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Rail Baltica Final Report

Executive Summary

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Rail Baltica Final Report

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Executive Summary

1.0 INTRODUCTION

This report is the output from a feasibility study undertaken to identify the most feasible development option for a standard European gauge (1435mm) line between Marijampole and Tallinn via Kaunas and Riga using a 'top-down' transport strategy covering all three Baltic States and an EU – wide rail network rationale.

The role of this project is to deliver a comprehensive decision base for the construction of a new 1435 mm gauge line. The study focusses on detailed and quantitative analysis of various issues identified for further research within "Feasibility Study on Rail Baltica Railways, January 2007", financed by Directorate-General for Regional Policy.

The final objective of this study is to give a complete and substantiated picture for the authorities of the 3 Baltic countries and the EU if the project seems viable enough to justify a more detailed analysis on the respective national levels and to propose a possible period for implementation of further studies at the national levels.

This Rail Baltica project aims at ensuring a safe, fast and high quality connection between the Baltic States and the major economic, administrative and cultural centres of Western Europe. Interoperability with Polish and German 1435mm gauge networks is an important aspect of the project as a whole because international traffic in the North-South direction with the present 1520mm gauge rail network in the Baltic States is very inefficient and not effective.

Before a preferred route could be arrived at and analysed it was important to understand the economic position of the Baltic States, the levels of transport service currently provided, and the various constraints that will govern the route selection. From this information an assessment was made of the likely patronage on the route, both passenger and freight, and thus the potential revenues. An initial qualitative assessment of the various options proposed led to the selection of a preferred route which was then subjected to a cost benefit analysis to determine the true feasibility.

The issue of an interoperable North-South railway corridor linking the Baltic Countries (Lithuania, Latvia and Estonia) with Poland and the rest of the EU rail network can be seen as pivotal from the perspective of development of the railway transport mode in the region. The idea of Rail Baltica first appeared in 1994 in the joint political document "Vision and Strategies around the Baltic Sea 2010" as an important element for spatial development in the Baltic Sea Region.

The Baltic countries have historically been linked in transportation terms on an east-west axis and this is reflected in current rail traffic flows. In physical terms, the provision of rail transport services is through the 1520 mm gauge system which makes interconnecting traffic with Poland both difficult to operate and costly to provide. For all intents and purposes, the Baltic rail system is incompatible with mainland European standards. Until, Estonia, Latvia and Lithuania joined the European Union, the issue was not considered a high priority. Now, within the European Union, there is a full consensus that the 3 countries need to be fully integrated into the wider rail transport system.

In October 2001 the European Commission initiated a revision of the TEN-T guidelines. This resulted in the adoption by the European Parliament and the Council in April 2004 of Decision No. 884/2004/EC amending the community guidelines for the development of the TEN-T. This Decision dedicated particular attention to the development of the trans-national infrastructure projects providing a response to the growth of international traffic whilst promoting cohesion within the EU, notably in the sections of the pan-European corridors situated within the territory of the new Member States as well as to the concept of "motorways of the sea". Within this Decision the Rail Baltica axis Warsaw – Kaunas – Riga – Tallinn was identified as priority project No. 27 with the following timeframe for implementation:

i) Warsaw – Kaunas (2010)
ii) Kaunas – Riga (2014)
iii) Riga – Tallinn (2016)

On 15 September 2003 the Rail Baltica Coordination Group (representing Poland, Lithuania, Latvia and Estonia) agreed on the key aspects to be considered in future studies for investment in Rail Baltica. This was followed on 27 March 2006 by the signature of a Declaration of Intent by the transport ministers of the four project countries and Finland to implement Rail Baltica. In the meantime between November 2005 and December 2006 the European Commission Directorate – General Regional Policy commissioned a strategic study of the Rail Baltica railway. The final report, published in January 2007, acknowledged that none of the options identified had a dominant business case.

Most recently, on 8 June 2010 representatives of the transport ministries of Poland, Lithuania, Latvia, Estonia and Finland during the conference "TEN-T Days 2010: Trans-European Transport Networks" held in Zaragoza, Spain, signed a memorandum expressing their political will to continue with the implementation of the Rail Baltica project. In addition, the Rail Baltica development plans have been evaluated in the context of the White Paper – Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, dated March 28, 2011.

The development of Rail Baltica complies with the National Level Planning Strategies of all three Baltic States in terms of improvements to the national transport networks and thus in providing a stimulus to economic growth. In addition one of the most important factors in national and international planning is that of providing a sufficiently high standard of transport infrastructure to support the defence and security needs of member states of different organisations. The three Baltic States are part of the 27 countries that make up the European Union. They are also members of NATO whose mission is a political one to share democratic values and cooperate on defence with its 28 members. NATO is committed to peaceful resolution of disputes but if diplomacy fails it has the military capacity needed to undertake crisis management operations. In a worst case scenario a fast, direct rail route connecting the Baltic States to Central Europe would facilitate the swift movement of military equipment to the necessary locations. Increasingly military equipment is being moved in containers and the provision of intermodal terminals enables this to happen seamlessly.

1.1 ECONOMIC AND SECTOR CONTEXT

The key factors examined in determining the macroeconomic and sector context are population, Gross Domestic Product (GDP), Gross Value Added (GVA) and trade and commodity flows.

Within the three Baltic States and the surrounding area the population is generally in decline. The exception to this is Finland which is showing a small average growth of 0.2% over the life of the study. In determining the trend data was obtained from multiple sources. In addition to the overall decline the population is also aging. By 2025, the median age within the Baltic region will be more than 10 years greater than it is now in about half of the countries in the region. Within the three Baltic States the populations are not large with a great percentage of the total population living in a relatively small number of towns. For example there are only 7 towns in Estonia with a population greater than 20,000 inhabitants.

GDP is the internationally recognised measure used in the analysis and forecasting of economic performance and growth. In determining the forecast of GDP growth an average of data obtained from numerous sources such as the IMF and Eurostat was used. The forecast GDP growth in Estonia, Latvia and Lithuania is 2.4%, 2,2% and 2.2% respectively. These values are typical for all the countries likely to be served by Rail Baltica.

Gross added value (GVA) is a measure of the value of goods and services produced in an economy and is linked to GDP as follows: GVA + Taxes on Products – Subsidies on Products = GDP

The average values of GVA growth in Estonia, Latvia and Lithuania are 2.6%, 2.2% and 2.2% respectively. In the passenger demand modelling GVA has been used as it enables regional differences in growth to be taken into account as GVA historic data is available at a NUTS 3 level. This historic data combined with forecast GDP growth has been used to derive forecasts of GVA growth at NUTS 3 level.

The key to the success of Rail Baltica will be its ability to capture a significant percentage of the international trade between the Baltic States and the surrounding countries particularly that percentage of the overall trade moving in a north/south direction. The major commodity flows (greater than 300,000 tonnes) have been examined and are listed in below:

Table 1 – Major commocity flows in the Baltics

Origin - Destination	Commodity	Thousands metric tons (2008)
Finland - Germany	Paper	2 549
Latvia – Finland	Wood Products	1 257
Finland – Poland	Mineral Fuels and Oils	1 149
Finland – Germany	Wood Products	1 084
Lithuania – Latvia	Mineral Fuels and Oils	825
Lithuania – Estonia	Mineral Fuels and Oils	599
Lithuania – Finland	Wood Products	411
Finland – Poland	Paper	404
Germany – Finland	Iron and Steel	404
Finland – Germany	Mineral Fuels and Oils	347
Latvia – Germany	Wood products	325
Poland - Lithuania	Food	305

A conservative approach was taken in forecasting future freight demand. In fact, since the preparation of the freight model, a number of factors, some of which were expected, have all enhanced the case about rail freight's prospects given the right infrastructure and market conditions:

1) Continuing rise in world fuel prices.
2) Competition – which is starting to evolve in the Baltic States
3) Container market is growing again
4) EU Policy is favouring a move to more sustainable transport, as referenced in the EC White Paper "Roadmap to a Single European Transport Area"

In addition to the global economic factors it is important to understand the existing supply of transport services and the level of current demand before a prognosis of the Rail Baltica patronage levels can be undertaken.

In terms of rail throughout the Baltics the international passenger service is poor and whilst there are a number of key internal routes served the services are generally perceived as being infrequent and slow. The services however are relatively cheap and do offer reasonable quality. For freight there is a developed east/west network but not a competitive north/south one.

The lack of a passenger rail service, combined with a comprehensive road network, has led to the development of a reasonable quality coach network offering both internal and international services which is very popular particularly for the shorter distances. For longer distances air becomes more popular even though its cost is significantly higher.

For north/south freight movement road and sea are the main options.

In assessing the existing passenger and freight demand use was made of a number of data sources including the statistics offices of the individual member states, the Estonian Technical Surveillance Authority, LDZ Latvia, JSC Lithuanian Railways, Eurostat etc.

From the existing passenger demand data it can be seen that Passenger demand is generally low for cross border movements e.g 2,270 travelling from Tallinn to Riga daily of which 81% travel by road (car or coach). For 'in Country' movements passenger demand could be classified as moderate over certain sections e.g. Riga to Jelgava but road still has an 80% market share. In general terms it can be seen that road is the preferred mode of travel for shorter distances but that this changes to air for longer journeys e.g Tallinn to Warsaw 76% travel by air.

The existing freight demand falls into three layers for non-bulk flows. These are transit traffic from Central Europe and St. Petersburg Area, exports from the Baltic States of goods such as wood and paper products, food and drink etc and inter Baltic traffic. In the case of the first type it requires good service levels, reliability, a modern fleet and is sensitive to journey times. The second type is currently generally carried by road and is seen as that most likely to transfer to a new rail service. In addition to the non-bulk freight there is also the bulk traffic currently operating within the Rail Baltica catchment area.

In terms of tonnage the 2008 demand revealed the movement of 20.6m tonnes of bulk and 15.2m tonnes of non-bulk cargo. In both cases the percentage of cargo carried by rail was very small, just 11% of the bulk and 4% of the non-bulk cargo. The remainder was split roughly 50/50 between road and sea.

To predict the likely patronage by both passenger and freight traffic on the new Rail Baltica line two separate models were constructed. In terms of predicting future passenger traffic a common approach to forecasting changes in rail demand following changes in service provision or pricing is through the application of simple elasticities. This approach can provide a useful starting point for when there is an existing rail service and can reduce the need for more complex transport modelling. Within the Baltic States however there is only a very limited existing rail service across national borders, which means there is no existing rail demand to forecast forward from. Internal to each country although there are existing rail services the proposed high speed Rail Baltic service is likely to provide a "step change" in level of service which means that the simple elasticity approach will only provide part of the answer.

