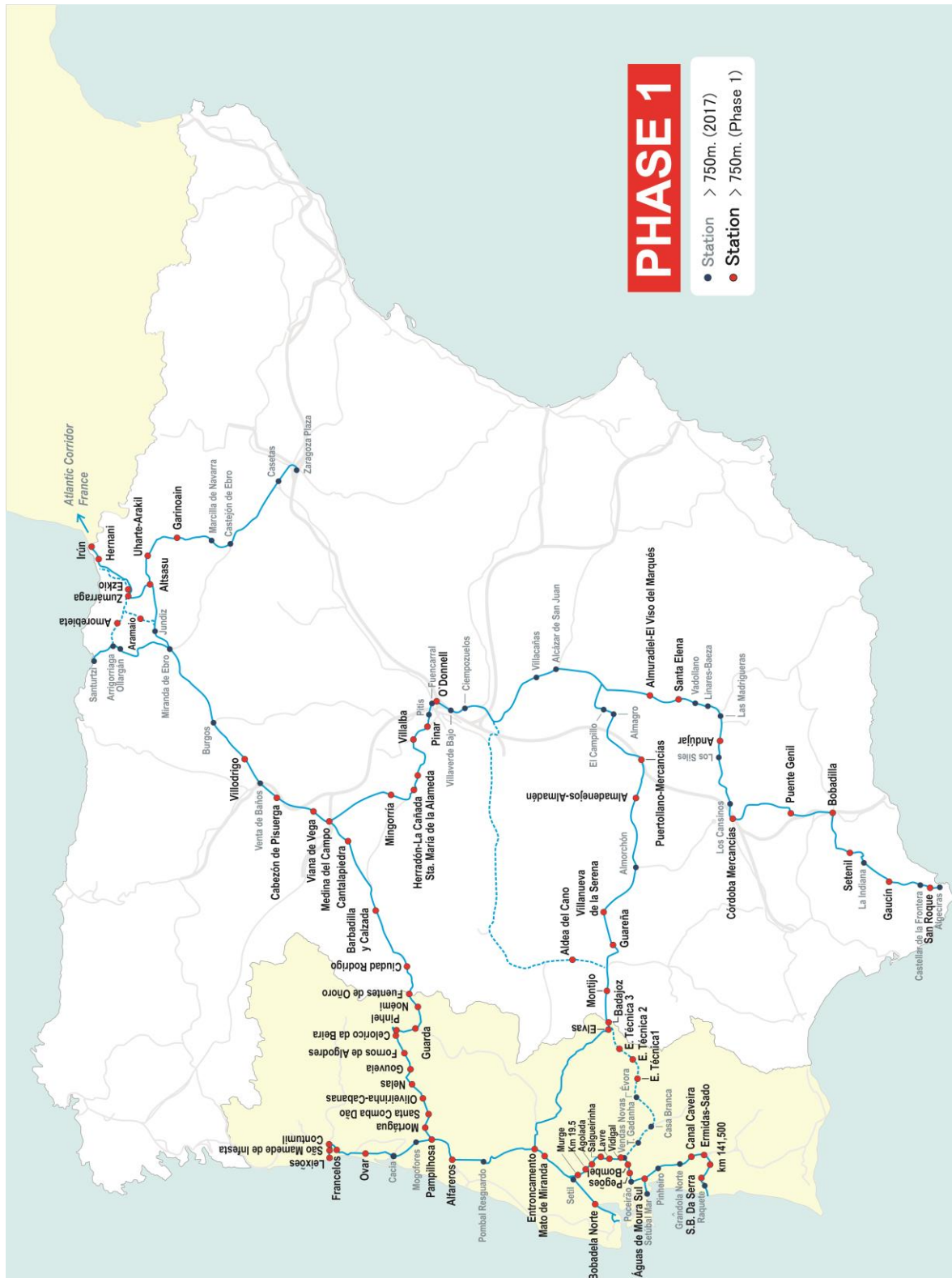
The Map 1 represents the location of all the stations (in red) that will be adapted in order to receive 750 m length trains in phase 1.

In Portugal, all the forecasted projects will be implemented mainly to accept the increased traffic in a short term.

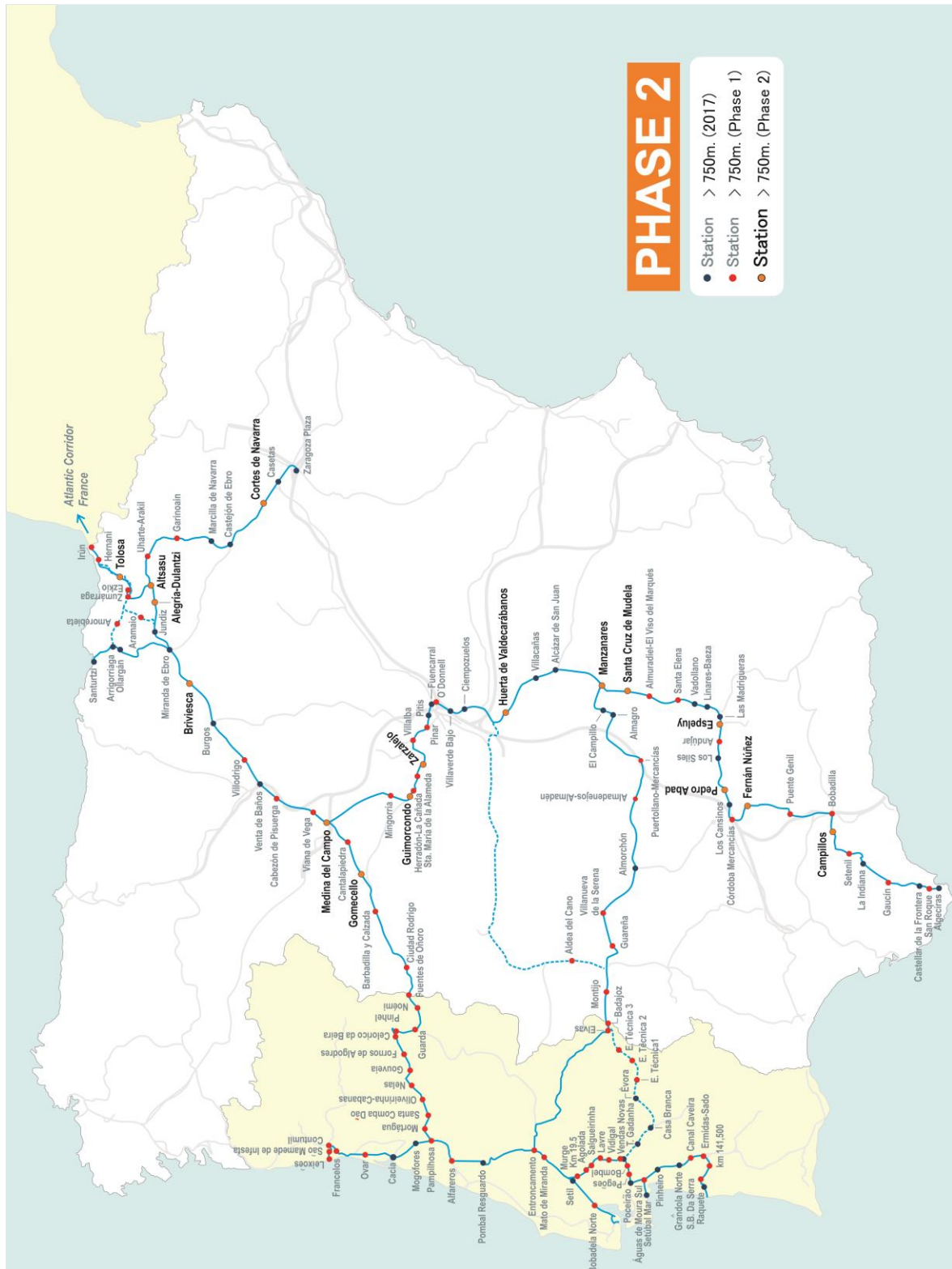
In Spain, some projects are already underway, as the Basque HSL (Y Vasca) and the Madrid-Badajoz HSL.

The Map 2 represents the location of the implementation phase 1 (red) and the location of the stations that will be adapted during the phase 2 (orange).

