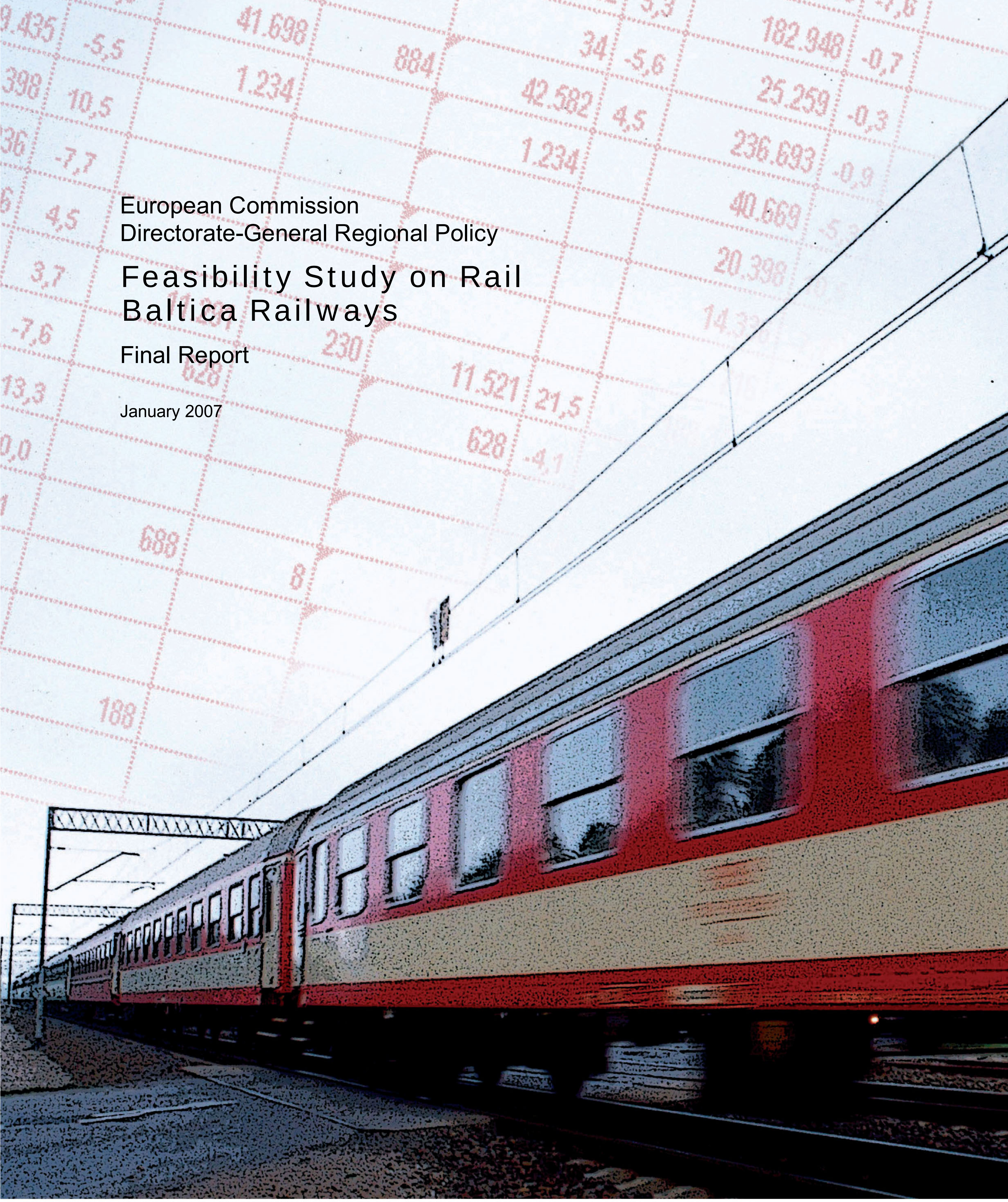
European Commission
Directorate-General Regional Policy

Feasibility Study on Rail Baltica Railways

Final Report

January 2007



COWI

TRANSPORTO IR KELIŲ TYRIMO INSTITUTAS

NEA a member of Panteia

Universität Karlsruhe

ETC TRANSPORT CONSULTANTS

OBET PP

KONSORTS SIA

The study has been carried out by a consortium led by COWI A/S on the request of the European Commission, Directorate-General Regional Policy. The contents and the views expressed remain the responsibility of the consultant.

European Commission
Directorate-General Regional Policy

Feasibility Study on Rail Baltica Railways

Final Report

January 2007

Report no.	4
Issue no.	4
Date of issue	16 January 2007
Prepared	TOD, EWI, PJM, SBJ, JNF, KSP, LR, EZ, KK
Checked	KSP
Approved	KSP

Table of contents

List of abbreviations

AGC	European Agreement on Main International Railway Lines
AGTC	European Agreement on Important International Combined Transport Lines and Related Installations
CIM	Uniform Rules Concerning the Contract for International Carriage of Goods by Rail
CIS	Commonwealth of Independent States
CIV	Uniform Rules concerning the Contract for International Carriage of Passengers by Rail
COTIF	Convention concerning International Carriage by Rail
EC	European Commission
ECE	Economic Commission for Europe
EIA	Environmental Impact Assessment
ERTMS	European Rail Traffic Management System
ESPON	Potentials for Polycentric Development in Europe, Nordregio
ETCS	European Train Control System
ETIS	The European Transport Policy Information System
GDP	Gross Domestic Product
IRR	Internal Rate of Return
MEGA	Metropolitan European Growth Areas
NEAC	(model)
NPV	Net Present Value
NUTS 2	(region)
NUTS 3	(region)
OD	Origin/Destination
OSZhD	Organisation for Cooperation between Railways
OTIF	Intergovernmental Organisation for International Carriage by Rail
PPP	Public Private Partnerships
SAC	Special Areas of Conservation
SCI	Sites of Community Importance
SMGS	Agreement on International Goods Transport by Rail
SMPS	Agreement on International Passenger Transport by Rail
SPA	Special Protection Areas
TEN-T	Trans-European Transport Network
TSIs	Technical Specifications for Interoperability
UN	United Nations
VACLAV	(model)

1 Main conclusions and recommendations

A strategic study of the Rail Baltica railways has been conducted in the period November 2005 - December 2006 on the request of the European Commission, Directorate-General Regional Policy. The objective of the pre-feasibility study has been to assess strategically the overall need and potential for developing Rail Baltica and to provide recommendations for project implementation of the most suitable development option in terms of alignment, technical standards and organisation.

The concept of Rail Baltica refers to the imaginative, strategic and sustainable north-south rail project connecting Tallinn in Estonia - via Latvia and Lithuania - with Warsaw in Poland. Despite the fact that Rail Baltica is one of the TEN-T priority projects, it has become clear that very little specific planning and analysis has been made for the project in the countries.

Other ongoing studies are also addressing issues of relevance for making decisions on the development of Rail Baltica, such as the EC INTERREG IIIB study "*Rail Baltica – Transnational Integration through Coordinated Infrastructure and Regional Development"*. The goals are to analyse the Rail Baltica railway link in terms of spatial planning and regional development and to raise the awareness in the Baltic Sea region of the benefits of attractive railway connections.

1.1 Rail Baltica - policy and planning context

Rail Baltica is identified as priority project no. 27 of the Trans-European Transport Network in Europe as specified in the Decision number 884/2004/EC amending the Community guidelines for the development of the TEN-T. This Decision was adopted by the European Parliament and the Council in April 2004. Rail Baltica is part of the Corridor I, which also consists of Via Baltica (road component) and Branch A to Kaliningrad (Via Hanseatica).

Presently, the Baltic States make little use of rail transport for north-south bound international passenger and freight transport. The existing north-south network is of poor quality. The level of service and the speed is low and there are barriers for interoperability with the rest of the EU due to differences in standards, especially different gauges.

A vision and strategy for the Baltic Sea region was elaborated by the countries in the region in the early 1990s and 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 latest update of the document was made in 2001. Later, on 15 September 2003 the Rail Baltica Co-ordination Group (representing Poland, Lithuania, Latvia and Estonia) agreed on the key aspects to be considered in future studies of Rail Baltica investments. And most recently, a *Declaration of Intent* was signed on 27 March 2006 by the transport ministers of the four project countries and Finland.

The main idea behind Rail Baltica is to develop high-quality connections for passenger and freight transport between the Baltic States and Poland, as well as between the Baltic States and other EU countries through the hub Warsaw. Improved rail lines will result in more efficient land-bound connections between the Baltic and the Nordic countries (particularly Finland) and in the long run potentially further to Central Asia. Improved rail links will benefit the environment, contribute to alleviate congestion on the European road network, increase the accessibility of the Baltic States and potentially improve conditions for accelerated regional development in the countries involved.

A good and cost-effective transport system is a pre-condition for maintaining high economic growth and improving the European integration.

1.2 Economic development and future demand for transport

The project countries have presently high levels of economic growth due to i.a. the increased economic integration with the rest of the EU and, consequently, the transport sector experiences a rapid growth in traffic.

The future size of and type of demand for transport depends, on the one hand, on the economic and demographic development in both the Rail Baltica countries and the other European countries and, on the other hand, on the type and quality of transport services provided. The supply of services is linked to i.a. the investments made in the transport sector and the European policy framework with regard to financing/charging, harmonisation, environmental sustainability and regional development.

The overall future demand for transport is estimated in a complex European trade and traffic model forecasting system including the whole of Europe. The future north-south rail traffic in the Baltic States is related to the overall demand for transport, but very specifically to the transport services which can be offered. The future demand for rail services on Rail Baltica is analysed for a situation without real improvements of the rail infrastructure in the north-south corridor compared to today[1]. Traffic analyses are then made for specific devel-

[1] The remaining transport infrastructure is assumed to be improved according to existing investment plans in the countries. This is called the *reference situation*

opment options/investment packages to calculate the change in traffic patterns when implementing these options.

1.3 Range of development options

The outline plan for the Trans-European Transport Network provides an indicative routing of a Rail Baltica corridor and forms the basis for identifying possible alignments for Rail Baltica. A number of alignment options and technical development options have been discussed in the countries, and together the combinations make up more than 20 development options.

A screening of the combinations of options was conducted considering the following criteria: preliminary investment cost estimates, preliminary assessment of traffic potential, environmental issues and the need to consider both Russian and European gauge standard solutions. Three main investment packages were selected for economic and financial analysis.

1.3.1 Package 1: Design speed of minimum 120 km/h

Package 1 represents a solution, which secures a minimum design speed of 120 km/h from Tallinn to Warsaw.

The package describes a situation where Russian standards are maintained in Estonia, Latvia and Lithuania - except from the section from Kaunas to the Lithuanian/Polish border where a new line with European standards (not electrified) is constructed according to already agreed standards. The package includes the construction of a 185 km partly new and more direct line from Joniskis via Radviliskis to Kaunas. Alternatively, the existing line could be upgraded/extended. This option is considered a sub-variant in Package 1.

This package requires that a re-loading station or logistics centre be established in the Kaunas region.

Figure 1.1 Graphical presentation of Package 1

	Upgrade of existing line	New line
Russian standard	120 km/h 160 km/h	160 km/h
European standard	120 km/h 160 km/h	160 km/h 200 km/h

Note: The section from Kaunas to the Polish/Lithuanian border is not electrified in Package 1.

1.3.2 Package 2: Design speed of minimum 160 km/h

The second package reflects a rather ambitious plan for implementing Rail Baltica. It includes a north-south connection providing a design speed of at least 160 km/h.

The package also includes the construction of a new line from Kaunas to the Lithuanian/Polish border based on European standards (not electrified). It requires that a re-loading station or logistics centre be established in the Kaunas region.

The main option includes the construction of a new and more direct line from Joniskis via Radviliskis to Kaunas, but as for Package 1, a sub-variant is considered, based on upgrading of the existing line between these cities.

Another sub-variant is also considered where a new line is constructed from Riga - via Bauska and Panevezys - to Kaunas.

Figure 1.2 Graphical presentation of Package 2

	Upgrade of existing line	New line
Russian standard	120 km/h 160 km/h	160 km/h
European standard	120 km/h 160 km/h	160 km/h 200 km/h

Note: The section from Kaunas to the Polish/Lithuanian border is not electrified in Package 2.

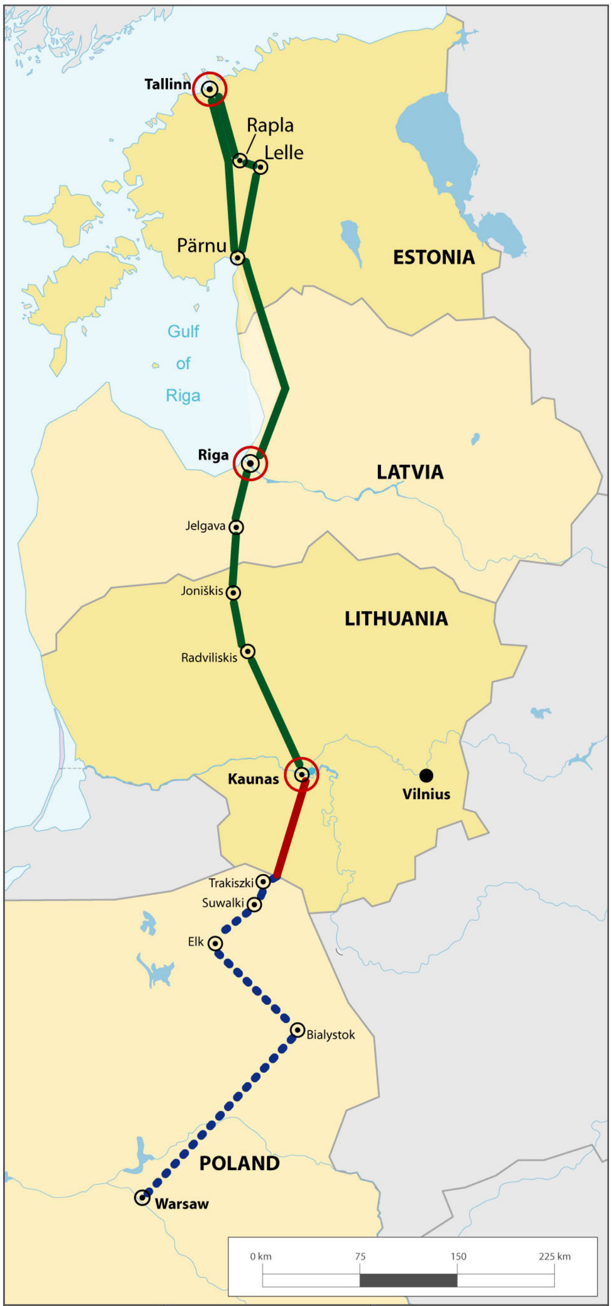
1.3.3 Package 3: European gauge standard

The third package reflects the most ambitious plan for implementing Rail Baltica. The package is based on the European gauge standard on all north-south sections.

The alignment between Tallinn and Riga will run via Pärnu (the shortest route), while the section between Riga and Kaunas will run via Radvilikis (the shortest route). From Kaunas to the Lithuanian/Polish border a new line is constructed with a design speed of 200 km/h. The Polish part of the link (via Elk) is upgraded to 160 km/h and the section from Bialystok to the Lithuanian/Polish border is electrified.

Investment package 3 includes 2 sub-variants. One variant is to construct a new line via Lelle/Pärnu instead of a direct link from Tallinn to Pärnu, while the second sub-variant considers the consequences of no further electrification.

Figure 1.3 Graphical presentation of Package 3



	Upgrade of existing line	New line
Russian standard	●●●●● 120 km/h ●●●●● 160 km/h	▬ 160 km/h
European standard	●●●●● 120 km/h ●●●●● 160 km/h	▬ 160 km/h ▬ 200 km/h

Note: The section from Kaunas to the Polish/Lithuanian border is electrified in Package 3. The second sub-variant is no electrification north of Bialystok.

1.4 Analysis of three investment packages

The three investment packages have been analysed with respect to the consequences for passenger and freight transport and compared to a situation without investments in the Rail Baltica corridor, the *reference situation*. The financial and economic feasibility of the packages compared to the reference situation has been assessed and an environmental screening performed.

1.4.1 Traffic analysis

Traffic has been modelled for a network covering the EU and the surrounding countries to the East such as Belarus and Russia. Hence, the effects of improving the infrastructure of the Rail Baltica are analysed for the whole network.

Passenger traffic
The current passenger transport flows have the following characteristics:

- Particularly in Latvia and Estonia, the market share of the rail mode is at a remarkably low level
- International rail passenger transport flows along the Rail Baltica corridor are negligible and road transport is predominant
- The only section of Rail Baltica with a substantial passenger rail flow is the line between Warsaw and Bialystok

The implementation of investment package 1 is expected to increase the passenger transport flows along the Rail Baltica corridor, which is induced both by modal shifts and by changes in the route choice. Furthermore, the implementation of investment package 1is expected to result in a moderate increase in the passenger demand on the lines feeding the Rail Baltica corridor, such as Liepaja – Jelgava or Klaipeda – Siauliai. The impacts in the southern part of Rail Baltica are more prominent than in the northern part of the corridor. One reason for this is that the section Tartu – Tallinn is expected to be upgraded, independently of the investment options under examination. In 2034 around 1.9 million passengers per year are expected between Bialystok and Elk, 1.2 million are expected to be carried across the Polish/Lithuanian border, while 1.5 million passengers per year are forecasted on the new line between Kaunas and Radviliskis.

The investments of package 2 are expected to result in a further increase in demand in the southern part of the Rail Baltica corridor. On the new line between Kaunas and Radviliskis, the annual passenger transport volume is expected to amount to 1.6 million passengers per year in 2034.

The forecasted passenger transport volumes on Rail Baltica for investment package 3 tend to be slightly lower than in investment package 2. Relatively modest rail passenger volumes are expected on the new rail link Riga – Pärnu – Tallinn. The forecasted passenger volumes on these sections amount to 0.3 to 0.5 million passengers per year in 2034.

Freight traffic

Although being relatively small countries in size, density and economy compared to other EU countries and neighbours, the Baltic States' networks accommodate significant flows of international and transit freight traffic. In this respect, Poland serves to a major extent as transit country for Baltic goods flows to and from the rest of the EU25 and non-EU countries in the south-eastern part of Europe. Generally, large rail freight flows in the countries are strongly oriented in the east-west direction (except in Estonia).

The implementation of investment package 1 shows that a moderate shift of approximately 1.5 million tonnes from road to rail can be expected in the future.

The implementation of investment package 2 will only slightly improve the operational speeds of freight trains compared to the speeds of investment package 1, as the freight trains can only to a limited degree make use of the potential for higher speeds. The Rail Baltica traffic will in some sections share the tracks with quite intensive east-west traffic, which goes towards the Baltic ports. The transport flows generated in investment package 2 are to a large extent similar to that of investment package 1.

The railway network after implementation of investment package 3 is different, because the whole Rail Baltica line will have the same gauge standard and much transshipment of goods will be avoided. The operational speed will be relatively high and the alignment will be more direct. With a properly functioning Rail Baltica freight train service (i.e. premium trains) more than 4 million tonnes could be shifted from road to rail. With implementation of a competitive pricing policy the effect could be even higher. Finland-bound traffic could be one of the major candidates for this additional modal shift.

1.4.2 Investment costs

The infrastructure costs of implementing Rail Baltica are shown below. The table shows the estimated investment costs (construction, necessary equipment, acquisition), which are considered absolutely necessary for the implementation of the three main investment packages and investment package 3 without further electrification. The cost estimates do not include the costs of reconstruction in cities or new terminals as such works will be part of larger schemes with much wider aims than that of Rail Baltica. Furthermore, the capital costs of rolling stock are included as a capital cost element of rolling stock and not as part of the infrastructure investment costs below.

Table 1.1 Infrastructure investment costs (million €, 2006 price level)

	Package 1	Package 2	Package 3	Package 3 without electrification
Investment costs	979	1,546	2,369	1,830

Note: VAT and taxes are not included.

The cost assessment shows that the costs of electrification account for a rather large share of the costs for implementing package 3. Upgrading of the existing line in Lithuania north of Kaunas compared to the construction of a new line will reduce the investment costs by about €150 million.

Given that the project is in the early stage of the planning process and few details therefore are available on the investment packages, the assessment is subject to large uncertainties.

The pure construction costs are expected to remain relatively constant in real prices over time, but the costs for land acquisition are highly uncertain due to a number of factors, including uncertainties about the future legislation on expropriation. The cost assessment shows, however, that the costs of land only account for a minor share of total investment costs.

1.4.3 Financial and economic assessment

Both the financial and economic viability of the investment packages has been analysed. The analyses have been carried out as an incremental analysis, i.e. an evaluation of the investment packages compared to the reference scenario. The assessments cover all four countries as a whole and include all effects on the entire rail network in the four countries and thus not only the affects on the Rail Baltica line.

The **financial analysis** gives an overview of the financial flows of investment, the operating costs and the revenues over the lifetime of the project and it calculates the financial internal rate of return on the total investment (FIRR/C) and the own capital (FRR/K) assuming that the EU grants equal 60% of the total investments costs. The financial analysis focuses on the costs and revenues from the perspective of the following three agents:

1. The infrastructure manager
2. The operator of passenger trains
3. The operator of freight trains

Table 1.2 Results of the financial analysis

	Inv. package 1	Inv. package 2	Inv. package 3
Rail manager			
Financial NPV (FNPV)	-10	-109	-274
FIRR on own capital (FRR/K)	4.7%	3.4%	2.6%
Rail operator, passengers			
Financial NPV (FNPV)	-26	-105	-96
Rail operator, freight			
Financial NPV (FNPV)	33	39	70

Note: The financing gap is in all packages higher than 60% of investment costs. No firm estimate of a likely EU contribution is available, but 60% are considered a realistic assumption.

The financial analysis shows a mixed picture where none of the investment packages are dominating. The different financial perspectives are consequently associated with different investment package preferences.

Compared to the main result of investment package 3, the sub-variant without electrification improves the financial result of the rail manager to an IRR of 3.4%.

With the current assumptions and traffic analyses, none of the investment packages seem to be financially viable for the rail manager assuming funding from EU grants equal to 60% of the total investments costs, so the funding gap is in all packages more than 60% of the investment costs. From the rail manager's perspective, investment package 1 is the most attractive option, while investment package 3 is the least attractive option. Higher revenue from access charges in packages 2 and 3 compared to package 1 cannot outweigh the higher investment costs.

For the rail operator running passenger trains none of the investment packages or sub-variants are financially viable. This means that additional public subsidies will be required to sustain the passenger services, which the traffic demand analyses anticipate. Investment package 1, however, gives the lowest net loss.

All investment package variants are financially viable for the rail operator running freight trains. Most profitable is investment package 3 and least attractive is investment package 1. However, taking into account the considerable uncertainty, the results are almost identical for the three main investment packages.

It should be stressed that the above conclusions heavily depend on the applied assumption that the fares and infrastructure access charges are kept at current levels in real prices. Furthermore, there is uncertainty about the rail manager's actual maintenance costs and the operator's actual operation and maintenance costs.

The **economic analysis** encompasses more than just the considerations of the financial returns of the project, such as user benefits and external costs (air pollution, CO_2 emissions and accidents), but most of the project data on costs and benefits are provided by the financial analysis. The economic results of the cost-benefit analysis are presented in terms of the net present value (NPV), the internal rate of return (IRR) and the benefit-cost ratio (B/C ratio).

Table 1.3 Results of the economic analysis

	Inv. package 1	**Inv. package 2**	**Inv. package 3**	**Inv. package 3 without electrification**
Economic NPV	1,044	1,304	1,496	1,856
Economic IRR	13.3%	10.8%	9.0%	10.9%
B/C ratio	2.8	2.3	1.9	2.5

The economic analysis shows that all three investment packages are economically viable.

Measured as NPV, package 3 has the best result, followed by package 2 and finally package 1. When looking at the IRR and the B/C ratio, however, the best result is obtained for package 1, then package 2 and finally package 3. However, if electrification is not a part of package 3, the calculated internal rate of return will be at the same level as for package 2.

Hence, the most preferable solution will depend on the available investment capital and the return on alternative investments.

The largest benefit of the investments is time savings for passengers. The applied values for time savings follow the recommendations made in recent EU research, but are high compared with the values normally used in the countries. If such national values are applied, the economic feasibility of all packages will be *significantly reduced,* but the packages will still be economically viable (IRRs for the three packages are 7.7%, 5.3% and 6.3%, respectively).

Time savings for freight and increased revenue from rail fares for the rail operators are also substantial benefit contributors.

The time savings for passengers in packages 1 and 2 are valued to more than the investment costs. The times savings for freight add to the benefit in all packages. However, especially in package 3, the time savings for freight are high, due to the reduced waiting time for transhipment between the Russian and European gauge.

The increased revenue for the rail operator is caused by an increase in the number of passenger-km and tonnes-km and an increase in the fares. The increase in revenues is not accompanied by a similar reduction in the fares for the transport users.

The effects on external costs are of limited size. All three packages have a positive net benefit from externalities, which both comes from savings as a result of fewer road accidents and reduced air pollution. Finally, there is a small net benefit from reduced CO_2 emissions.

1.4.4 Environmental assessment

From an environmental perspective, any infrastructural development option, which includes acquisition of new land for the Rail Baltica alignments, will have effects on the environment. In terms of possible impacts on the environment, it is therefore the establishment of a new railway line (package 3) that will have the greatest impact. Establishing a railway line along the existing tracks will have less impact, while the upgrading of an existing railway line will have the least impact. (In certain instances, an upgrading can even improve the living conditions of certain species.)

All investment packages will, on the other hand, reduce air pollution and CO_2 emissions from transport due to the shift from road to rail.

It can be concluded that environmental constraints can potentially be a main barrier for implementing some parts of Rail Baltica, but that paying sufficient attention to the main types of environmental impacts can reduce the overall impacts on the environment. The construction of a new alignment will have the largest impact on the environment, followed by adding a track within an existing corridor and improvements within an existing alignment.

It appears that the environmental barriers are most prominent for the alignment option from Kaunas to Warsaw "Via Sokolka".

Strategic environmental assessments and detailed environmental impact assessments (EIA) will be the responsibility of the relevant national environmental authorities in each of the individual detailed design projects, prepared as parts of the Rail Baltica implementation.

1.5 Recommended development and investment strategy

Economic results

All three investment packages are considered economically - but not financially - feasible. None of theme is clearly dominant, although package 1 provides the highest return on investments and must be considered the economically most robust option. So strategically, it *has to be decided if the development of Rail Baltica shall be implemented by improving and modernising the existing broad gauge system or as a new independent rail system with European gauge*.

The economic results point in the same direction for all three main investment packages and the IRRs are almost at the same level. Package 1 has a moderately higher IRR than packages 2 and 3 without electrification, and the two latter ones have IRRs at the same level. Therefore, it is strongly recommended to consider if electrification in package 3 could be excluded and a decision on this matter be postponed until electrification is considered more broadly for the rail networks in the countries.

Financial considerations
There are clear limitations on the funding available for investments in Rail Baltica from both national budgets, from the Cohesion Fund and the TEN-T budget in the coming period 2007-2013. Furthermore, railway infrastructure investments in Europe have, in general, had difficulties in attracting private risk capital due to the often large uncertainty associated with these investments. Rail Baltica is not assessed to be a realistic candidate in the short to medium term for involving private capital to take on revenue risks. The willingness and ability to commit the necessary public funds for investments in Rail Baltica in the coming years are a key factor.

In order to improve the financial situation for both rail operators and rail infrastructure managers, it is - independently of the choice of investment option - recommended to carry out specific analyses to assess if present rail access and rail tariffs are optimal for infrastructure managers, rail operators and users, respectively.

Rail passenger operations may not be financially feasible, so in order to realise the estimated increase in rail transport, the countries need to have the will to subsidise the operators within the current EU legislation framework.

Dual gauge operations
The main advantages of a European gauge solution is the interoperability and compatibility with the European network, which will increase the potential for transport market liberalisation and the availability of infrastructure components at more competitive prices.

The main disadvantages of a European gauge solution is that it will become an "isolated system" in the national networks and it will be incompatible with the important freight transport from outside the EU and with the main part of the national networks. Dual gauge operations in national networks servicing both conventional freight and passenger transport are avoided in other countries for both cost and operational reasons, so experience with such dual systems are limited and they will not facilitate the optimisation of operations.

The interoperability with the existing network could be improved by establishing additional reloading stations or logistics centres similar to that in the Kaunas region.

Management and organisation
The four project countries have well established co-ordination arrangements, so there is a basis for creating a coherent management structure for the implementation of agreed development plans.