As a result we have therefore developed a modelling suite that represents both the existing base year demand by different modes as well as the generalised cost (in terms of wait time, travel time, fares and vehicle operating costs) of making journeys by these modes. Based on these base year costs a mode choice model was then developed and calibrated to reflect the split between modes on existing movements. This modelling base provides, along with an estimation of trip growth, a tool to assess how mode shares for all modes will alter in future when Rail Baltica becomes an option for travellers. A key strength of this approach is that the forecasts of Rail Baltica patronage is driven not from the very small number of exiting international trips, but from an calculation of the proportion of the existing rail, air, bus and car trips that will shift to Rail Baltica.

For freight the model that was created is a mode choice model accounting for road, rail and sea traffic. The model has two streams which run in parallel; demand and modal split. By considering all modes and calculating the modal split based on the generalised cost the model can predict future potential for shift from existing road, rail and sea onto the Rail Baltica line.

Within the model base demand is split into bulk and non bulk commodities. Demand growth was forecast using GDP growth forecasts and separate timber industry forecasts where applicable. Change in future costs was predicted using growth in fuel, labour and other costs.

For the freight model the model base year was taken as 2008. 2009 saw dramatic changes in tonnage levels for the majority of origins / destinations north-south due to the global recession. The Future of Transport, Focus Groups' Report, 20.02.2009 states that transport demand is closely linked to economic growth. In times of economic slowdown, there tends to be a sudden fall in transport demand, which however is bound to recover more quickly than the rest of the economy. Reactions during previous recessions clearly confirm this resilience of transport demand. In times of economic recovery, freight transport usually grows faster than overall GDP. This can in part be explained with the faster growth in international trade. Based upon this reasoning it was decided to take 2008 as the base year as this is likely to be more representative of long term volumes than 2009 information.

1.2 ECONOMIC, ENVIRONMENTAL, REGULATORY AND TECHNICAL CONSTRAINTS

Economic Constraints. Government debt in the Baltic States is an important economic constraint on the development of the Rail Baltica project, as the situation in the government budget will affect the decisions about the necessary minimum of 15% co-financing made by each of the Baltic State authorities. Further, each of the Baltic States still have differing currencies, which imposes currency and exchange rate risk. In January 2011 Estonia joined the Euro zone; Latvia and Lithuania is planned to join in 2015. Nevertheless, the join of Latvia and Lithuania is still uncertain and depends on the economic development of the countries.

Currently, there is no singular EU fund that would be legally allowed to support all the included stakeholder countries together (Latvia, Estonia and Lithuania, as well as neighbouring countries of the Baltic States - Finland, Russia, Belarussia and Poland) without a multi-national cooperation agreement in which a leading partner is identified. Article 4 of Regulation (EC) No 680/2007 defines general rules for the granting of EU TEN financial aid. An application for EU financial aid should be submitted to the Commission by one or more Member States, with the agreement of the MS concerned, by international organizations, joint undertakings, or public or private undertakings or bodies.

Usual practice in infrastructure projects in Eastern Europe (that are financed through EU structural funds - ERDF) is that:

(1) all countries involved nominate a leading partner (the one who can be considered as a final beneficiary), who is responsible for submission of application form and provides overall project management for the whole project and implements project in its domicile country;
(2) Partners establish a Programme Steering Committee (PSG) and an Integrated Programme Organization (IPO) that act as project management team on behalf of the leading partner;
(3) The IPO can prepare the grant, but it has to be signed either by a leading partner or by all partners that may be considered as a final beneficiaries.

Furthermore, it should be emphasized that right now there are only forecasts of the allocation and management of the EU co-financing for the 2014 - 2020, as well as the structure of EU funding programmes. The available information about the next EU financial period varies and is not yet reliable. However, the uncertainty of the funding allocation for the next financial period of 2014-2020 can be used in the interests of Rail Baltica. By increasing the awareness of the necessity of Rail Baltica, the funding can be allocated in the most beneficial way for infrastructure of the Baltics.

Environmental Constraints. Four major areas of environmental constraints were investigated: noise, emissions, protected territories and sustainability targets.

The European Directive 2001/16 Interoperability of the Trans – European Conventional Rail System prescribes noise limits for rolling stock in the following categories: stationary noise, starting noise, pass by noise, and interior noise. Currently in the specific case for Estonia, Latvia and Lithuania these noise limits do not have to be complied with as a series of measurements are being carried out in the three countries that will lead to a revision to the TSI. By the time the line is constructed compulsory noise limits will have been established. The limiting noise values, as measured at the building facades, are different in Estonia, Latvia and Lithuania. In general the levels vary between 35 dBA for residential and other critical areas at night to 50 dBA during the day.

Emission limits are based on the requirements of EU Directive 2004/26/EC as amended by the Corrigendum to the Directive 2004/26/EC dated 25 June 2004. The limits are expressed for both locomotive engines and railcar engines and summarize criteria for carbon monoxide, the sum of hydrocarbons and oxides of nitrogen and particulates.

Within the Baltic States there are a large number of Natura 2000 sites. Natura 2000 is the main part of EU nature & biodiversity policy. It is an EU wide network of nature protection areas established under the 1992 Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive (SCI), and also incorporates Special Protection Areas (SPAs) which are designated under the 1979 Birds Directive. Wherever possible in the development of the route options these areas should be avoided.

All three countries have long term national strategies setting overall targets for sustainable development. These documents are consistent with EU Sustainable Development Strategy and intended to implement EU sustainability targets at the national level.

Regulatory Constraints. The key regulatory contraints that impact Rail Baltica are the beraucracy of planning at the national, regional and municipal levels, the process of land expropriation, and the setting of tariffs for freight and passenger service.

The time taken to complete the planning process is different in all three countries but in the worst case could take in excess of seven years. In some European countries the designation of a project as being in the 'national interest' allows a reduction in the planning process but that is not the case in the the Baltics.

In all three countries the process of land expropriation can only be instigated by the state or under certain circumstances by the municipalities. The process can only be started once the plans justifying the need for the land have been approved. Each country has a well defined expropriation process and whilst there is no overall defined timeframe, historically in Estonia the process can take between 2 – 2.5 years.

Setting of tariffs for freight and passenger service varies between the three member states. Since existing policies and regulations are based on existing railway infrastructure and existing operational and maintenance procedures, it has been decided to apply a generalized approach to infrastructure tariffs that is more based on EU standards than local calculation methodology.

Technical Constraints. Rail Baltica will be constructed to the latest Technical Specifications for Interoperability (TSI). The primary scheme parameters have been developed based on a New Core TEN-T line operating as a mixed traffic line.

Key TSI Parameters are:

Line Category IV-M

Structure Gauge GC

Maximum axle Load 25 tonne

Maximum line speed 240 kmh

(the speed which is used for the design of the track alignment / geometry)

Maximum Train Length 750m

Since the success of Rail Baltica is founded on a mix of freight and passenger service on the line, fast conventional service is being proposed rather than very high speed rail service. In order to run at very high speeds, HSR trains need to be far more powerful than conventional trains. In order to maintain their top speeds, the lines that they travel on must be built with the fewest possible curves – and where curves are unavoidable, they must use larger turning circles to change direction. Braking distances must also be longer to allow the trains to slow down safely and rail construction tolerances are far more exact, all of which considerably increase construction and maintenance costs.

Table 2 – Design parameter comparison (conventional vs.HSR)

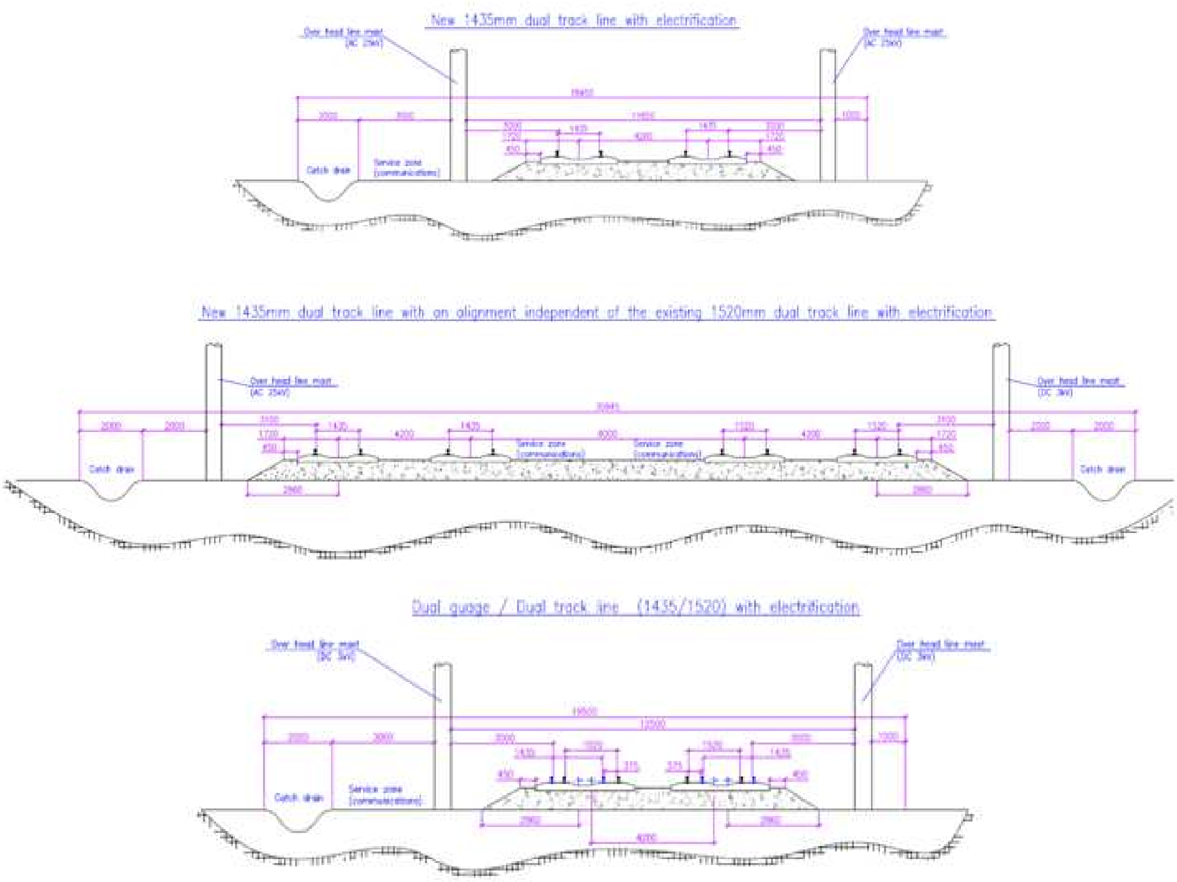
	Conventional Rail	HS Rail
Top speed (kph)	200	400
Installed power (MW)	4	20
Maximum gradient incline (%)	1	3
Minimum radius of curvature (m)	1800	7200
Average braking distance (m)	2000	5500

(Note: these figures are representational and are based on typical design parameters for comparison purposes only)

In addition, the train design and the stations serving them must also have different characteristics. High speed stations are more comparable to airport terminals than conventional train stations, which in the context of Rail Baltica is not required based on passenger densities anticipated as calculated and validated via journey time sensitivity analyses in the passenger demand models of this study

Three different infrastructure implementation scenarios were evaluated – independent 1435mm gauge line (new alignments), 1435mm Gauge Line adjacent to the existing 1520mm gauge line (existing alignments), and dual gauge 1435/1520mm line. Technical constraints were outlined for rail infrastructure, civil and structures, signalling and telecoms, electrification, maintainability and rolling stock. Each option under consideration includes various combinations of the infrastyructure scenarios depicted below. The dual guage scenario, due to the technical constraints inherent in the design of such layouts, is to be considered a worst-case scenario and is contemplated only in urban areas where other options are not viable.