The annex 1 presents the details of the adaptation/modification expected for the implementation of the 750 m length trains on the Iberian Peninsula.



Map 1 Implementation of the phase 1



Map 2 Implementation of the phase 2

9. Financial estimation

According to the previous maps, a financial estimation has been made to quantify the investment of each country, for each phase, per each section. The both tables below indicate also the estimated price of the 750 m length train implementation including in the underway project. These costs are indicative and do not be part of the global amount of the investment.

All the costs include:

- The materials
- The labour
- The supervision:
 - The rate of the project ownership*: 6%
 - The rate of the project manager**: 16%

The rate of unforeseen event is 10%. This rate is high because of the stage of the study. The rate of health and safety is 2%.

An additional price for the compliance check with TSI is adding.

The costs include the following fields:

- Earthwork
- Civil engineering
- Track
- Switch (turnout)
- Signalling
- Electrification (catenary)
- Telecommunications

The expropriations are not included.

The technical assumptions are:

- For each cross-over between the main lines (usually V1 and V2), we chose switches for a speed limit of 100 km/h
- For each switch from the main line to the 1st siding (usually V3 or V4), we chose switches for a speed limit of 60km/h
- For each switch in the yard, usually from the 1st siding to the others, we chose switches for a speed limit of 30km/h
- The final length of each siding is 820 m, except when the technical documents we received about the planned interventions mention another length.
- The earthwork is divided into 3 levels of work:
 - None: when there is no embankment or excavation
 - Low: when there is embankment or excavation which does not exceed 1m
 - Heavy: when the environment is constrained. If necessary, an adjustment of the total amount of the earthwork is made (usually revised upwards)

The Salamanca – Fuentes de Oñoro – Border section is considered as electrified from the first phase of the investment.

The Bobadilla – Algeciras section is considered as electrified from the second phase.

SPAIN	Nb of stations	Phase 1	Phase 2	underway
Section 1	12	45.30 M€	25.20 M€	85.90 M€
Section 2	7	35.80 M€	15.10 M€	0 M€
Section 3	16	25.40 M€	31.30 M€	0 M€
Section 4	6	13.20 M€	2.20 M€	0 M€
Section 5	6	18.60 M€	xxx M€	1.60 M€
Section 6	4	4.30 M€	8.40 M€	0 M€
Section 7	0	0 M€	0 M€	0 M€
Section 8	1	0 M€	0 M€	19.0 M€
Total	52	142.60 M€	82.20 M€	106.50 M€
Total all phases		224.80 M€		

Table 2 Financial estimation - Spain

PORTUGAL	Nb of stations	Phase 1	underway
Section 1	7	92.90 M€	0 M€
Section 2	11	58.80 M€	0 M€
Section 3	5	11.20 M€	45.60 M€
Section 4	5	24.70 M€	xxx M€
Section 5	6	15.50 M€	xxx M€
Section 6	1		Cost included in section 3
Section 7	3	4.30 M€	0 M€
Total	38	207.40 M€	45.60 M€

Table 3 Financial estimation - Portugal

Conclusion

The maps hereunder represent the location of each station per phase, with the associated investment that should be done in order to allow the 750 m length trains circulation according to the forecasted traffics. The number of station has been optimized, considering the previous studies. It is important to notice that all the input data were applied as assumptions for this study, and that ERTMS is considered as achieved, in order to not be surprised when the implementation will be done.