Joint development is mandatory for the implementation of especially package 3, which requires very detailed coherent planning and management among the countries to agree on all technical specifications and alignments - and, very importantly, on the timing for the construction of the various sections, which also means close coordination on financing plans. The trans-national management is recommended to be done in a dedicated organisational structure involving staff from all involved countries. Such a structure needs to be guided by a policy committee, which has the power to make the necessary decisions in the process.

The requirements for integrated planning and financing will be considerably lower when developing packages 1 and 2 compared to package 3, as sections in these packages can be developed more independently, as long as clear long-term goals for the north-south line are agreed.

The first recommended step is to agree on:

- a plan for the detailed feasibility studies, environmental impact studies etc, which need to be carried out
- a process for making decisions

Furthermore, a strong focus is recommended on maintaining or improving the attractiveness of north-south rail transport in the coming 5-10 years' developing period in order to ensure that there is a good basis for utilising the investments made in Rail Baltica when they are completed.

Risk issues
The following issues are considered the most important risks elements, which can influence both investment costs and timing:

- Investment costs escalation is a major risk
- Traffic demand is a major risk
- Lack of experience with dual gauge operations
- Environmental risks may be high
- National planning risks may be high
- Trans-national co-ordination risk may be high
- Lack of funding may also be a risk issue

Generally, all types of risks increase from package 1 to package 2 and again from package 2 to package 3, due to the increase in the scale and complexity of the options.

1.6 Implementation of development strategy

Choice of action
As no development option is dominant in economic terms, a trans-national agreed strategy for development of and investing in Rail Baltica needs to balance:

- The economic efficiency of investments
- Funding constraints
- The risk awareness
- The technical consistency within rail networks
- The transport and regional policy priorities
- Environmental considerations

The least costly investment package (1) has the highest IRR and B/C ratio and it is assessed to be the most robust solution, which can be developed further over time in pace with the development in the demand. Furthermore, it is the fastest and least complicated option to implement, but it will offer limited benefits to freight transport.

The most ambitious and costly package (3) is assessed to be the option, which has the highest risks on all parameters, but it is also the option, which has the highest ability to divert freight transport from road, and if more restrictions on road transport are introduced in the future, it provides the best solution to deal with this.

A successful implementation of any of the analysed development options will be a means to realise a long-term development vision: *to change Rail Baltica from an imaginative and policy-driven European project to a strategic and sustainable, but pragmatic north-south rail corridor providing cost-effective transport services for the countries involved in pace with the development of the demand for such services.*

In order to maintain the north-south railway connection as a realistic transport option in the short to medium term, it is recommended that investments are made as fast as possible.

Combining the robustness in economic and financial terms with the financial constraints and the risk profiles, investment package 1 or its sub-variant seem to be a sound choice, which can be further developed over time in pace with the growth in traffic.

Implementation

Implementation of the preferred investment package can naturally be made in different ways depending on the preferred tender strategy and the management capacity in the countries. It is assessed that implementation plans for the three investment packages will be in the range of minimum 4 years and up to 8.5 years after the delivery of this feasibility report, say 1 January 2007. This will of course require that no time be wasted in the planning processes, so the suggested timing range is likely to be optimistic.

The main uncertainties are related to the length of the various periods where decisions have to be made by the national governments and the European Commission, and to the capacity to manage many activities at the same time.

The construction phase will obviously be longer for investment package 3 than the much simpler package 1.

Step-by-step implementation

Obviously, a European gauge system will have to be developed from south to north in order to make sense, but if Rail Baltica is developed by improving the existing broad gauge system, it is recommended that detailed studies are used to identify the most optimal sequence of investments in the network.

The current analysis shows that it could prove to be optimal to give first priority to:

- Sections around the major cities, as a significant share of the benefits is linked to regional transport
- Sections, which are also used for east-west transport, as this accounts for a large share of rail transport in the project countries

Furthermore, it could prove to be optimal to begin upgrading the existing infrastructure in the north, as traffic volumes are higher in the northern part of the corridor.

2 Introduction

This final report for the *Feasibility study on Rail Baltica railways* presents the findings and conclusions of the Consultants based on the performed analyses and the comments received at various Steering Group and Work Group meetings during 2006.

The study is prepared by a consortium of consultants led by COWI A/S in the period November -2005 to December 2006.

2.1 Context

The Baltic countries currently make little use of rail transport for north-south bound international passenger and freight transport. The existing network is of poor quality, the service and speed is low and the system is not interoperable with the rest of EU due to differences in standards.

Broadly speaking the term "Rail Baltica" refers to the north-south rail connection from Tallinn in Estonia - via Latvia and Lithuania - to Warsaw in Poland. The main idea is to enable high-quality connections for passenger and freight transport between the Baltic States and Poland, as well as – through the hub Warsaw – between the Baltic States and other EU countries, particularly Germany, the Czech Republic and the Slovak Republic. The project could also allow more efficient land-bound connections between the Baltic and the Nordic countries (particularly Finland).

A further dimension of the rail corridor relates to modal split effects, since the provision of high-quality rail infrastructure can shift demand from road and air to rail to the benefit of the environment and potentially alleviate congestion on the European road network, increase accessibility and inspire regional development.

Moreover, the corridor could provide a high-capacity and high quality connection to the port of Tallinn, which is of strategic importance for passenger and freight transport relations between the Nordic countries and the Baltic and other Central and Eastern European countries.

The Rail Baltica project is identified as the priority project no. 27 of the Trans-European Transport Network in Europe. Rail Baltica is part of Corridor I, which also consists of Via Baltica (road component) and Branch A to Kaliningrad (Via/Rail Hanseatica).

Despite that Rail Baltica is one of the TEN-T priority projects it has become clear during the current process that very little specific information is actually available about the project, as only a small part of the railway axis has been analysed in detail. Some of the very fundamental issues which have not been settled yet are:

- The alignment of the rail connection: A number of alignment options are discussed in all four project countries.
- The technical options for establishing Rail Baltica: The options range from limited upgrading of the existing rail infrastructure to the construction of a new high speed line based on European standards
- The costs of upgrading/renewing the infrastructure
- The potential for attracting (international) passenger and freight traffic
- The funding of the project
- Barriers for the implementation of Rail Baltica

2.2 Objective

The objective of this study is for each of the above components to assess the overall need and potential for developing Rail Baltica and to provide recommendations for project implementation of the most suitable development options in terms of alignment, technical standards and organisation.

2.3 Structure of the report

The report contains five sections:

Section A: Background and context
Section A provides and overview of the background for the development of Rail Baltica.

Chapters 3 and 4 present the international and national planning and policy context in which the implementation of Rail Baltica will take place.

Chapter 5 describes the existing legacy railway infrastructure on the planned Rail Baltica axis, including an assessment of its short-term evolution.

Section B: Investment packages, investment costs and constraints
Section B presents the three investment packages, which have been selected for detailed analyses (chapter 6), the detailed cost assessment of the investment packages (chapter 7) and discusses the constraints for implementing Rail Baltica (chapter 8).

Section C: Transport assessment
Section C presents the transport assessments for each of the selected three investment packages and a situation without investments in Rail Baltica. Chapter 9 presents the modelling assumptions including the assumptions made regarding the future infrastructure supply. Chapter 10 and 11 present the assessment of the current and future demand for passenger transport for each investment package and the impacts on accessibility, while Chapter 12 presents the same for freight transport.

Section D: Financial and economic assessment
Section D presents the results of the financial assessment (chapter 13) and the economic assessment (chapter 14) of the three investment packages.

Section E: Recommendations and implementation
Finally, Section F synthesises the results of the strategic feasibility study by presenting the recommendations and the implementation plan for Rail Baltica (chapter 15).

Finally, a separate Annex report is produced with additional and more detailed information on e.g. the existing infrastructure, costing of options, traffic modelling assumptions, environmental assessments and the screening process which led to the definition of the three investment packages.

SECTION A: BACKGROUND AND CONTEXT

3 International planning and policy context

The objective of this chapter is to provide an overview of the international planning and policy context within which the implementation of Rail Baltica will take place.

First, the general planning and policy context of Rail Baltica in relation to the European Union is described (section 3.1). Second, the most important agreements between the project countries in recent years are outlined (section 3.2).

3.1 Planning and policy context of the European Union

Priority projects[2]

The EC Treaty (Chapter XV, Article 154-156) states that the European Union must aim at promoting the development of trans-European networks as a key element for the creation of the internal market and the reinforcement of economic and social cohesion. This objective includes the interconnection and interoperability of national networks as well as the access to such networks. To this end, on July 1996 the European Parliament and the Council adopted the Decision number 1692/1996/EC on the Community guidelines for the development of the trans-European transport network (TEN-T).

To tackle the new challenges facing transport and to help meeting the objectives of the new transport policy as described in the Transport White Paper (COM, 2001), the Commission initiated in October 2001 a revision of the TEN-T guidelines.

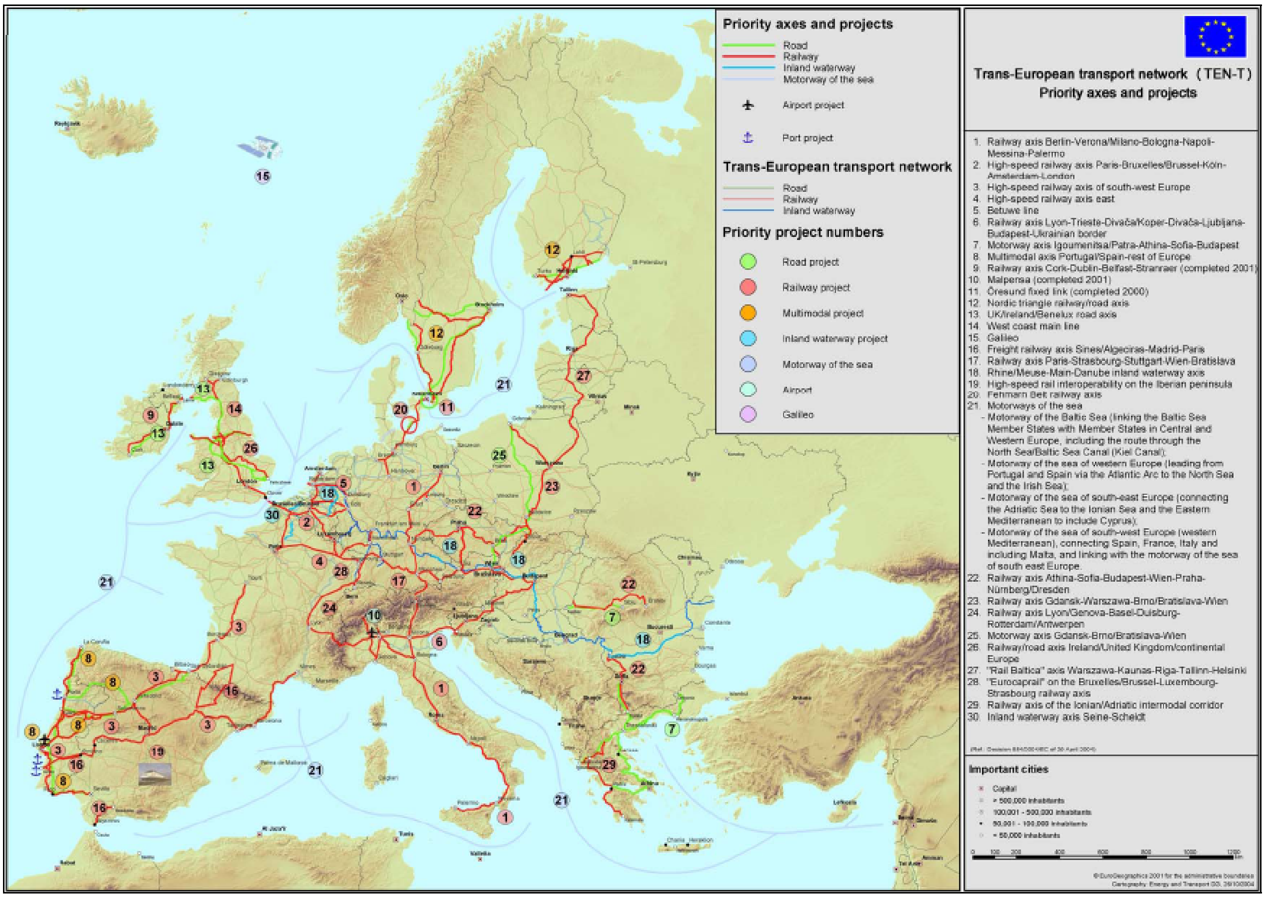
This resulted in the adoption by the European Parliament and the Council in April 2004 of Decision number 884/2004/EC amending the Community guidelines for the development of the TEN-T. These guidelines dedicate particular attention to the development of trans-national infrastructure projects providing a response to the growth of international traffic whilst promoting cohesion within the EU, notably in the sections of the pan-European corridors situated on the territory of the new Member States and as regards the concept of motorways of the sea. 30 axes and priority projects were identified. The rail axis

---

[2] This section is based on the COM (2001), COM (2005) and the terms of reference of the *Feasibility study on Rail Baltica railways.*

Warsaw-Kaunas-Riga-Tallinn (i.e. Rail Baltica) was identified as priority project no. 27 (see Figure 3.1).

Figure 3.1 TEN-T, axes and priority projects



Source: DG TREN (http://ec.europa.eu/ten/transport/maps/axes_en.htm)

The target dates for completion of the sub-sections are shown in the table below. The target dates indicate that Rail Baltica should be developed stepwise from south to north. According to the plan, Rail Baltica is to be completed by 2016.

Table 3.1 Time schedule for completion of subsections of Rail Baltica

Sub-section	Date set for completion
Warsaw-Kaunas	2010
Kaunas-Riga	2014
Riga-Tallinn	2016

Trans-European transport network outline plan - Railways
The priority projects are only part of the Trans-European network. The table below shows the extent of the network by 2020.

Table 3.2 Extent of the TEN-T network by 2020

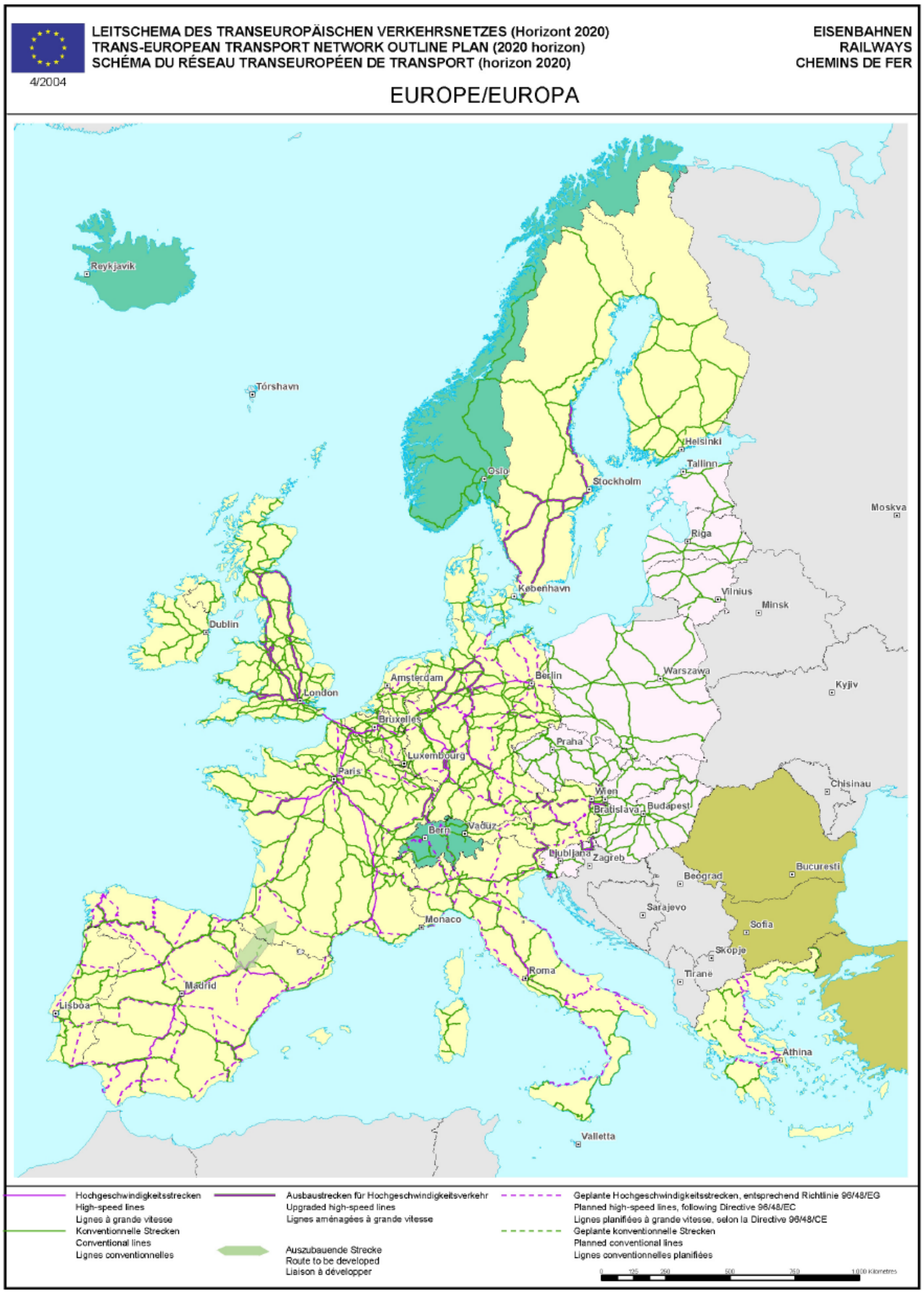
Mode	Extension
Road	89,500 km
Rail	94,000 km, including 20,000 km of high speed lines
Inland waterways	11,250 km, including 210 inland ports
Air	366 airports
Sea	294 seaports

Source: COM, 2005a

The outline plan for the Trans-European rail transport network is shown in the following figures - first for EU-25 and then for each of the four project countries. This plan forms the basis of discussions on possible alignments for Rail Baltica. The following sections clarify that discussions on Rail Baltica are not limited to the alignments outlined below.

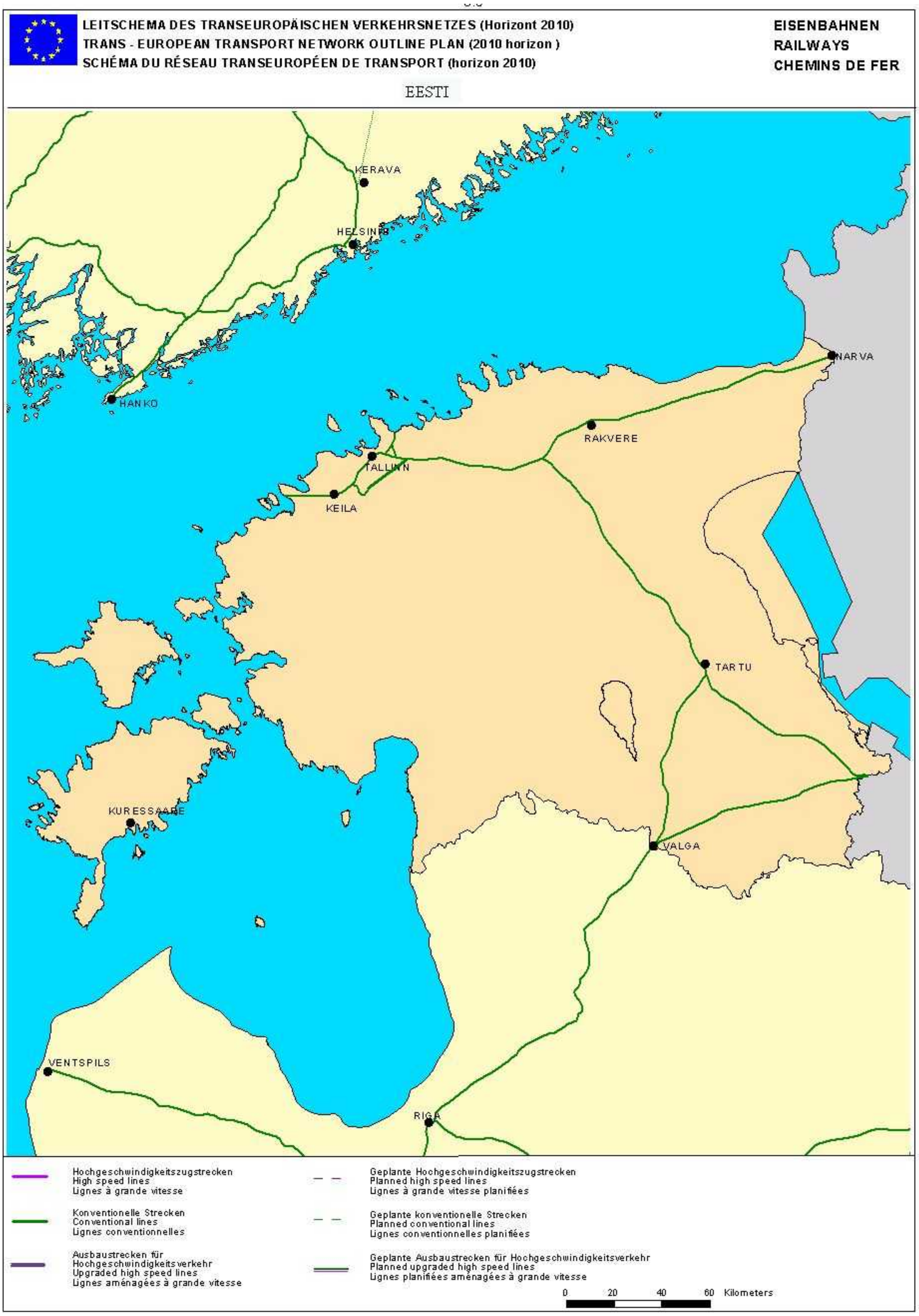
Figure 3.2 shows the outline plan for EU-25, which reflects an ambitious plan for the development of the European rail network. The corresponding outline plan for the road network is shown in Annex A.

Figure 3.2 Outline plan - Europe (Rail)



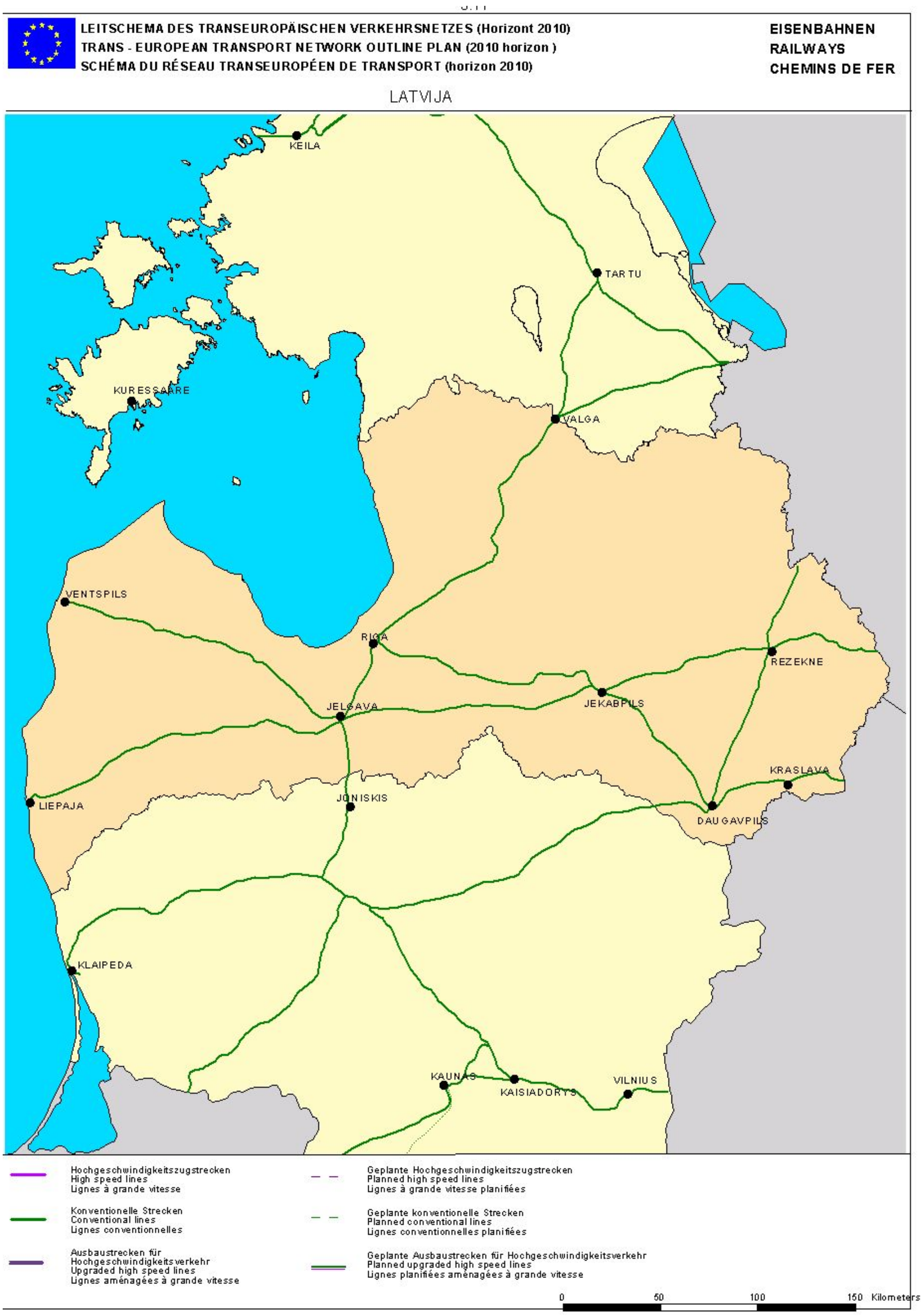
In the outline plan for Estonia, the *Tallinn - Tartu - Valga* link (the existing line) was identified as the main north-south corridor (see Figure 3.3).

Figure 3.3 Outline plan - Estonia (Rail)



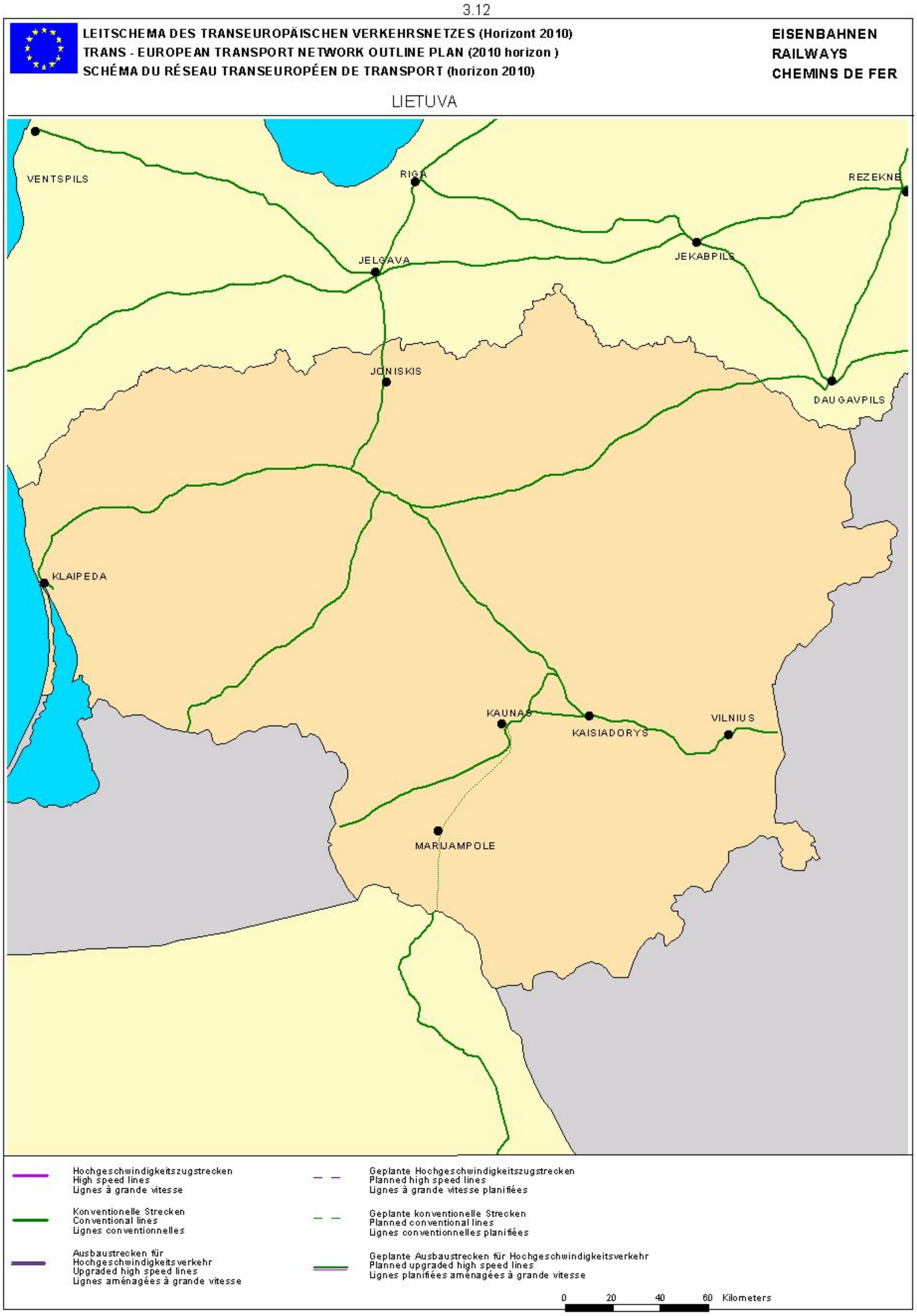
In the outline plan for Latvia, the *Valga/Valka - Riga - Jelgava - Joniskis (in Lithuania)* link (the existing line) was identified as the main north-south corridor (see Figure 3.4).