Figure 1 – Infrastructure implementation scenarios



1.3 OPTION IDENTIFICATION

By identifying areas to be avoided wherever possible, such as the various Natura 2000 sites, and the areas of demand drivers such as the major cities over 20 initial sections of possible routes were identified. This process also suggested that the geography between the key destinations dicussed in the terms of reference should be broken down into segments. Four segments were identified: 1) Tallinn to Parnu/Tartu, 2) Parnu/Tartu to Riga, 3) Riga to Radviliskis/Panevežys and 4) Radviliskis/Panevežys to the Lithuanian border via Kaunas. When looking at new alignments care was taken to miss settlement areas wherever possible to minimise the environmental impact.

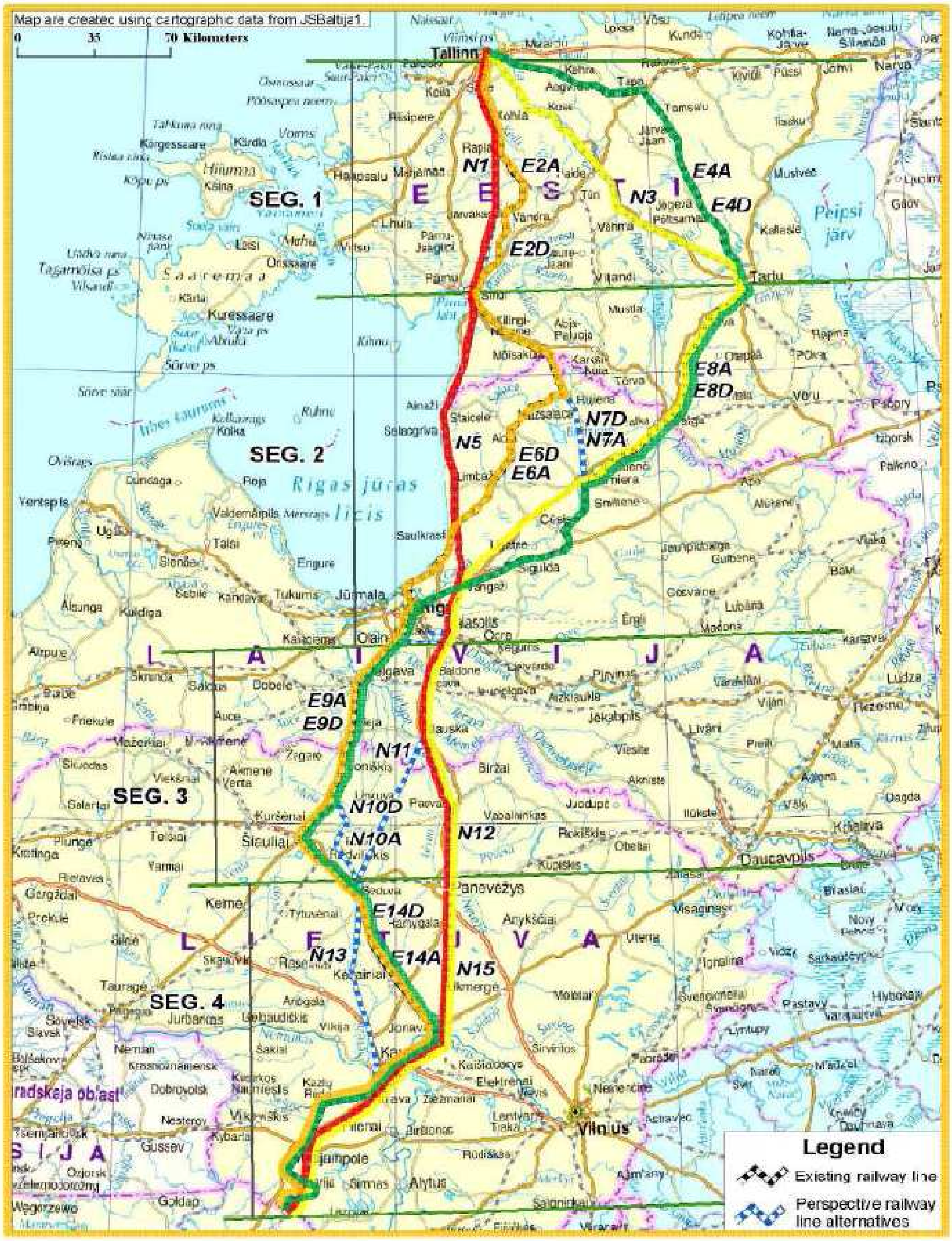
Considering various technical and environmental constraints 4 key options were identified. In assessing journey times and average speeds, particularily for alignments adjacent to existing raoutes, consideration was given to the various constraints governing the existing alignment speed and where it was felt that these could not be easily negated a similar speed was used for the new route. Due consideration was given to station dwell time, acceleration and deceleration.

Table 3 – Key option distance, journey time and average speed comparison

			PASSENGER / FREIGHT		
			Distance (km)	Journey Time (hrs) (hours_minutes)	Ave. Speed (kph)
Option 1	New Alignment		701/708	4.13/10.38 (4h8m/10hr23m)	170/68
LT Border – Kaunas – Panevežys – Riga – Parnu – Tallinn					
Option 2	Existing Alignment		788/804	6.14/11.56 (6h8m/11h34m)	128/70
LT Border – Kaunas – Jelgava – Riga – Parnu – Tallinn					
Option 3	New Alignment		791/792	4.81/11.17 (4h49m/11h10m)	165/71
LT Border – Kaunas - Panevežys – Riga – Valmiera – Tartu - Tallinn					
Option 4	Existing Alignment		858/859	6.74/11.88 (6h44m/11h53m)	127/72
LT Border – Kaunas – Jelgava – Riga – Valmiera – Tartu – Tallinn					

(Note: Distances differ between passenger and freight routes due to differing locations of passenger stations and freight ports/facilities)

Figure 2 – Route options



Option 1 – Red Route

This alignment has been selected and designed to be the most direct and shortest route from the southern most point to the northern most point of the corridor.

Option 2 – Orange Route

This alignment has been selected as the most direct existing rail route from the southern most point to the northern most point of the corridor.

Option 3 – Yellow Route

This alignment has been selected to try and maximise potential passenger demand by passing through the majority of the major population centres.

Option 4 – Green Route

This alignment has been selected to utilize ALL existing routes from the southern most point to the northern most point of the corridor.

Figure 3 – Distance/passenger journey time comparison with the Business As Usual case scenario and the Existing Service.

(Note: Total duration noted at the top of the figure includes time spent at stations along the route. Times shown between stations represent only travel times)

1.4 TECHNICAL ANALYSIS OF PACKAGES

In the analysis of the various options it is necessary to compare them against the defined 'business as usual' option. In terms of rail, the 'business as usual' is the essential upgrade of the existing route between Marijampole and Tallinn to give a speed of 120 kph wherever it is practically possible. In addition other specific road and rail improvements were also specified.

Passenger Demand

To be able to assess the potential passenger demand on each route assumptions had to be made on the frequency of service to be provided and the likely fares. In the initial estimates a 2 hour frequency was assumed and the fare used was €0.05/km. This latter value was chosen as it was in line with the current typical fares.

Table 4 – Passenger demand by option (2020, 2030, 2040)

Flow (2-way Daily)	Red			Orange			Yellow			Green		
	2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
Tallinn to Parnu	4,029	4,734	5,545	2,834	3,339	3,923	-	-	-	-	-	-
Parnu to Riga	3,004	3,566	4,204	1,964	2,343	2,775	-	-	-	-	-	-
Tallinn to Tartu	-	-	-	-	-	-	4,261	5,017	5,916	2,677	3,191	3,808
Tartu to Valmiera	-	-	-	-	-	-	2,564	3,113	3,644	1,397	1,695	2,008
Valmiera to Riga	-	-	-	-	-	-	3,730	4,417	5,109	2,306	2,706	3,136
Riga to Jelgava	-	-	-	3,963	4,581	5,200	-	-	-	4,307	4,965	5,600
Jelgava to Kaunas	-	-	-	2,724	3,188	3,624	-	-	-	2,902	3,402	3,855
Riga to Panevezys	3,572	4,172	4,736	-	-	-	3,578	4,180	4,733	-	-	-
Panevezys to Kaunas	6,523	7,428	8,336	-	-	-	6,529	7,435	8,331	-	-	-
Kaunas to Poland	2,272	2,486	2,654	1,730	1,889	2,004	2,267	2,483	2,653	1,727	1,887	2,002

As the success of the service will be measured on the revenues generated an exercise was carried out to determine the revenue maximising fare for each section of each route. As fare rates increase passenger demand falls. At low fare rates generally demand falls by less than the fare has risen meaning there will be an increase in revenue as a result of the fare rise. However, a point will be reached where further increases in fare result in a reduction in demand greater than the fare increase. When this happens the revenue starts to fall. This feature of demand/cost relationship means that for each route there is a fare rate that gives the maximum revenue which will be different for different routes depending upon the route characteristics.

Table 5 – Optimum Revenue Generating Fares for each Option.

		2020	2030	2040
Red	Tallinn – Riga	€ 0.075	€ 0.084	€ 0.095
	Riga-Poland	€ 0.108	€ 0.126	€ 0.158
Orange	Tallinn – Riga	€ 0.067	€ 0.076	€ 0.087
	Riga-Poland	€ 0.099	€ 0.119	€ 0.141
Yellow	Tallinn – Riga	€ 0.076	€ 0.086	€ 0.099
	Riga-Poland	€ 0.108	€ 0.126	€ 0.158
Green	Tallinn – Riga	€ 0.063	€ 0.073	€ 0.084
	Riga-Poland	€ 0.099	€ 0.119	€ 0.141

(Example: Fare from Tallinn to Riga on Rail Baltica in 2040 would be 32.30 EUR using the Red Route)

Table 6 – Anticipated revenues from using optimized fares (m eur)

	2020	2030	2040
Total Yellow Option	**68.0**	**85.6**	**108.2**
Total Green Option	**44.2**	**55.8**	**70.3**
Total Red Option	**61.4**	**76.9**	**97.2**
Total Orange Option	**41.3**	**52.2**	**66.2**

Various sensitivity tests were then run on the above scenario to consider the effect of a more frequent service and faster journey times.