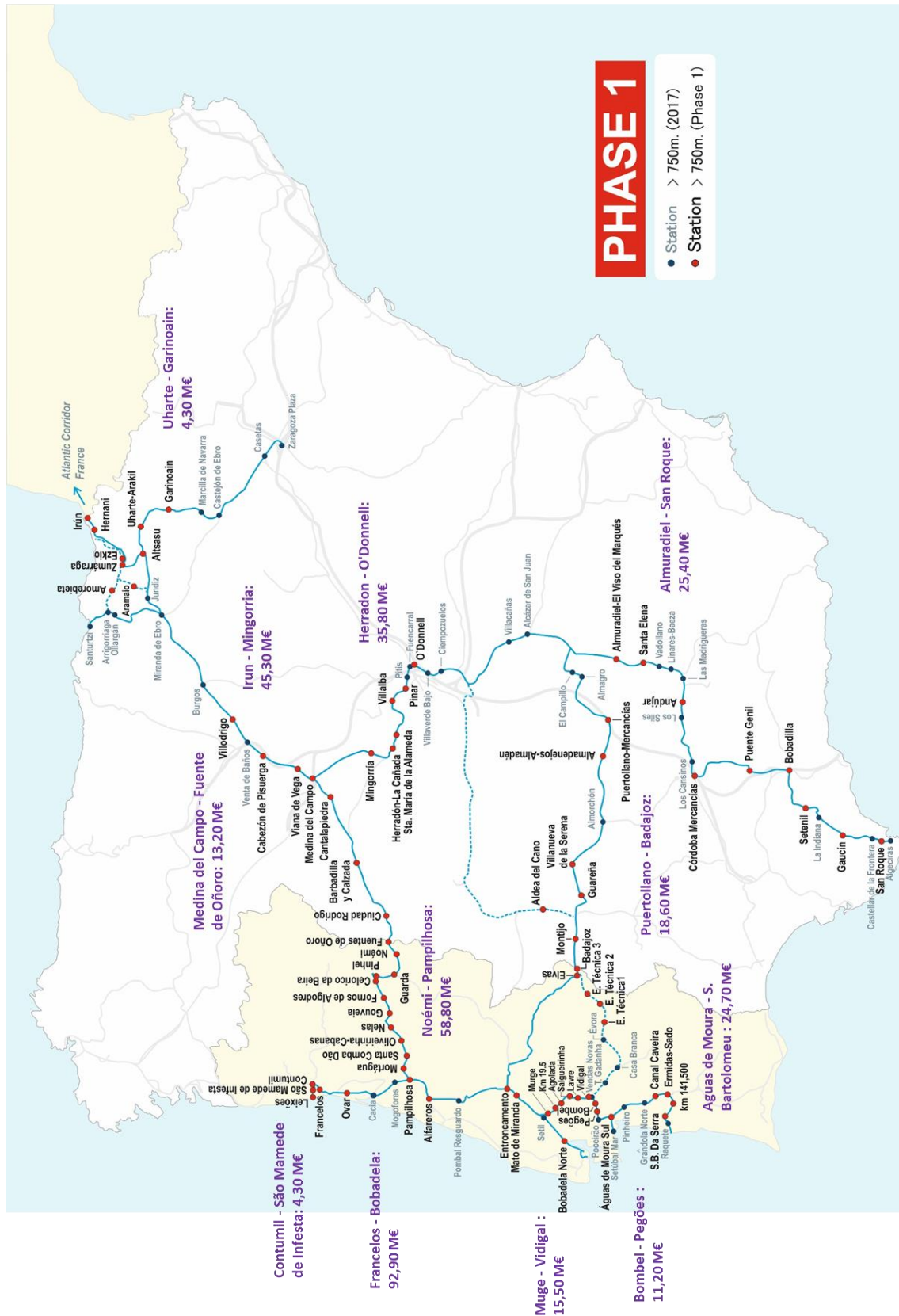


Figure 10 Synthesis of the investments - Phase 1

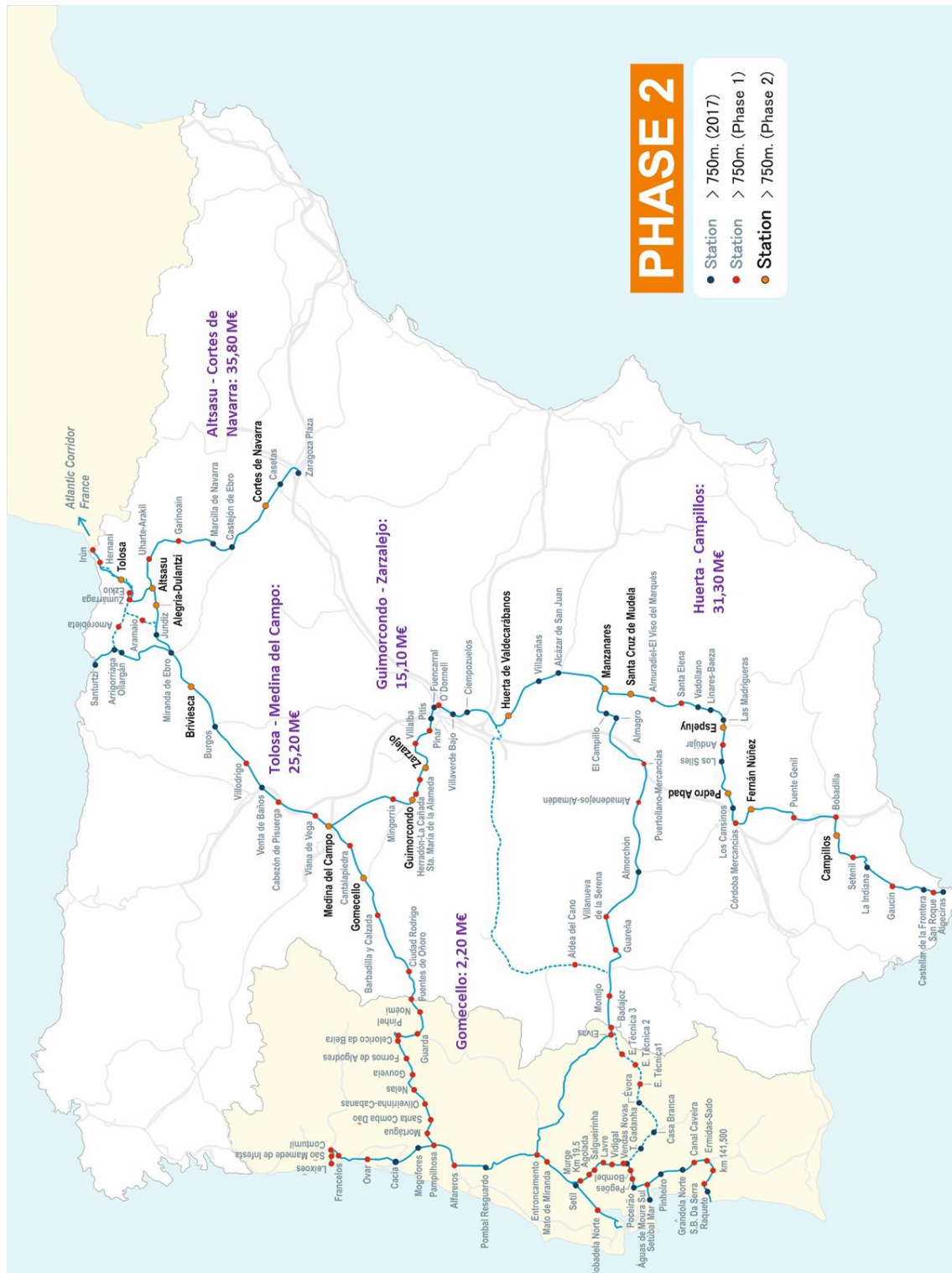


Figure 11 Synthesis of the investments - Phase 2

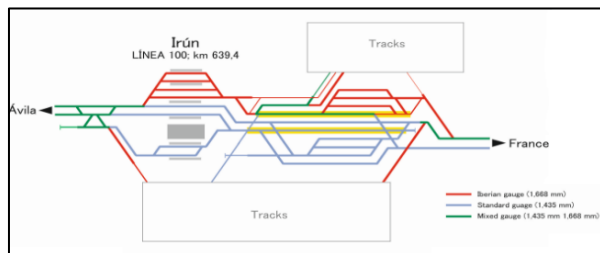
Annex

I. 750 m length train adaptation in Spain

I.1. Section 1 phase 1

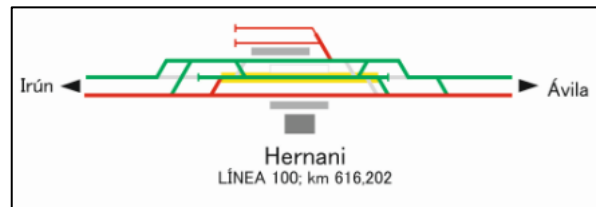
I.1.1. Irun

The works will consist of the remodeling of the current tracks layout coinciding with the arrival of the mixed gauge rail tracks from San Sebastián, included in the new high-speed railway access of the Basque Country (Y Vasca). As the entire station will be modified, the costs of 750 m adaptation works will not be included in the global investments.



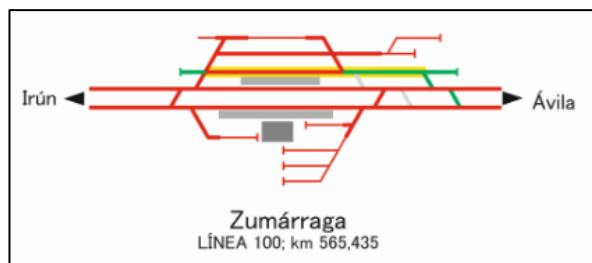
I.1.2. Hernani

The station of Hernani is in the vicinity of San Sebastián, counting on an important traffic of suburban services. The station is located in a highly urbanized area, which implies a complex action with a total modification of the current station layout and the creation of a new central siding track and an extension to the south. The modification of station platforms is also necessary. As the works are already underway, the cost is not included in the global investment.



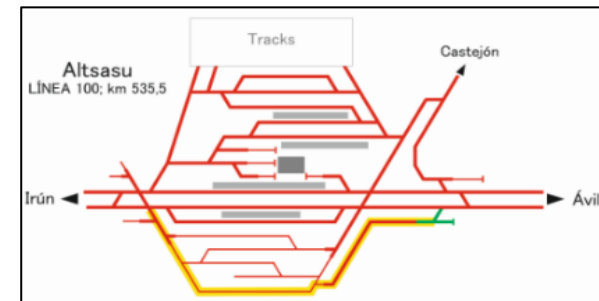
I.1.3. Zumárraga

The station is located in the mountainous area near the beginning of influence area of the suburban trains of San Sebastián (moderate traffic). The works will consist of the adaptation of an abandoned siding track situated on the Ávila side. As this station is closed to the Y vasca, the implementation of 750 m track there will be determined with the traffic forecasted for the new line. **The global cost is estimated at 8,3 M€.**



I.1.4. Altsasu

The Altsasu station is an important railway junction in the north of Spain. Within the Atlantic Corridor, it is the point where section 1 and section 6 meet. There, it will adapt an abandoned track located between Altsasu and a factory near the station. **The global cost is estimated at 5.3 M€.**



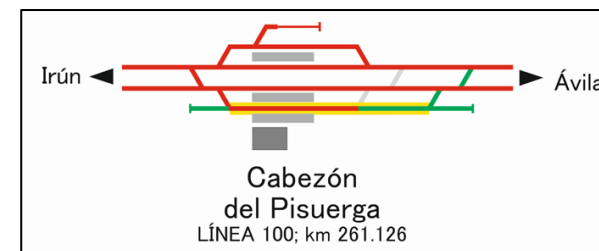
I.1.5. Villodrigo

The works will consist of an extension of the existing siding track 3 no the Irún side. **The global cost is estimated at 7.7 M€.**



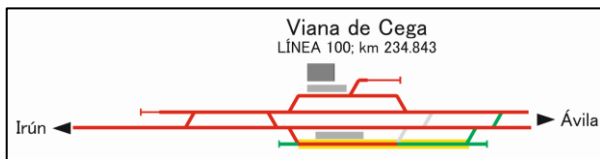
I.1.6. Cabezón de Pisuegra

The works will consist of the extension of the existing siding track 3 on the Ávila side. **The global cost is estimated at 7.7 M€.**



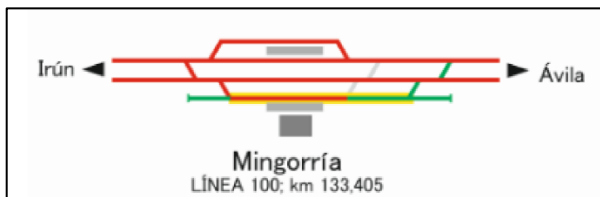
I.1.7. Viana de Cega

The location of this station is a key at the time of railway operation because of its location next to a single-track section. The work will consist of the extension of the existing siding track 3 on the Ávila side. **The global cost is estimated at 7.6 M€.**