Figure 3.4 Outline plan - Latvia (Rail)



In the outline plan for Lithuania the *Jelgava (in Latvia) - Joniskis - Kaunas - Marijampole - Bialystok (in Poland)* link (the existing line from the Latvian border to Kaunas, a new line from Kaunas over Marijampole to the Polish border) was identified as the main north-south corridor (see Figure 3.5).

Figure 3.5 Outline plan - Lithuania (Rail)



Finally, in the outline plan for Poland, the *Mirijampole (in Lithuania) - Bialystok - Warsaw* link was identified as the main north-south corridor (see Figure 3.6).

Figure 3.6 Outline plan - Poland

Corridor I

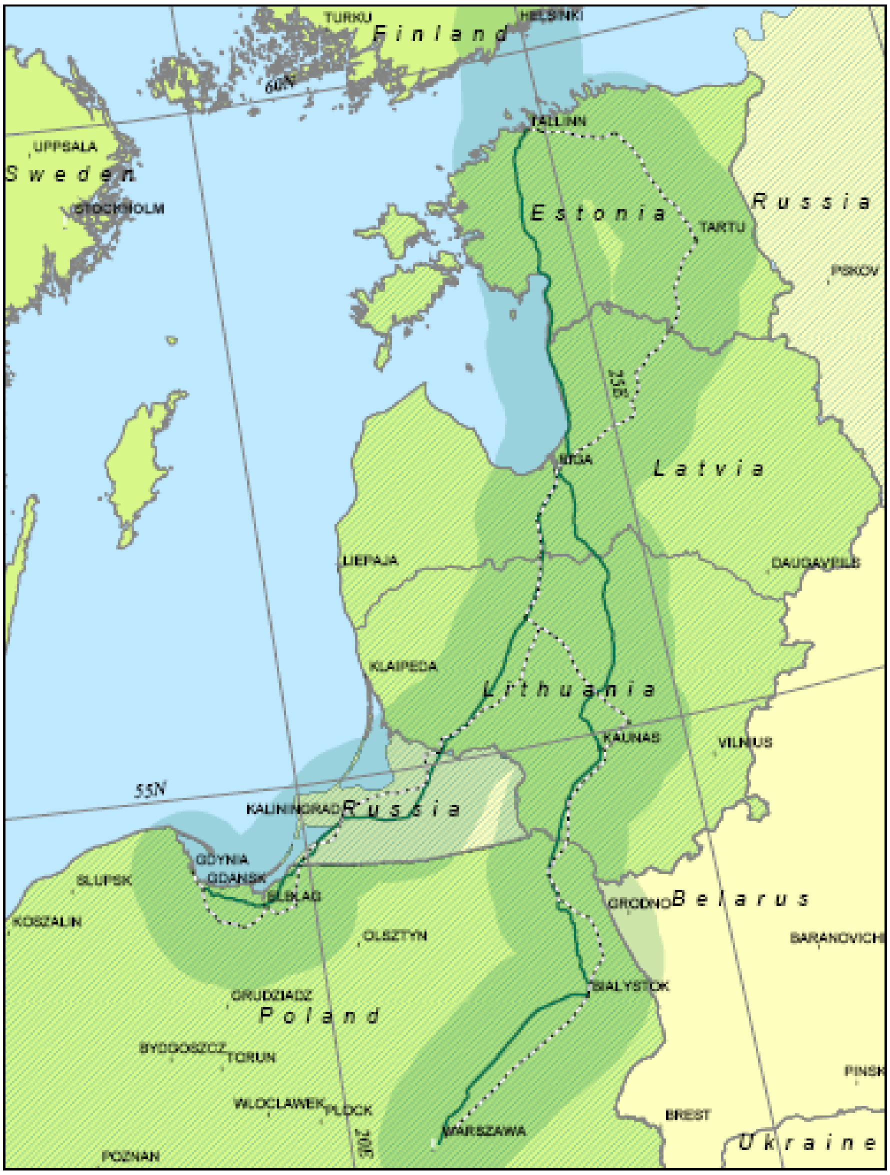
Rail Baltica is part of Corridor I, which consists of three separate components:

- Via Baltica (road component).
- Rail Baltica (rail component).
- Branch A to Kaliningrad (Via/Rail Hanseatica).

The spatial positioning of Corridor I is illustrated in Figure 3.7[3].

[3] Again, it should be noted that the discussions on Rail Baltica are not limited to the alignment option indicated in the figure below.

Figure 3.7 Spatial positioning of Corridor I (solid line: road, dotted line: rail)



Source: Pan-Eurostar (2005).

European Coordinators

The European Commission has nominated two high-profile European Coordinators to facilitate the project implementation, and to dialogue with operators and stakeholders.

Pavel Telicka has been nominated for Rail Baltica, whereas Karel Vink has been nominated for the European rail traffic management system (ERTMS) and rail corridors strategy.

Possible sources of funding

The development of attractive rail connections between the three Baltic States and Poland will require substantial investments.

There are several possible sources of funding for infrastructure investments:

1. National budgets
2. User contributions from infrastructure charging
3. Community budget, through (either):
   - The trans-European network budget
   - The Cohesion Fund and Structural Funds in regions which are eligible.
4. Private capital (PPP)
5. Grant and/or loans from the international financial institutions; in particular the European Bank for Reconstruction and Development (EBRD) and European Investment Bank (EIB).

Financial issues are covered in more detail in Chapter 8.

3.2 Agreements between the project countries

Several agreements have been made between the project countries over recent years.

One of the early initiatives took place during 1992-1994 when the vision and strategy for the Baltic Sea Region was elaborated by the countries in the region. In its most explicit way this was reflected in the joint political document – *Vision and Strategies around the Baltic Sea 2010* where the idea of the Rail Baltica first appeared as one of the most important elements for spatial development in the Baltic Sea Region. The document was prepared for the third Ministerial Conference of the Baltic Sea Region held in Tallinn, Estonia, in December 1994. The latest update of the document made in 2001 states that high-quality infrastructure and public transport services to link the Baltica States with Western Europe are still missing and it is a main challenge to link national spatial plans with corresponding plans in other countries.

After a number of activities in the 90'ies, the transport ministers of Estonia, Latvia and Lithuania signed a cooperation agreement committing to the Rail Baltica project in September 2001 in the Estonian city of Pärnu.

Most importantly and most recently, on 15 September 2003 the Rail Baltica Co-ordination Group (which consists of authorised officials from the relevant national authorities of Poland, Lithuania, Latvia and Estonia) agreed on the key aspects to be included when preparing feasibility studies in all the countries concerned and on a time plan for future actions[4]. And most recently a *Declaration of Intent* was signed 27 March 2006 by the Transport Ministers of the four project countries and Finland.

---

[4] Taking into account the contents of a number of previous agreements/studies. For details please refer to *Rail Baltica Co-ordination Group (2003).*

Time plan and follow-up

It was agreed that by the end of 2006 a common pre-feasibility and other feasibility studies and the approval of final solutions by relevant national authorities should be completed. Furthermore, it was agreed that the countries should aim at starting the design-build activities for the Rail Baltica project in 2007.

Alignment options

The alignment options shown in the table below have been included in the long list of options considered in the further work. The final decision on the alignments can be based on the results of this pre-feasibility study.

Table 3.3 Alignment options considered by the Rail Baltica Co-ordination Group

Country	Option
Estonia (2 options)	Tallinn - Tartu - Valga/Valka (in accordance with TINA Final Report, October 1999). *
	Tallinn - Pärnu - EE/LV Border.
Latvia (2 options)	Valga/Valka - Riga - Meitene/Joniskis (in accordance with TINA Final Report, October 1999).
	EE/LV - Riga - Meitene/Joniskis. **
Lithuania (1 option)	Meitene/Joniskis - Kaunas - Mockava/Trakiszki (in accordance with TINA Final Report, October 1999).
Poland (1 option)	Mockava/Trakiszki - Suwalki - Sokolka - Bialystok - Warsaw (in accordance with TINA Final Report, October 1999).

Note: * Discussed but not agreed as preferred option

** Specific border crossing not defined/agreed yet

The following sections show that several other alignment options are currently considered.

Technical issues

Regarding the technical issues it was agreed that the Rail Baltica feasibility study should be based on the European standard track gauge of 1435 mm. Furthermore, it was agreed that the *main technical parameters* will be defined according to the European Rail Agreements AGC/AGTC and the *technical specifications for interoperability* of the trans-European rail systems.

The AGC and AGTC standards are summarized in the table below.

Table 3.4 AGC and AGTC standards

	AGC		AGTC	
	A*	**B****	**A***	**B*****
Number of tracks	-	2	not specified	2
Vehicle loading gauge	UIC B	UIC C1	UIC B	UIC C
Minimum distance between track centres	4.0 m	4.2 m	4.0 m	4.2 m
Nominal minimum speed	160 km/h	250 km/h	120 km/h	120 km/h
Authorized mass per axle:				
Locomotives (≤ 200 km/h)	22.5 t	22.5 t		
Rail cars and rail motor sets (≤ 300 km/h)	17 t	17 t		
Carriages	16 t	16 t		
Waggons ≤ 100 km/h ≤ 120 km/h	 20 t 20 t	 22.5 t 20 t	 20 t 20 t	 22.5 t 20 t
Maximum gradient	-	12.5 mm/m	not specified	12.5 mm/m
Minimum platform length in principal stations	400 m	400 m		
Minimum useful siding length	750 m	750 m	600 m	750 m
Level crossings	none	none		

Source: AGC, Annex II and AGTC, Annex III

Remarks:

* Existing lines which meet the infrastructure requirements and lines to be improved or reconstructed

** New lines (for passenger and goods traffic)

*** New lines

It will be clear from the following sections that the options for Rail Baltica are not limited to the technical standards specified above.

3.3 Regional development impacts and the INTERREG IIIB project

The study "*Rail Baltica – Transnational Integration through Coordinated Infrastructure and Regional Development*" is running in parallel with this study[5]. The study is financed by EC INTERREG IIIB budget in terms of spatial planning and regional development and will amount to approx. 1.15 million EUR. Among the partners are ministries and several institutions from Latvia, Ger-

[5] See website for more details (http://www.rail-baltica.net)

many, Lithuania, Poland, Estonia and Finland. The lead partner is Riga Region Development Agency. The project has started in June 2005 and will last to December 2007.

The Interreg IIIB project Rail Baltica has two main goals:

- The definition of the most favourable route for the Rail Baltica railway link in terms of spatial planning and regional development.
- The raising of the awareness of the relevant actors (national and regional administrations and decision makers, industry and the public) in the Baltic Sea Region (BSR) about the benefits of attractive railway connections.

4 National planning and policy context

The objective of this chapter is to provide an overview of the national planning and policy context within which the implementation of Rail Baltica will take place.

First, the issues which are relevant for all four project countries are described (section 4.1). Second, country-specific issues are described (sections 4.2-4.5).

It should be noted that issues related to financial constraints and details on the current railway infrastructure are covered in separate chapters of this report.

4.1 General

The situation in the four project countries, especially in the three Baltic States, is, to a large extent, similar. The situation is characterised by:

- Volumes of north-south bound passenger and freight traffic are low.
- Transit traffic from mainly Russia (east-west bound) accounts for a dominant share of the freight market.
- The current infrastructure on the Rail Baltica axis is of poor quality and service level and speed are low. The main reasons for this are that the east-west traffic has higher priority (in the Baltic States) and that there is a general lack of funds available (see Chapter 5 for more details on the existing infrastructure and Chapter 8 for a discussion of sources of funding).
- The different railway gauges in Western/Central Europe ("European standard gauge" of 1435 mm) and Eastern Europe including the Baltic countries and Finland ("Russian gauge" of 1520 mm) remain a major obstacle for the all-European railway integration. This implies that Rail Baltica should either be developed as a stand-alone system based on European standards or by improving the existing system based on Russian standards with an improved transhipment and gauge-changing facility at the point of conversion between the two standards[6] (see Chapter 8 for a discussion about technological constraints).

---

[6] In October 2000, HPC-Consulting GMBH (Germany) prepared a study *"Intelligent Transport Systems and Inter-Operability Development Concept for the Kaunas Logistic Node"*. The new intermodal terminal place was proposed in Mauručiai, 20 km South-West

- The Rail Baltica project has been discussed for many years in all four project countries. However, as it will be clear from the following sections very little information is available about the options discussed. In fact, it is only the line from Kaunas to the Lithuanian/Polish border, which has been specifically analysed.

It is within this context that the implementation of Rail Baltica will take place. The following sections go into more detail with the situation in each of the project countries.

4.2 Planning and policy context of Estonia

4.2.1 Transport development plans

General
There are two main documents in Estonia, which concern Rail Baltica.

The first is the *Estonian Transport Development Plan (TDP)* for the years 2006-2013, which has been sent to the Government for approval in February 2006. The plan is the logical continuation of the previous Transport Development Plan 1999-2006.

Based on several studies on the performance of the Estonian transport sector, considering the opinions of the logistics and transport stakeholders and taking into account the needs of the present transport service market, one of the objectives of the TDP is the development of the railway passenger services along the major domestic and international routes, including the development of Rail Baltica (standard gauge 1435 mm). The decision to implement the plans will be based on more detailed studies of the feasibility of the plans including this study.

According to the visions of the TDP, the Rail Baltica line will be completed in 2016 in conformity with EU standards, allowing a high-speed connection from Estonia to Western Europe.

Other measures are focused on improving the quality and safety of railway infrastructure and on improving the capacity of railway lines and border crossing stations.

The second important document is the *Estonian National Spatial Plan - 2010***.** This document was elaborated by the Estonian Ministry of Environment and was approved in September 2000 by the Estonian Government. The main ob-

---

from Kaunas. In December, 2003 Ardanuy (Spain) completed the study *"European Gauge Railway Line from Polish-Lithuanian Border to Kaunas and Multimodal Centre"*. The technical solutions including multimodal centre were proposed.

jectives concerning transport are that Estonian transport connections, when co-ordinated, must enable the achievement of three main goals:

- "Time-space compression" of Estonia
- Safe, environmentally friendly and energy-saving transport
- Utilization of development opportunities founded on international common interests

In the context of spatial development, attention should be paid primarily to those aspects of transport that require regulation or financing by the government. The focus is on issues related to physical infrastructure and public transport. When planning public transport it is necessary to increase the speed, frequency and comfort of passenger transport on railways in at least three directions: Tallinn - Tartu - Valga/Petseri, Tallinn - Narva and Tallinn - Pärnu.

According to the Estonian National Spatial Plan - 2010, Estonia must develop the Rail Baltica line for fast rail transport, extended in the north by rail-ferry connection(s) to Finland.

National funds available for Rail Baltica
According to the financial annexes of the draft Transport Development Plan 2006-2013, state budget contributions to the Rail Baltica investment are not foreseen as construction works are not expected before 2013. Therefore, in the state draft documents on the utilisation of the EU Cohesion Fund and ERDF resources in the period 2007-2013, no investments for the Rail Baltica project are planned.

According to the information given, only TEN-T MIP of 2007-2013 budgets will be used as financial resources for detailed and relevant studies of Rail Baltica. These studies will be co-financed from the state budget.

In financial terms, the demand for large-scale transport infrastructure investments in Estonia is approximately four times higher than the amount that EU Cohesion Fund and ERDF can allocate to Estonia for the years 2007-2013. Other state budget resources will be used for public transport subsidies, road maintenance, maritime safety and navigation aid etc.

4.2.2 Organisation and regulation

The organisation of the rail sector
The rail network in Estonia (1520/1524mm wide gauge) accounts for about 1,000 km of tracks, of which 960 km of lines (132 km of electrified lines included) are considered as the public network open for regulated access. The main business is freight transport (more than 40 million tonnes per year), mainly oil in tank wagons, in transit between the former CIS countries and the ports of Estonia bound for Western Europe and the USA.

The organisation of the rail sector in Estonia has in recent years been different from what is seen in most other countries, as the railway infrastructure is privately owned and most traffic is made with third countries.

The railway infrastructure in Estonia is, as mentioned, privately owned and the 2 main undertakings, AS Eesti Raudtee (freight transport) and Edelaraudtee AS (mainly passenger transport), are vertically integrated, i.e. at the same time rail operators and infrastructure managers. Formally, Edelaraudtee Infrastruktuuri AS which owns the infrastructure is a subsidiary of Edelarauudtee AS. Elektriraudtee AS, which operates suburban passenger transport belongs 100% to the State.

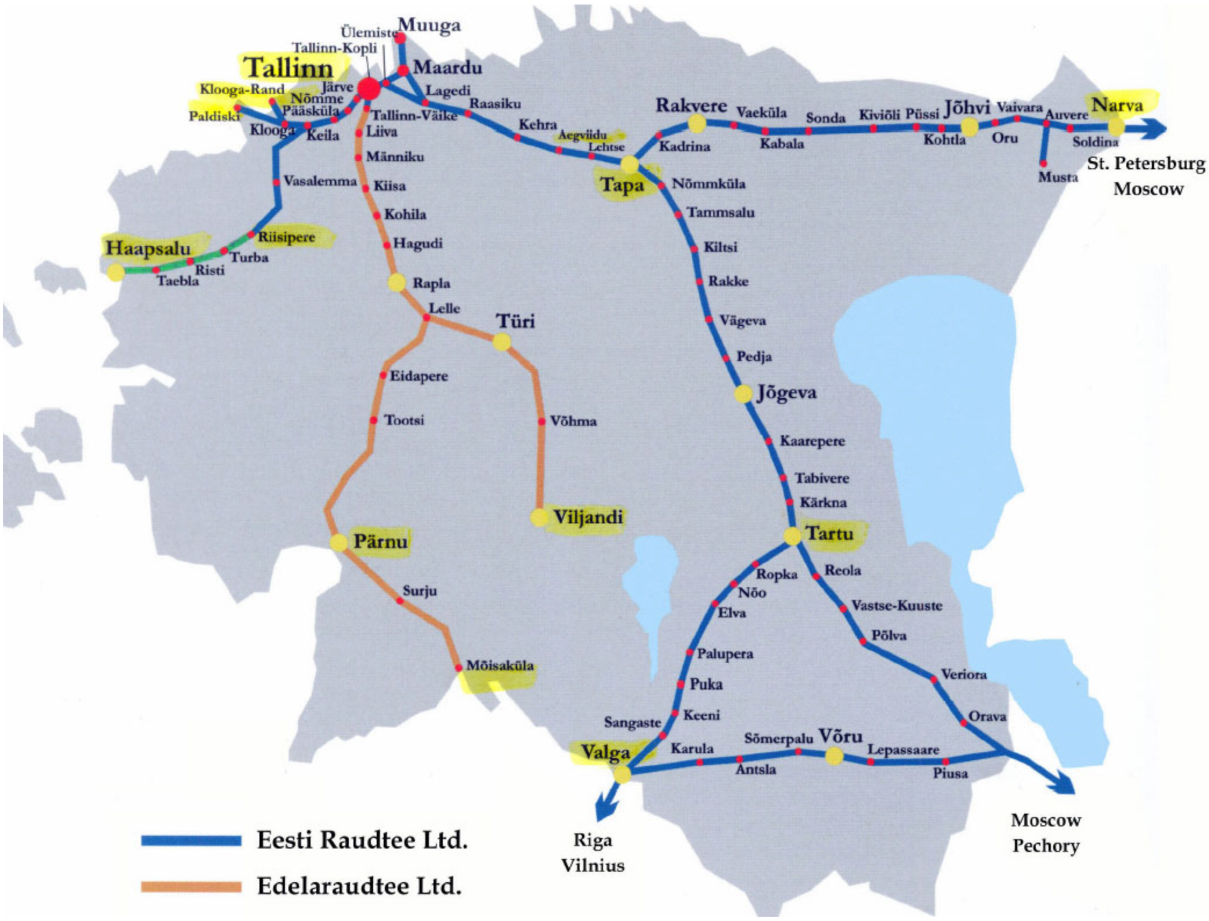
Figure 4.1 provides an overview of the present (but not future) rail infrastructure in Estonia including the split of ownership between AS Eesti Raudtee and Edelaraudtee AS.

Edelaraudtee AS was fully privatised in 2001 (owned by UK interests, 20% and Estonian citizens, 80%), whereas the State owns 34% of the share in AS Eesti Raudtee. The remaining 66% of the shares in AS Eesti Raudtee are presently privately owned by Baltic Rail Services (BRS), but will now be taken over by the Estonian government.

The railway sector will be re-organised in the future, as the Estonian government on 10 November 2006 decided to stop the privatisation contract. A cancellation agreement between the State and the private shareholders was signed on 17 November 2006, and the agreement now awaits acceptance from the Parliament.

AS Eesti Raudtee is responsible for both operation and infrastructure management, but under separate accounts.

Figure 4.1 Estonian rail network



Note: There is no longer track from Riisipere to Haapsalu anymore and operations from Pärnu to Moisakula have stopped.

The market for rail operation is totally open to competition in Estonia. Several smaller companies also operate freight trains. The Railway Inspectorate is the capacity allocation body.

According to the coordination decision, the infrastructure capacity allocations for the traffic period 2006/2007 were offered to the following operators:

- AS Elektriraudtee - urban and suburban passenger transport (state-owned company)
- AS Eesti Raudtee - freight transport (mostly private company)
- AS Edelaraudtee - domestic passenger transport and freight transport (private company)
- AS GoRail (private company)
- Russian-Estonian Rail Services AS - freight transport (private company)
- Westgate Transport OÜ - freight transport (private company)

- AS Spacecom - freight transport (private company)
- AS Goal Terminal Trans - freight transport (private company)

The improvement of interoperability during the last decade has contributed to the development of rail freight transport between the Baltic countries and the CIS railways. The Estonian, Latvian and Lithuanian railways use freight wagons of the standards of CIS countries. The agreement for joint use of wagons with the railways of the CIS countries was signed in 1993. This agreement has defined the conditions of joint use of wagons, the cost of wagon use, maintenance rules and tariffs. A special system for accountancies and payments for wagon use and a special joint register have been implemented. It has solved principle maintenance and repair problems of the wagon park.

Relevant national regulation
In Estonia the Ministry of Economic Affairs and Communications (MEAC) is responsible for the transport strategy, while the Ministry of Internal Affairs is responsible for spatial planning and regional development plan aspects. Finally, the Ministry of Environment is responsible for the environmental strategy.

The main legislative act for the Estonian railway sector is the Railway Act and its secondary regulations approved by the Government or the Minister of Economic Affairs and Communications.

According to the Railway Act, the missions of the Ministry of Economic Affairs and Communications (MEAC) are:

- Defining the general railway policy and acting as a railway market regulator
- Developing the legislative framework
- Representing the Estonian State in all topics related to international railway agreements
- Licensing railway operators and supervising on licenses
- Arbitrating body for charging and allocation problems
- Defining the public use of infrastructure

The MEAC also has an Emergency Management Department, which investigates the railway traffic accidents and incidents.

According to the Railway Act the missions of the Estonian Railway Inspectorate (ERI) as technical regulator are:

- Issuing safety certificates for the infrastructure managers and rail operators.
- Issuing licences to locomotive drivers.
- Technical inspection of infrastructure and rolling stock
- Managing the railway registers.
- Co-ordinating the Network Statement

- Allocating the infrastructure capacity; as the infrastructure managers are also railway operators
- Approving the level of access charges, the MEAC setting up the methodology

According to the Competition Act the mission of the Competition Board is to regulate the overall competition.

In addition to the Railway Act, the Public Transport Act provides the basis for the organisation of public transport in road, railway, waterways and air traffic.

With regard to path allocation, the Railway Act clearly gives first priority to international rail passenger traffic, then to domestic passenger traffic followed by freight operations. The MEAC defines the methodology for access charging, which is enforced by the ERI.

Network Statements have been elaborated by Eesti Raudtee AS and Edelaraudtee Infrastructure AS and coordinated by the Estonian Railway Inspectorate. Estonia as well as other Baltic States is paving the way for national railway registers, as rolling stock, infrastructure and locomotive driver registers already exist in Estonia.

4.2.3 Development options for Rail Baltica

In Estonia the concept of Rail Baltica is mainly based on the political willingness at present, as economic, technical, environmental and spatial planning aspects are not investigated yet.

A number of issues should be taken into account when discussing the development options for Rail Baltica, including:

- Estonia is a small country with an average density of 30 inhabitants per square km (in rural areas even 15 inhabitants per square km).
- In domestic railway transport, the demand for services is still limited.
- Operations are not efficient.
- In freight transport the east-west transit traffic has a high share
- One opinion is that north/south traffic volumes (demand for passenger and freight transport) are too small to provide a cost-effective solution to the railway connection
- The main industrial production areas are Tallinn and East-Viru county
- Mid- and Western Estonia are low population density areas with no remarkable industrial concentration

The general discussions at the public level concerning the possible alignment for the future Rail Baltica line touch the following issues:

- The three alignment options, which have been discussed most intensively, follow the existing 1520/1524 mm railway lines. Also a completely new option for Rail Baltica has been the subject of several disputes.
- The interoperability questions as regards the railway system itself and also regarding the Estonian port systems in the north coastline of the Finnish Gulf as intermodal nodes for the Rail Baltica are also a key concern.

Taking into account the existing railway infrastructure, the passenger and freight flows, the obvious needs and the public opinion, the following four possible alignment options for Rail Baltica are proposed by the MEAC (see Figure 4.2):

1. *Tallinn - Tapa - Jõgeva - Tartu - Valga/Valka (existing border crossing) - Valmiera - Riga* (red line)
2. *Tallinn - Rapla - Lelle - Türi - Viljandi - Mõisaküla - Riga* (green line)
3. *Tallinn - Rapla - Lelle - Pärnu - Mõisakula - Riga* (dark blue line to Pärnu)
4. *Tallinn - Pärnu - Riga* (light blue line)

The Rail Baltica cross-border section between Estonia and Latvia is not fixed. Therefore close cooperation between Estonia and Latvia is necessary, also at the official level.

The route 'via Tartu' will connect the two major cities Tallinn and Tartu (more than 100,000 inhabitants) and has perspectives for high-quality passenger transport services in the domestic market. This route is the longest, but it seems suitable for passenger and freight transport. At the same time, the Tapa - Tallinn and Tartu - Tapa sections are heavily loaded with the east-west transit traffic, which will need to continue to use the 1520/1524 mm standards.

AS Eesti Raudtee has planned to reconstruct the section Valga-Tartu in 2008-2009 and the section Tallinn -Tapa in 2010-2011. The plan is to raise the speeds up to 120 km/h for passenger traffic and 90 km/h for freight traffic. AS Eesti Raudtee is, however, not satisfied with the infrastructure charges set by the Estonian Railway Inspectorate. AS Eesti Raudtee claims they are too small to cover the cost and according to Eesti Raudtee the plans cannot be completed before this issue has been solved[7].

The route 'via Viljandi' is one of the shortest directions towards Riga, but Viljandi is the end point for the existing railway network. Therefore, in addition to the upgrading of the existing railway infrastructure along the route, the construction of a new embankment and other necessary installations are needed. The demand for domestic passenger transport services is not so high in com-

[7] AS Estonian Railway can not provide more information on this issue as there some court cases. MEAC has presently the view that there is a risk that the investment will not be made as planned if AS Eesti Raudtee has to cover all costs.

parison with the Tartu and Pärnu directions. As mentioned earlier, like the Rail Baltica alignment option via Pärnu there is free capacity available for the international freight and fast passenger services.

The route 'via Lelle/Pärnu' also offers one of the shortest directions towards Riga and furthermore has the advantage of connecting Pärnu to the network. The existing railway network is, however, of poor quality and traffic volumes are low. It might be possible that at some point the railway will be abandoned, as the costs and service level will become unbearable.