Doubling the service frequency i.e. providing an hourly service increases the revenue and demand by 40-65% depending upon the route option considered. This indicates that the average train load factors and revenue per train would be lower for an hourly service and would therefore not offset the increase in operating costs. However on certain discrete sections the demand did double showing that there may be an option of developing a local shuttle service on these sections.

Not unexpectedly the introduction of faster journey times did have an increase on both demand and revenue. Two scenarios were examined namely reducing the journey times by 15% and 30% respectively. The impact is less marked for the faster routes (Red route Option 1 and Yellow route Option 3), however, as these route options already offer significant journey time savings over the alternative modes of travel. It was also seen that the increases in revenues are greater when increasing the speeds by 15% than when increasing the speeds from +15% to +30%. This implies there is limited scope to generate much higher revenues by increasing design speed. In addition it must be noted that even a 15% faster journey time would require the introduction of high speed trains which in turn would mean that the line could no longer operate as a mixed line. Freight would then have to be incorporated of further new lines and obviously the capital costs associated with providing two sets of tracks would significantly outweigh the benefits of the increased revenue.

Freight Demand

In determining the potential freight demand a set of core parameters were assumed to determine the central case against which the various sensitivity tests were undertaken. These key core parameters were:

- Medium Freight Price
- Average Speed 70kph
- 15% induced demand
- No green agenda

Results were derived for key freight service indicators, including:

- Volume of Freight Carried (in million Tonnes)
- Revenue (in million Euros)
- Journey Time savings (in million Euros)
- CO_2 Savings in Tonnes
- GHG CO_2E Savings in Tonnes

Table 7 – Freight Demand Core Parameters

Options	Sensitivity	2020	2030	2040
Red Route	Volume in Million Tonnes	9.8	12.9	15.8
	Revenue in Million Euros	132	176	222
	Journey Time savings in Million Euros	37	52	69
	CO_2 Saved Tonnes	374	517	672
	GHG CO_2E Saved Tonnes	380	525	683
Orange Route	Volume in Million Tonnes	7.6	10.1	12.6
	Revenue in Million Euros	106	144	188
	Journey Time savings in Million Euros	25	36	50
	CO_2 Saved Tonnes	264	377	514
	GHG CO_2 E Saved Tonnes	269	383	522
Yellow Route	Volume in Million Tonnes	8.1	10.6	13.2
	Revenue in Million Euros	107	144	187
	Journey Time savings in Million Euros	25	36	50
	CO_2 Saved Tonnes	268	380	513
	GHG CO_2 E Saved Tonnes	273	386	521
Green Route	Volume in Million Tonnes	6.6	8.7	10.9
	Revenue in Million Euros	88	120	160
	Journey Time savings in Million Euros	18	26	38
	CO_2 Saved Tonnes	200	287	405
	GHG CO_2 E Saved Tonnes	204	291	412

With the core parameters as described above the red route performed best in terms of revenue generated and volume carried. This was due to the journey times and cost competing favourably with road and sea freight for similar journeys. In all of the options shown above these parameters attract some bulk traffic but the majority is intermodal traffic where the focus on speed and price is far more important. This is best illustrated by the fact that in 2040, 18 of the 21 freight trains per day are expected to be carrying intermodal traffic on long distance trips. Rail Baltica would connect into the internationally significant European TEN-T rail network at Warsaw and provide much enhanced connectivity from Central and Western Europe to the Baltic States, Finland and North West Russia.

Although the ‘business as usual’ option could potential capture some of the road or shipping bulk traffic it is unlikely to attract significant volumes of intermodal traffic due to the slow journey times. Sensitivity analyses were carried out on the key elements of price, speed, level of induced demand and the green agenda. The results, using the red route as an example, show change from the central case, in terms of volume carried between +120% (low price, high induced demand, high speed, strong green agenda) and -54% (high price, low speed, no induced demand, no green agenda). Detailed review of the individual components shows that price is the most significant demand driver.

Table 8 – Freight Demand Sensitivities

Sensitivity	Indicator	2020	2030	2040
Low Price	Volume in Million Tonnes	19.1	23.5	27.5
	Revenue in Million Euros	200	245	287
Medium Price	Volume in Million Tonnes	9.8	12.9	15.8
	Revenue in Million Euros	132	176	222
High Price	Volume in Million Tonnes	5.1	6.8	8.1
	Revenue in Million Euros	87	120	152

As seen in the table above a reduction in price below the medium level increased the level of demand significantly, and this increase in demand results in a greater cost incurred by the operator, for example, through needing to purchase additional rolling stock. Further analysis of this concluded that the medium price offered the best value option by maximising the profit for the operator whilst maintaining a satisfactory level of freight demand.

Thus by selecting the red route for fast journey times with pricing options favourable to intermodal traffic the line is given the best chance of operating successfully as a fast “mixed use” railway. The type of freight trains on a mixed use railway has a bearing on timetabling. As intermodal trains are usually able to travel at a top speed of 120km/hour they are easier to slot into a timetable than bulk trains which traditionally have a top speed of around 90km/hour. Over the full length of Rail Baltica the fact that there are likely to be few bulk trains makes a difference to potential capacity. It is our belief that the existing rail network will continue to serve the bulk freight market well.

Other Key Factors

None of the route options proposed is fully defined within the spatial plans of the three Baltic States and as such each option poses various levels of risk from a planning perspective. Of the four options the red and yellow routes are perceived as having a lower planning risk although even in these cases it has been designated as a medium level. Within the orange and green options because the route utilises much of the existing rail corridor it might be expected that the planning process would be easier however as they pass through numerous settlement areas it is highly likely that many of the existing plans will require adjustment and therefore the chances of objections much higher. These two route options have therefore been designated as offering a high risk from a planning perspective.

Each of the four route options was also considered from an environmental perspective in terms of noise, landscape/townscape, biodiversity, heritage sites and water environment. Issues such as greenhouse gasses and CO_2 are considered within the freight demand results.

From a noise aspect the yellow and red route cross the least number of settlement areas, 28 and 29 respectively and as such have been assessed as having a medium impact. The orange and green routes cross 44 and 46 areas respectively and have therefore been assessed as having a high impact.

From a landscape/townscape perspective the converse position is true with the red and yellow routes being assessed as having a high impact and the orange and yellow routes as having a medium or medium/low impact. This is because running new lines adjacent to existing tracks will have little effect of the overall townscape in any location.

Throughout the option development phase one of the key considerations was to minimise the impact on the numerous Natura 200 sites designated within the Baltics. Whilst it was not possible for any option to avoid all the sites the yellow route impacts the lowest number. The red and orange routes impact the greatest number of sites.

The potential impact on heritage sites has also been assessed and the again because of the limited number of settlement areas crossed by the red and yellow route options they have the lowest impacts.

The effect of the routes on the water environment was also qualitatively assessed; In this case the orange and green routes had the lower impacts as they generally fall inside the existing rail corridors.

The results of the various analyses undertaken on the route options identified are summarised in the table below. In identifying which route is the best under each category either actual values have been used e.g. the actual revenues, a ranking has been assigned between 1 and 4 or they were assigned an impact (high, medium or low).

Aspect	Best Route
Capital Cost	Red
Journey time savings	Red
Revenues	Red
Wider Economic Benefits	Red and Yellow equal
Environment	Red , in terms of CO_2 savings

As a result of the analysis it was considered that the Red Route Option 1 appeared to be the route that offered the greatest benefits for the least capital cost.

1.5 BEST FEASIBLE OPTION

The preferred alignment (Option 1 – Red Route) for the Core TEN-T Rail Baltic 1435mm route was selected and designed to offer the most direct and shortest route from the southern-most point to the northern most point of the corridor. The new 1435mm gauge line starts at the LT border and proceeds into Kaunas on a new alignment to minimize curves and speed restrictions. At Kaunas the route will not serve the Central Station directly but will use Palemonas station as the transfer connection to the existing 1520mm gauge line to link to the Central Station and a transfer location for shuttle service to the airport via bus or 1520 mm rail. The new proposed intermodal facility is also in this area and can also be easily served by this route. The line progresses northbound through the west-side of Panevezys, where a stop for passengers and freight is planned, and continues north into Latvia. In Latvia the alignment proceeds adjacent to Iecava and then crosses the Daugava River to the east of Riga, at Salaspils at which point an east-west intermodal transfer station is contemplated. Riga City is served by new 1435mm gauge rail infrastructure utilizing the old "Ergli" alignment through to the Central Station. Trains from Central Station use the same route to arrive back at the main north south section. From this connection point the line proceeds northbound following parallel to the Via Baltica roadway alignment to Parnu, another intermediate stop and subsequently to Tallinn Central Station stopping first at Tallinn Airport. In the vicinity of Tallinn spurs are provided from the main line to serve both Muuga Port and the proposed location of the proposed fixed crossing to Helsinki.