I.1.8. Mingorría

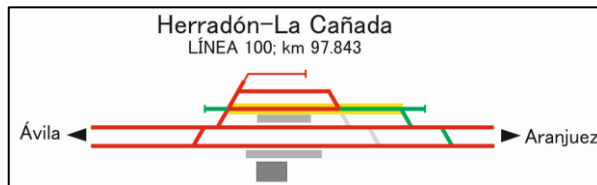
The works will consist of the extension of the track 3 on the Avila side. For the realization of these works, terrain is available to occupy and it does not interfere with other existing infrastructures. An overpass is included in the estimate, to eliminate the level crossing that is in the vicinity of the station at Km 133.59. **The global cost is estimated at 8.70 M€.**



I.2. Section 2 phase 1

I.2.1. Herradón-La Cañada

The works will consist of the extension of the existing siding track 4 on the Aranjuez side. **The global cost is estimated at 7.9 M€.**



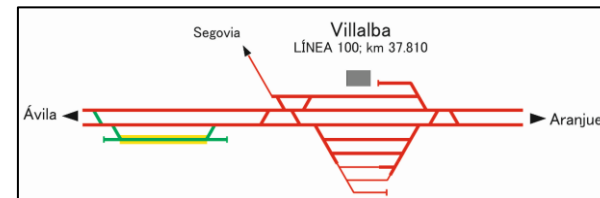
I.2.2. Sta. María de la Alameda

The works will consist of an extension of the existing siding track 4 on the Ávila side. **The global cost is estimated at 8.4 M€.**



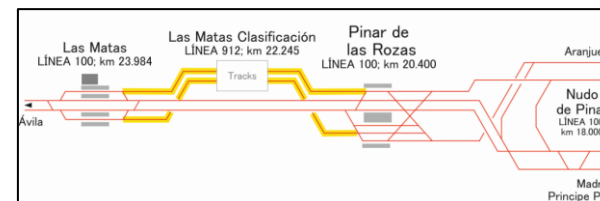
I.2.3. Villalba de Guadarrama

The station of Villalba de Guadarrama has an important traffic of suburban services and is located in a highly urbanized area. Due to this and the inability to act in the current station itself, it was decided to create a new siding track in the vicinity of the station on the Avila side. In this area free terrain is available and the works to implement the new track would be simple. **The global cost is estimated at 12.0 M€.**



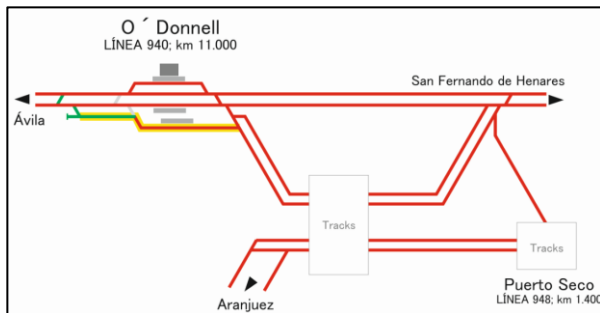
I.2.4. Pinar de las Rozas

The Las Matas Clasificación station is located between those of Pinar de las Rozas and Las Matas. The station of Las Matas Clasificación is not on the main rail track, but it has two connections with the main rail tracks (overpass). The work will be focused on the signaling, since the length of the infrastructure allows it. The overpass facilitates the railway operation in this case. **The global cost is estimated at 1.0 M€.**



I.2.5. O'Donnell

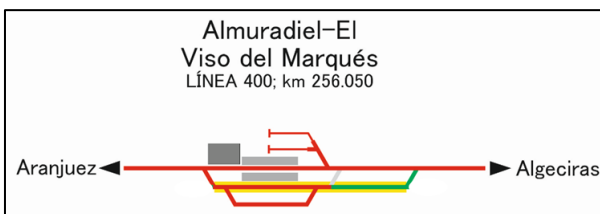
This station is strategically located at a junction in an environment with an intensive traffic of suburban trains. The works will consist of an extension of the track 4 on the Ávila side. **The global cost is estimated at 6.5 M€.**



I.3. Section 3 – Phase 1

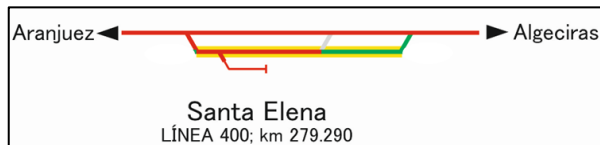
I.3.1. Almuradiel-El Viso del Marqués

The works will consist of the extension of the existing siding track 2 on the Algeciras side. **The global cost is estimated at 1.7 M€.**



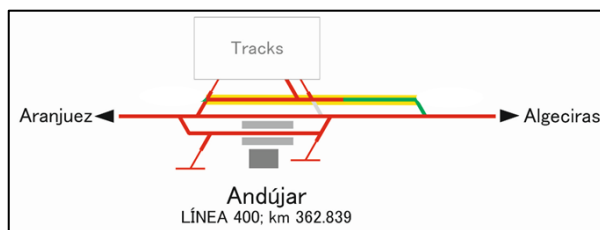
I.3.2. Santa Elena

The Santa Elena station is located in a single track section in a mountainous environment. The works will consist of the extension of the existing siding track 2 on the Algeciras side. **The global cost is estimated at 1.8 M€.**



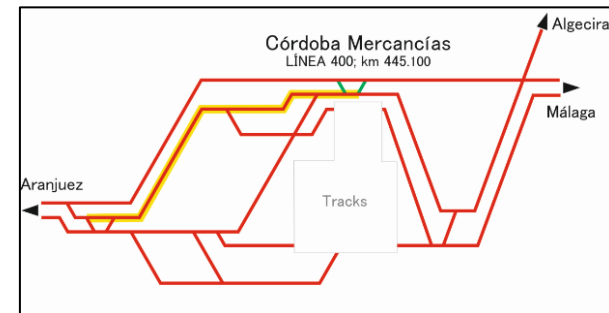
I.3.3. Andújar

The works will consist of extension/adaptation of a shunting neck on Algeciras side. **The global cost is estimated at 2.0 M€.**



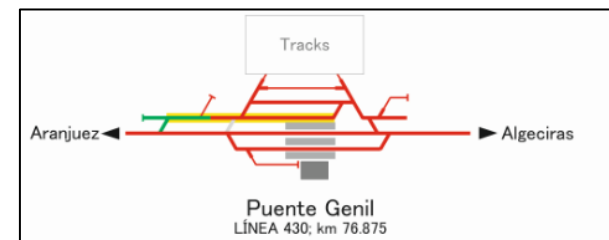
I.3.4. Córdoba Mercancías

Córdoba Mercancías is an important freight terminal of the South of Spain and is a junction between lines Córdoba/Seville and Córdoba/Algeciras. The works will consist of a simple reconfiguration of tracks in the freight terminal. This will allow the siding of trains running to Algeciras and also to Seville. **The global cost is estimated at 6.1 M€.**



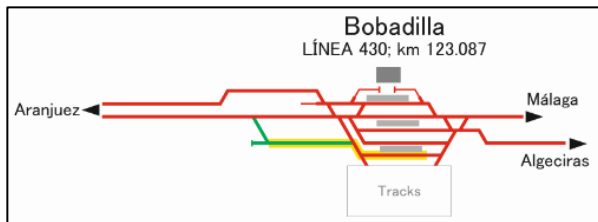
I.3.5. Puente Genil

The works will consist in a rehabilitation/connection of an abandoned track existed on Aranjuez side. **The global cost is estimated at 3.9 M€.**



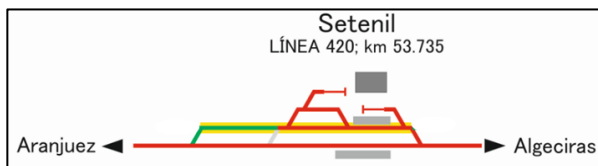
I.3.6. Bobadilla

Bobadilla is an important railway junction in the south of Spain, and also is a point of locomotive change because of the lack of electrification between Bobadilla and Algeciras. The work will consist of extension/adaptation of a shunting neck on Aranjuez side. **The global cost is estimated at 3.4 M€.**