A completely new and direct route from Tallinn to Riga 'via Pärnu' requires huge investments and preparatory time to solve:

- Possible location of new embankment using geological and geomorphologic surveys, as this part of Estonia mostly consists of marsh areas
- Environmental questions (Natura 2000 etc)
- Land acquisition problems
- Cross-section areas with the other infrastructure elements etc

A new direct and high-standard railway infrastructure can offer safe and fast international railway services for passengers and freight.

The interoperability problems of the Rail Baltica railway system itself along the routes and also of the Estonian port systems in the north coastline of the Finnish Gulf as intermodal nodes for Rail Baltica are, as mentioned previously, a key question.

Figure 4.2 Possible alignments for Rail Baltica in Estonia

4.2.4 Other issues

Other planned major transport infrastructure projects

During the previous five years intensive investments into the main road network have been taken place. The main resources for investments have been EU ISPA and the Cohesion Fund as well as international bank loans.

As examples can be mentioned:

- Via Baltica phase I - the project involved the rehabilitation and reconstruction of selected sections along the road E67 Via Baltica Ikla-Tallinn and the road E20 Tallinn-Narva, altogether 120.6 km of rehabilitation. The project was finalized in 2002
- Via Baltica phase II – reconstruction of selected sections along the road E67 Via Baltica Ikla-Tallinn and the road E20 Tallinn-Narva, altogether 120.4 km. The project was completed in 2004
- Reconstruction of sections along the road E20 Tallinn-Narva, 62.7 km. The project was completed in 2005
- Rehabilitation works along the road Tallinn – Tartu – Luhamaa in 2000 – 2004. 179 km of road were rehabilitated

Concerning the major investments in transport infrastructure in the medium and long term perspective, two types of influence on the Rail Baltica project can be mentioned:

- Direct impact related to the investments into the road and air transport infrastructure, which will facilitate an increase in the passenger and freight transport volumes
- The overall need for other transport infrastructure investments exceeding the State budget and EU funds possibilities for the period 2007-2013

The indicative list of the other major projects which will have an impact on Rail Baltica is the following:

Direct impact on traffic volumes:

- Upgrading of Tallinn Airport passenger terminal – increasing passenger volumes
- Reconstruction of Tallinn Airport airside area – higher safety standards and capacity; increasing of numbers of flight operations and passenger volumes
- Reconstruction of Tallinn ring road and Tallinn - Paldiski road sections - higher road safety standards and improved capacity, facilitation of further road transport
- Reconstruction of Pärnu ring road along the Via Baltica route - higher road safety standards and improved capacity, facilitation of further road transport
- Reconstruction of Jõhvi - Tartu - Valga road sections - the opening of the new Sillamäe port complex (in the north-east of Estonia) in 2005 will affect the road transport volumes to be carried along this route considerably

Future large-scale transport infrastructure investment projects are:

- Construction of Tallinn railway bypass and reconstruction of different existing railway sections
- Establishing Koidula border station. The objective of this project is to: 1) Ease the increased workload of the Narva Border Station by dispersing the transit capacity; 2) Establishing a border station between the European Union and a third country; 3) Ensuring a fast reaction in case of possible danger (threats) deriving from cargoes and transportation means; and 4) Developing a possible international transportation centre. This will enable the use of the Koidula-Valga line, thereby enabling transport on the Valga-Riga-Ventspils line that used to be an important transport route. Currently the Estonian State Property Enterprise is buying land etc., but it is currently unclear whether the project will obtain financing from the 2007-2013 budget
- Construction and reconstruction of different road sections along the Tallinn - Tartu - Luhamaa route
- Reconstruction of different road sections along the Tallinn - Narva route including the construction of the new Narva road bridge between Estonia and Russia
- Reconstruction of road networks in Tallinn city to connect major TEN-T roads with the ports

- Construction of the Saaremaa fixed link
- Extension of Muuga Port eastern side infrastructure
- Construction of breakwaters for the Muuga and Paldiski-South ports
- Construction of Tallinn light rail system
- Reconstruction and renovation of the electric train traffic network in Tallinn and its neighbourhood area
- Reconstruction of small ferry harbours in the western part of Estonia
- Dredging and reconstruction of fairways in the West-Estonian archipelago
- Design and construction of multi purpose ice-breakers
- Purchase of a hydrological ship for deep-sea measurements etc

Other relevant information
Some new research carried out for the Estonian Ministry of Economic Affairs and Communications (composing TDP) based on a Least Cost Model showed which transport mode is the cheapest, and thereby in which it is reasonable to invest. All transport system costs were considered (suppliers, users, infrastructure owners and environment). Calculations were made for:

1. *Regional passenger transport*: The result was that the demand for railway transport is not sufficient for it to be the cheapest mode (rail will be the cheapest when demand is at least 1000 passenger/h - the domestic transport is less than this value), but the difference between rail and bus is not that big.
2. *Long distance/intercity passenger transport*: Railway transport will be the cheapest mode from 300 passenger/h at a speed of 100 km/h.

There has not been made any other cost studies or comparative analysis between the different transport modes in Estonia.

4.3 Planning and policy context of Latvia

4.3.1 Transport development plans

In Latvia the development of the railway lines in the direction east-west is considered more important than north-south direction due to the high volumes of cargo coming from Russia, Belarus, Ukraine, Kazakhstan etc to the ports of Riga and Ventspils. However, there are also plans to improve and develop transport infrastructure of international significance in the direction north-south.

In July 2006 the Republic of Latvia's Cabinet of Ministers approved two main planning documents concerning *Rail Baltica*. One of them is *Latvian National Development Plan 2007-2013*. This plan indicates improvement of the transport infrastructure of international significance by paying special attention to trans-boundary projects of importance for the global integration of the national market, especially in the context of the extended European Union.

The other planning document is *Guidelines for Transport Development 2007-2013* (it replaced *National Transport Development Programme 1996-2010)* which states that all technical and legal obstacles for the development of railway traffic to Central and Western Europe should be eliminated. In order to obtain this it is envisaged that the Rail Baltica pre-feasibility study will become a basis for a decision on the development of a railway system which meets the transport market requirements for traffic between the Baltic States and the Central and Western Europe.

Besides, the *Guidelines* envisage elaboration of a Development Programme for the Railway system for 2007-2013 where one of the sections will be devoted to *Rail Baltica*.

The *Guidelines* envisage also development of *Development Programme for the Main Latvian Roads for 2007-2013*.

Another planning document is *Development Guidelines of the Public Passenger Transport for 2005-2014* approved by the Government on 28 September 2004. The guidelines also have the quality of services and the safety of passengers as main objectives.

The position in the Ministry of Transport and Communications is that the feasibility study for this project must be completed before any planning of the further project development can be made

4.3.2 Organisation and regulation

The organisation of the rail sector

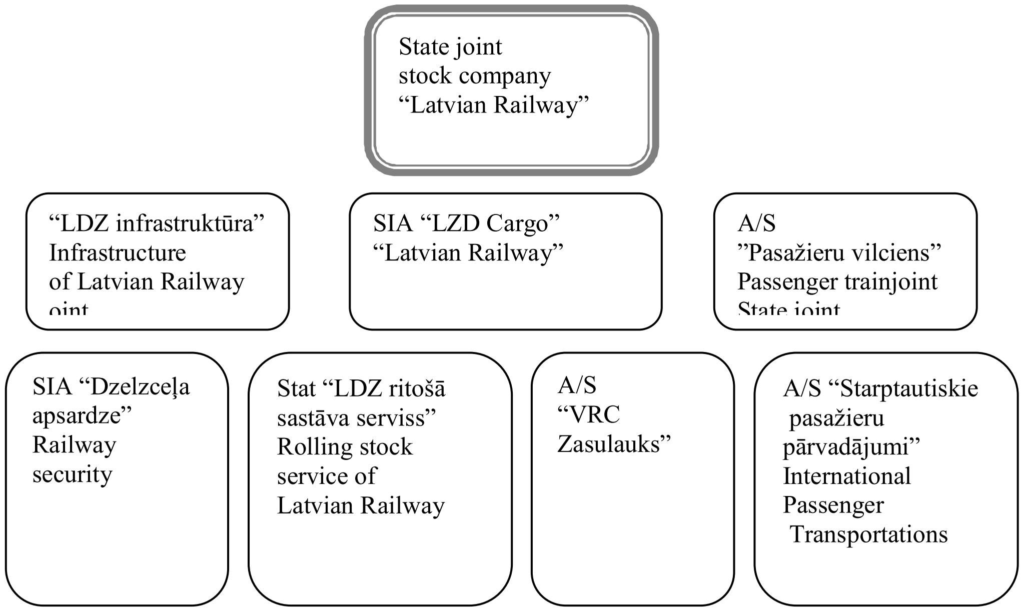
The following State institutions and organisations are involved in the implementation process of the *Rail Baltica* project:

- The Ministry of Transport and Communications of the Republic of Latvia, in particular the Railway Department
- The state joint stock company “Latvijas Dzelzcels” (“Latvian railway”) under supervision of the Ministry and currently undergoing restructuring

The restructuring process of the railways is continuing by reorganizing the existing company structure into a corporation, where the parent company’s functions will be passed on to a non-privatised State stock company, which will manage the infrastructure, i.e. the state will continue to own the infrastructure. The group's subsidiaries will work with cargo and passenger transport, repairs of the rolling stock, etc (see below). The subsidiaries may in a longer perspective be privatised, but so far no decision has been made on this issue.

The restructuring programme has been approved by the government.

Figure 4.3 Structure of Latvian Railway after the restructuring process



Regarding the possible organisation of Rail Baltica, heads and leading experts in all institutions, namely the Ministry of Transport and Communications and Latvijas Dzelzceļš, have the opinion that if Rail Baltica materializes with European gauge standard, the operator of the infrastructure should be a separate legal entity, responsible for the entire length of this rail line.

Relevant national regulation

In recent years, Latvia has put emphasis on financial regulatory instruments instead of mere administration. As a result, the Government approved *The Concept of State Orders for Passenger Transportation by Railways for 2007-2016* on 1 November 2005. The aim of this concept is to provide financial facility for reaching the long-term goals of national railway passenger transport, namely to develop a safer and environmentally friendlier mode of transport.

No specific regulations have been adopted by Latvia's Government in relation to the development of Rail Baltica.

4.3.3 Development options for Rail Baltica

Possible alignments

Several possible alignments are discussed in Latvia. All of them can be regarded in two major parts:

- Part 1 is alternatives from the Estonian/Latvian border to Riga
- Part 2 is options from Riga to the Latvian/Lithuanian border

In addition, several options through or around Riga exist. Each of the options discussed is outlined below.

Part 1 - from the Estonian/Latvian border to Riga:

1. *Tallinn – Tartu – Valga/Valka – Riga*. This route stretches along the existing railway and involves comparably large cities in Latvia and Estonia. The counter-argument here can be that a new railway line obviously would have fewer stops to guarantee low travel times between main cities. Hence, connecting lines can be built if and where necessary, rather than to introduce additional stations.
2. *Tallinn – Parnu – Riga*. The main advantage of this option is that it is the straightest alignment (shortest distance) and that it runs along the motorway Via Baltica. However, this alternative also has several weak points. One of them is that it requires a new section to be constructed from Pärnu in Estonia to Saulkrasti in Latvia. This implies that land for this part of the railway should be purchased. Furthermore, it is questionable whether the existing railway section from Saulkrasti to Riga can be used, as it passes through dense residential areas. Currently a new motorway bypass is in the development process to alter the transit traffic off these areas.
3. *Moisakula* (in Estonia) - *Rujiena - Aloja - Limbazi - Saulkrasti - Riga.* This is an existing railway line. As mentioned above, it is questionable whether the existing railway section from Saulkrasti to Riga can be used. However, the land under the former line between the state border and Skulte is temporarily reserved for the potential *Rail Baltica* line.

Part 2 - from Riga to the Latvian/Lithuanian border:

1. The existing railway *Riga – Jelgava – Eleja – Joniskis* (in Lithuania) and further to Kaunas. This project alternative would be the least expensive, as only some renovation of the existing railway will be made.
2. A new railway built *along Via Baltica motorway*. The advantage of this option is that it could generate positive intermodal effects.

Through and around Riga:

1. The existing railway *Saulkrasti - Riga central station – Jelgava* (or the new railway as in Part 2, point 2). The main problem of this option is the highly congested area around Riga central station.
2. *The north-west by-pass with a station near Riga airport.* The possibility to include this in the airport project seems highly advantageous for obvious reasons. This alternative has the additional supportive argument – the North Daugava river crossing, which already is in long-term Riga city development concept. However, no specific implementation planning has been specified so far for this possible project.

3. *The east by-pass* as the section of alternative two in Part 2 (along the Via Baltica motorway). In this case, the railway would run along the existing motorway by-pass. However, there are also a number of complexities which should be considered, as the Daugava river crossing over the dam and hydropower station is involved, as well as a subtle logistics junction in Salaspils.

Theoretically, if Russia is involved, one option could be: *St.Petersburg – Rezekne – Vilnius – Warsaw.* However, it is not preferred in Latvia, as Rezekne is more than 200 km away from Riga.

The latest discussions of the future spatial planning in the Riga region will provide a new motorway Daugava crossing near Saulkalne, the *Rail Baltica* can use the same place; in this case a probable place for the logistics junction may be *Saurieši*, as a point of existing railway, *Via Baltica* and *Rail Baltica* crossing.

4.3.4 Other issues

The Latvia Advisory Council on the Rail Baltica project was established after the transport ministers of Estonia, Latvia and Lithuania signed a cooperation agreement in Pärnu (Estonia) in 2001 regarding Rail Baltica (see section 3.2 for details on agreements between project countries).

The elaboration of the feasibility study has been supported by all Transport and Communications ministers in Latvia.

Latvia's Ministry of Transport and Communications prepares regular reports to the Government on issues related to the Rail Baltica project, including the Interreg IIIB project Rail Baltica (see section 3.3).

In other ministries, particularly in the Ministry of Economics and the Ministry of Regional Development and Local Government, the respective departments are following up on activities related to the Interreg IIIB project. In addition to the ministries the foundation "Riga region development agency" and Vidzeme region and Zemgale region development agencies are involved in the project:

Leading political parties in Latvia support further integration in the Baltic Sea Region, the EU and the development of infrastructure facilities like Rail Baltica as means of this process. However, at this stage the overall political position in Latvia is to await the conclusions of the feasibility study, to make sure that the implementation of the project and related investments would create sufficient economical, political and social gains to justify the required investments.

4.4 Planning and policy context of Lithuania

4.4.1 Transport development plans

The idea of modernisation of the north-south rail connection in Lithuania began in the early nineties and the development plans for Rail Baltica are today an integrated part of the transport development plans in Lithuania.

The development plans for Rail Baltica are as such described in a number of "official plans". The most important are[8]:

- On 11 November 1999 the Government of Republic of Lithuania confirmed the Decree No 1273: "The Special Plan of Alignment of European Standard Gauge Railway Polish-Lithuanian Border - Marijampolė - Kaunas".
- The "*Strategy of Development of Transport and Transit in Lithuania*" (2002) foresees to begin the construction of Rail Baltica before 2010. The completion of the section from Kaunas to the Latvian border is planned for 2015. Various technical variants are possible, but the minimal speed is to be at least 160 km/h.
- The construction of Rail Baltica is foreseen in the "*Master Plan of the Territory of Lithuania*" (2002) confirmed by the Seimas of the Republic of Lithuania. The alignment from the Polish border to Kaunas is according to the approved Spatial Plan. The alignment from Kaunas to Latvia is placed beside the existing railway line (Corridor I).
- The construction of Rail Baltica is foreseen in the "*Long Term Development Strategy of Economy of Lithuania*". According to this strategy, the first stage from the Polish border to Kaunas is to be completed before 2010.
- Maps of the railway sector are presented in part F of the "*Trans-European Transport Network*" of the 8th section "Transport Policy" of the agreement of Lithuania joining the European Union. The maps present the construction of a conventional line from the Polish border to Kaunas, which connects the Polish network with the network of the Baltic States in 2010.
- The new line from the Polish border to Kaunas is foreseen in the "*Lithuanian Strategic National Rail Transport Development Plan for 2005-2015*" (2004).

4.4.2 Organisation and regulation

The organisation of the rail sector

The Lithuanian State is the owner of the Lithuanian railway infrastructure.

The JSC "Lietuvos geležinkeliai" (Lithuanian Railways) is responsible for the management of the railway infrastructure and the land belonging to the railway as well as railway equipment.

---

8 See section 3.2 for a description of agreements between the project countries.

The activities of JSC “Lietuvos geležinkeliai” are regulated according to the “Lithuanian Rail Transport Code”(2004).

The process of reforming the railway transport sector is taking place, but the exact timing of all phases has not been settled yet. Several units within JSC “Lietuvos geležinkeliai” have been formed, which all have separate accounts:

- Freight transportation unit
- Passenger transportation unit
- Infrastructure maintenance unit
- Infrastructure asset unit
- Traffic control centre

The liberalisation process of the rail transport activities is ongoing. The following legal acts have been confirmed:

- Licensing regulations of passenger, baggage and freight transportation (2003)
- Regulations for allocating the Public Railway Infrastructure activities (2004)
- Regulations for determining charges for using the Public Infrastructure (2004)

The Law “On the Railway Transport Sector Reform” was confirmed in 2004. The main objectives of the reform are to:

- Ensure the effective activities of the rail transport sector under the conditions of the open market
- Create possibilities of developing the public rail transport infrastructure
- Ensure free access to railway infrastructure
- Ensure the financial stability of the railway transport sector
- Maintain separately passenger, baggage, freight and infrastructure maintenance and management

Two stages of reform are planned. During the second stage of the reform a public enterprise will be established. This enterprise will be responsible for the management of state-owned public railway infrastructure.

Relevant national regulation
The Ministry of Environment of the Republic of Lithuania is responsible for the preparation (organisation) of obligatory documents (ex. IEA) in relation to EU regulation, except Natura 2000 documents. The confirmation is performed by the Seimas (parliament).

The legal acts on territorial planning strictly require agreements with the land owner to solve land acquisition issues. Experience shows that land acquisition of much smaller areas takes at least 1-1.5 years.

4.4.3 Development options for Rail Baltica

The possible alignments for Rail Baltica in Lithuania are not so well defined north of Kaunas as they are south of Kaunas. Several options are discussed for by-passing Kaunas.

First, the possible alignments north of Kaunas are discussed followed by a presentation of the confirmed alignment south of Kaunas (for a discussion on possible options for by-passing Kaunas).

The alignment, gauge and other parameters of the Rail Baltica line from the Latvian border to Kaunas (north) are not defined yet. In fact, no detailed studies of possible alignments north of Kaunas exist, so virtually no details are available for the options discussed below.

In principle, the whole alignment of Rail Baltica is specified in the "*Master plan of the Territory of Lithuania*" including the section north of Kaunas. In the plan the alignment from Kaunas to the Latvian border runs along the existing railway line. Despite this, three other options are also currently discussed.

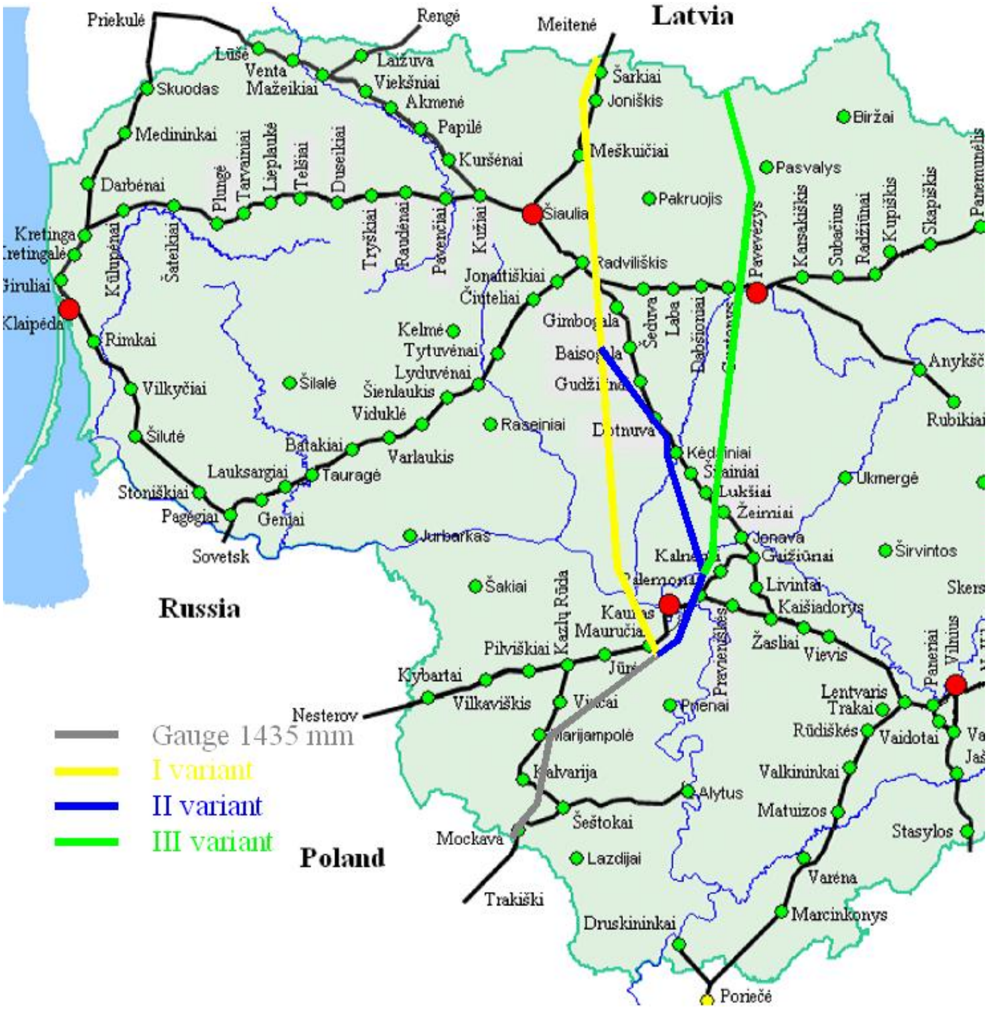
Thus, the four possible alignments are:

- *I Variant: Via Radviliskis/western by-pass of Kaunas* (yellow line)
- I*I Variant: Via Radviliskis/eastern by-pass of Kaunas* (blue line/yellow line to the Latvian/Lithuanian border)
- *III Variant: Via Panevezys*[9] (green line)
- *The existing line in Corridor I (Latvian border - Joniskis - Siauliai - Radviliskis - Guziunai - Kaunas)*: Both upgrading of the existing line and the construction of a European gauge standard line besides the existing line are discussed

The four alignment options are outlined in the figure below.

[9] One of the four international logistics centres should be located in Panevezys.

Figure 4.4 Alignment options - Latvian border to Kaunas



The advantages and disadvantages of the possible options have not been analysed yet. The Variant III alignment in the territory of Lithuania (green line) between Kaunas and Riga is the shortest, being about 90 km shorter than the existing line. Technical construction problems could arise due to soil problems north of Panevėžys (gypsum layers).

The only existing document regarding a border crossing is an agreement between the Lithuanian and the Latvian Ministries of Transport, where an existing point (North of Joniskis) is foreseen as the Rail Baltica border crossing point.

Contrary to the situation regarding possible alignments north of Kaunas, the alignment of Rail Baltica from <u>Kaunas (south) to the Polish border</u> is fully analyzed and the alignment is in principle agreed politically.

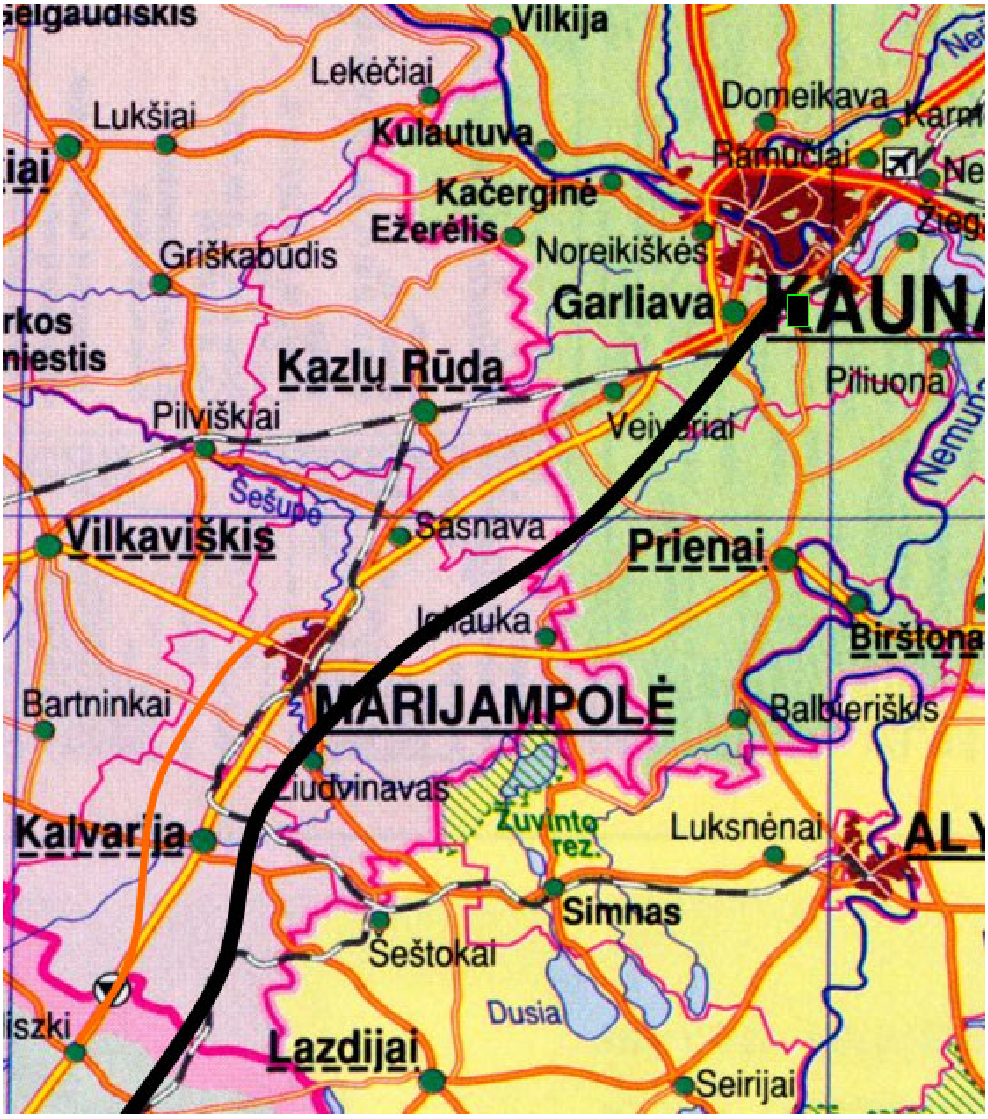
The “Special Plan of Alignment of European Standard Gauge Railway Polish-Lithuanian Border – Marijampolė – Kaunas” describes a solution based on the following technical parameters:

- Length: 85 km
- Gauge width:1435 mm
- Mixed (goods and passengers) transportation
- Designed speed: 160 km/h
- Vertical and horizontal alignment assure a speed of ≥200 km/h
- Grade-separated crossings

It is therefore planned to construct a new line from Kaunas to the Polish border.

The alignment from the Polish border to Kaunas is presented in the figure below. The new alignment is 30 km shorter than the existing line. The existing line from Kaunas to the Polish border (Kaunas - Kazlų Rūda - Marijampolé - Šeštokai - Polish border) is of poor quality and even after repair the maximum achievable speed would be only 80 km/h.

Figure 4.5 Approved alignment from Kaunas to the Polish border (black line)



4.4.4 Other issues

In relation to the development of Rail Baltica it is important to note that:

- The Lithuanian Government and the Ministry of Transport and Communications of the Republic of Lithuania express strong interests in the construction of Rail Baltica
- In March 2005 the Transport Investment Directorate under the Ministry of Transport and Communications was charged with the task to implement the functions of initiator (customer) for the preparation of the obligatory documents for the Rail Baltica project
- JSC "Lietuvos geležinkeliai" is interested in construction of Rail Baltica

Other planned major transport infrastructure projects
A number of major transport infrastructure projects are considered in Lithuania. The most important are shortly described below.