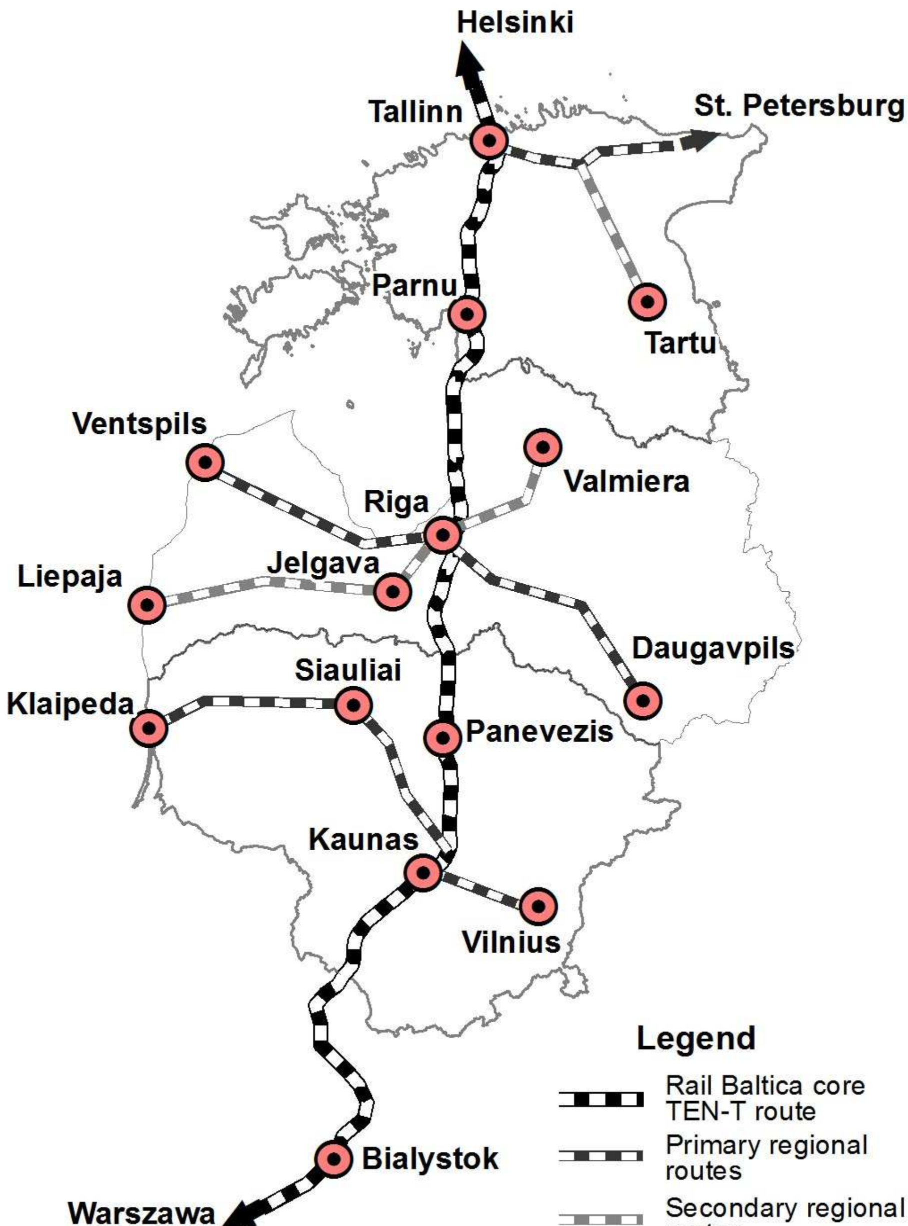
The key features of the route are:

- Overall length of new track 728km
  - Estonia = 229km
  - Latvia = 235km
  - Lithuania = 264km
- Design speed 240 kph maximum
- The route is a mixed traffic conventional route
- Journey times between Tallinn and the Lithuanian/Polish Border (Table 1.1)
  - Passenger 4.13 hrs (4h8m)
  - Freight 10.38 hrs (10h29m) (variable time depending on the number of calls)
- Average speeds
  - Passenger 170 kph
  - Freight 68 kph
- Passenger service frequency every 2 hrs starting at 06.00 and finishing at 24.00hrs approximately
- New/Upgraded passenger stations at Palemonas (serving both Kaunas Centre and the Airport along the existing 1520mm gauge line), Panevežys, Riga Central Station, Parnu, Tallinn Airport and Tallinn Central Station.
- Primary intermodal terminals at Tallinn, Riga and Kaunas and secondary intermodal terminals at Panevezys and Parnu.
- Maintenance facilities at Rapla, Riga, and Jonava.
- The route is twin track for its entire length on mainly new alignment
- Some dual gauge (1520/1435) sections are required.

Various sub-options were identified that merit further definition in later stages of the implementation process including:

1) Sub-option 1: an approach to Tallinn via the existing N-S railway alignment from Rapla to Tallinn,
2) Sub-option 2: an alternate route south of Parnu to Saulkrasti that utilizes portions of the already reserved planning territories in and south of Limbazi, and
3) Sub-option 3: using the existing rail alignment from Marijampole to the LT/Polish border, since this section is already undergoing 1435mm/1520mm gauge infrastructure upgrades and has been approved by the Republic of Lithuania.

Figure 4 – Best Feasible Option – Red Route



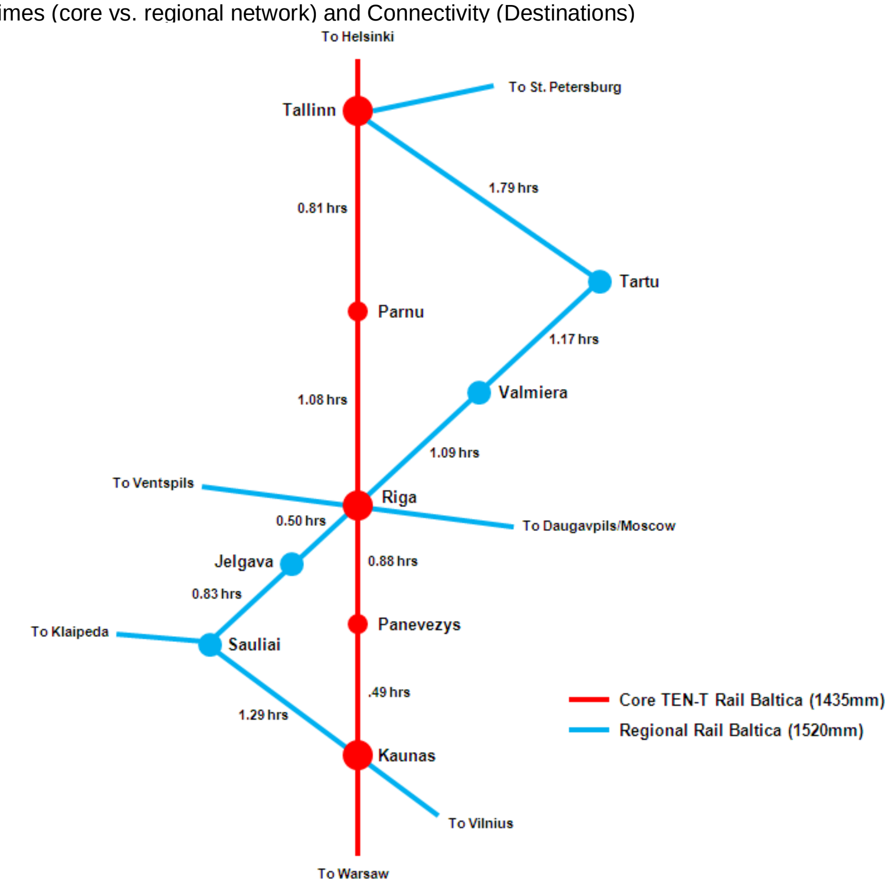
To maximize effectiveness, the operational framework for Rail Baltica aims to utilize the infrastructure asset to the maximum extent possible which in turn will require less train sets for both passenger and freight service. This gives the best return on investment, utilization of assets and lower operating costs. Initial assumptions for the mixed-train service:

1) The timetable has been based on a 24 hour day operating on six days of the week.
2) The track will need to be inspected roughly once a week.
3) Sundays have been identified for a limited service to enable planned maintenance or reactive maintenance should inspection and testing require it.
4) Facing and trailing crossovers will be situated along the track to facilitate single line working
5) Maintenance can be carried out on a single line at a time (this will not apply to crossover areas where all lines will need to be blocked to undertake works.
6) Periodic blocks of a longer period (18-27 hours) will be available but not on a planned weekly basis
7) Time difference between Warsaw and Baltic States not taken into consideration duration are critical factors in determining service provisions. Exact and time zones need to be clarified at final design stages and integration with local arrivals and departures.

These assumptions provide the basis for enabling the passenger and freight traffic to meet its market demand requirements in a more cost effective manner (i.e. reduce the number of train sets through availability of a longer operating day; and need for less stabling/handling sidings; less crew).

Journey times will differ between the Rail Baltica Core TEN-T 1435mm route and the regional 1520mm rail network. The regional rail network journey times as were considered in the future Business as Usual case scenario (at max speeds of at least 120 kmh without any restrictions) are roughly similar to travel times via the road network. The current passenger rail network is considerably slower (i.e. journey time from Riga to Valmiera is currently 2 hours 20 minutes). Other key urban centers in the Baltic States that are not directly on the 1435mm gauge line that have been considered for connection to the Rail Baltica line are Tartu, Daugavpils, Ventspils, Jelgava, Liepaja, Sauliai, Klaipeda and Vilnius.

Figure 5 – Journey Times (core vs. regional network) and Connectivity (Destinations)



1.6 COST BENEFIT ANALYSIS

The costs of implementing and operating Rail Baltica are extremely important inputs to determine the economic costs and benefits of the project. Given that the project is in the early stage of the planning process and the cost model is subject to various uncertainties and therefore contingencies have been included to mitigate these uncertainties. The costing information for the preferred alignment includes various elements that relate to capital costs (CAPEX - planning, design, land, and construction costs), as well as operational costs. All costs represented in the analysis do not include VAT.

Capital Costs (CAPEX)

The track infrastructure estimate is based on materials (50%), equipment (20%), labour (22%) and other (8%) costs associated with double railway track, power network, electrification, SCB network, telecommunications, and GSM-R network. In addition, costs related to topographic surveys, geotechnical investigations, planning and design, author/technical supervision and a 5% contingency have been added to calculate the total expenditures related to track infrastructure. The total track-related construction costs are roughly 2,430M EUR.

In addition to the track infrastructure, additional above-grade road crossings and water crossings need to be considered along the entire alignment since TSI's dictate grade – separated crossing along the entire route (exceptions in urban areas). A total of 521 road crossings or road diversions were identified that included crossings of main roads, 1^{st} class roads, 2^{nd} class roads and other roads. A total of 228 water crossings were identified. Each crossing was assigned a unit cost. Total cost related to bridges is roughly 438M EUR.

In addition to rail infrastructure and bridges, additional costs were included for passenger station upgrades/construction, intermodal terminal construction, maintenance facility construction, cross-over integration and required passing-loops. Total additional costs for facilities related improvements and construction is roughly 522M EUR.

Costs for land expropriation were established by reviewing current market assessment values (using 2011 market data) for the various types of land that will be required for implementing the preferred alternative. Various territory types will be required as referenced in the Land Uses (forest, agricultural and wetlands) and various settlement types will be impacted (towns/cities and suburbs). It is also assumed that a new alignment will require 100m ROW and an existing alignment will require 50m additional ROW. Total cost for land expropriation (based on 2011 values) is roughly 149M EUR.

TOTAL CAPEX = 3,539M EUR

Table 9 – Capital cost breakdown by Country

CAPEX SUMMARY (M EUR)	**Construction**	**Land**	**TOTAL**	**%**
Estonia	€ 935	€ 108	€ 1 043	29%
Latvia	€ 1 196	€ 26	€ 1 222	35%
Lithuania	€ 1 259	€ 15	€ 1 274	36%
TOTAL	**€ 3 390**	**€ 149**	**€ 3 539**	

Operational Costs (OPEX)

Cost estimates have been also made for the operating costs of the proposed passenger and freight Rail Baltica services. Passenger service is assumed to be electric and passenger freight service is assumed to be diesel.