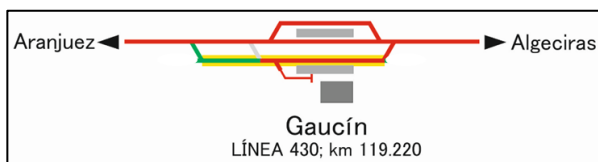
I.3.7. Setenil

The works with a siding track of at least 750 m length, will consist of an extension of the existing siding track 3 to the Aranjuez side. **The global cost is estimated at 1.9 M€.**



I.3.8. Gaucín

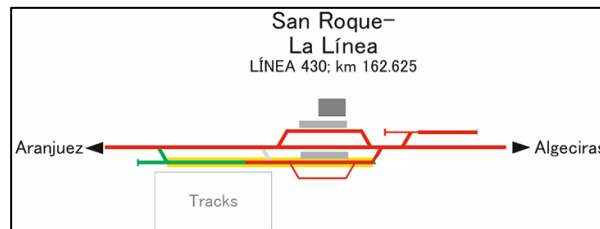
The works will consist of an extension of the existing siding track 2 on the Aranjuez side. **The global cost is estimated at 1.5 M€.**



I.3.9. San Roque- La Línea

San Roque-La Línea is situated near the Port of Algeciras, and would act as a point of regulation of

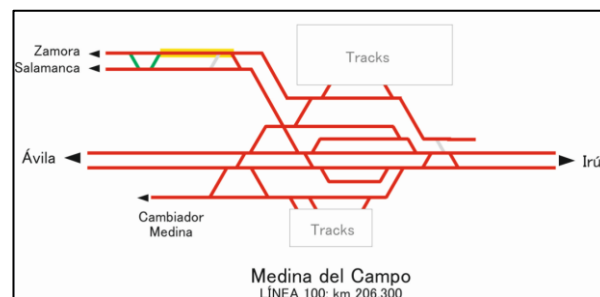
traffic entering or leaving the Port. The works will consist in the use of double track without used nowadays, to create a new siding track of at least 750 m (no the Aranzuez side). **The global cost is estimated at 3.1 M€.**



I.4. Section 4 – Phase 1

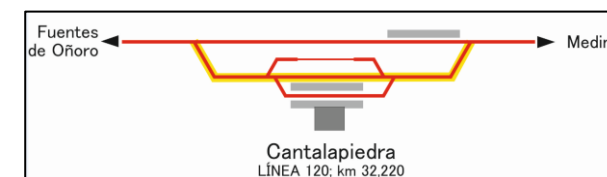
I.4.1. Medina del Campo

Medina del Campo is an important railway junction in north-western Spain and serves as connection between sections 1 and 4. The works will consist of the creation of new switches in tracks to Salamanca and Zamora to allow the use of these tracks as a siding tracks for trains of at least 750 m. **The global cost is estimated at 6.3 M€.**



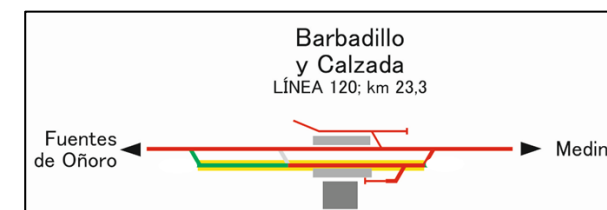
I.4.2. Cantalapedra

The works will consist of the use of the old track that passes through the station as a siding track for the long trains, allowing the passing traffic to continue circulating through the variant that exists at this point. A new platform will be built in the variant to allow the transit of passengers in this station. **The global cost is estimated at 0.7 M€.**



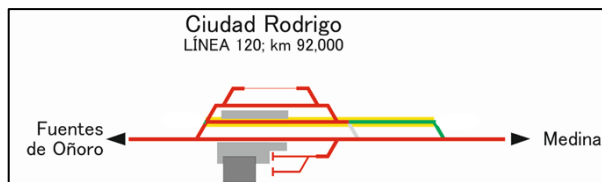
I.4.3. Barbadillo y Calzada

The works with a siding track of at least 750 m length, will consist of the extension of the existing siding track 3 to the Fuentes de Oñoro side. **The global cost is estimated at 1.2 M€.**



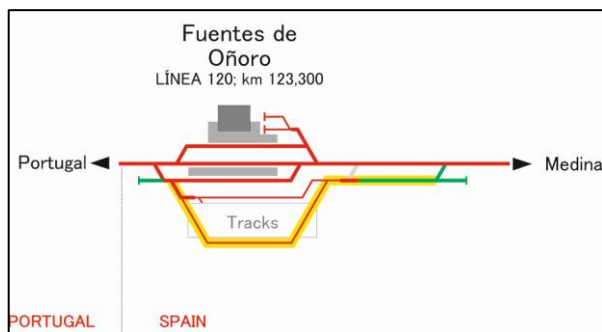
I.4.4. Ciudad Rodrigo

The works will consist of the extension of the existing siding track 2 on the Medina del Campo side. **The global cost is estimated at 1.2 M€.**



I.4.5. Fuentes de Oñoro

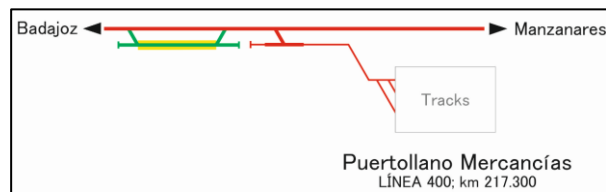
Fuentes de Oñoro is a border station. The works will consist of an extension of track 5 situated on the Medina side. **The global cost is estimated at 3.8 M€.**



I.5. Section 5 – Phase 1

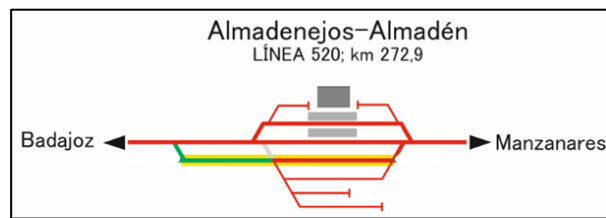
I.5.1. Puertollano Mercancías

The works will consist of a new siding track construction in the vicinity of the station on the Badajoz side. **The global cost is estimated at 8.0 M€.**



I.5.2. Almadenejos - Almadén

The works will consist of the extension of the existing siding track 3 on the Badajoz side. **The global cost is estimated at 2.2 M€.**



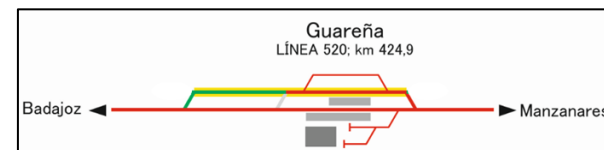
I.5.3. Villanueva de la Serena

The works will consist of the extension of the existing siding track 2 on the Manzanares side. **The global cost is estimated at 4.0 M€.**



I.5.4. Guareña

The works will consist of the extension of the existing siding track 2 on the Badajoz side. **The global cost is estimated at 1.2 M€.**



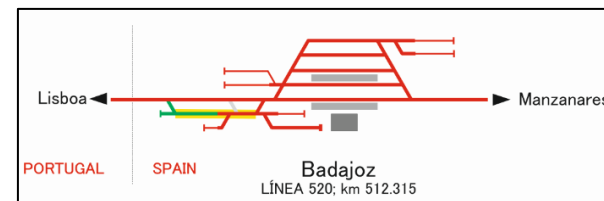
I.5.5. Montijo

The works will consist of the extension of the existing siding track 3 on the Manzanares side. This project is included in the global project of the Madrid-Badajoz high speed line and is underway. Its cost is not included in the global investment of the 750 m train length implementation.