Regarding rail projects, JSC "Lietuvos geležinkeliai" is preparing a study "*Improvement of Railways to 160 km/h technical speed standard*":

- G-1 Vilnius – Kaunas – Kybartai
- G-2 Kaišiadorys – Šiauliai – Joniškis/Klaipėda

Furthermore, in the "*Lithuanian Strategic National Rail Transport Development Plan*" it is foreseen to:

- Reconstruct section Kaišiadorys-Šiauliai for 120-160 km/h. Planned period 2009-2013, upgrading costs 322 mill EUR, financing sources the Cohesion Fund, State funds, company funds and loans
- Upgrade Vaidotai and Radviliškis marshalling yards. Planned period 2005-2009, upgrading costs 22 mill EUR, financing sources the Cohesion Fund, State funds, company funds and loans
- Renewal of telecommunication in section Kaišiadorys-Kybartai, renovation of the Kaunas tunnel. Planned period 2005-2007, costs 24 million EUR, financing sources the Cohesion Fund, State funds, company funds and loans
- Electrification of corridors I, IXB, IXD. Planned period 2016-2020, costs 240 million EUR

For the road sector the "*Lithuanian State Road Maintenance and Development Program for 2002-2015*" foresees to:

- Upgrade the Via Baltica section from Marijampolė to Kaunas to motorway standard
- Construct missing grade-separated intersections

In addition, the Lithuanian Ministry of Transport and Communications approved in 2005 the "*Plan for Preservation and Development of Motorways*", where upgrading of the Via Baltica road to motorway standard is foreseen till 2035.

Finally, it is worth noting that:

- It is planned to establish four international logistics centres in Lithuania - in the regions of Kaunas, Klaipeda, Panevezys and Vilnius
- The container train "Baltic-Transit", which transports freight from Estonia, Latvia, Lithuania and Kaliningrad sea-ports through Russia to Kazakhstan and Uzbekistan, has started in 2003. This train is a common project of Estonia, Latvia and Lithuania. The aim of the project is faster and cheaper freight transportation by containers in the west-east direction.

Other relevant information
The cost studies for the existing railway network were made by JSC "*Lietuvos geležinkeliai*", COWI and other companies. The detailed revenue and operating costs are presented in the "*Lithuanian Strategic National Rail Transport Development Plan for 2005-2015*" (2004).

The cost-benefit analysis of a new Rail Baltica alignment was performed in several studies covering parts of the line. The most important studies are as follows:

- *"The Special Plan of Alignment of European Standard Gauge Railway Polish-Lithuanian Border - Marijampolė - Kaunas" (1999)*
- *"Pre-feasibility Study for EGR Link from the Polish border to Kaunas", GOPA-Consultants (2000)*
- *"European Gauge Railway Line from the Polish-Lithuanian Border to Kaunas and the Multimodal Centre" (2003)*

All studies showed that the benefits of the project will not outweigh the costs, i.e. the results of the economic analysis were negative. Furthermore, the studies showed that the project will not be financial viable without EU grants.

The latter study concluded that the following solution is the most appropriate one:

- Construction of the new line according to the AGC and interoperability requirements (standard gauge 1435mm, 225 kN/axle maximum load, 160 km/h, etc)
- Western by-pass of Kaunas city
- Construction of a new passenger station on the intersection of the Corridors I and IX near Mauručiai
- Implementation of the Intermodal Logistic Centre in Mauručiai area (south of Kaunas)
- Implementation of the Gauge Changing Facility in Mauručiai area (south of Kaunas)

4.5 Planning and policy context of Poland

4.5.1 Transport development plans

The key plans, which are setting the main objectives of transport development in Poland, are the following:

- *The National Development Plan 2007-2013*[10], which will be the continuation of the NDP 2004-2006 and will specify medium- and long-term activities for different sectors of the economy, including transport.
- *The National Transport Policy 2006-2025*, which is the continuation and amendment to the Policy for the years 2001-2015. The document shows the vision, targets and measures for achieving them, both in the general scope and for specific branches of transport. The detailed tasks for transport will be included in the National Strategy for Transport Development 2007-2013.
- *The Strategy of Transport Infrastructure Development in 2004-2006* and the following years, which shows the following priorities until the year 2013: development of land and air connections of the capital and main regional centres with the EU countries and the neighbouring countries; complementary to the first priority, development of domestic land and air connections; reconstruction of the basic road network towards the standard axle load of 11.5 tonnes; improvement of transport safety; development of sea port infrastructure; and development of intermodal transport infrastructure.
- *The National Strategy for Transport Development 2007-2013* (is currently being developed), which will become the basis for elaboration of the new NDP in the field of transport. The Strategy will determine new targets for the next EU budgetary period and define the main guidelines of the transport policy until 2020

All the above documents state that the railway lines located within the Pan-European Transport Corridors and covered by AGC/AGTC agreements should be modernised by 2013. These lines are enumerated and the list also includes the E-75 railway line, which is the Polish part of Rail Baltica (Corridor I).

4.5.2 Organisation and regulation

The organisation of the rail sector

Since the beginning of the 1990s, the Polish government has implemented restructuring measures to reform the Polish State Railways (PKP). These measures affected PKP's internal structures and processes as well as its external environment through the implementation of the Rail Transport Law (1997) and the Law on Commercialization, Restructuring, and Privatisation of Polish State Railways (2000). The combined effect of these reforms has enabled PKP to proceed with a partial privatisation of the State Railways.

The state-owned enterprise PKP was transformed on 1 January 2001 into a joint stock company PKP S.A. as part of a complex restructuring programme

[10] A first proposal of the *National Development Plan 2007-2013* was prepared by the former Polish government at the end of September 2005. The plan was, however, not entirely accepted by the new Polish government, but the current Polish government accepted the preliminary proposal of the National Strategic Reference Framework (required by the European Commission - which in Poland is called National Cohesion Strategy), which is based on the national development plan. These two documents do not differ in the strategic part, but do differ in the operational part.

adopted by the Polish Government and governed by the law of commercialization, restructuring and privatisation of PKP. Over the following several months, until October 2001, more than 40 subsidiaries were created based on the assets of PKP S.A.

Based on the directions indicated by the law on commercialisation, restructuring and privatisation of the State enterprise Polskie Koleje Państwowe, PKP was transformed into a holding company consisting of three major core businesses:

- Companies providing passenger transport (PKP Intercity Sp. z o.o., PKP Przewozy Regionalne Sp. z o.o., PKP Szybka Kolej Miejska Sp. z o.o., PKP Warszawska Kolej Dojazdowa Sp. z o.o.)
- Companies providing freight transport services (PKP Cargo S.A., PKP Linia Hutnicza Szerokotorowa Sp. z o.o.)
- Railway infrastructure operator (PKP Polskie Linie Kolejowe S.A.)

In 2003, the preparatory actions leading to the privatisation of some of the PKP companies (e.g. PKP SKM, PKP WKD, PKP Cargo) were initiated within the PKP Group and the years 2004-2006 were supposed to be the period of change in the ownership structure of these companies.

In January 2006, the Ministry of Transport and Communication presented a completely new conception of the restructuring and privatisation programme of PKP. Instead of prompt privatisation of individual rail companies, the Ministry would like first to consolidate the whole PKP Group in order to strengthen the ownership control over the companies and increase their value.

All property assets that are under control of, but are not appurtenant to PKP Cargo, will be transferred to relevant companies. E.g. the PKP companies providing passenger transport services will take over the locomotives that are used by those companies. Also every component of generally accessible infrastructure – tracks, shunting yards or harbour stations – will be transferred from PKP Cargo to the infrastructure manager, PKP PLK.

The project of this new restructuring strategy assumes that in less than three years some companies of the PKP Group such as PKP Cargo and PKP Intercity will improve their financial condition, so it will be possible to privatise them via the stock exchange. Nevertheless, 51% of PKP Cargo's shares will still be held by the Treasury.

It is also known that PKP Polish Railway Lines, i.e. the railway infrastructure manager will not be privatised at all. The plan is, however, to engage the company only in the maintenance of the railway network and in providing access to the railway infrastructure. A totally new entity will be responsible for investments (modernisation and development of railway lines).

The process has implied that a number of companies are today operating on the Polish rail network. According to the Office for Railway Transport, there where

77 licensed railway operators by 31 December 2005, of which 26 were given the license for passenger transport and 61 were given the license for freight transport. Also 26 operators were granted the license for making traction vehicles available.

As far as the market of passenger railway transport is concerned, the dominating operators are the four companies of the PKP Group mentioned above, which together hold almost 100% of this market.

The dominant player on the market of freight transport services is also one of the PKP Group's companies, namely PKP Cargo which transported 55.2% of the total freight volume in 2004. The second largest freight operator was PTKiGK Rybnik (18.6%)[11], and the third one PTKiGK Zabrze (12.1%). Some other significant operators on this market are: PCC Rail Szczakowa (3.3%), PKP LHS (2.6%) and CTL Rail (2.2%).

Referring to the Polish section of Rail Baltica, so far only companies (both passenger and freight) from the PKP Group have been operating on this line. However, it should be mentioned that the low volume of passenger traffic was the reason for replacing the only direct rail passenger connection between Warsaw and Vilnius by a regular bus connection (in July 2005).

In 2004, the total length of the railway lines in operation in Poland amounted to around 20,000 km, of which 19,000 km were managed by the largest railway infrastructure manager in Poland, i.e. PKP Polish Railway Lines (PKP PLK). PKP Polish Railway Lines is a joint stock, state-owned company run in conformity with market economy rules. PKP PLK is in charge of providing access to the railway operators and infrastructure managers in Poland. They also develop and administer (i.e. invoicing) the charging mechanism for track use. PKP PLK is responsible for the maintenance of tracks. In Poland there are 11,442 km of lines of national importance and they are and will be managed exclusively by the PKP Polish Railway Lines. All railway lines are part of Trans-European Transport Network, so also the Polish section of Rail Baltica has the status of a line of national importance.

Relevant national regulation
There are no specific national regulations in Poland related to Rail Baltica.

4.5.3 Development options for Rail Baltica

Possible alignments
The official alignment of the Polish part of Rail Baltica is: *Warsaw Wschodnia – Białystok – Sokółka – Suwałki – Trakiszki – Polish/Lithuanian border*.

However, environmental issues create significant problems with providing railway services on the section from Białystok via Sokółka to Suwałki, since

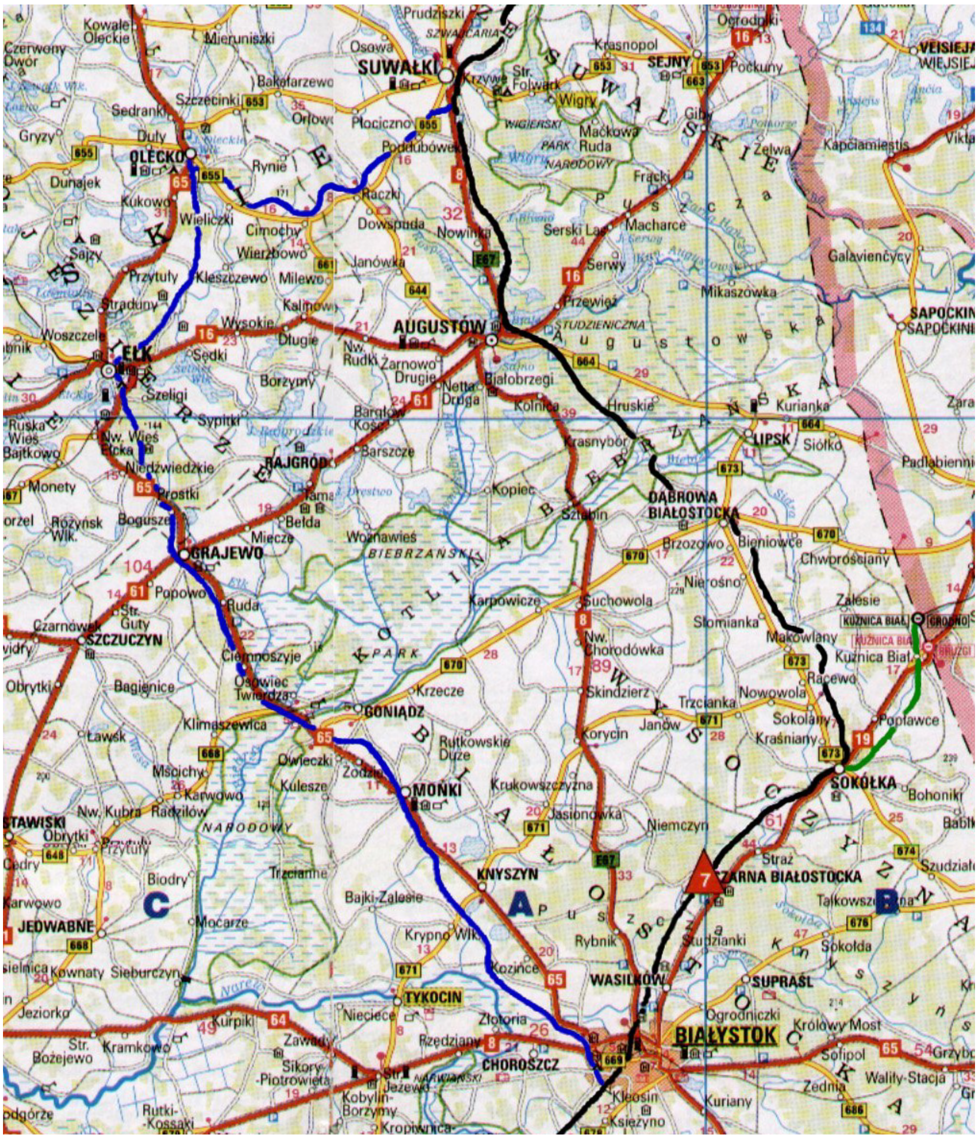
[11] However, in terms of transport work PKP Cargo performed 87.3%, and PTKiGK Rybnik – 1.3% of the total transport work in 2004.

the line in this area runs through several environmentally sensitive areas – national and landscape parks as well as Natura 2000 sites. The modernisation and upgrading of this section of line, i.e. adding additional tracks, electrifying and increasing axle loads, might be difficult or even impossible, as it would require large areas of forest to be cut down (the current track lies very close to the woods). Also the ground conditions are quite poor (many loose soils and marshy grounds).

Nevertheless, although the alignment of the sections: *Warsaw – Białystok and Suwałki – Polish/Lithuanian border* is presently specified as the Rail Baltica alignment, another alignment option is also being considered as the link between Białystok and Suwałki. It is the railway connection from Białystok via Ełk and Olecko and further to Suwałki. Primarily, this possible alignment does not conflict very much with environmental areas and its technical status is also better, especially on the section Białystok – Ełk. The line is single-tracked, but there is a lot of space for an additional track and the existing bridges are already constructed for two tracks. Unfortunately, in terms of upgrading the section *Ełk – Olecko – Suwałki* creates also some problems, as it runs through hilly grounds and there will be a need to cut numerous curves in the track.

In addition, there is one more future alignment option for Rail Baltica, which runs from Białystok via Sokółka and Kuźnica to Polish-Belarusian State border and further via Grodno (Hrodna) to Vilnius. This connection would use the old historical Warsaw – Petersburg trunk line. However, this option it not considered part of the Rail Baltica feasibility study.

Figure 4.6 Alignment options in Poland



The above figure presents all three alignment options for Rail Baltica in Poland as follows:

1. The official alignment (*Białystok – Sokółka – Suwałki*) is marked with a black line
2. The “Via Ełk” alignment option (*Białystok – Ełk – Olecko – Suwałki*) is marked with a blue line
3. The “Via Kuźnica” alignment option (*Białystok – Sokółka – Kuźnica up to Vilnius*) is marked with a green line.

4.5.4 Other issues

Other planned major transport infrastructure projects
The main project that may have an impact on Rail Baltica is the development programme of Via Baltica (road connection within Pan-European Corridor I),

since this project has even greater conflicts with the environmentally sensitive areas than in case of Rail Baltica. At the end of 2005, the construction of Via Baltica has been stopped by the Ministry of Environment, as the permissions issued at the start of the construction of three sections of Via Baltica were withdrawn, since they did not meet the legal regulations and violated the environmental requirements.

Due to these environmental conflicts as well as the concerns over heavy road traffic to/from the Baltic States, the recent position of the Polish Ministry of Transport and Construction is to give the priority to railways in Corridor I. According to the Ministry, feasibility studies for the development of Rail Baltica should concentrate on modelling logistics solutions (e.g. the development of piggyback transport (Ro-La), construction of logistics centres, etc) to be used on this railway link.

Other relevant information
Also, the new government is currently working on several documents describing the strategies for the development of the transport sector in Poland, including the *Strategy for railway transport up to 2009*.

5 The current railway infrastructure

The implementation of Rail Baltica can exploit a number of options with regard to existing lines as well as the construction of new line sections, if feasible. This chapter summarises the features and technical specifications and condition of existing line sections, which may be part of Rail Baltica. Annex B contains further details.

5.1 General information on the Rail Baltica infrastructure

About 40% of the Corridor 1 is equipped with double tracks. The remaining lines are single tracks. The loading gauge on the Rail Baltica line is UIC GB and UIC GC. The maximum permissible axle load is generally up to 23.0 tonnes, but parts of the network in Estonia have been upgraded to 32 tonnes because of the use of US locomotives. Presently, all four countries use diesel traction for international trains. Operation on electrified lines is only taken place on a minor part of the network.

The infrastructure in all Rail Baltica countries is designed for a maximum line speed of 120 km/h. Due to lack of maintenance, it is frequently necessary to operate at reduced speed, however.

A particular feature originating from the period after the World War II is that a 100 m wide zone is cleared for vegetation (except grass) along the railway line. The track is always positioned in the centre of the zone. According to present legislation, this zone must be maintained also if the position of the track is changed so that the track remains in the centre of the zone. For residential areas the zone may be reduced to 60 m.

In the same period all the existing lines in Estonia, Latvia and Lithuania were changed from 1000 or 1435 mm gauge to Russian standard gauge on 1520 mm. Since 1991 Estonia has modified some of their lines to Finnish gauge (1524 mm).

In Poland the majority of the railway lines have Western European gauge (1435 mm).

The table below provides an overview of the line features of the Rail Baltica corridor.

Table 5.1 Overview of line features

Line sections		Track length, km		Track gauge	Clearance gauge	Line speed	Axel load	El traction	Catenary voltage
City	City	Double	Single	mm	UIC	km/h	kN	Y/N	AC/DC
Tallinn	Tapa	78		1520	GB	80/120	225[1]	N	-
Tapa	Tartu		113	1520	GB	80/120	235[1]	N	-
Tartu	Border EE/LV		85	1520	GB	40	235	N	-
Border EE/LV	Riga	52	115	1520	GB	120	235	N	-
Riga	Border LV/LT	43	33	1520	GB	120	235	N	-
Border LV/LT	Kaunas	101	116	1520	GB	120	235	N	-
Kaunas	Sestokai	37	57	1520	GB	120	235	N	-
Sestokai	Border LV/PL		22	1435	GB	80	206	N	-
Border LV/PL	Bialystok		169	1435	GB	60/40	206	Y	3kV DC
Bialystok	Warszawa Rembertow[2]	172		1435	GB	80	216	Y	3kV DC
Total		483	710						

Note: [1] part of the infrastructure upgraded to 32 tonnes. [2] Via Sokolka.

The total length of the Corridor 1 from Warsaw to Tallinn is 1,193 km along the existing lines.

A general problem in the Baltic countries is the huge number of level crossings for road traffic and people.

In contrast to many European countries, the Baltic countries and Poland allow level crossings and passenger crossings in level with the track for a speed of up to 160 km/h.

If the speed is increased to more than 160 km/h the construction of out of level crossings will add considerably to the cost of design. Also a huge investment in many stations can be foreseen, due to the building of tunnels or bridges out of level for the crossing traffic if the design speed is increased to more than 160 km/h.

Level crossings are in any case not suitable in highly trafficked areas or when the train frequency is high. Apart from the safety risk, level crossings impose delay on the traffic, which may be unacceptable if the traffic density is high.

The picture below shows how level crossings are secured by full stop signs and warning lamps. Level crossing gates would add to the security.

Figure 5.1 Road crossing in level with road signs and warning lamps

5.1.1 Estonia

This section provides an overview of the existing infrastructure in Estonia.

Operations

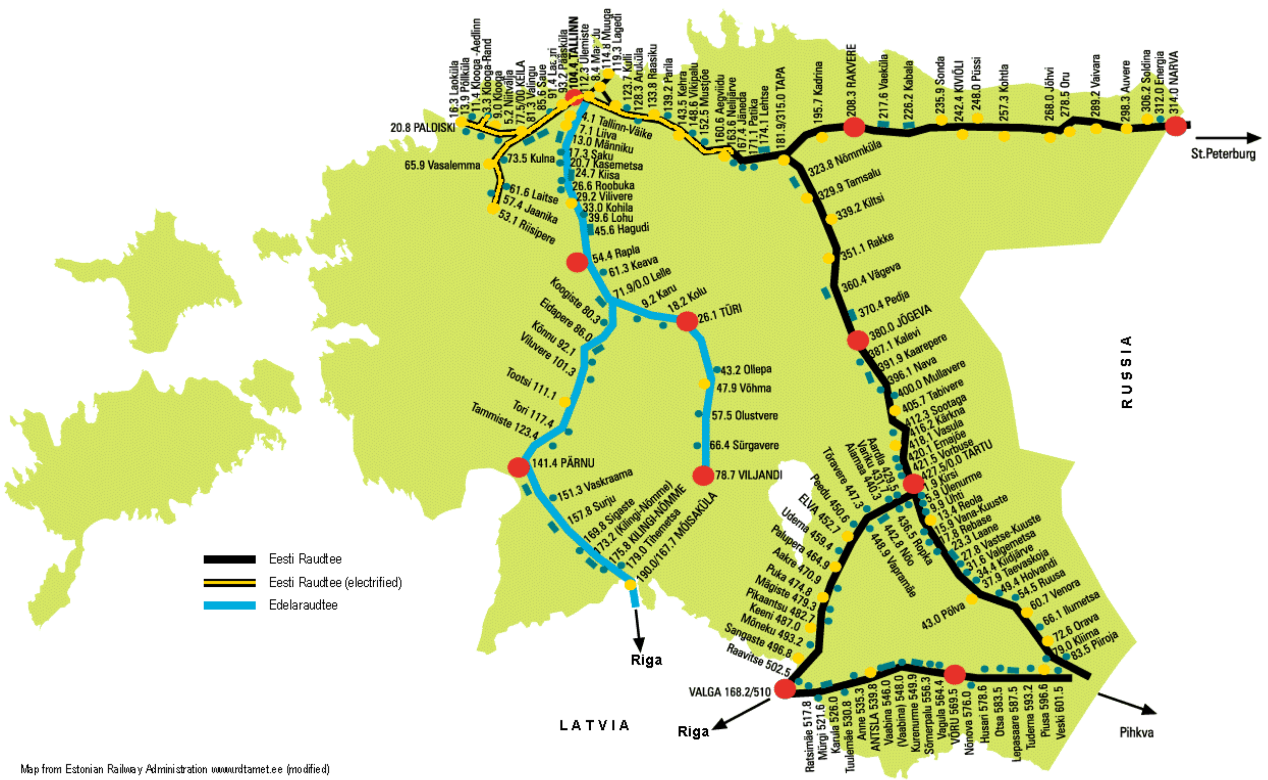
In Estonia there are presently three major lines in service (see Figure 5.2):

- The freight line from Tallinn to Narva and further on to the Russian border Narva
- The passenger and freight line from Tallinn to Pärnu
- The main line in Estonia from Tallinn - Tapa - Tartu and further on to the Latvian border at Valga

Around Tallinn there are additional lines for commuter trains between Tallinn and the suburbs.

The main part of freight traffic in Estonia is running on the sections: Tallinn - Tapa, Tapa-Narva and Tapa-Tartu.

Figure 5.2 Lines in operation



Note: Operations from Pärnu to Moisakula has stopped.

The section from Tallinn to Pärnu is not heavily trafficked today. Further, the operations from Pärnu to Moisakula and further on to the Latvian border have been stopped completely. This part of the railway line is abandoned and is now deteriorating, as it has not been maintained since the operations stopped.

The whole line can be rehabilitated to the original 120 km/h or up to 160 km/h without major reconstructions and probably within a reasonable budget (see section 7 for cost assessment). The main requirements will be track renewal and maintenance of the signalling system.

Most of the section running via Tartu has already been refurbished and rehabilitated to 120 km/h and 32 tonnes axle load (due to the acquisition of new and heavy locomotives). The programme for complete rehabilitation of the section was planned to be finished in 2008, but due to disputes between AS Eesti Raudtee and the government this is no longer certain. The capacity is, however, nearly fully exhausted because of heavy freight transport from Russia.

An operation plan based on higher speed can solve the issue of the possible need for changing the automatic line block system and/or construction of additional sidetracks.

General technical information
As mentioned previously all railway lines in the whole country lie in a 100 m wide zone (in cities the zone is 30 m wide) and the track is always positioned in the centreline of the zone. According to the existing law, the track shall always remain in the centre of the zone meaning that if the railway is realigned to a new position, the zone must be realigned as well.[12]

From the data provided in the chapter it is evident that there is a very big difference in the quality of the infrastructure in the eastern and in the western parts of Estonia corresponding to the infrastructure managed by Eesti Raudtee and Edelaraudtee respectively. The heavy trafficked freight lines in east are in a much better position than the lines with much lower levels of traffic in the west. The pictures below illustrate the situation in the western part of the network.

Many lines were originally constructed of used materials, mainly coming from Russia. The typical superstructure consists of aggregate ballast (limestone), 1,700 wooden sleepers per km and R 65 or R 50 jointed rails, 25 m long. The fastening system is spikes. The track components are generally around 50 years old meaning that they have exhausted their expected lifetime (see for example Figure 5.5).

All existing lines are equipped with automatic or semi-automatic line block systems.

Detailed technical information
The list below presents more detailed technical information:

- Total length of network : 1021 km
- Mainline : 691 km
- Double track :115 km
- Electrified lines 132 km
- Rail Baltica part of the network (as presently defined TEN-T network): 275 km
- Gauge : 1520 mm (after 1991 Finnish gauge on 1524 mm in smaller sections only)
- Electrification : 3 kV DC
- Rail size on mainlines : UIC 60 and R 65
- Axle load : 22,5 tonnes
- Maximum train weight : 8000 tonnes (normally 5500 tonnes or 4000 tonnes)
- Line speed passenger trains : 100 / 120 km/h
- Line speed freight trains : 90 km/h

[12] This regulation seems outdated. As it may be necessary in connection with an increase in the design speed to change the alignment of the tracks, it would be practical if the whole zone can be used, instead of, as it is today, only the centreline of the zone.

- Safety system in the track : Automatic block system
- Safety system rolling stock : VEPS
- Locomotives and wagons couplers : Russian and American style

Figure 5.3 Present rolling stock for passengers and track maintenance worker on job. Tallinn West station

Figure 5.4 Russian rail from 1952 fastened with spikes. The Pärnu line

Figure 5.5 Jointed track, wear between the rails. The Pärnu line

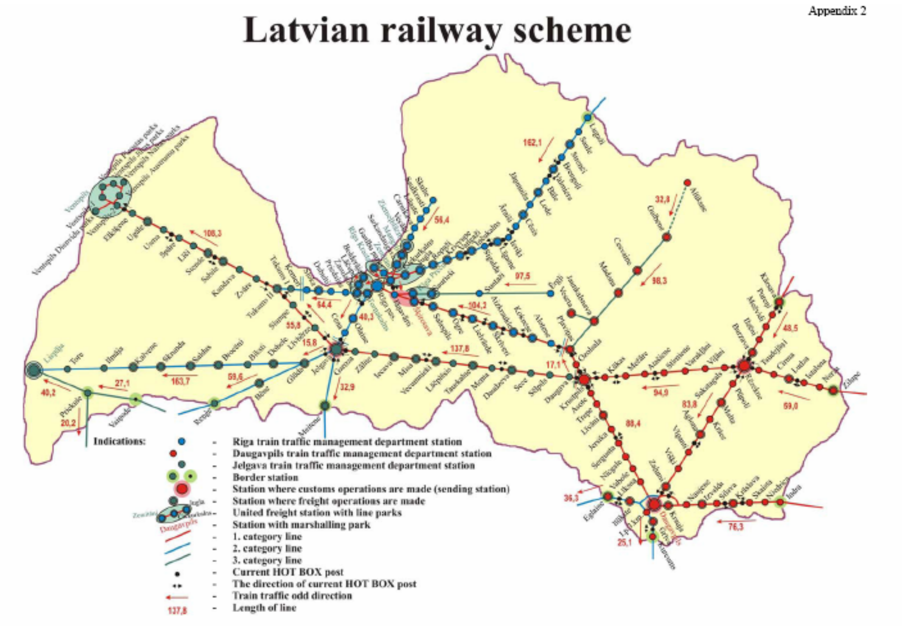
5.1.2 Latvia

The rail network

Latvia also focuses on the east-west traffic. The east-west going sections are under rehabilitation and upgrading, while this is not the case for the north-south bound sections. According to the information provided, parts of the north-south sections are presently in very bad shape.