The Rail Manager will incur operational costs related to maintaining the rail infrastructure including track maintenance and replacement, signalling and telecommunications maintenance and replacement, catenary system maintenance and replacement and surrounding area maintenance.

The track access charge is paid by the passenger and freight operators to the rail manager. It is a reservation charge and allows the operator to use the infrastructure that is provided by the manager for a specific train path. The EC document 2010/0253(COD) 'Proposal for a Directive of the European Parliament and of the council establishing a single European railway area (recast)' outlines proposals for changes to the directives covering the rail sector. This document includes changes to the principles of charging (article 31); and introduces exceptions to charging principles (article 32) to improve the coherence of national track access charging schemes through the introduction of common criteria for identifying market segments on which operators may be able to pay a mark-up in access charge.

The EC document indicates that the starting point for setting track access charges should be a calculation of direct costs to the rail manager of the services running. This is calculated based on the total rail managers maintenance cost over the appraisal period, and the total number of train km. Article 32 of EC document 2010/0253(COD) states that mark-ups may be applied to obtain full recovery of the costs incurred by the infrastructure manager. Therefore, track access charges have been calculated in an iterative process to minimise the financial losses of the rail manager whilst still providing financial return for the operators. The following optimal track access charges were determined:

Passenger services **€ 3.95 per train km**
Freight services **€ 5.92 per train km**

The Rail Operator also has to incur operating and train maintenance costs in order to provide a service. These costs are offset to some degree by the revenue that is paid to the operator by both passengers and freight hauliers.

Freight service operating costs consist of fuel costs (diesel fuel consumption), labour costs, total cost of rolling stock (lease charges for locomotives and wagons and maintenance costs for locomotives and wagons), overheads, and track access charges. Passenger service operating costs consist of fuel costs (electricity), labour costs, total cost of rolling stock (lease charges and maintenance charges), overheads and track access charges.

Table 10 – Total Operating Costs

	EUR/train km	Total Annual Cost 2020 (M EUR)	Total Annual Cost 2030 (M EUR)	Total Annual Cost 2040 (M EUR)
Freight	11.55	52.9	77.1	117.1
Passenger	8.63	54.2	54.2	54.2

In addition, other key factors were evaluated and calculated for passenger and freight service including revenues, social costs and benefits, journey time savings, accidents, air pollution, and climate change.

Economic Analysis

The Economic Cost Benefit uses discounted cash flow techniques to take account of the fact that benefits and costs that occur further into the future are valued less highly than those that occur in the short term. The positive impact of the project is measured by the economic indicators of the Net Present Value (NPV) of the project, which is the sum of the net benefits of the project discounted using the given rate to base year (2010) values, and in terms of the Economic Rate of Return (EIRR), which is the discount rate which gives a Net Present Value of zero.

In line with EU guide to Cost benefit analysis of investment projects a discount rate of 5.5% has been used in the economic assessment with an appraisal period of 30 years after opening.

National Governments and international bodies such as the European Union set certain standards for the EIRR of transport infrastructure projects: as a benchmark the EIRR of rail projects sponsored by the EU during the previous programming period was 11.6%.

Table 11 – Economic Analysis Summary

Economic Impact (€,000,000)	Rail Baltica Total: Discounted Cost or Benefit	Rail Baltica Total: Share in Total Costs/ Benefits	Rail Baltica Estonia: Discounted Cost or Benefit	Rail Baltica Estonia: Discounted Cost or Benefit (per km of track)	Rail Baltica Latvia: Discounted Cost or Benefit	Rail Baltica Latvia: Discounted Cost or Benefit (per km of track)	Rail Baltica Lithuania: Discounted Cost or Benefit	Rail Baltica Lithuania: Discounted Cost or Benefit (per km of track)
Cost to Infrastructure Manager/Government								
Capital / Investment Costs	1,886	103%	565	2.47	648	2.76	674	2.55
Residual Value	-117	-6%	-34	-0.15	-43	-0.18	-41	-0.16
Maintenance Costs	61	3%	19	0.08	20	0.08	22	0.08
Benefit to Manager								
Track access charges	521	16%	108	0.47	111	0.47	125	0.47
Passenger	*170*		*35*	*0.15*	*36*	*0.15*	*41*	*0.15*
Freight	*351*		*73*	*0.32*	*75*	*0.32*	*84*	*0.32*
Benefit to Operator								
Passenger Operator								
Operating costs *(including track access charges)*	-372	-12%	-77	-0.34	-79	-0.34	-89	-0.34
Revenues	605	19%	129	0.56	160	0.68	215	0.81
Freight Operator								
Operating costs *(including track access charges)*	-685	-21%	-142	-0.62	-146	-0.62	-164	-0.62
Revenues	1,142	36%	353	1.54	339	1.44	322	1.22
Benefit to Users								
Value of Time Savings	1,158	36%	397	1.73	340	1.45	284	1.08
Passenger	*340*		*135*	*0.59*	*88*	*0.38*	*71*	*0.27*
Freight	*818*		*262*	*1.14*	*252*	*1.07*	*213*	*0.81*
External Impacts								
On Safety (Accidents)	338	11%	116	0.51	105	0.44	89	0.34
Air Pollution	148	5%	35	0.15	29	0.13	77	0.29
Climate Change	342	11%	117	0.51	108	0.46	85	0.32
Total Costs	**1,829**		**550**	**2.41**	**625**	**2.66**	**654**	**2.48**
Total Benefits	**3,198**		**1,034**	**4.52**	**967**	**4.11**	**944**	**3.58**
Net Present Value (NPV)	1,368		484		342		289	
EIRR	**9.3%**		**9.7%**		**8.4%**		**7.9%**	
Benefit/Cost Ratio	**1.75**		**1.88**		**1.55**		**1.44**	

The elements of the total costs and benefits that are experienced by each nation have been isolated. This allows the CBA to be run for each individual Baltic nation. It should be noted however, that the benefits allocated to each country will only be generated if the whole scheme is implemented.

To breakdown the CBA to a national level the costs and benefits have been split across the states. This allocation has been based on either allocating benefits to the country in which they occur, such as accident savings and emissions reductions; or, allocating them to the country from which the trip originated or was destined, such as journey time savings. Details of how costs and benefits have been split are given below.

Capital Investment Costs – calculated for each nation by considering the length of track and specific land type and infrastructure elements required within each country. This means the cost per km of track varies with countries that contain a greater number of crossings and infrastructure experiencing a greater average cost per km.

Maintenance Costs – calculated for each nation by considering the share of the track length within each country. This means the maintenance cost per km of track is constant across the countries; however, the total cost varies due to differing track lengths within each country.

Operating Costs - Calculated for each nation by considering the share of the total annual train- km within each country. For Passenger services, which run from Warsaw to Tallinn the share of train-km is the same as the share of track km. however, for freight services, as service patterns vary with differing numbers of services on different sections of track the share of train-km is not the same as the share of track km.

Track Access Charges – Calculated for each nation by considering the share of the total annual train- km within each country. For Passenger services, which run from Warsaw to Tallinn the share of train-km is the same as the share of track km. however, for freight services, as service patterns vary with differing numbers of services on different sections of track the share of train-km is not the same as the share of track km.

Revenue Benefits – Calculated for each nation by considering the share of the total annual train- km within each country. For Passenger services, which run from Warsaw to Tallinn the share of train-km is the same as the share of track km. however, for freight services, as service patterns vary with differing numbers of services on different sections of track the share of train-km is not the same as the share of track km.

Passenger Time Savings Benefits – Calculated on a matrix level, therefore benefits have been allocated to each nation based on the origin and destination of each trip. Benefits associated with trips internal to a country have been entirely allocated against that nation, whilst the benefits associated with international trips have been split equally between the origin and destination nations. This means the benefits are higher for countries with large volumes of internal trips, and for countries where there are key trip attractors.

Freight Time Savings Benefits – Calculated on a network basis. Journey time savings have been allocated to the country in which they occur. This means that the journey time saving for a freight trip from Estonia to Lithuania will be split between all three nations depending upon the difference between the ‘with project’ and ‘without project’ times on the stretches of the route within each country.

External Benefits, such as accidents and emissions benefits have been allocated to the nation where the reduction in accidents or emissions occurs.

Job Creation - Over the five year construction period 11,900 FTE jobs will be created (3,283 in Estonia, 4,199 in LV and 4,419 In Lithuania). From opening the passenger service creates 221 FTE jobs. As the number of freight services increased the number of FTE jobs created ranges from 110 on opening, 160 in 2030 to 244 in 2040. The impact of direct job creation has not been explicitly included in the CBA analysis. The EC guidance indicates that job creation benefits should not be included explicitly as they are already accounted for in the adjustment to shadow prices (conversion factors).

The allocation of benefits and costs to nations means that there are elements of the whole scheme benefits and costs which are allocated to nations outside the Baltic region; these include revenue, operating costs and track access charges from the Lithuanian border to Warsaw and elements of the time savings for trips originating or destined outside the Baltic states (e.g. trips to/from Poland).

Financial Analysis

The nature of the construction and operation of Rail Baltica mean that there are two sets of stakeholders, from whose viewpoint the financial analysis needs to be undertaken. These are:

1) the Rail Manager, who constructs and maintains the rail line, these costs are offset to some extent by the track access charges paid by the operators
2) the Passenger and Freight Service Operators who operate the services whose costs include maintenance of the train fleet and payment of access charges to the rail manager in exchange for the opportunity to run services on the track. These costs are offset to some extent by the revenue paid by the passengers and hauliers who use the service.

Financial projections are calculated in real prices on a base of 2010, in Euro. In accordance with EC guidance a discount value of 5.0% is used with an appraisal period covering 30 years post opening. The 30 years appraisal period, recommended for rail projects, is applied after opening as it related to the project lifetime.

- Investment period (13 years): 2012 – 2024;
- Operational period (30 years): 2025 – 2054.