I.5.6. Badajoz

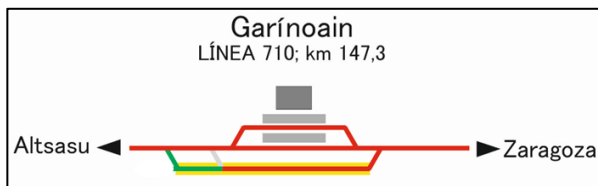
The works will consist of the extension/adaptation of the shunting neck no Portugal side. **The global cost is estimated at 3.2 M€.**



I.6. Section 6 – Phase 1

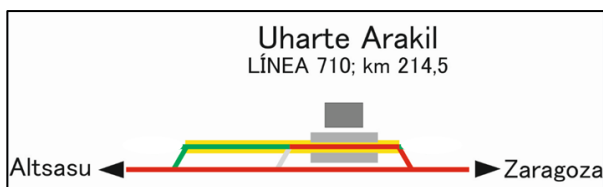
I.6.1. Garínoain

The works will consist of the extension of the existing siding track 3 on the Altsasu side. **The global cost is estimated at 2.0 M€.**



I.6.2. Uharte Arakil

The works will consist of the extension of the existing siding track 3 on the Altsasu side. **The global cost is estimated at 2.3 M€.**

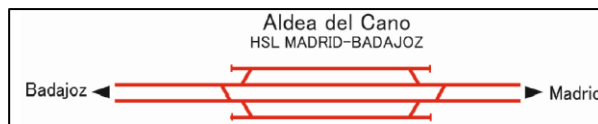


I.7. Section 7 – Phase 1

There is no improvements proposed for this section due to its replacement by the Y Basque (new high speed line).

I.8. Section 8 – Phase 1

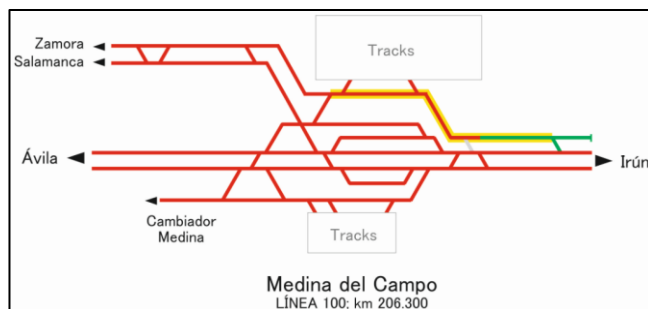
A new station with 750 m siding tracks is included in the Madrid-Badajoz HSL project, that will be in Aldea del Cano.



I.9. Section 1 – Phase 2

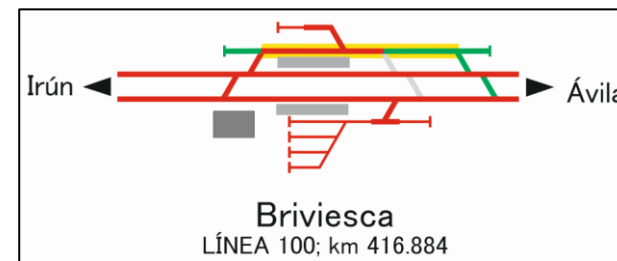
I.9.1. Medina del Campo

The works will consist of the extension of the existing shunting neck on the Irún side. **The global cost is estimated at 3.5 M€.**



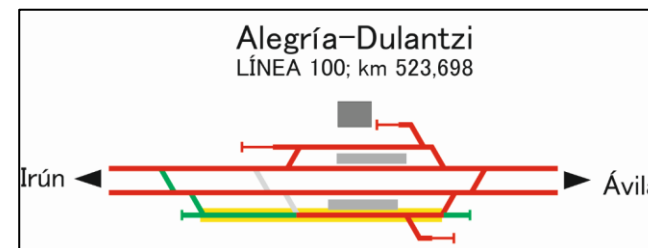
I.9.2. Briviesca

The works will consist of the extension of the existing siding track 4 on the Avila side. **The global cost is estimated at 7.1 M€.**



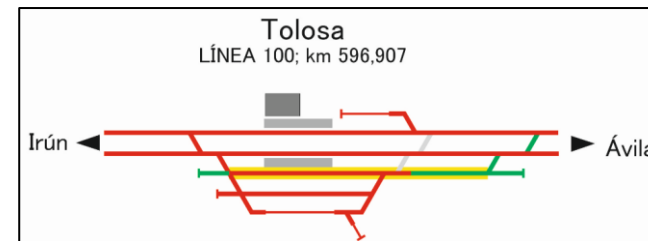
I.9.3. Alegría - Dulantzi

The works will consist of the extension of the existing siding track 3 on the Irún side. **The global cost is estimated at 7.1 M€.**



I.9.4. Tolosa

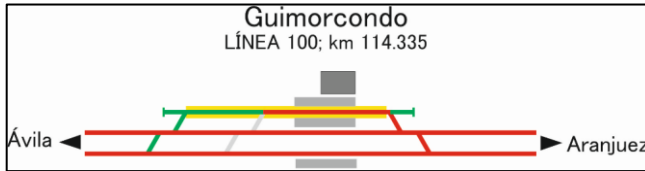
The works will consist of the extension of an existing shunting neck on the Avila side. **The global cost is estimated at 7.5 M€.**



I.10. Section 2 – Phase 2

I.10.1. Guimorcondo

The works will consist of the extension of existing siding track 4 on the Avila side. **The global cost is estimated at 7.6 M€.**



I.10.2. Zarzalejo

The Works Will consist of the extension of the existing siding track 3 on the Avila side. **The global cost is estimated at 7.5 M€.**



I.11. Section 3 – Phase 2

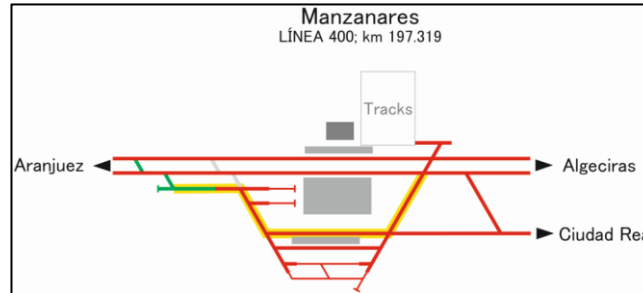
I.11.1. Huerta de Valdecarábanos

The Works Will consist of the extension of the existing siding track 4 on the Algeciras side. **The global cost is estimated at 7.7 M€.**



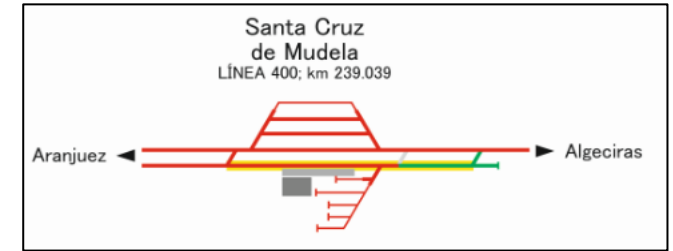
I.11.2. Manzanares

The works will consist of the extension/adaptation of the existing track 4 on the Aranjuez side. **The global cost is estimated at 5.5 M€.**



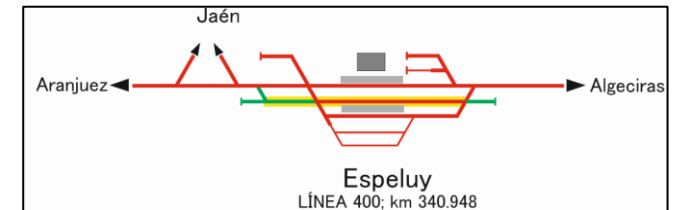
I.11.3. Santa Cruz de Mudela

The works will consist of the extension of the existing siding track 2 on the Algeciras side. **The global cost is estimated at 3.7 M€.**



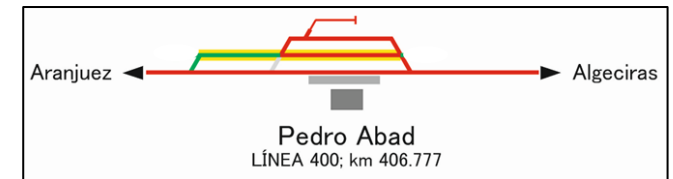
I.11.4. Espeluy

The works will consist on the extension of the existing siding track 2 on the Aranjuez side. **The global cost is estimated at 5.6 M€.**