The figure below provides an overview of the rail network in Latvia.

Figure 5.6 Schematic overview of railway lines in Latvia



The existing infrastructure in Latvia is designed for a line speed of 120 km/h and an axle load of 23.5 tonnes.

In Latvia, the Corridor 1 line runs via Valka to Riga and via Jelgava to Meitene at the Lithuanian border.

Today, all north-going traffic uses the existing 167 km long line from Riga via Valmiera to the Estonian border near Valga (TR1). All south-going traffic uses the 76 km long line through Jelgava. (RK1)

All the lines can possibly be rehabilitated to 120 km/h or upgraded to 160 km/h within reasonable costs. The main input will be track renewal or rehabilitation and maintenance of the signalling system.

In Latvia, the rehabilitation of the track and the turnouts on the east-west-going lines is an ongoing process. This is expected to be finished in 2008. According to our information there are no projects for rehabilitation or track renewal on the north-south bound lines.

Previously, it was possible to go to Estonia via Moisakula from Riga, but according to the received information the track is now in such a bad shape that it has been removed at a distance of around 20 km from the Estonian border. Before operation on this line, the track has to be reconstructed.

Investigations shall later determine if the line should be reconstructed or a new connection established from Moisakula to Valmiera.

Figure 5.7 Jelgava station or junction south of Riga

As in Estonia the railway is centred within a "clear" zone, but here it is only 60 m wide.

Figure 5.8 30 m corridor along the southern line at Meitene

In the cities the corridor is restricted to 6 m to each side.

Detailed technical information
The list below presents more detailed technical information on the Latvian network:

- Total length of network : 3397 km
- Mainline : 2282 km
- Double track :302 km
- Electrified lines : 257,4 km
- Rail Baltica part of network : 243 km
- Gauge : 1520 mm
- Electrification : 3 kV DC
- Rail size on mainlines : UIC 60 and R 65
- Axle load : 23,5 tonnes
- Maximum train weight : 8000 tonnes (normally 5500 tonnes or 4000 tonnes)
- Line speed passenger trains : 120 km/h
- Line speed freight trains : 80 km/h

- Safety system in the track : Automatic block system (automatic / semi automatic)
- Safety system rolling stock: (ALSN, class B for interoperability)
- Locomotives and wagons couplers : Russian standards

Figure 5.9 Old fastening on the mainline south of Riga

Rehabilitation and upgrading
The general impression of the railways in Latvia is that rehabilitation to the original design speed of 120 km/h on the most important lines is possible through relatively low cost interventions, i.e. track renewal and minor works on signalling systems. Re-alignment is not required for rehabilitation works (to 120 km/h) and the sub-grade seems to be in a generally acceptable condition, needing no or little intervention.

Speed increases to more than 160 km/h will trigger much higher costs i.a. due to the conversion of many level crossings to out of level crossings, realignment of tracks in curves, improvements in the signalling and telecommunication system and perhaps more. Also the rolling stock may need replacement to match this speed. Realignment with the existing 60 m zone (to increase curve radii) would be possible, but requires a change of the existing law.

The costs of upgrading the existing infrastructure are further discussed in section 7.

Figure 5.10 Mainline against Lithuania, South of Jelgava : Wooden sleepers with spikes

5.1.3 Lithuania

Lithuania has in its strategy plan proposed an upgrading of the sections of its east-west corridor overlapping with the proposed alignment for Rail Baltica. The goal is years to upgrade the sections Siauliai to Kaisiadorys and Vilnius - Kaunas to 160 km/h including doubling of tracks within the next 5-7. The upgrading also includes realignment, reconstruction of structures, two-level crossings, modernisation of signalling and telecommunication, and renewal of marshalling yards. The existing Russian gauge will be kept. The planned upgraded sections correspond to approximately half of the total length of Rail Baltica in Lithuania.

The section north of Siauliai to the Lithuanian/Latvian border is not foreseen to be upgraded in the short term perspective.

In the southern part of Lithuania, the construction of a new line with West European gauge from the Polish/Lithuanian border to Kaunas has been investigated. There is no short term plans for upgrading the existing railway section in this region.

Detailed technical information

The list below presents more detailed technical information on the Lithuanian network:

- Total length of network : 1674 km broad gauge + 21,8 km standard gauge
- Mainline : 691 km
- Double track :530 km
- Electrified lines : 122 km
- European standard gauge : 21,8 km
- Rail Baltica part of network : 333 km
- Gauge : 1520 mm (1435 mm from Sestokai to Polish border)
- Electrification : 25 kV AC, 50 Hz
- Rail size on mainlines : UIC 60 and R 65
- Axle load : 23,5 tonnes
- Maximum train weight : 8000 tonnes (normally 5500 tonnes or 4000 tonnes)
- Line speed passenger trains : 120 km/h
- Line speed freight trains : 80 km/h
- Safety system in the track : Automatic block system
- Safety system rolling stock : VEPS
- Locomotives and wagons couplers : Russian standards

On the first 20 km from Poland into Lithuania the gauge is European standard. There is a political agreement between Poland and Lithuania to extend this line with 1,435 mm gauge up to Kaunas.

The line from Kaunas to Trakiszki in Poland can be rehabilitated under the same conditions as in the other Baltic countries (track renewal/rehabilitation and moderate maintenance)

Also here there is a wide zone around the railway, in which upgrading and /or adjustment of the alignment can be done. As in the other states there is a need for a permission to replace the track position without repositioning of the zone.

The biggest obstacle in Lithuania is the power station and power dam just outside Kaunas (see Figure 5.11 below). The construction of new lines will cause the building of a new bridge near the power station.

Figure 5.11 Power station at Kaunas

If the alignment is not changed, it is possible to build an extra track on the top of the dam, but a few hundred metres later the railway runs through the only tunnel in Lithuania with only one railway track.

The alignment around Kaunas shall therefore be considered very carefully.

Figure 5.12 Railway tunnel in Kaunas

5.1.4 Poland

In Poland two options are considered; namely via Sokolka or via Elk. Poland is planning to rehabilitate the line section from Warsaw to Bialystok while there are no immediate plans for upgrading any of the extensions to Suwalki. In these sections the complete railway is in poor condition and the trains operate at reduced speed all or most of the way to the Lithuanian border.

Detailed technical information

The list below presents more detailed technical information on the Polish network:

- Total length of network : 19435 km
- Mainline : 10248 km
- Double track : 8,792 km
- Electrified lines : 12,107 km
- Rail Baltica part of network : 340 km (via Sokolka)
- Gauge : 1435 mm
- Electrification : 3 kV DC
- Rail size on mainlines : UIC 60 and R 65

- Axle load : 216 kN
- Maximum train weight: 8000 tonnes (normally 5500 tonnes or 4000 tonnes)
- Line speed passenger trains: 100 / 120 km/h
- Line speed freight trains 90 km/h
- Safety system in the track: Automatic block system
- Safety system rolling stock: VEPS
- Locomotives and wagons couplers : European standards

In Poland, the Corridor 1 line starts at Warszawa Rembertow and proceeds north for the first 200 km to Bialystok. In Bialystok the line splits into two directions, to Elk and to Sokolka, which meet again in Suwalki from where the line continues to the Lithuanian border and further on to Kaunas. Both lines are in operation, although in poor condition, and the train speed is well below 100 km/h.

Figure 5.13 Malkinia station at the line to Bialystok

From Warsaw to the Lithuanian city of Sestokai, the railway has a standard West European track gauge of 1,435 mm. At present, there is an agreement between Poland and Lithuania to extend the line with a European standard gauge to Kaunas.

The biggest constraint for the alignment option via Sokolka is that it will adversely affect a large national park between Sokolka and Elk (see section 8.3

for further details). The Polish Government gives the protection of this area high priority and therefore favours the line option via Elk.

SECTION B: INVESTMENT PACKAGES, INVESTMENT COSTS AND CONSTRAINTS

6 Investment packages

A number of alignment options for Rail Baltica are discussed in the four project countries. Furthermore, a wide range of technical options are discussed ranging from limited upgrading of the existing infrastructure based on Russian standard (gauge) with an improved re-loading station/logistics centre to upgrading of some existing infrastructure and the construction of new lines based on European gauge standard.

On the basis of a gross list of development options three investment packages have been selected for further analysis. These three packages are described in this chapter.

The packages have been established on the basis of the results of a screening process, comments provided at the Second Work Group meeting on 26th July in Brussels following the delivery of the Draft Interim Report and comments provided at the Third Work Group meeting on October 26th in Vilnius following the delivery of the Draft Final Report. For more details see Annex F.

Please note that the speed indications in this section refer to *design speed* - not *operational speed*.

The investment packages are compared with a Do-minimum scenario, where the Rail Baltica project is not realised. The Do-minimum scenario defines a situation where in general current speed, travel times, frequencies and capacity is maintained in the Rail Baltica corridor[13]. However, the Estonian part of the line between Tallinn and Riga and the section from Warsaw to Bialystok in Poland will be upgraded to 120 km/h. In the Do-minimum Scenario the state of the railway will not deteriorate further. Investments, inspections and maintenance work (including error corrections) necessary to maintain the current level of service will be carried out to maintain present standards.

[13] Other parts of the rail and road networks are assumed to be developed in accordance with existing plans.

6.1 Package 1: Design speed of minimum 120 km/h

Package 1 represents a solution, which secures a minimum design speed of 120 km/h from Tallinn to Warsaw.

The package describes a situation where Russian standards are maintained in Estonia, Latvia and Lithuania - except for the section from Kaunas to the Lithuanian/Polish border, where a new line with European standards (not electrified) is constructed.

This requires that a re-loading station/logistics centre is established in the Kaunas region.

Package 1 (and 2) includes the construction of 185 km partly new and more direct line from Joniskis via Radviliskis to Kaunas. Alternatively the existing line could be upgraded/extended, which is considered as sub-variant 1A to investment package 1. If the existing line is used for Rail Baltica it requires that the sections, which are double track are upgraded to 120 km/h, and that the sections which are single track are extended to double track to eliminate the bottlenecks, which limit the capacity of the line.

The advantages of constructing a new and more direct line are:

- It provides a more direct link between Riga and Kaunas.
- Upgrading of the existing line will disrupt the important east-west service.
- It could potentially move traffic from the existing line from Kaunas and Siauliai, which in periods with high volumes of bulk cargo being transported from Russia/Belarus to Klaipeda operates close to the capacity limit.

Possible disadvantages of constructing a new line are that construction costs could be higher and that land acquisition could be a technical barrier for the implementation of Rail Baltica.

Package 1 is specified in the table below.

Table 6.1 Specification of Package 1

Connection	Section	Description
Tallinn-Riga	Tallinn - EE/LV border	No upgrade of the existing line via Tartu, as it is upgraded to 120 km/h irrespective of the implementation of Rail Baltica.[1]
	EE/LV border - Riga	Upgrade of the existing line via Valmiera to 120 km/h
Riga-Kaunas	Riga - LV/LT border	Upgrade of the existing line via Jelgava to 120 km/h
	LV/LT border - Kaunas	Upgrade of part of the existing line from LV/LT border to Joniskis to 120 km/h and construction of a new and more direct line from Joniskis via Radviliskis to Kaunas. Design speed of 160 km/h. (Sub-variant is to upgrade/extend the capacity of the existing line)
Kaunas - Warsaw	Kaunas - LT/PL border	Construction of a new line based on European standard gauge with a re-loading station/logistics centre in the Kaunas region. Design speed of 160 km/h. Not electrified.
	LT/PL border - Warsaw	Upgrade of the existing line via Elk to 120 km/h.

[1] On the section Tallinn - Tapa – Jõgeva – Tartu - Valga the line capacity is almost depleted. Hence in case the implementation of Rail Baltica transfers or induces large volumes of freight or passenger traffic it could be necessary to increase the capacity of the line. This is not included in the construction cost estimate. This issue should be investigated further in the design phase.

The figure below provides a graphical presentation of *Package 1: Design speed of minimum 120 km/h.*

Figure 6.1 Graphical presentation of Package 1

	Upgrade of existing line	New line
Russian standard	120 km/h 160 km/h	160 km/h
European standard	120 km/h 160 km/h	160 km/h 200 km/h

Note: The section from Kaunas to the Polish/Lithuanian border is not electrified in Package 1.

An important advantage of Package 1 is that it allows for continued upgrades of Rail Baltica in case that the demand for transport services proves to be high. Package 1 can therefore represent the first step in realising a high quality service on the Rail Baltica line without restricting a future choice of technical standard. The obvious advantage is that only limited resources are tied to the project until the actual need for and potential of the line is revealed.

6.2 Package 2: Design speed of minimum 160 km/h

The second package referred to as *Package 2: Design speed of minimum 160 km/h* reflects a rather ambitious plan for implementing Rail Baltica. It includes a north-south connection providing a design speed of at least 160 km/h.

The package also includes the construction of a new line from Kaunas to the Lithuanian/Polish border based on European standards (not electrified) with a re-loading station/logistics centre in the Kaunas region.

The main option also includes the construction of a new and more direct line from Joniskis via Radviliskis to Kaunas (ref. discussion in previous section).

A sub-variant (2A), where a new line is constructed from Riga - via Bauska and Panevezys - to Kaunas is also considered. No total traffic model calculations are made for this variant, but the investment costs are estimated and the related benefits are assessed qualitatively on the basis of the traffic model calculations for the option via Radviliskis. A possible advantage of this option is that it could be better integrated in the transport system, as this alignment follows the Via Baltica road corridor. This creates a potential for positive modal split effects. Furthermore, the construction of a new line via Panevezys could potentially move traffic from the existing line from Kaunas and Siauliai, which in periods with high volumes of east-west bulk cargo operates close to the capacity limit.

A second sub-variant (2B) is to upgraded/extended the capacity of the existing line. This includes that the sections which are double track are upgraded to 160 km/h, and that the sections which are single track are extended to double track.

Package 2 is specified in Table 6.2.

Table 6.2 Specification of Package 2

Connection	Section	Description
Tallinn-Riga	Tallinn - EE/LV border	Upgrade of the existing line via Tartu to 160 km/h. [1]
	EE/LV border - Riga	Upgrade of the existing line via Valmiera to 160 km/h
Riga-Kaunas	Riga - LV/LT border	Upgrade of the existing line via Jelgava to 160 km/h. (Sub-variant is to construct a new line from Riga-Kaunas via Panevezys in Lithuania).
	LV/LT border - Kaunas	Upgrade of part of the existing line from the LV/LT border to Joniskis to 160 km/h and construction of a new and more direct line from Joniskis via Radviliskis to Kaunas. Design speed of 160 km/h. (Sub-variant A is to construct a new line from Riga via Panevezys to Kaunas in Lithuania; Sub-variant B is to upgrade/extend the capacity of the existing line)
Kaunas - Warsaw	Kaunas - LT/PL border	Construction of a new line based on European standards with a re-loading station/logistics centre in the Kaunas region. Design speed of 160 km/h. Not electrified.
	LT/PL border - Warsaw	Upgrade of the existing line via Elk to 160 km/h.

[1] On the section Tallinn - Tapa – Jõgeva – Tartu - Valga the line capacity is almost depleted. Hence in case the implementation of Rail Baltica transfers or induces large volumes of freight or passenger traffic it could be necessary to increase the capacity of the line. This is not included in the construction cost estimate. This issue should be investigated further in the design phase.

The figure below provides a graphical presentation of *Package 2: Design speed of minimum 160 km/h.*

Figure 6.2 Graphical presentation of Package 2

	Upgrade of existing line	New line
Russian standard	120 km/h 160 km/h	160 km/h
European standard	120 km/h 160 km/h	160 km/h 200 km/h

Note: The section from Kaunas to the Polish/Lithuanian border is not electrified in Package 2.

6.3 Package 3: European gauge standard

The third package reflects the most ambitious plan for implementing Rail Baltica. The investment package is based on electrified European gauge standard on all north-south sections.

The alignment between Tallinn and Riga will be via Pärnu (the shortest route), while the section between Riga and Kaunas will be via Radvilikis (the shortest route). The design speed from Tallinn to Kaunas is 160 km/h. From Kaunas to the Lithuanian/Polish border a new electrified line is constructed with a design speed of 200 km/h. The Polish part of the link (via Elk) is upgraded to 160 km/h and the section north of Bialystok is electrified.

Investment package 3 also includes 2 sub-variants.

Sub-variant 3A considers an alignment via Lelle/Pärnu instead of a direct link from Tallinn to Pärnu, while sub-variant 3B considers the consequences of no further electrification (the section from Warsaw to Bialystok is electrified today).

Again no traffic model calculations have been made for the sub-variants. The investment costs are however estimated and the effects on benefits are assessed qualitatively on the basis of traffic models calculations for the main option.

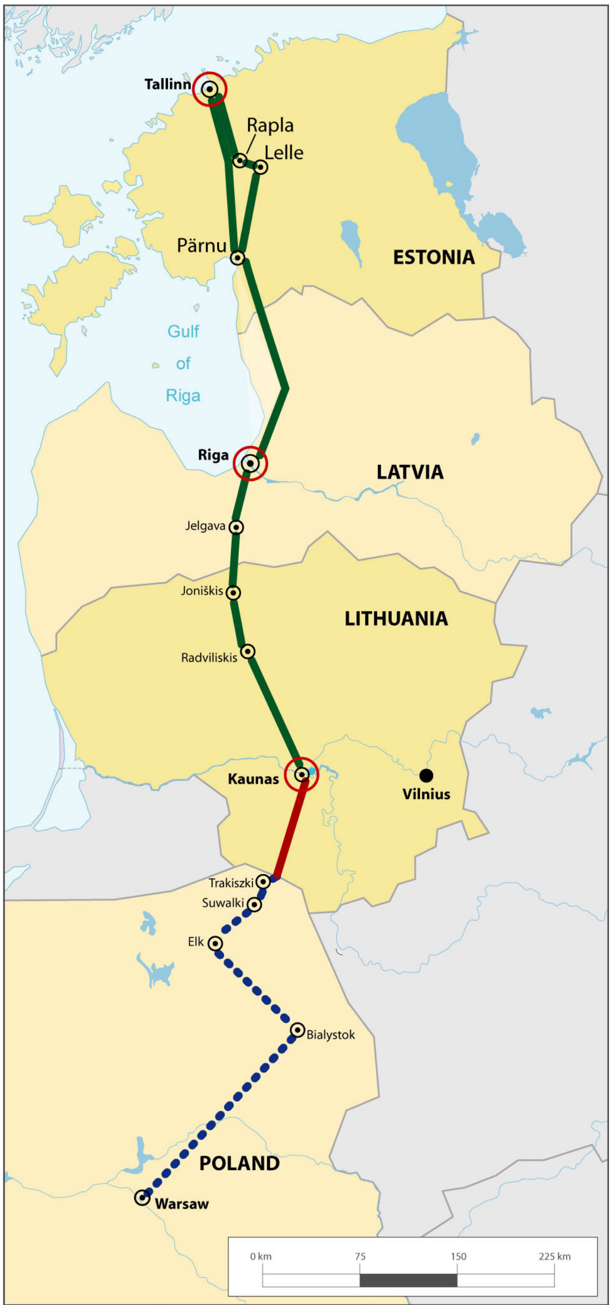
Package 3 is specified in Table 6.3.

Table 6.3 Specification of Package 3

Connection	Section	Description
Tallinn-Riga	Tallinn - EE/LV border	Construction of a new line based on European standards via Pärnu (the shortest route). (Sub-variant A is to go via Lelle/Pärnu). Electrified. (Sub-variant B; no electrification).
	EE/LV border - Riga	Construction of a new line based on European standards providing a direct link from Pärnu to Riga (the shortest route). Electrified. (Sub-variant B; no electrification).
Riga-Kaunas	Riga - LV/LT border	Construction of new line based on European standards via Jelgava. Electrified. (Sub-variant B, no electrification).
	LV/LT border - Kaunas	Construction of new line based on European standards via Joniskis and Radviliskis. Electrified. (Sub-variant B; no electrification).
Kaunas - Warsaw	Kaunas - LT/PL border	Construction of a new line based on European standards with a re-loading station/logistics centre in the Kaunas region. Design speed of 200 km/h. Electrified. (Sub-variant B; no electrification).
	LT/PL border - Warsaw	Upgrade of the existing line via Elk to 160 km/h. Electrified. (Sub-variant ; no electrification).

The figure below provides a graphical presentation of *Package 3: European gauge standard.*

Figure 6.3 Graphical presentation of Package 3



	Upgrade of existing line	New line
Russian standard	120 km/h 160 km/h	160 km/h
European standard	120 km/h 160 km/h	160 km/h 200 km/h

Note: The section from Kaunas to the Polish/Lithuanian border is electrified in Package 3 and base infrastructure prepared for later upgrade to speed of 200 km/h. Sub-variant B is no electrification north of Bialystok.

7 Investment costs

The costs of implementing Rail Baltica are of course one of the most important criteria for selecting a solution.

The cost assessment is presented in this chapter.

Given that the project is in the early stage of the planning process and few details therefore are available on the investment packages, which were presented in the previous chapter, the assessment is subject to large uncertainties.

7.1 Background and assumptions

The cost assessment for each of the investment packages is based on the following assumptions/observations (see Annex C for more details):

- All existing lines are designed to 120 km/h. However, due to lack of maintenance including poorly maintained tracks etc, the operational speed is usually much less than 120 km/h.
- The various technical systems are today more or less the same in the Baltic countries and similar to the systems in Poland. A generalisation is therefore possible.
- It is anticipated that the **inclination and vertical radius** are low and below what is normally considered to be limiting values
- For upgrading to 160 km/h:
    - 64% of the railway line has a sufficient horizontal radius, length of transition curves and cant, which can be covered by the general upgrading of the track substructure.
    - 22% of the railway line has sufficient horizontal radius, but an increase in the cant and length of the transition curve is necessary.
    - 14% of the railway line has an insufficient horizontal radius. The cant, the horizontal radius and the length of the transition curves must therefore be altered.

- The above has the effect that for upgrading to 160 km/h:
  - 22% of the line needs repositioning of the entire curve and adjustment of the substructure
  - 14% of the line needs a change of the entire curve and a new substructure
- For **new lines** it is assumed that 25% of the line is constructed with a **double track** (stations, sidings etc) in order to allow passing trains or overtaking slow (freight) trains.
- Only a few of the existing **bridges** are capable of carrying trains at a speed of 160 km/h. It is anticipated that 75% of the bridge length need to be upgraded to 160 km/h.
- It is assumed that **level crossings** can continue to exist for speeds up to 160 km/h[14], but should be eliminated above this speed. It is further assumed that in general, the level crossings are not equipped in an appropriate way with regard to higher speed and, consequently, level crossings have to be upgraded for a speed up to 160 km/h. It is assumed that level crossings exist for each 5-10 km of railway line. Existing level crossings are generally equipped with bells and light signals, but not with bars in all cases.
- The situation of **land acquisition** is unclear and the estimated costs of land acquisition are highly therefore uncertain. However, the cost assessment shows that the cost of land only accounts for a minor share of the total investment costs.
- Potential major **reconstruction works in especially big cities** are not included in the cost assessment.

7.2 Unit costs

The unit costs for construction and land acquisition are presented below.

7.2.1 Construction

The cost assessment is based on the unit prices reproduced in the table below.

Table 7.1 Unit values used in cost assessment

Category	Million €
Upgrade of existing line to 120 km/h (per km single track)	0.5
Upgrade of existing line to 160 km/h (per km single track)	0.7
New line, Russian standard (no electrification) (per line-km)	1.9[1]
New electrified line, European standard (per line-km)	2.5[1]

[1] Including 25% double track

[14] Level crossings are not allowed with 1st and 2nd class roads.

Furthermore, it is estimated that it will costs approximately 0.5 million € per km of single track to electrify an existing line.

The unit values used have primarily been derived from the UIC report *"Infra-cost - The Cost of Railway Infrastructure"*, which was published in June 2002. The objective of the study was to benchmark real projects such as new lines, extension/upgrading and major renewal against each other. The project data-base is updated yearly and hence gives a very representative indication on cost development and levels. Together with a participant from the UIC working group the Consultant has verified the estimated unit cost used for the Rail Baltica study with the data provided by UIC report. Further the Consultant has compared the estimated unit cost with present data from on-going projects in Denmark and Eastern Europe mainly Poland and the cost information received from the project countries.

The costs for upgrading to 120 km/h mainly covers track works, drainage works and absolutely necessary road works, while the costs for upgrading to 160 km/h also includes upgrading of civil engineering structures (platforms). The difference in the unit costs for upgrading to 120 km/h and 160 km/h is primarily due to necessary geometrical changes caused by speed increases.

The cost assessment only includes upgrades, which are absolutely necessary for running the specified trains services, e.g. it does not include costs for upgrading buildings at stations and connections to stations. Also potential major reconstruction works in especially cities are excluded, as they in most cases are projects having much wider goals than Rail Baltica. This means cost estimates for other rail project may be different from the unit cost applied here, as they often include a number of improvements of stations, communication systems etc which are not strictly necessary for implementation of the investment packages analysed for Rail Baltica.

The pure construction costs are expected to remain relatively constant over time, despite that the average wages in the construction sector is increasing rapidly in the region (e.g. in Lithuania the average wage has increased from 350 €/month in 2003 to 700 €/month in 2006). The reason is that labour costs only account for a minor part (20%) of total costs and because the productivity in the construction sector is expected to increase in the coming years.

The unit cost figures reflect an average for the corridor. Hence on some sections it will be more costly to upgrade the existing line/construct new line and on some sections it will be cheaper.

7.2.2 Land

The costs of land in the four project countries are highly uncertain due a number of factors, including uncertainties about the future legislation on expropriation, large differences in costs across countries and regions and uncertainties about the future alignment of Rail Baltica.

The cost assessment for land acquisition is based on the unit prices reproduced in the table below. The unit values used have been estimated on the basis of information received from the project countries.

Table 7.2 Unit costs of land (€/m^2)

Type of land	€/m^2
Arable land	0.5
Urban	80.0

Note: See annex C for details

The cost assessment does not include costs of building to be destroyed, which however most likely will only account for a minor fraction of total costs.

7.3 Cost assessment

The cost assessments for the main options are summarised in Table 7.3, while the cost assessments for the sub-variants are summarised in Table 7.4 and Table 7.5.

Table 7.3 Summary of investment cost assessment, main options (million €)[15]

	Package 1			Package 2			Package 3		
	Construc-tion	Land	Total	Construc-tion	Land	Total	Construc-tion	Land	Total
Estonia	0[1,2]	0	0	241[2]	0	241	450[2]	8	458
Latvia	169	0	169	231	0	231	513	8	521
Lithuania	572	33	605	575	33	608	790	33	823
Poland	204[3]	0	204	466[4]	0	466	566[4]	0	566
Total	**945**	**33**	**979**	**1,513**	**33**	**1,546**	**2,319**	**50**	**2,369**

[1] Estonia has recently spent 66 million € on upgrading the existing line from Tallinn via Tartu to Valga to 120 km/h. [2] On the section Tallinn - Tapa – Jõgeva – Tartu - Valga the line capacity is almost depleted. Hence in case the implementation of Rail Baltica transfers or induces large volumes of freight or passenger traffic it could be necessary to built an additional track between Tapa and Tartu. This is not included in the construction cost estimate. This issue should be investigated further in the design phase. [3] Poland has continuously spent resources on maintaining the standard of the existing line from Warsaw to Bialystok, which implies that only minor upgrades are necessary for this section. Upgrades are however necessary on the section from Bialystok to the Lithuanian border. [4] Including costs for upgrading existing bridges.

[15] The cost assessment only includes upgrades, which are absolutely necessary for running the specified trains services.

Table 7.4 Summary of investment cost assessment, sub-variants to investment package 1 and 2 (million €)

	Package 1, sub-variant A (Existing line in LT)			Package 2, sub-variant A (Via Panevezys)			Package 2, sub-variant B (Existing line in LT)		
	Construc-tion	Land	Total	Construc-tion	Land	Total	Construc-tion	Land	Total
Estonia	0	0	0	241	0	241	241	0	241
Latvia	169	0	169	319	8	327	231	0	231
Lithuania	437	17	453	593	25	618	495	17	512
Poland	204	0	204	466	0	466	466	0	466
Total	**810**	**17**	**827**	**1,618**	**34**	**1,652**	**1,433**	**17**	**1,450**

Table 7.5 Summary of investment cost assessment, sub-variants to investment package 3 (million €)

	Package 3, sub-variant A (via Lelle/Pärnu in Estonia)			Package 3, sub-variant B (no electrification)		
	Construc-tion	Land	Total	Construc-tion	Land	Total
Estonia	475	16[1]	491	338	8	346
Latvia	513	8	521	384	8	393
Lithuania	790	33	823	593	33	626
Poland	566	0	566	466	0	466
Total	2,344	58	2,402	1,780	50	1,830

[1] The cost of land in Estonia could prove to be slightly higher for the option via Lelle/Pärnu due to extra need for land acquisition in urban areas.