Table 12 – Financial Return on the Investment Cost (excludes the impact of any EU grant)

Indicator	Total (€ million)				
	To Rail Manager	To Rail Operator			Consolidated
		Total	Freight	Passenger	
Investment Cost excluding EU Grant	*3,678*				*3,678*
Maintenance	*353*				*353*
Residual Asset Value	*-1,569*				*-1,569*
Operating Costs		*2,559*	*1,676*	*882*	*2,559*
Track Access Charges		*2,508*	*1,764*	*744*	*2,508*
Total Outflows	***2,463***	***5,066***	***3,440***	***1,626***	***7,529***
Track Access Charges	*2,508*				*2,508*
Revenues		*8,270*	*5,429*	*2,842*	*8,270*
Total Inflows	***2,508***	***8,270***	***5,429***	***2,842***	***10,778***
Net Cash Flows	45	3,204	1,988	1,216	3,249
Net Cash Flows (discounted)	-1,386	785	517	268	-601
Financial NPV of Investments (FNPV/C)	**-1,386**	**785**	**517**	**268**	**-601**
Financial IRR of Investments (FIRR/C)	**0.05%**	**-**	**-**	**-**	**3.10%**
Financial MIRR of Investments (MIRR)			**6.22%**	**6.18%**	

(Note: Investment Costs include Capital Costs + Planning/Design Costs +Project Management Costs + Site Supervision Costs)

For this project the funding gap calculation considers the following cash flow elements related to the rail managers account in the calculation of the Funding Gap Rate:

- Investment costs – Total cost of design and construction
- Operating costs – cost of maintenance of the trail infrastructure
- Revenues – Track access charge payments from the rail operators.

Table 13 – Funding Gap Calculation

No.	Main Elements and parameters		Value Not Discounted	Value Discounted (NPV)
			€ million	
1	Reference period (years)	30		
2	Financial discount rate (%)	5.0%		
3	Total investment cost excluding contingencies		3,678	
4	Total investment cost			2,093
5	Residual value		1,569	
6	Residual value			183
7	Revenues			594
8	Operating costs			71
Funding Gap				
9	Net revenue = revenues – operating costs + residual value = (7) – (8) + (6)			707
10	Investment cost – net revenue = (4) – (9)			1,386
11	**Funding gap rate (%) = (10) / (4)**	**66%**		

Table 14 – Community Contribution Calculation

No.		Value (€ million)
1	Eligible cost (not discounted)	3,678
2	Funding gap rate (%)	66.2%
3	Decision amount, i.e. the “amount to which the co-financing rate for the priority axis applies” = (1)*(2).	2,436
4	Co-financing rate of the priority axis (%)	85.0%
5	**Union contribution (in euro) = (3)*(4)**	**2,070**

Following calculation of the EU grant, the financial return on the national capital has been calculated (FNPV/K). This includes the impact of EU funding in terms of a reduced investment cost. In effect this is a measure of the value for money in terms of the balance between benefits and only the element of capital investment made by the member states.

Table 15 – Financial Return on National Capital

Indicator	**Total (€ million)**				
	To Rail Manager	To Rail Operator			Consolidated
		Total	Freight	Passenger	
Investment Cost	*3,678*				*3,678*
Maintenance	*353*				*353*
EU Grant	*-2,070*				*-2,070*
Residual Asset Value	*-1,569*				*-1,569*
Operating Costs		*2,559*	*1,676*	*882*	*2,559*
Track Access Charges		*2,508*	*1,764*	*744*	*2,508*
Total Outflows	***392***	***5,066***	***3,440***	***1,626***	***5,458***
Track Access Charges	*2,508*				*2,508*
Revenues		*8,270*	*5,429*	*2,842*	*8,270*
Total Inflows	***2,508***	***8,270***	***5,429***	***2,842***	***10,778***
Net Cash Flows	2,115	3,204	1,988	1,216	5,319
Net Cash Flows (discounted)	-208	785	517	268	577
Financial NPV of Investments (FNPV/K)	**-208**	**785**	**517**	**268**	**577**
Financial IRR of Investments (FIRR/K)	**3.70%**	**-**	**-**	**-**	**8.17%**
Financial MIRR of Investments (MIRR)			**6.22%**	**6.18%**	

Having determined the investment costs, operating costs and sources of finance, it is possible to determine the project's financial sustainability. A project is financially sustainable when it does not incur the risk of running out of cash in the future. The sustainability assessment determines whether the timing of cash spending and generation results in the cash inflows consistently matching the cash outflows. Stability occurs if the cumulative net cash flow is positive in all years.

Overall the project shows positive cumulative cash flow in all years suggesting that at this level the project is financially stable. The net cash flow for the rail manager is positive in all years. The positive annual cash flow leads to a large cumulative net cash flow by the end of the appraisal period.

1.7 INTEROPERABILITY ASSESSMENT

Interoperability Directive and its related TSIs are designed to facilitate the "optimal level of technical harmonisation" of the entire EU rail system with a view to improving its competitiveness, for example, by lowering production, acceptance, operation and maintenance costs. The aim is, on one hand, to facilitate international railway services and, on the other hand, to set up common EU-wide rules for conformity assessment and placing in service of infrastructure, fixed facilities and vehicles.

In respect to the Rail Baltica 1435mm railway, the Directive and its related TSIs must set the "optimal level of technical harmonisation" of the entire Rail Baltica system, as well as within each of the three (3) distinct and different Baltic States and in relation to the neighbouring counties Poland and Helsinki.

Table 16 – Key Issues related to Compliance with Interoperability Directives

Interoperability Directives Related to Rail Baltica

Subsystem	Reference	Specification Parameter	Potential Impacts/Risks
Infrastructure	CR INF TSI	Line Layout, Track Parameters, Switches, and Crossings	Adjacency to existing 1520mm gauge tracks, dual gauge track complications, minimum radius of curves in constrained locations, internal (1435mm) and external (1435/1520mm) switching and crossings.
		Track and Structure Resistance to Loads	Resistance of existing bridges and earthworks to traffic loads
		Track Geometrical Quality	Geometrical quality at locations near stations, terminals and facilities where 1520mm gauge exists
		Platforms	Lenghts and heights of platforms in existing stations, access and entry/exit to stations and dedicated platform locations
Energy	CR ENE TSI	Power Supply	Overall capacity and grid, substation connections and location on new corridors, sectioning locations, separation sections and return circuits
		Geometry of the OCL and Quality of Current Collection	Contact line systems and interference with adjacent existing electrified 1520mm lines, geometry, pantograph gauge and contact force at cross-overs with existing 1520mm electrification.
Control-Command and Signalling (CCS)	2006/679/EC	On-board systems	ERTMS implications on ETCS functionality, interfaces to internal and external control-command, electromagetic compatibility
		Track-side systems	ERTMS implications on ETCS functionality, interfaces to internal and external control-command, track-side train detection systems in urban areas/cross-overs of various gauge lines.
Rolling Stock - Noise	2006/66/EC & 2011/229/EU	Noise Emitted by Freight Wagons	Development of new noise TSIs during project development that currently are not mandated based on "Specific Cases" for Estonia, Latvia, and Lithuania.
		Noise Emitted by Locomotives, Multiple Units and Coaches	Development of new noise TSIs during project development that currently are not mandated based on "Specific Cases" for Estonia, Latvia, and Lithuania.
		Interior Noise of Locomotives, Multiple Units and Driving Trailers	Development of new noise TSIs during project development that currently are not mandated based on "Specific Cases" for Estonia, Latvia, and Lithuania.
Operation and Traffic Management	2006/920/EC	Staff/Organization	Establishing appropirate roles and responsibilities for railway undertakings staff and infrastructure manager staff to ensure safety, reliability, availability, health, environmental protection and technical compatibility of the line.
Telematic Applications for Freight and Passenger Services	2001/16/EC	Information Systems & Monitoring	State-of-the-art systems and monitoring devices will be employed and will be required to share data and information with existing inforamtion systems at the national level.
		Marshalling and Allocation Systems	Marshalling and allocation systems will need to interface with existing 1520mm gauge freight systems at intermodal terminal locations.
		Management of Connections with Other Modes of Transport	Specifically at transfer points for both passenger services (ports/airports/train stations) and freight services (ports/intermodal terminals).

1.8 IMPLEMENTATION ISSUES

The current feasibility study has provided the economic and technical justification for a single option route alignment to be considered further. Given the strategic and feasibility nature of the study, it cannot be assumed that the route identified is now in a position where more detailed design can be considered. The study has simply identified the broad parameters of a major rail programme which can now be further developed and refined as projects within their own right. The identification of a single route option cannot be considered as the definition of a single option for a rail system. This requirement is the starting place for the next phase of the Rail Baltica Programme.

It is recommended that the principle objectives of the Rail Baltica implementation should encompass the principle elements:

1) the definition of an overriding sponsorship remit for the Rail Baltic programme in general and the key individual national programme elements,
2) the development of a refined statement of benefits and costs arising from the preferred route option,
3) an assessment of the current capability of the existing systems and railway facilities which would be impacted on or be part of the Rail Baltica programme,
4) the development of stage 1 single option designs to route sections noting the overall programming phasing requirements. These designs will be required to generate to a satisfactory standard, programme costs. In addition they will provide the basis on which market testing can be carried out in respect of future scheme procurement. Of particular concern will be the need to ensure designs conform to national, EU and international environmental and sustainability requirements,
5) the Rail Baltica programme will consist of a number of individual (but in their own right) major projects. Under the single option developed in this study, there will be a range on individual programme options. As part of the overall programme assessment, each individual option should be assessed in respect of its ability to meet both the overall programme requirements and those identified at a local level. This process will require value engineering studies to be carried out of system wide component options and geographically defined route choices,
6) refinement of system functional specifications. It is noted that Rail Baltica may be developed over a number of time periods and as such, the demands placed on the system and the emergence of new technological solutions is likely to require refinements to functional specifications at a local and regional level,
7) a report into the constructability of the whole programme and the individual components. This ongoing report is required at all stages of the programme to confirm not only are the individual design proposals capable of meeting the commercial specification, but also to ensure that it is feasible to build. The report will be a key component in assessing overall programme construction risk, and
8) the definition of a robust national and international consultation strategy.

The Rail Baltic programme is in its early stages of development and significant activities will need to be undertaken prior to concluding final service specifications, technical requirements, route alignments and final single option design components. Such a situation is commonplace amongst all major transport projects. The position is however complicated by the following factors:

- the presence of up to 4 nation stakeholders in addition to other national interested parties
- the existence of differing regional economic objectives
- the need to accommodate the requirements of a range of stakeholders including potential users, railway undertakings, infrastructure managers
- an acknowledgement that the programme will challenge existing regional transport provision and will impact on current rail solutions employed

Setting these issues in context, it is important to note the high degree of co-operation which has been achieved to date between the project countries and the acceptance that robust arrangements need to be in place to facilitate project delivery including construction and finance. Further, the strategic objectives of the European Union, their ongoing support and the existence of mandatory technical standards will have a significant positive impact on programme delivery. The mandatory requirement to conform to interoperability requirements will do much to remove technical risks associated with the introduction of new systems. The ongoing political support of the EU will also provide support in mitigating some financial risks associated with the programme.

It is recommended that Rail Baltica development should as now be overseen by a programme steering group (PSG). The PSG function would be to have overall control of the strategic delivery of the Rail Baltica programme. The PSG would comprise of representatives from the principle member states and assisted by other key stakeholders including the European Union.