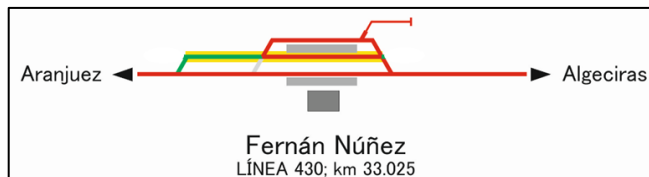
I.11.5. Pedro Abad

The works will consist of the extension of the existing siding track 3 on the Aranjuez side. **The global cost is estimated at 3.4 M€.**



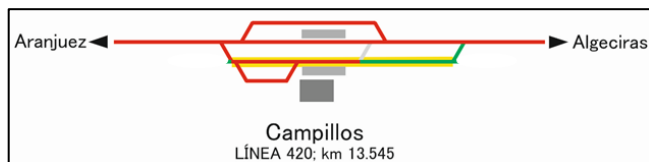
I.11.6. Fernán Núñez

The works will consist of the extension of the existing track 3 on the Aranjuez side. **The global cost is estimated at 3.4 M€.**



I.11.7. Campillos

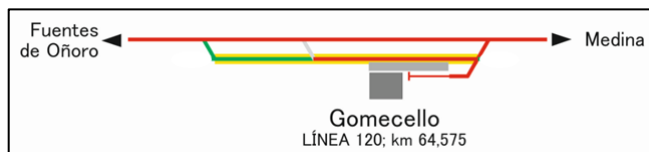
The works will consist of the extension of the existing track 3 on the Algeciras side. **The global cost is estimated at 2.0 M€.**



I.12. Section 4 – Phase 2

I.12.1. Gomecello

The works will consist of the extension of the existing track 3 on the Fuentes de Oñoro side. **The global cost is estimated at 2.2 M€.**



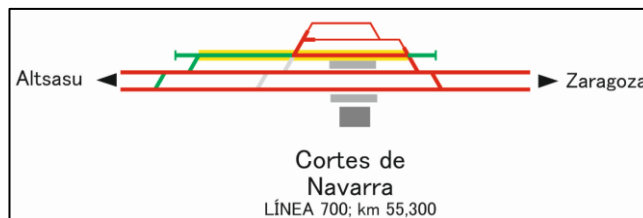
I.13. Section 5 – Phase 2

There is no implementation in the phase 2.

I.14. Section 6 – Phase 2

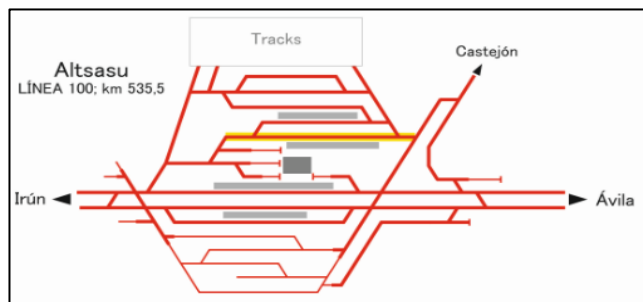
I.14.1. Cortes de Navarra

The works will consist of the extension of the existing track 3 on the Altsasu side. **The global cost is estimated at 7.4 M€.**



I.14.2. Altsasu

The works will consist of signaling modifications. **The global cost is estimated at 1.0 M€.**

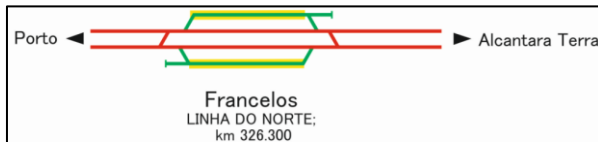


II. 750 m length train adaptation in Portugal

II.1. Section 1

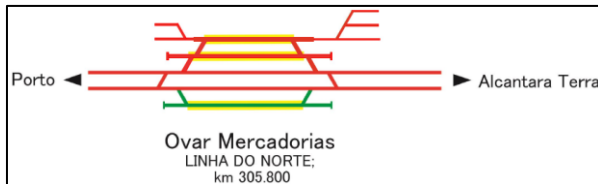
II.1.1. Francelos

This station is closed to Porto and it is not in a fully urbanized area. The works will consist of the creation of two new siding track. **The global cost is estimated at 15.2 M€.**



II.1.2. Ovar Mercadorias

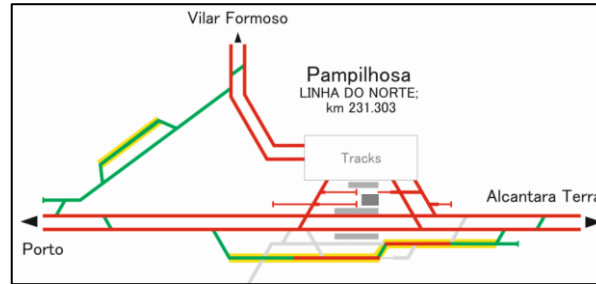
This station is closed to Ovar and in a not fully urbanized area. The works will consist of the creation of a new siding track to create a new freight terminal. **The global cost is estimated at 6.6 M€.**



II.1.3. Pampilhosa

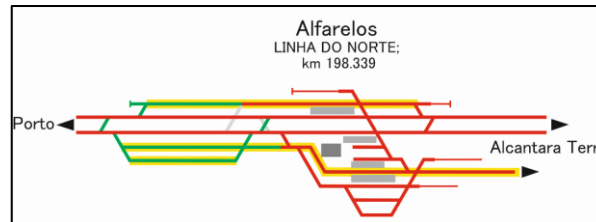
This station is the point where the sections 1 and 2 meet. The works will consist of the modification of the tracks 2 and 4 on the one hand, and on the other hand in the construction of a new bypass that will allow the direct circulation coming from section 2 and going to the north. This new bypass

track will have its own siding track of at least 750 m. **The global cost is estimated at 32.3 M€** (respectively 18 M€ + 14.3 M€).



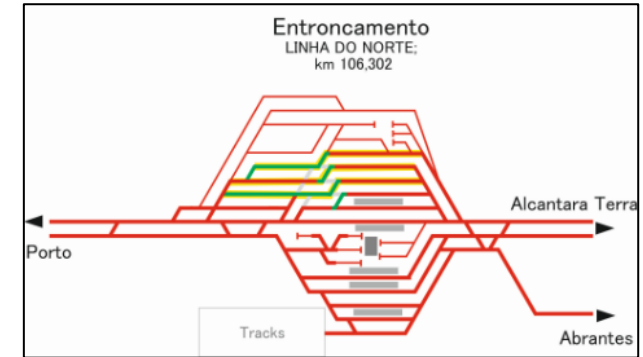
II.1.4. Alfarelos

The Alfarelos station is an important railway terminal. The work will consist of the adaptation of the existing tracks and of the creation of new siding tracks. **The global cost is estimated at 27.1 M€.**



II.1.5. Entroncamento

The Entroncamento station is an important railway terminal. The works will be carried out on tracks 12, 13 and 14 of the station, including extension, creation and union of tracks. **The global cost is estimated at 9.8 M€.**



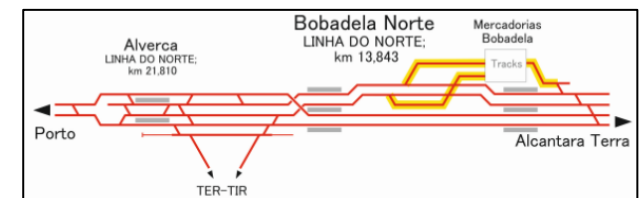
II.1.6. Mato de Miranda

The works will consist of the two new siding tracks construction in the vicinity of the station on the Porto side. **The global cost is estimated at 19.0 M€.**



II.1.7. Bobadela Norte

At that point, the station of Bobadela Mercadorias is not on the main rail track, but it has two connections with the main rail tracks. Bobadela Mercadorias is a freight terminal that will be used as a siding track for 750 long trains. **The global cost is estimated at 0.9 M€.**