Package 1
It will require an investment of approximately 979 million € to implement investment package 1.

No further investments are necessary in Estonia, as Estonia has recently spent 66 million € on upgrading the existing line from Tallinn via Tartu to Valga to 120 km/h. It is however worth noting that the capacity is almost depleted on the existing line. In case the implementation of Rail Baltica transfers or induces large volumes of freight or passenger traffic in Estonia, it could prove necessary to increase the capacity. This is not included in the construction cost estimate, but this issue should be investigated further in the design phase.

The upgrade of the existing line in Latvia will require investments of approximately 169 million €.

Package 1 includes the construction of a new and more direct line from Joniskis to Kaunas and from Kaunas to the Lithuanian/Polish border. It is estimated that it will cost 564 million € to construct this new line (not including electrification). On top of this, it will cost around 8 million € to upgrade the existing line from the Latvian/Lithuanian border to Joniskis to 120 km/h and 33 million € for land acquisition for the new line.

As Poland has continuously spent resources on maintaining the standard of the existing line from Warsaw to Bialystok only minor upgrades are necessary on this section. The section from Bialystok via Elk to the Lithuanian border however needs to be upgraded to secure a maximum speed of 120 km/h. It total it is estimated that Package 1 will cost 204 million € to implement in Poland.

The costs assessment for the sub-variant, where the existing line from Joniskis to Kaunas is upgraded and the capacity is extended instead of constructing a new line, shows that this option in total will cost 152 million € less to implement. Hence, if the upgrade of the sections which are double track and the extension of the sections which are single track to double track provides sufficient capacity for servicing the important east-west traffic and the increased north-south traffic this could prove to be an attractive alternative.

Package 2

Package 2 secures a design speed of at least 160 km/h from Tallinn to Warsaw. The total costs of implementing this package will be around 1,546 million €.

It will cost approx. 241 million € to upgrade the existing line in Estonia to 160 km/h, while the costs in Lithuania is almost identical as for package 1, except that the section from the Latvian/Lithuanian border to Joniskis is upgraded to 160 km/h instead of 120 km/h.

It will cost in the region of 466 million € to upgrade the existing line in Poland to 160 km/h, including costs for upgrading existing bridges.

Sub-variant A to package 2, where a new line is constructed from Riga via Bauska and Panevezys to Kaunas, will cost in the region of 96 million more in Latvia (including costs for land acquisition). The costs for the Lithuania section will be slightly higher as the new line via Panevezys is slightly longer compared to the new line via Radviliskis (from Joniskis to Kaunas). All in sum, the sub-variant will cost approximately 106 million € more compared to the main option.

The costs assessment for sub-variant B, where the existing line from Joniskis to Kaunas is upgraded/capacity increased instead of constructing a new line, shows that this option in total will cost 96 million € less to implement.

Package 3
Package 3 is the most ambitious plan for Rail Baltica, as it is based on electrified European gauge standard on all north-south sections.

It will costs in the region of 450 million € (excluding land acquisition) to establish the line in Estonia (the shortest route), while it will cost roughly 513 million € to construct the direct north-south connection in Latvia.

For Lithuania the cost of construction a new electrified direct line will be the region of 790 million € (excluding land)[16].

The costs in Poland for upgrading the existing line in Poland to 160 km/h, including electrification, will be 566 million €.

All in sum the costs of implementing package 3 will be 2,369 million €, including 50 million € for land acquisition.

In Estonia it is considered to construct a line via Lelle/Pärnu instead of a direct link from Tallinn to Pärnu (sub-variant A). This will costs approximately 33 million € more compared to the main option.

The main option include electrification from Tallinn to Warsaw (the section from Warsaw to Bialystok is already electrified). If the line is not electrified (sub-variant B) the total cost will be approximately 1,830 million €, which is considerably less than the costs of implementing the main option.

7.4 Risks and uncertainties

The total investment costs depend on both on the unit costs applied and the quantities required as well as the technology applied.

The quantities depend on the specific alignment chosen in sections which require new constructions and the final specifications and requirements for equipment. The development in recent years in Europe where provision of rail infrastructure has been liberalised have generally led to reduced (or at least not increasing) unit prices. The largest risk in the project countries is therefore considered to be related to the characteristics of the decided detailed alignments and the final requirements to equipment. New and tougher environmental regulation and costs of avoiding currently unknown environmental damages could potentially also lead to increased costs.

Further, the costs of land acquisition is uncertain both due to the legislation in the countries and the rapid increase in prices on land in some parts of the countries. So the timing of the project may influence the size of the risk of costs of land.

[16] The section from Kaunas to the Lithuanian/Polish border is prepared for later upgrade to speed of 200 km/h.

In general the cost assessment for investment package 3 is considered to be much more uncertain compared to investment package 1 and 2.

8 Constraints

The objective of this chapter is to present an inventory of different types of potential constraints for developing Rail Baltica including the framework within which infrastructure projects of a trans-national nature have to be implemented and rail services are to be operated within the Member States of the European Union.

Section 8.1 explores the regulatory framework and section 8.2 examines economic and technological issues. Section 8.3 provides an indication of the potential environmental constraints and Section 8.4 deals with organisational and other issues.

8.1 Regulatory context and constraints

8.1.1 Regulatory framework in the railway sector

International regulatory framework

Currently there are two separate legal systems regulating the international carriage of passengers and freight by rail in the project countries:

- The Uniform Rules Concerning the Contract for International Carriage of Passengers by Rail (CIV) and the Uniform Rules Concerning the Contract for International Carriage of Goods by Rail (CIM) as part of the Convention concerning International Carriage by Rail (COTIF) within the framework of the Intergovernmental Organisation for International Carriage by Rail (OTIF).
- The Agreement on International Passenger Transport by Rail (SMPS) and the Agreement on International Goods Transport by Rail (SMGS) within the framework of the Organization for Cooperation between Railways (OSZhD), an intergovernmental organisation founded in 1956.

Finland, Latvia, Lithuania and Poland are Member States of OTIF. Estonia applied for membership in 2005. All four project countries take part in the work of the OSZhD.

Both systems regulate the relations among their respective parties with respect to carriage of passengers and freight, but they differ significantly both in the form and content of individual provisions of transport law.

The principal objective of **OTIF** is to establish a uniform legal system applicable to the carriage of passengers, luggage and goods in international through traffic by rail between its Member States, and to facilitate the application and the development of this system.

While OTIF concentrates solely on a uniform system of laws, **OSZhD** is active in many fields of co-operation in the railway sector.

As to the harmonisation of the rules for passenger and freight transport (CIV/CIM and SMPS/SMGS), neither the Intergovernmental Organisation for International Carriage by Rail (OTIF) nor the Organisation for Co-operation of Railways (OSZhD) has really addressed this issue recently.

Another relevant body with regard to regulations concerning railway transport in the Rail Baltica corridor is the ***Council for Railway Transport of the CIS Member States.***

In 1992 the heads of the governments of 11 Member States of the Commonwealth of Independent States (CIS) signed an Agreement on Co-ordinating institutions in the field of railway transport. In accordance with this agreement the Council for Railway Transport was founded. The Council consists of the heads of the railway administrations of the CIS Member States.

The head of the railway administration of Latvia takes part in the Council as an associated member. The railway administrations of Lithuania and Estonia take part on the basis of special agreements/contracts.

The main objectives of the work of the Council are:

- To secure the technical and technological interoperability of the railway network of the Member States
- To co-ordinate the development of infrastructure and rolling stock
- To co-operate in the field of tariffs and information policy
- To create a common regulatory framework for interstate freight and passenger traffic

The Council adopted more than 130 agreements, regulations, instructions and other documents in the fields of common exploitation of the rolling stock, the improvement and maintenance of infrastructure and other technical facilities, the interstate and international carriage of freight and passengers.

The Council of Railway Transport has also established a Special Commission for Rolling Stock. This Commission is responsible for uniform technical and technological rules and recommendations. They also agreed upon:

- Rules on passenger transit by interstate passenger trains
- Rules of the use of passenger wagons in interstate traffic

- Regulations on high-quality trains in interstate traffic

EU Acquis in the railway sector
An overview of EU regulations in the railway sector which are relevant to the Rail Baltica project is given below.

Infrastructure / railway operation
In the so-called "first railway package" the Council and the European Parliament adopted far-reaching measures in the railway sector. This first railway package includes the following documents:

- Directive 2001/12/EC of the European Parliament and of the Council of 26 February 2001 amending Council Directive 91/440/EEC **on the development of the Community's railways**

- Directive 2001/13/EC of the European Parliament and of the Council of 26 February 2001 amending Council Directive 95/18/EEC **on the licensing of railway undertakings**

- Directive 2001/14/EC of the European Parliament and of the Council of 26 February 2001 **on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification**

Interoperability
In 1996 the Council adopted Directive 96/48/EC on the interoperability of the trans-European high-speed rail system.

According to the Directive the European high-speed lines shall comprise:

- Specially built high-speed lines equipped for speeds generally equal to or higher than 250 km/h.
- Specially upgraded high-speed lines equipped for speeds up to 200 km/h.
- Specially upgraded high-speed lines which have special features as a result of topographical, relief of town-planning constraints where the speed must be adapted accordingly.

The infrastructure also includes traffic management, tracking and navigation systems on these lines in order to guarantee the safe and harmonious operation of the network and efficient traffic management.

In order to achieve the objectives of that directive, Technical Specifications for Interoperability (TSIs) have been drawn up for the various technical subsystems. These TSIs were adopted by Commission Decision of 30 May 2002 for the following subsystems:

- Operation
- Rolling stock
- Energy
- Control/command and signalling
- Maintenance

The Commission also adopted recommendations on the basic parameters of the trans-European high-speed rail system (2001/209/EC of 21 March 2001). These recommendations concern:

- Minimum gauges for infrastructure and rolling stock
- Minimum radius of curvature
- Track gauge
- Minimum track stressing
- Minimum platform length and maximum train length, platform height
- Power supply voltage and catenary geometry
- Axle load
- Boundary characteristics of rolling stock
- Maximum gradients, minimum track centre distance

With regard to the conventional rail network, the Directive 2001/16/EC of 19 March 2001 has been adopted by the Council and the European Parliament. The Directive required a first group of priority TSIs to be adopted in the following areas:

- Control/command and signalling
- Telematics applications for freight services
- Traffic operation and management (including staff qualifications for cross-border services)
- Freight wagons
- Noise problems deriving from rolling stock and infrastructure

Directive 96/48/EC and Directive 2001/16/EC were amended by Directive 2004/50/EC in April 2004 following a number of lessons learned from the work on developing TSIs and the application of the directives to specific projects. According to this directive, a work programme is to be adopted, aiming at the development of new TSIs and the review of TSIs already adopted.

In 2004 the European Commission presented a further series of measures to revitalise the railways - the Third Railway package- which are not yet fully implemented. The main objectives are:

- The opening up of the market in passenger services by rail in several steps (first niche markets, then services without cabotage and, finally, all services)
- Improving passenger rights
- Ensuring quality rail freight services

State aids and competition, public service obligations
With regard to public service obligations, state aids and competition the following documents are of relevance:

- Council Regulation (EEC) No 1893/91 of 20 June 1991 amending Regulation (EEC) No 1191/69 on action by Member States concerning the obligations inherent in the concept of a public service in transport by rail, road and inland waterway
- Regulation (EC) No 1/2003 of the Council of 16 December 2002 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty
- Commission Regulation (EC) No 2843/98 of 22 December 1998 on the form, content and other details of applications and notifications provided for in the Council Regulations (EEC) No 1017/68, (EEC) No 4056/86 and (EEC) No 3975/87 applying the rules on competition to the transport sector
- Regulation (EEC) No 1107/70 of the Council of 4 June 1970 on the granting of aids for transport by rail, road and inland waterways

According to these regulations and based on the stipulations on competition in the Treaty establishing the European Economic Community, no state aids may be granted for transport by rail, road and inland waterways. However, these regulations do not apply to Public Service Obligations (PSO). Such services are normally performed to support social, environmental and town and country planning objectives as well as with a view to offering affordable fares to certain categories of passengers, and they have to be operated on the basis of a public service contract. Thus, it is uncertain if it is legal to grant public aid to the operation of long-distance passenger traffic and freight transport - as would be the case in the Rail Baltica corridor - if such services could not be made financially viable.

The process of implementing the EU Acquis in the railway sector is in progress in the project countries:

- The process of liberalisation of the rail transport market is ongoing
- Discrimination-free access to the infrastructure will be guaranteed
- The railway infrastructure management functions and the operation of freight and passenger traffic are being separated

- Independent structural units for freight and passenger transport will be or are established

With regard to **technical standards**, the Rail Baltica Co-ordination Group, consisting of authorised officials from the project countries, in 2003 agreed on the key aspects which should be included in a feasibility study for this project:

- European track gauge standard of 1435 mm
- The definition of main technical parameters according to AGC/AGTC and the technical specifications for interoperability of the trans-European rail system

Apparently, these decisions were taken at a very early stage of the project development process and have left the final decisions to be taken in the light of the present feasibility study. The main issues of these technical considerations of the Rail Baltica Co-ordination Group are highlighted below.

The main conclusions with regard to the regulatory framework are:

- There should be no major constraints for the development of Rail Baltica with regard to the international legislative framework.
- The Baltic countries will most likely continue to apply OSZhD regulations and the close cooperation with the Council for Railway Transport of the CIS Member States due to the intense freight traffic relations with Russia. If Rail Baltica is developed as a separate line there is no need to apply these regulations.
- In all the project countries the EU Acquis is being implemented. There should be no special constraints with regard to infrastructure ownership / infrastructure management and to the future operating of traffic in the corridor.
- With regard to a potential high-speed line (according to Directive 96/48/EC on the interoperability of the trans-European high-speed rail system), the track gauge standard of 1.435 mm has to be used.
- According to the relevant EU regulations, the possibility to grant public aids for the operation of intercity traffic in the Rail Baltica corridor could be a constraint.

8.1.2 Land use and acquisition requirements

After the accession of the project countries to the European Union, the land market in all countries has become more liberalised and, at the same time, subject to more unified legal regulation.

Legal acts regarding territorial planning strictly require agreements with the land owner to solve land acquisition issues. In all project countries expropriation of land property is clearly regulated by law. In Poland, for example, the *Law on Land Management and Expropriation of Real Estate* stipulates that property may be expropriated only in accordance with statutory provisions such as the construction of public works, national security considerations or other specified cases of public interest. In Latvia, the Law on Expropriation of Real Property for State or Public Purposes stipulates that expropriation of land property is permitted only in exceptional cases. In each individual case a decision by the Parliament is required. In the case of expropriation full compensation (at market value) is required. These processes are normally rather time-consuming.

A new law is in 2006 adopted by the Parliament, which state that in specific cases of public interest the State has the right to start construction works without waiting for a potential court decision provided that compensation based on market value is paid.

The share of cost for land acquisition of the total investment costs will depend on the alignment option finally selected (see section 7 for more details).

The major conclusions with regard to land acquisition are:

- There are regulations on land use and land acquisition in all project countries, which after different transition periods will be in accordance with EU standards, but acquisitions are in practise time consuming, complicated and costly
- Future implications with regard to investment costs may be estimated in more detail only after final decisions regarding the alignment
- Regulations on land acquisition will not hinder initiatives with regard to private ownership of a newly built (European gauge) line

8.2 Economic and technological constraints

8.2.1 Economic constraints

Economic constraints will be analysed under two different aspects:

- In a broader aspect, i.e. with regard to available funds for infrastructure investments
- With regard to different technical solutions and alignment options

Financing sources and funds available for transport infrastructure development

In all project countries funds for investments in transport infrastructure will remain rather limited in the coming years compared with the needs. The identified overall needs for investments in transport infrastructure clearly exceed State budget and EU funds possibilities for the period 2007 - 2013. It seems that the general economic situation and the budgetary constraints in the countries will not allow significant increases in public funding of infrastructure projects in the short and medium term.

The following table presents figures on planned investments in the railway sector in the project countries for the period 2007 - 2013 - as far as they are known at this stage.

Table 8.1 Planned investments in the railway sector 2007 - 2013 (million €)

	Total investments planned	Related to Rail Baltica
Estonia	416.	2*
Latvia	800-1000	265-365
Lithuania	725	140
Poland	n.a.	135

Note: * funding will be provided for planning and analyses of Rail Baltica sections in the period but no constructions are expected
Source: National governments October/November 2006

All or part of the costs of providing and operating infrastructure may in the long run be covered by revenues from rail operators using the infrastructure. However, financing is needed to develop the rail infrastructure and the main funding sources are shortly presented below.

State budget
National budgets are the principal source of financing for most infrastructure projects.

As a percentage of GDP, the share of spending on transport infrastructure has been decreasing in the EU 15 countries over recent years. Presently, these countries invest less than 1 % of their GDP into transport infrastructure.

Although the State budget contribution to infrastructure investments as a percentage of the GDP in most of the new Member States has increased over the last years, it is still insufficient to meet the requirements due to a lack of sufficient resources.

In Poland, the contribution of the State budget to the financing of transport infrastructure amounted to 3,230 MEUR in the period from 1991 till 2003, which was approximately 45% of the total investments in transport infrastructure. The total expenditure of the State budget in the transport sector (including subsidies) was 0.6 % of the GDP in 2004.

In Latvia, the expenditure of the State budget in the transport sector amounted to 1.6% of the GDP in 2004.

For the year 2004, the Lithuanian Government approved a State budget contribution of approximately 24 MEUR for transport infrastructure projects co-financed by the EU structural funds.

Cohesion Fund
The allocation of resources among the Member States depends on a number of criteria. However, the total amount that a Member State might receive from the Cohesion Fund (together with assistance from the Structural Fund) may not exceed 4% of its GDP.

TEN-T funds
In 2004 the EU adopted revised guidelines and financial regulations with regard to the Trans-European Transport Network, including the list of 30 priority projects. From a dedicated TEN-T budget, preparatory studies are financed (up to 50%) and construction costs are co-financed up to 10% (in certain cases up to 20%).

The total costs of completing these 30 projects by 2020 were then estimated at 225 billion EUR. Since 2000, an average of 600 MEUR per year has been allocated to TEN-T projects.

For the period 2007 - 2013, a significant increase of the budget up to almost 3 billion EUR per year will take place. Furthermore, for cross-border projects the maximum contribution from the TEN-T budget might be increased up to 50 %.

Public-private partnerships
In recent years there has been a trend towards stronger involvement of the private sector in developing, financing and operating transport infrastructure and transport services, including public-private partnerships. Generally, railway infrastructure investments have had difficulties attracting private money. The most promising areas for public-private partnerships in the railway sector in the study countries are expected to include:

- Development and operation of infrastructure on a concession usage-fee or availability-fee basis of certain lines or line sections (examples: Channel Tunnel Rail Link, HSL-High Speed Link Zuid, Perpignan - Figueras line),
- Installation and operation of various technical systems on a line or parts of the network (e.g. GSM-R),
- Construction /operation of stations or terminals.

The European experience from recent years clearly demonstrates that large transport infrastructure projects are not likely to be financed by the private sector alone or to a major part, and railway projects have often failed to demonstrate their commercial feasibility when considering the:

- Substantial investment volumes
- Risks inherent in the construction phase
- Revenue/operating risks
- Long payback periods for infrastructure
- Uncertain political context, especially if several countries are involved

Furthermore, the existing regulatory framework needs to be updated to make PPP projects more attractive for both private and public investors. Presently, risks, constraints and uncertainties exist not only for private investors, but also for the public site.

The following preliminary observations can be made for the development of Rail Baltica:

- Private engagement is most likely in the case of the construction of a new (European gauge) line. There are no examples in Europe so far for private investments in individual line sections as part of the common nationally owned railway networks. Privately owned railway infrastructure (i.e. in Estonia) normally includes major parts of the networks.
- Any engagement of private capital will mainly be influenced by the level of guaranteed incomes.
- Transhipment facilities or multi-modal terminals at the track gauge changing points or along the corridor might be a possibility for public-private partnership and thus attracting private capital, at least partly, for the development of the corridor.

National investment priorities
All four project countries have identified as a main priority in infrastructure development the upgrading and rehabilitation of their existing network to EU standards, focusing on the trans-European corridors.

Investments in road, port and airport infrastructure will facilitate passenger and freight volumes on these modes and thus have a direct impact on the future potentials for rail traffic.

Priorities for the development of railway infrastructure
Investment priorities for railway infrastructure in the **Baltic States** are mainly influenced by freight traffic.

- All Baltic States have a rather limited national market for railway traffic, both passengers and freight.
- International freight traffic (mainly transit) accounts for more than 85 % of total rail traffic in these countries.
- Revenues from freight traffic are an important financing source for upgrading / maintenance of infrastructure.
- In all the Baltic countries international rail freight traffic, especially transit flows contribute to an important extent to the GDP.

Thus, developing competitive rail corridors for transit traffic to/from Russia, including improvement of access to the national sea ports, is a first priority.

It is also important to notice that the Baltic countries are competitors with regard to east-west transit traffic and the role of their sea ports.

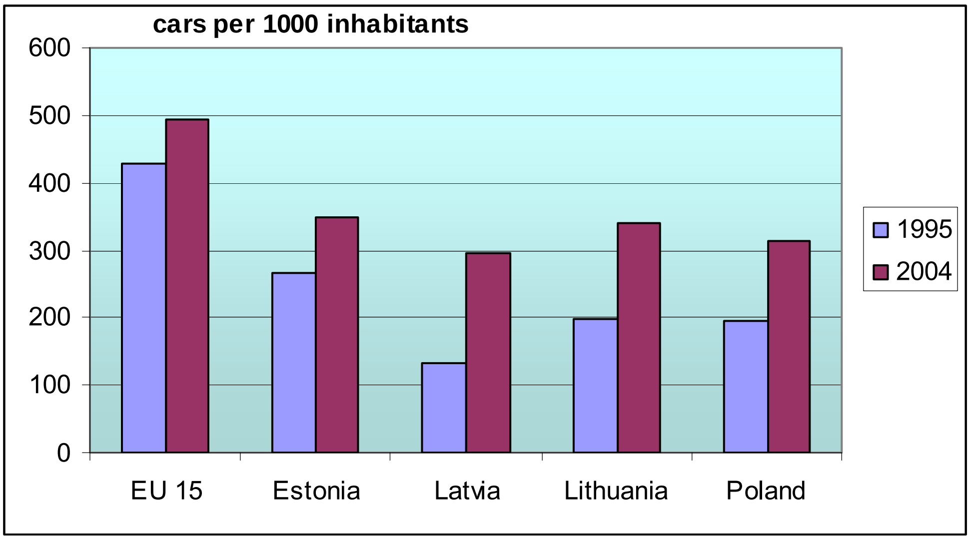
Investments in the **Polish** rail network are also focused on main transit corridors such as.

- East-west corridors E20, E30/EC30
- North-south traffic on corridors E59/EC59, E65/EC65 and E75 (Warsaw - Bialystok section)

Priorities for the development of other infrastructure
The fast growing numbers of cars (see figure below) and steadily increasing shares of road transport both in passenger and freight traffic require an adequate development of the road infrastructure. The main priorities with regard to the road network are in all countries:

- Extension of the network of motorways and express road
- Upgrading and reinforcing the structure of road surfaces to meet the requirements of heavy freight traffic
- Building by-passes around major cities
- Improving road traffic safety

Figure 3.1: Number of passenger cars



Remark: EU 15 and Lithuania - Data for 1995/2002
Source: Eurostat, National Statistics

In all the project countries the major share of available funds for investments in transport infrastructure is dedicated to the extension and modernisation of the road network (compare tables below).

Especially in the Baltic countries, but also in Poland, the upgrading of port infrastructure (including access road and rail connections) is a strategic objective in order to improve/maintain the competitiveness for international transit freight flows.

Increasing the capacity of the line to Ventspils, the major sea port of the country, is on the top of the priority list in Latvia. Another high priority in Latvia is the electrification of the existing rail network, where presently only 10% of the network are electrified.

In Estonia major priorities of relevance for Rail Baltica is a rail bypass in Tallinn, the improvements of road sections between Tallinn and Tartu and the renovation of the electrified rail network in the Tallinn region.

In Lithuania, the priority in the railway sector is the modernisation of Corridor IX in the two sections:

- Vilnius - Kaunas - Kybartai
- Kaisiadorys - Siauliai - Klaipeda

The corridor is to be upgraded to a line speed of 160 km/h for passenger traffic and to 120 km/h for freight traffic. Another priority for the railways is the electrification of the main corridors.

Investments in the Polish rail network are focused on main transit corridors:

- East-west corridors E20, E30/EC30
- North-south traffic on corridors E59/EC59, E65/EC65 and E75 (Warsaw - Bialystok section)

A further priority is the gradual improvement of the technical condition of the railway network and to overcome the significant backlog in maintenance. Further, in Poland it is a major concern to find environmentally acceptable solutions to the development of Via Baltica

Thus, national investment priorities may be summarised as follows:

- There is strong competition between the various transport modes and also between the individual sectors of the national economy for the available, rather limited national and international funds for future investments in all countries.
- Upgrading and modernizing the road sector in all project countries in order to bring it up to European standards require the major parts of the available investment funds. Way of developing Via Baltica in North Eastern part of Poland is a special concern.
- The development of Rail Baltica is in all countries only considered a priority if the economic feasibility of investments can be clearly established.
- Investment priorities in the railway sector are influenced by the railways' core business, i.e. in the Baltic countries the freight transit traffic to and from Russia and in Poland the east-west transit and freight traffic between the ports and the southern border.

8.2.2 Technical and technological constraints

The development of Rail Baltica will be highly influenced by the impact of different technical solutions and related technological constraints.

Decisions on technical options for Rail Baltica refer mainly to:

- The selection of track gauge
- High-speed / normal standard
- New / existing alignment
- Single/double track

With regard to **technical standards**, the Rail Baltica Co-ordination Group, consisting of authorised officials from the project countries, in 2003 agreed on key aspects which should be included in a feasibility study for this project:

- The European track gauge standard of 1,435 mm
- The definition of main technical parameters according to AGC/AGTC and the technical specifications for interoperability (comp. Chapter 2.1.2) of the trans-European rail system

However, during consultations within this project all countries indicated that the technical standards agreed upon in 2003 are not mandatory. They can be revised if the feasibility study shows that these standards are economically not viable and other development options, especially with regard to the track gauge (e.g. improvement / reconstruction of existing broad gauge lines) are feasible.

There are many advanced and proven technical solutions available for the different options. The important factors, however, for the final selection of the preferred option are:

- The future potentials for (high-speed) long distance passenger traffic
- Stable flows of high-quality freight traffic

Another important criterion for the selection of technical solutions is the impact on the technological processes and related costs.

The decision with regard to a possible **high speed** line will mainly be influenced by the future potential in long distance passenger traffic and high-quality freight traffic along the corridor.

Regarding the **alignment** of Rail Baltica, the above Co-ordination Group agreed that various alignment options should be considered. But the Group also agreed that a final decision with regard to the alignment, especially in Estonia and Latvia, should be taken on the basis of a feasibility study.

Constraints for the different alignment options will mainly result from the following aspects:

- The environmental context
- The land use planning and land acquisition constraints
- The chosen technical solution (i.e. should it be the European gauge option and thus most probably new alignments in the Baltic States)

Track gauge options
The different railway gauges in Western/Central Europe ("European standard gauge" of 1,435 mm), in Eastern Europe including the Baltic countries ("Russian gauge" of 1,520 mm) and in Finland (1,524 mm) remain a major obstacle to the all-European railway integration.

A general adaptation of the track gauge of the national railway networks in the Baltic countries to the European standard is unlikely, as it would seriously hamper the important transit freight traffic from and to Russia.

All Baltic countries have a limited market for local freight transport. International freight transports accounts for almost 90% of the total railway's freight volume. Transit traffic, mainly to and from Russia, is by far the most important sector for the railway market of these countries. The structure of the infrastructure is adapted to this trade pattern with heavy freight trains with moderate speed mainly on transit from east to west and vice versa.

When considering different technical options for Rail Baltica, e.g. the European standard track gauge or the broad gauge, and assessing the resulting technical, technological and economic constraints, the above framework conditions have to be taken into account.