Whatever development option is chosen, it is recommended that an integrated programme organisation (IPO) is established at the earliest opportunity with the principle objective of facilitating project development. The IPO must be a technical based organisation operating within defined terms of reference and be of short term of regional, national and local influences.

International experience suggests that an independent IPO will be able to execute programme functioned quickly within the terms of reference. Project activities can be effectively undertaken without time consuming and costly interventions.

It is recommended that one of the key objectives of the PSG would be to put in place an independent review group (IRG) which would allow programme business objectives to be kept under review. The role of an independent review board would be to provide the PSG (and through them, the IPO) with the very latest information on:

- emerging national, regional and international commercial requirements in terms of rail systems looking ahead in a 5, 10 and 30 year time period
- a review of the current and future technical capabilities of rail systems which may warrant inclusion within the Rail Baltica programme.

It is recommended that the international group be comprised of independent rail and commercial experts who can draw on both regional and international experience.

The following Implementation Road Map provides an indicative timeframe for the implementation of the Rail Baltica programme. At all stages of the programme, options will exist for decision review criteria to be applied by the PSG. It should be noted that many tasks can be undertaken simultaneously as is conceptually defined in the following Rail Baltica Implementation Programme.

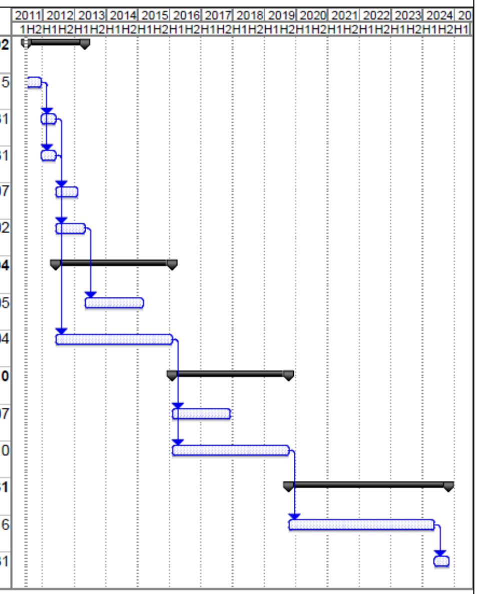
Table 17 – Implementation Road Map

	Task	Duration	Notes
1	Review and confirm high level feasibility report	6 months	Accepting strategic objectives and preferred routing will require significant consultation
2	Establish PSG, IPO and the 2 IRGs	6 months	Agreeing composition, terms of reference and governance structures will be complex but can be undertaken in parallel with task 1.
3	Strategic stakeholder consultation	6 months	A critical process to ensure all parties endorse strategy
4	Definition of programme plan, resourcing and financing arrangements	9 months	Establishing at a strategic level, overall structures for progressing with the programme including high level procurement and financing strategies. Opportunities to propose financing arrangements including PPP.
5	Review of options assessment for individual projects within the programme	12 months	Process designed to allow scheme to move towards single option design for all components of the system. Opportunity to test proposal option]s and apply value and risk management processes
6	Environmental Impact Statement	24 months	Environmental Impact Assessment of proposed option, including alternative solutions. Strategic environmental assessment has to be done by municipalities in parallel.
7	Spatial and Regional Planning	36 months	Detail planning and reservation of territories
8	Single option design	24 months	Activity to cover all elements
9	Scheme procurement	48 months	Rolling programme to procure all necessary elements associated with scheme construction. Land acquisition will be a significant issue and consideration will need to be given to corridor reservation and acquisition.
10	Construction	60 months	
11	Testing and commissioning	6 months	

Figure 6 – Implementation Programme

RAIL BALTICA
IMPLEMENTATION PROGRAMME

ID	Task Name	Duration	Start	Finish
1	**PHASE 1: PRE-PLANNING**	**24 mons**	**Fri 11.07.01**	**Thu 13.05.02**
2	Task 1: Confirm Feasibility Report (Baltic States/EU)	6 mons	Fri 11.07.01	Thu 11.12.15
3	Task 2: Establish PSG/IPO/IRG(2)	6 mons	Fri 11.12.16	Thu 12.05.31
4	Task 3: Strategic Stakeholder Consultation	6 mons	Fri 11.12.16	Thu 12.05.31
5	Task 4: Programme Planning/Resourcing/Financing	9 mons	Fri 12.06.01	Thu 13.02.07
6	Task 5: Options Assessment	12 mons	Fri 12.06.01	Thu 13.05.02
7	**PHASE 2: PLANNING**	**48 mons**	**Fri 12.06.01**	**Thu 16.02.04**
8	Task 6: Environmental Impact Statement	24 mons	Fri 13.05.03	Thu 15.03.05
9	Task 7: Spatial/Regional/Detail Planning	48 mons	Fri 12.06.01	Thu 16.02.04
10	**PHASE 3: DESIGN/PROCUREMENT**	**48 mons**	**Fri 16.02.05**	**Thu 19.10.10**
11	Task 8: Technical Design	24 mons	Fri 16.02.05	Thu 17.12.07
12	Task 9: Scheme Procurement	48 mons	Fri 16.02.05	Thu 19.10.10
13	**PHASE 4: CONSTRUCTION**	**66 mons**	**Fri 19.10.11**	**Thu 24.10.31**
14	Task 10: Construction	60 mons	Fri 19.10.11	Thu 24.05.16
15	Task 11: Testing and Commissioning	6 mons	Fri 24.05.17	Thu 24.10.31



Project: 110531_Rail Baltica Implemen
Date: Fri 11.06.17

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

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1.9 RECOMMENDATIONS AND CONCLUSIONS

An interoperable North-South railway corridor linking the Baltic Countries with Poland and the rest of the EU rail network has been seen by many as pivotal from the perspective of development of the railway transport mode in the region. The idea of Rail Baltica first appeared in 1994 in the joint political document "Vision and Strategies around the Baltic Sea 2010" as an important element for spatial development in the Baltic Sea Region.

Initially over 20 different route segments were considered before condensing them down to 4 key route options, designated the red, orange, yellow and green routes. The red and yellow routes were for the most part on new alignments the primary difference between them being in Estonia where the red route passes through Parnu and the yellow route passes through Tartu. The orange and green routes followed for the most part the existing route corridors and again the primary difference is in Estonia where the orange route passes through Parnu and the green route passes through Tartu.

For each of the four options freight and passenger demand was assessed along with other issues including environmental impacts and the wider economic benefits, based upon an initial assumption of a mixed service, with passenger trains every 2 hours and freight trains running predominantly during the night. The results of the assessment showed that for passengers the yellow option would be best. The reasons for this were that it offered a fast journey time and picked up a significant internal demand at Tartu. For freight the greatest demand was seen on the red route predominantly as a result of the shortest journey time. The key issue with freight demand was however found to be price.

A full qualitative assessment of each route option was undertaken taking into account the wider economic benefits, the potential planning impacts and environmental issues. From this analysis it was recommended that the red route option should be investigated further, in the form of a detailed Cost Benefit Analysis (CBA) as it was felt that it offered the potentially most viable solution.

As stated above the red option is primarily on a new alignment passing through mainly agricultural and forest land. Whilst it passes through a number of Natura 2000 sites and this will have an effect on the planning process it is not anticipated that this will present a major problem to the projects implementation. Obviously a full Environmental Impact Assessment will have to be undertaken as part of the future project development.

The results from the CBA, based on the assumptions made for the project are such that the project can be considered as generally viable. With an overall discount rate of 5.5%, there is a positive NPV of 1,368M EUR, at 2010 prices, and a benefit cost ratio of 1.75. The corresponding EIRR is 9.3%. However, in normal circumstances to attract EU funding for transportation projects The EIRR would normally have to be greater than 11.0% and the BCR higher. Political factors will be a serious factor in the future of this project both in terms of the desire of the EU to link the Baltic States with the rest of the EU using a standard gauge railway and in terms of the individual Baltic States whose development could be stimulated by this project.

In addition, the Financial Analysis shows the project having a positive cumulative cash flow in all years suggesting that at this level the project is financially stable. Financial indicators of the investment, without EU funding, show negative results emphasising the importance of securing the EU funding. Although, FRR/K on a consolidated basis (IRR of national investments), which has been calculated in accordance with method set out in the EC Guide to Cost Benefit Analysis of Investment Projects is 3.10%

The figures also show that there should be no need for subsidies during the operational period, although in order to help stimulate initial demand, in particular for freight traffic subsidies may be helpful during the start up period.
On a country basis it is seen that the best results are in Estonia. This is not particularly surprising as passenger benefits are accrued by having three stations; Tallinn Central, Tallinn Airport and Parnu as opposed to one station in Latvia and two in Lithuania. In addition freight demand is strong and therefore the benefits higher as a result of the strong flows from St Petersburg and Finland. Construction costs are also lower in Estonia as there are no major structures required.

Sensitivity tests were run for the CBA on the whole route focussing on the key variables of capital cost, spend profile, operation and maintenance costs, demand, cost of time savings and GDP growth. With each parameter change the NPV remained positive, but in the case of a 50% freight demand drop only just. There is no reason to believe that most of these variables are correlated; however, it is possible that some of them will be downside whilst others are upside at the same time. For this reason, to assess the likely results of parameter fluctuation a risk analysis was conducted using @Risk which uses a Monte Carlo simulation approach. The result of the risk analysis is that there is a more than 95% chance that the NPV will be positive.

The project should be able to be implemented to comply with the Technical Standards of Interoperability, but certain parameters will need to be carefully engineered in relation to infrastructure, energy, and control-command and signalization systems. The overall framework and procurement of the required operational equipment will also need close scrutiny to comply with directives related to rolling stock, operations and information systems.

From an implementation perspective, it is recommended that Rail Baltica development should be overseen by a programme steering group (PSG). The PSG function would be to have overall control of the strategic delivery of the Rail Baltica programme. The PSG would comprise of representatives from the principle member states and assisted by other key stakeholders including the European Union. Upon commencement of the implementation, it is recommended that an integrated programme organisation (IPO) is established at the earliest opportunity with the principle objective of facilitating project development. The IPO must be a technical based organisation operating within defined terms of reference and be of short term of regional, national and local influences. The IPO should be both organisationally and financially separate and independent from existing national and international bodies.

By separating the functions of strategic control and programme, the delivery risk which has surrounded many international projects in the past can be more effectively controlled.

In order to successfully implement such a large scale project it is also necessary to have sound project communication with and between the parties involved. It is very necessary to provide appropriate marketing and public communications support – a solid public affairs strategy to build consensus among the various stakeholders of the project including, but not limited to: decision makers of the involved countries of Rail Baltica; the involved countries and the EU member states; the involved countries and EU institutions; all involved parties within each of the involved countries (governments and local municipalities), and the general public.