II.2. Section 2

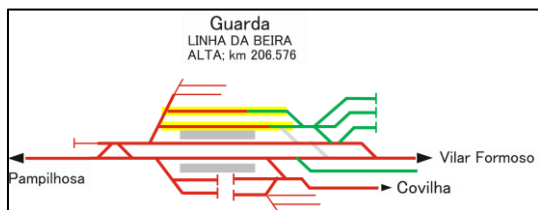
II.2.1. Noémi

It is decided to act in Noémi station, given the impossibility of acting in Vilar Formoso because of the urban environment. The works will consist of the extension of the existing siding track 2 on the Pampilhosa side. **The global cost is estimated at 2.1 M€.**



II.2.2. Guarda

The works will consist of an extension of the existing siding tracks 2 and 3 on the Vilar Formoso side. **The global cost is estimated at 9.1 M€.**



II.2.3. Pinhel

The works will consist of the extension of the existing siding track 2 on the Pampilhosa side. **The global cost is estimated at 2.0 M€.**



II.2.4. Celorico da Beira

The works will consist of the extension of the existing siding track 2 on the Pampilhosa side. **The global cost is estimated at 2.7 M€.**



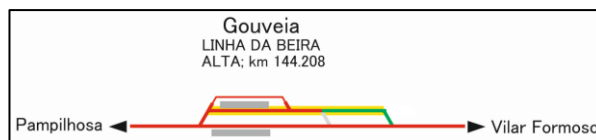
II.2.5. Fornos de Algodres

The works will consist of the extension of the existing siding track 2 and 3 on the Pampilhosa side. **The global cost is estimated at 4.4 M€.**



II.2.6. Gouveia

The works will consist of the extension of the existing siding track 2 on the Vilar Formoso side. **The global cost is estimated at 3.2 M€.**



II.2.7. Nelas

The works will consist of the extension of the existing siding track 2 on the Pampilhosa side. **The global cost is estimated at 4.5 M€.**



II.2.8. Oliveirinha Cabanas

The works will consist of the extension of the existing siding track 2 on the Pampilhosa side. **The global cost is estimated at 2.3 M€.**



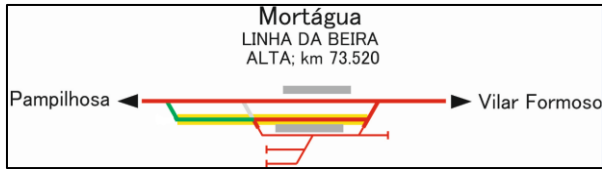
II.2.9. Sta. Comba Dão

The works will consist of the extension of the existing siding track 2 on the Vilar Formoso side in a very constraint environment. **The global cost is estimated at 7.4 M€.**



II.2.10. Mortágua

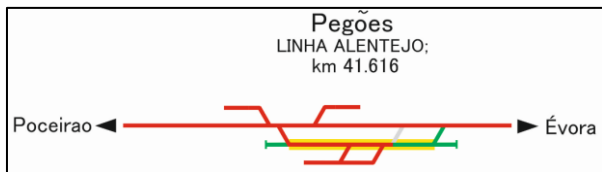
The works will consist of the extension of the existing siding track 2 on the Pampilhosa side. **The global cost is estimated at 3.1 M€.**



II.3. Section 3

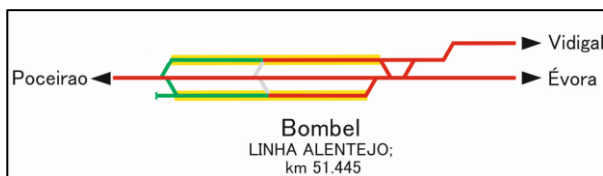
II.3.1. Pegões

The works will consist of the extension of the existing siding track 2 on the Evora side. **The global cost is estimated at 5.5 M€.**



II.3.2. Bombel

The works will consist of the extension of the existing siding tracks 1 and 3 on the Poceirão side. **The global cost is estimated at 5.5 M€.**



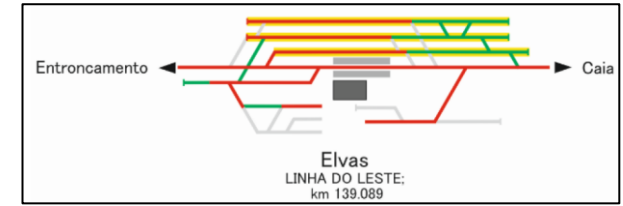
II.3.3. Estação Técnica (1, 2 and 3)

The construction of the new connection Evora-Caia includes the construction of three new technical stations, allowing the 750 m long trains. As the project is underway, the global investment costs are not included in the total amount of the invest.



II.3.4. Elvas

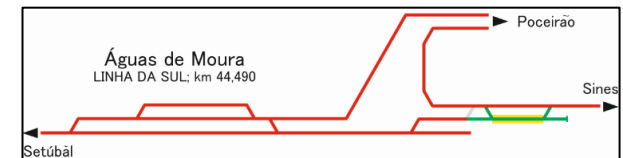
Elvas is a border station. Its adaptation is part of the new railway connection Evora-Caia. The works will consist of the existing siding tracks 2, 3 and 4 extension. As the project is underway, the global investment costs are not included in the total amount of the invest.



II.4. Section 4

II.4.1. Águas de Moura

The works will consist of the prolongation of the shunting neck and the implementation of new switches to allow the use of a part of these tracks as a siding track for long trains. **The global cost is estimated at 11.4 M€.**



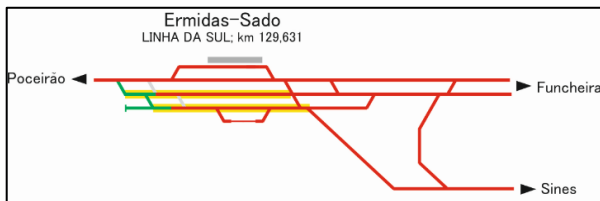
II.4.2. Canal Caveira

The works will consist of the extension of the existing siding track 1 on the Poceirão side. **The global cost is estimated at 2.4 M€.**



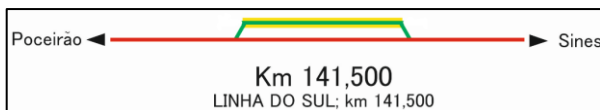
II.4.3. Ermidas-Sado

The works will consist of the extension of the existing siding tracks 1 and 2 on the Setúbal side. **The global cost is estimated at 5.2 M€.**



II.4.4. Km 141,500

The works will consist of the creation of a new siding track. **The global cost is estimated at 3.9 M€.**



II.4.5. S. Bartolomeu da Serra

The works will consist of the extension of the existing siding track 1 on the Sines side. **The global cost is estimated at 1.8 M€.**



II.5. Section 5

II.5.1. Muge

The works will consist of the extension of the existing siding track 2 on the vendas Novas side. **The global cost is estimated at 2.1 M€.**



II.5.2. Desvío

The works will consist of the extension of the existing siding track 2 on the Vendas Novas side. **The global cost is estimated at 1.7 M€.**



II.5.3. Agolada

The works will consist of the extension of the existing siding track 2 on the Setil side. **The global cost is estimated at 4.6 M€.**



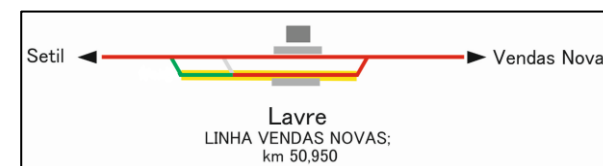
II.5.4. Salgueirinha

The works will consist of the extension of the existing siding track 2 on the Vendas Novas side. **The global cost is estimated at 2.1 M€.**



II.5.5. Lavre

The works will consist of the extension of the existing siding track 2 on the Setil Side. **The global cost is estimated at 2.4 M€.**



II.5.6. Vidigal

The works will consist of the extension of the existing siding track 2 on the Setil side. **The global cost is estimated at 2.6 M€.**



II.6. Section 6

No improvement will be proposed in this section. For the Elvas station, refer to the § II.3.4.

II.7. Section 7

II.7.1. São Mamede de Infesta

The works will consist of the extension of the existing siding track 1 on the Contumil side. **The global cost is estimated at 1.9 M€.**



II.7.2. Contumil

The works will consist of the extension of the existing track 2 on the Leixões side. **The global cost is estimated at 2.4 M€.**