The main **advantages** of a European standard solution would be:

- Interoperability and compatibility with the European railway network and rolling stock coming from Western Europe, which will increase the potential for transport market liberalisation
- Higher comfort for passengers travelling north - south (reduced travel time, higher service level)
- Broader availability of infrastructure components and rolling stock
- More competitive prices for such components

Having in mind the present pattern of passenger and freight flows in the Baltic countries, the main **disadvantage** of a new north-south European standard gauge line would be related to its incompatibility with freight traffic from Russia/Belarus/(Finland) and also with the major part of the national railway network. Operating two conventional rail systems are in other countries considered very inefficient and where they have existed attempts are made to eliminate them. The importance of this barrier depends of course on the amount of freight which could potentially be re-loaded.

The largest challenge for investments in European gauge standard rail lines is expected to be the size of the investment. From the technical point of view, various well proven solutions exist for parallel systems of different track gauge or the transfer between these systems.

High-speed lines in Spain and Portugal
A high-speed network in Spain using the European Standard gauge (1,435 mm) is being constructed and will be operated within the national railway network (1,680 mm). These high-speed lines will be used exclusively for high-speed passenger traffic. They are fully integrated in the major passenger stations.

Portugal also plans to construct high speed lines of European standard gauge of 1,435 mm.

But there are two important issues to take into consideration when discussing the possibilities integrating the different track gauge systems:

- A network with two different gauges does not facilitate the optimisation of operational processes. This is the main reason why both countries are planning an integration of the two systems in the future.
- To use these high-speed lines exclusively for passenger traffic requires adequate passenger volumes.

With regard to the integration of the different systems the following approaches exist:

Portugal is considering changing the track gauge of the whole network subsequently to European gauge in the future. (For this reason, sections of the existing network to be modernised will be equipped with gauge convertible sleepers.)

Spain will achieve the integration of the different systems mainly by using gauge-changing installations at the interfaces and rolling stock accordingly equipped.

With regard to passenger traffic volumes, the following figures may be quoted. For example, the Madrid - Sevilla section has been used by 6.2 million passengers in 2004. For the Madrid - Barcelona section approximately 12 million passengers per year are forecast for the period after 2007.

Automatic gauge-changing systems
There is a long experience of international passenger traffic between Spain and France, using Talgo trains equipped with bogies for automatic gauge change.

Poland has developed SUW 2000 - a technology for automatic gauge changing both for passenger and freight trains. This system was installed at the Polish / Lithuanian border and pilot trains both in passenger and freight traffic were operated.

The system worked from the technical and technological point of view, but apparently there was only a limited traffic potential at that time.

Bogie changing, transhipment of goods
There is a long experience of gauge changing at the borders of the former Soviet Union. Bogie changing is in use mainly for passenger trains; but sometimes this technology is also used for the transport of dangerous goods to avoid the risks of a transhipment process.

In freight traffic goods are normally transhipped between the wagons of the different track gauge standards. At some border points highly specialised transhipment facilities exist. Although this process is time- and work-intensive, there are sufficient capacities to handle large freight volumes as it is shown below (data for 2003):

E 20 Malaszewicze (Poland/Belarus)	5.70 million tonnes
E 30 Medyka (Poland/Ukraine)	6.45 million tonnes
E 75 Trakiszki (Poland/Lithuania)	0.35 million tonnes

In the following chapters the technological constraints resulting from the different technical solutions will be analysed.

Technological constraints of a European gauge option
The railway transport system, due to its physical constraints, is particularly sensitive to certain network effects. Investments in parts of the network, corridors etc will usually have broader effects on the whole system. In case of choosing the European gauge option for Rail Baltica, these network effects will be eliminated or extremely limited in the Baltic States.

In the Baltic countries, Rail Baltica will be an "isolated" system. While a European gauge line apparently might facilitate long distance passenger traffic in the region, the constraints of this technical option will mainly influence freight traffic. Therefore the impacts will be analysed separately for passenger and freight traffic:

Passenger traffic
A great advantage of the European gauge option would be a smooth border crossing between Poland and Lithuania and between the other Baltic States with such a standard that time will no longer be lost due to gauge-changing procedures or passengers physically changing trains.

A disadvantage of this option is that there will be no possibilities for direct train connections to major cities off the corridor (e.g. Warsaw - Vilnius, Riga - Vilnius), nor can the line be used for train connections which run only on certain sections along the investigated corridor.

The integration of a European gauge line into existing large passenger stations along the corridor is technically feasible, but may be costly.

Freight traffic
The impact on freight transport of a European gauge line will be more severe than for passenger traffic:

- There will be no direct access to the major part of the national railway networks
- There will only be limited access to the sea ports and to major clients unless additional investments are made in feeder lines
- Additional (multimodal) terminals are required to enable the transfer between both systems

A potential business could be the development of high-quality freight traffic on this line, for example shuttle services in combined transport between major terminals along the corridor. These terminals will provide transfer facilities between different transport modes (rail / road) and the two-track gauge systems. Such a high-quality freight service will, however, limit the overall available freight potential.

With regard to the financial appraisal it is important to take into account that the system will be operating efficiently only after completion of the whole corridor or at least major parts of it.

This requires a well harmonized investment policy and implementation strategy within the four project countries.

Additional (new and different) maintenance facilities for infrastructure and rolling stock are necessary.

A combination of both gauges within Rail Baltica is feasible, such as:

- A European gauge on the Warsaw - Kaunas section
- A broad gauge in the northern part from Kaunas to Tallinn

For such an option different solutions for operation and rolling stock are possible:

- European track gauge trains may be operated on the section Kaunas - Warsaw (and perhaps further into the Polish/European network), broad gauge trains are operated in the northern part of the corridor and in connected branch lines (e.g. Kaunas - Vilnius).
  In this case the integration of both lines into the same station (preferably the same platform) in Kaunas is necessary to ensure transfer between both systems without major constraints for the passengers.
- Train sets with automatic gauge-changing technology are used along the entire corridor. This would be the most convenient option for the passengers, but will result in higher costs for investments in rolling stock and operation. Use of the rolling stock will then be limited to the corridor for economical reasons.

With regard to freight traffic, the European gauge line has to be integrated into a transhipment terminal near Kaunas. This terminal should serve as transfer between the two gauge systems in the north-south direction and also for the freight traffic in the east-west corridor (Kena - Kybartai) as well as an intermodal terminal.

Technological constraints of a broad gauge option
There should be no major technical or technological constraints by maintaining a broad gauge (1,520mm) within the Baltic countries.

Technical and technological constraints of this option mainly refer to the transfer terminals / facilities between the different gauge systems in the Polish/Lithuanian border region.

This option will cause only minor problems in passenger transport. An automatic gauge-changing facility is already in operation at the Polish/Lithuanian border and international passenger trains between Warsaw and Vilnius were operated in the past, using rolling stock with bogies for automatic gauge changing. The use of the automatic gauge-changing technology also guarantees the operation of modern European passenger rolling stock in the entire corridor.

But the need for specially equipped rolling stock will result in higher investments and also in higher operating costs of international traffic in the future. The use of cost-intensive rolling stock will practically limit the operation of such specialised train sets to the corridor.

A continued broad gauge network will guarantee the unlimited use of the freight wagons within the railway networks of the Baltic States. There will be free access to the sea ports and the major clients. Furthermore, the interoperability with the Russian, Belarussian and Finnish railway networks will be ensured.

Increasing freight volumes and a changing commodity structure (increasing share of processed products) might, however, require additional transhipment facilities / modern terminals in the border region.

The broad gauge option will cause problems with regard to operating broad gauge wagons in the European network and vice versa. The main reasons for these technical constraints are:

- Different coupling systems and breaking systems
- Constraints as regards loading gauge / clearance

Even if these technical problems are solved, the technological/economical constraints remain. Bogie changing requires specially equipped freight wagons and a stock of bogies of both gauges at the border point. Discussions with operators, wagon leasing companies and large customers made it clear that they are only willing to keep a stock of such equipment, if there are stable long-term freight flows, which guarantee a permanent exploitation of the rolling stock in cross-border traffic.

International experience shows that existing modern technologies (automatic gauge changing, road-railer technology) for freight traffic are implemented only to a very limited extent so far, because of lack of required freight flows to justify investments.

High-speed or conventional line
The decision with regard to a high-speed line will first of all be influenced by the future potential of passengers for long-distance traffic.

When discussing necessary potentials for justifying investments in the high-speed option, it should be clear that such a line might be used almost exclusively for passenger traffic. For operational reasons it is difficult to mix high-speed and normal passenger traffic on the same line, and the same applies to freight traffic. Otherwise, the capacity of such a line would be severely limited.

If a high-speed option is selected, the relevant EU regulations with regard to interoperability have to be applied. A high-speed option implies for example a European track gauge standard.

8.2.3 The availability of resources in the region

Experience from projects recently carried out in the region (i.e. the Preparation of the Lithuanian Strategic National Rail Transport Development Plan; and the Modernisation of the E 30 Railway Corridor in Poland) demonstrates that competence and resources are available in the region in most areas of conventional railway systems, but in some highly specialised fields competence is limited.

From the point of view of planning, design, construction and maintenance of infrastructure, the situation in the project countries with regard to the resources available may be assessed as follows:

Resources and competences are available for:

- Planning, design and construction of tracks for conventional (broad gauge and European standard gauge) railway lines
- Conventional signalling and train control systems
- Traction power systems (partly for speeds up to 160 km/h)
- Maintenance of conventional rail infrastructure, but existing capacities in the Baltic countries might have to be increased
- Maintenance of conventional (broad gauge in the Baltic countries) rolling stock

Competences and resources are limited for:

- High-speed track systems
- ERTMS/ETCS systems
- Traction power supply systems for speeds higher than 160 km/h
- Maintenance of European gauge rolling stock (in the Baltic countries) and rolling stock for high-speed traffic

Potential constraints regarding available resources/capacities for upgrading the corridor will be influenced by the chosen technical solutions, alignment options etc. Thus, the availability of resources will be assessed in more detail for the selected modernisation option.

8.3 Environmental constraints

The current environmental assessment provides information on possible impacts on Natura 2000 sites, governed by the EU Birds and Habitats directives, in relation to the proposed Rail Baltica project. National railway development plans and programmes must be subject to Strategic Environmental Assessments, following the EU Directive 2001/42/EC. Further, findings must be studied in more detail in the Environmental Impact Assessments conducted during the detailed design stages of forthcoming specific projects. In this sense, the current assessment should be regarded as part of the scoping process prior to the detailed design studies.

The current options for the Rail Baltica alignment include present as well as new railway corridors. In existing corridors several options for railway upgrading are being considered. The present environmental assessment cannot take into account such details, though it presents an overview of the possible environmental consequences. For new alignments, the current proposals must be considered as drafts, which have not been located precisely. Therefore there is a lack of specific information at this stage concerning their exact location. For some of the sections, namely alternative alignments in Estonia, no indications of the precise location of the alignments were available.

Natura 2000 sites consist of areas designated to protect birds listed in Annex I covered by article IV of the Birds Directive 79/409/EEC, the so-called Special Protection Areas (SPA)s; and areas designated to protect habitat types and flora and fauna species listed in Annex II of Habitat Directive 92/43/EEC, the so-called Special Areas of Conservation (SAC)s. Finally, Sites of Community Importance (SCIs) are sites proposed as eligible for SAC or SPAs, but not yet designated. In this assessment many of the sites are still classified as SCIs.

From an environmental perspective any infrastructural development options, which include acquisition of new land for the Rail Baltica alignments, will have effects on the environment. In terms of possible impacts on the environment, it is therefore the establishment of a new railway line (Package 3), which will have the greatest impact; establishing a railway line along existing tracks will have less impact, while the upgrading of an existing railway line will have least impact. (In certain instances an upgrading can even improve the living conditions of certain species.)

The immediate objective of this environmental assessment is to provide an overview of the potential main problems and conflicts with the network of Natura 2000 sites caused by current and proposed alignments of the Rail Baltica sections.

Priorities, development plans and programmes for national railways should be subject to Strategic Environmental Assessments (SEA), following the requirements set out in the EU Directive on SEA (EU Directive 2001/42/EC). The SEAs will be the responsibility of the relevant national environmental authorities. The findings of the respective, national SEAs will add to the framework for making appropriate decisions for developing the railway systems, incl. the Rail Baltica network.

Subsequently, detailed Environmental Impact Assessments (EIAs) must be elaborated for each of the individual design projects, prepared. EIAs will be the responsibility of the relevant national environmental authorities in each of the individual detailed design projects, prepared as parts of the Rail Baltica implementation.

The current assessment serves to highlight the main problems and conflicts caused by a development of the Rail Baltica network. Findings should then be studied in more detail in the EIAs conducted during the detailed design stages of forthcoming specific projects. In this sense, the current assessment of potential constraints should be regarded as part of the scoping process prior to the detailed design studies.

Also, this environmental assessment, which is part of the feasibility study, will not include evaluations of the effects of the existing railway network on the environment. Existing railway sections will possibly become part of the Rail Baltica corridor or cross through or near designated Natura 2000 sites, as they originally were aligned through areas with significant natural values.

The main constraints and issues are summarised in the following, and the full environmental assessment can be found in Annex H.

8.3.1 Existing and new alignments

The current options for the Rail Baltica alignment include present as well as new railway corridors. In existing corridors several options for railway upgrading are being considered. The present environmental assessment cannot take into account such details, though it presents an overview of the possible environmental consequences.

For new alignments, the current proposals must be considered as drafts, which have not been located precisely. Therefore there is a lack of specific information at this stage concerning their exact location. This means that an environmental assessment cannot be conducted with any precision and only general statements concerning possible impacts on the environment can be applied at this stage.

8.3.2 Environmental issues

As the main goal of the environmental assessment has been to evaluate possible conflicts with topics governed by the EU Birds and Habitats Directives, the focus of the environmental assessment has been on Natura 2000 sites located in the immediate vicinity of the possible Rail Baltica alignments.

Existing railway lines likely to be included in the Rail Baltica corridor do pass through or near designated Natura 2000 sites. Thus, the current railway network does create impacts on the environment in general, and the Natura 2000 network specifically. The assessment carried out here, as a part of the feasibility study, does not include evaluations of the effects of the existing railway network on the environment. It does, though, include an effort to assess the additional effects on the Natura 2000 network by adding new alignments, tracks or by increasing traffic speed and frequency.

Table 8.2 Overview of affected Natura 2000 sites

Section and Project Package (PP)	Type	Existing Natura 2000 sites affected		
		Through	Along	Within 3 km
EE - Tallinn - EE/LV border (PP1)+PP2	Upgrade	1. Seljamäe 2. Elva-Vitipalu	1. Korvemaa 2. Antu 3. Mustallika 4. Vapramäe 5. Otepää	1. Anija 2. Ohepalu 3. Endla 4. Vooremaa Järved
EE - Tallinn - EE/LV border PP3 + sub-var.	New	Alignment is not yet known		
EE/LV border - Riga PP1 +PP2	Upgrade	1. Ziemelgauja 2. Gauja NP 3. Melturu sils 4. Garkalnes mezi	1. Sedas purvs 2. (Gauja NP)	
EE/LV border - Riga PP3	New	1. Salacas ieleja	1. Randusplavas 2. Piejura	1. Vitrupes ieleja 2. Vidzemes akmenaina jurmala
Riga - LV/LT border PP1+ PP2+PP3	Upgrade			1. Melna ezera purvs 2. Lielupes palienes plavas
Riga - LV/LT border PP2 -Sub- var. via Panevezys	New			1. Dolessala 2. Bauska
LV/LT border - Kaunas PP1+ PP2+PP3	Upgrade + New	1. Geduiunu miskas 2. Neries upe	1. Kauno marios 2. Kauno marios	1. Labunavos miskas
LV/LT border - Kaunas PP2 - Sub- var. via Panevezys	New	1. Neries upe	1. Lepsines miskas 2. Kauno marios 3. Kauno marios	1. Pasiliu pelke
Kaunas - LT/PL border PP1+PP2+PP3	New	1. Nemuno upes pakrantes ir salos tarp Kulautuvos ir Smliniku		1. Kamsoso miskas 2. Roku fortas
LT/PL border - Bialystok PP1+PP2+PP3	Upgrade	1. Dolina Dolnego Bugu 2. Ostoja Nadbuzanska 3. Bagienna Dloina Narwi 4. Narwianskie Bagna 5. Dolina Biebrzy		1. Puszcza Knyszynska 2. Ostoja Knyszynska

8.3.3 Environmental assessment

From an environmental perspective any infrastructural development options, which include acquisition of new land for the Rail Baltica alignments, will have significant effects on the environment. In terms of possible impacts on the environment, a simple ranking of potential quantitative impacts will look like the following, from "more" to "less" possible impacts (with the main types of possible impacts mentioned):

1. **New alignments/corridor**: Land and land-use (reduction and fragmentation); biodiversity; natural values and cultural heritage; community cohesion (traffic infrastructure; public services etc); emission of noise and air pollutants (in otherwise less disturbed or undisturbed areas); collision risks due to increased traffic and higher speeds; collision risks with electric lines.
2. **Adding a track within an existing corridor**: Some land and land use issues; some additional fragmentation; additional emissions caused by increased rail traffic; disturbances from increased traffic; collision risks due to increased traffic and higher speeds; collision risks with electric lines.
3. **Improvements within an existing alignment**: Additional emissions caused by increased rail traffic; disturbances from increased traffic; collision risks due to increased traffic and higher speeds; collision risks with electric lines.

New alignments

The consequences of locating Rail Baltica sections in all new corridors are the most severe from an environmental perspective. The following general types of impacts are likely to be seen by constructing a new railway in any of the four countries:

- **Natural values, habitats and biodiversity**: Fragmentation and reduction of habitats; prevention of local movements and migration of land animals; disturbances/noise; emission of air pollutants (diesel engines); risk of collision with power lines by birds (electric engines).
- **Land use and ownership**: Fragmentation of properties; difficulties in access to land; local traffic infrastructure.
- **Community health and cohesion**: Structure of local traffic infrastructure; emission of noise and air pollutants.

Adding tracks

From an environmental perspective, adding tracks within an existing corridor is much preferable when compared to the option of construction of a new railway within a new corridor. Possible environmental effects of adding tracks to an existing alignment include the following:

- Some land and land use issues
- Some additional fragmentation

- Additional emissions caused by increased rail traffic
- Disturbances of birds and animals from increased traffic
- Collision risks of birds and animals due to increased traffic and higher speeds
- Collision risks of birds with electric lines

Improvements within existing alignments
Improvements to the railway system, within the existing alignment and reserved corridor, may be carried out in several ways, depending on the state of the existing railway system. In general, the impacts on the environment will be modest and linked to the following problems:

- Additional emissions caused by increased rail traffic
- Disturbances on birds and animals from increased traffic
- Collision risks of birds and animals due to increased traffic and higher speeds
- Collision risks of birds with electric lines

Construction and operation
During construction of the Rail Baltica infrastructure, the main environmental issues concerning the environment include:

- The need to establish access roads and works and storage sites within and near the railway corridor
- The physical impact on habitats and the general environment within the sites and neighbouring the sites
- Disturbances by the increased activities at and near the railway

During operation, the main environmental issues concerning the environment include:

- The physical impact on the habitats within the sites
- The additional barriers to an unrestricted movement and migration of species within the sites
- Additional disturbances created by faster and more frequent train traffic

In areas with a high density of Natura 2000 sites and other protected areas of major importance, any additional infrastructural elements will eventually cause increased fragmentation of important sites, ecosystems and habitats. Also, more physical constructions will impact the unrestricted movements and migration of animals within and between Natura 2000 sites.

Table 8.3 Overview of sections and their ranking, given the above simple classification

Section	Project Package (PP)	Type	Environmental constraints: Ranking of types (explanation given above)
EE: Tallinn - EE/LV border	PP1	-	-
	PP2	Upgrade	3
	PP3 + sub-variant	New line and alignment	1
EE/LV border - Riga	PP1	Upgrade	3
	PP2	Upgrade	3
	PP3	New line and alignment	1
LV: Riga - LV/LT border	PP1	Upgrade	3
	PP2	Upgrade Sub-var: new via Panevezys	3 1
	PP3	New	1
LV/LT border - Kaunas	PP1	Upgrade: to Joniski New: J. to Kaunas	3 +1
	PP2	Upgrade: to Joniski New J. to Kaunas Sub-var: new Panevezys	3+1 1
	PP3	New	1
Kaunas - LT/PL border	PP1	New	1
	PP2	New	1
	PP3	New	1
LT/PL border - Bialystok	P1	Upgrade	3
	P2	Upgrade	3
	P3	Upgrade	3

We can conclude that environmental constraints potentially can be a main barrier for implementing some parts of Rail Baltica, but that paying sufficiently attention to the main types of environmental impacts can reduce the overall impacts on the environment. The construction of a new alignment will have the largest impact on the environment, followed by adding a track within an existing corridor and improvements within an existing alignment.

It appears that the environmental barriers are much larger for the alignment option from Kaunas to Warsaw "Via Sokolka" than for "Via Elk". The situation for competing alignments is analysed in Annex E.

8.4 Organisational and other constraints

8.4.1 Main stakeholders' interests

The stakeholders with regard to the development of the Rail Baltica corridor are:

- Public administrations
- Infrastructure owners
- Infrastructure managers
- Regulatory bodies
- Railway operators
- Other transport modes
- Users /customers
- Environmental bodies
- Land owners

The interests of the main stakeholders might be summarised as follows:

Public administrations
The political stakeholders (e.g. Ministries of Transport, Ministries of Finance) are influenced in their decisions mainly by the following aspects:

- A pressure to facilitate environmentally friendly transport technologies (railways)
- A growing demand for mobility and increased road safety, which requires modernisation and extension of the other modes
- Railway transit traffic and ports are contributing to a considerable extent to the GDP
- Other sectors of the national economies competing for the limited budgets

Railways

- Railways (infrastructure managers, operators) are mainly interested in the core business, which is Russian transit in the Baltic countries and east-west / north (ports)-south transit in Poland
- Railways in the Baltic countries are competitors with regard to east-west transit and thus primarily interested in the modernisation of their respective corridors

- Railway operators in the Baltic States are afraid that a European gauge Rail Baltica corridor will interfere with their flexibility to develop in freight transport
- Rail operators from other EU countries will have a potentially larger interest in developing business in the Baltic States on a European gauge system

Ports, maritime industry

- All the Baltic sea ports are highly interested in increasing their capacity and in diversifying the services offered in order to improve their competitive situations
- The sea ports demand upgrading of the access to the ports, both by rail and road
- Maritime operators (especially of ferry lines) are facing loss of traffic potentials when the Rail Baltica corridor is modernised, maybe with the exception of ferry operators between Tallinn and Helsinki

8.4.2 Organisational constraints

The potential future organisational set-ups must obviously be seen together with the technical options for the development of the north-south corridor, and possible organisational constraints will also be influenced by this.

If the Rail Baltica corridor primarily will be developed as a conventional broad gauge line, there should be no constraints with regard to the ownership/operation of the infrastructure in each country. This function will most probably be assumed by the current national infrastructure managers. Train operation will be regulated according to the relevant EU framework.

The main organisational concerns may arise with regard to coherent transnational project implementation among infrastructure managers.

If the Rail Baltica corridor primarily will be developed as a new line with a European track gauge, the organisational issues concern:

- Co-ordinated project planning across borders
- How to establish ownership and management of a stand-alone system with assets in at least two Baltic States
- Financing options depending on the infrastructure ownership
- How to define and provide train operations on the line

Setting up a transnational project implementation framework

The countries are already co-operating on the development of Rail Baltica at the general level, but a more focused implementation body will be needed to deal with planning, legal/administrative, technical and financing issues.

Infrastructure management / ownership
Principally the infrastructure in an improved Rail Baltica corridor can be owned:

- By individual infrastructure managers in the countries as today - potentially a first option if the corridor will continue as a broad gauge system
- By a dedicated infrastructure company (public or private) - potentially a first option if a European gauge corridor is established on the territory of more countries

Different financing options can be considered depending on the choice of ownership model

Train operation with in the corridor
The co-ordinated development of a concept for passenger and freight train operations in the corridor is an important prerequisite - as operations may not necessarily be financially viable for a long build-up of the traffic period. Issues and options are:

- Operators operate fully on market conditions at their own risk and making their own profit
- Commonly agreed service levels are developed and operations are tendered out, so the financial risk is borne by the countries/governments, provided that the current legislative framework allows this, and that models for sharing costs and revenues are developed.

The development of a concept of responsibility for capacity allocation in the corridor may also be needed.

SECTION C: TRANSPORT ASSESSMENT

9 Modelling assumptions

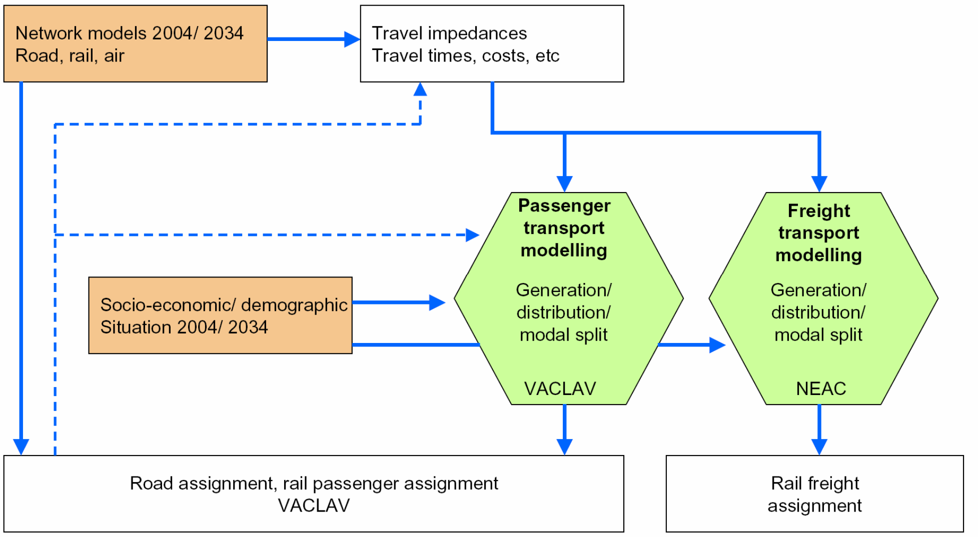
The purpose of this chapter is to describe how the traffic modelling for the traffic in the Rail Baltica region is performed. First, a short description of the model set-up is given and then the assumptions on present and future infrastructure supply are presented. Finally, some findings from recent research on modelled interdependence between Rail Baltica and other European corridors are summarised.

9.1 Model set-up

9.1.1 General overview of the modelling approach

When modelling transport in the framework of the Rail Baltica study, the VACLAV and the NEAC models are applied[17]. The overall structure of the modelling approach is presented in Figure 9.1.

Figure 9.1 A general overview of the modelling approach



[17] The detailed description of both models can be found in Annex II of the Technical Proposal.

The most important input to the modelling process are macroeconomic, socio-economic and demographic data for the base year (2004) and forecasts for the forecast horizon (until 2034) as well as the status of transport infrastructure in 2004 and 2034. For freight transport modelling also trade data are of significant relevance.

The network models are applied for the calculation of travel impedances and form the framework of the assignment. Socio-economic and demographic data as well as trade data for freight are imputed in the transport models to generate the origin-destination (OD) matrices for passenger and freight transport. For passenger transport modelling, NUTS 3 regions have been applied as traffic zones, whereas for freight transport modelling a combination of NUTS 3 and NUTS 2 zones has been used.

After computation of the modal shares per OD relation, the transport models assign the transport volumes. The road assignment is performed simultaneously for passenger and freight by the VACLAV model, whereas the rail freight assignment is performed by the NEAC model and the rail passenger assignment by the VACLAV model.

Technically, traffic is assigned to the road network under application of road-type specific speed/flow functions, which measure the travel time in dependence of the volume on a link. The road traffic volumes are assigned incrementally to the network - hence the travel time under capacity constraints is taken into account.

The traffic models include capacity restrictions for road traffic on specific routes based on the assumed future infrastructure in the reference case, which also include that the Via Baltica road route in North Poland will be improved (for instance, new bypasses are already planned and some construction works are due to start). In modelling the future flows, the improvements of all infrastructure networks are taken into account (see section 9.2).

9.1.2 Passenger modelling approach

The applied passenger transport model is a classical 4-stage approach, consisting of the generation of trips, the distribution of trips, the calculation of the modal shares and the assignment. The stages of generation and distribution are performed by a gravity approach. The market shares of modes are estimated by a multinomial logit model.

The zoning system applied is largely based on European NUTS 3 regions, enhanced by further regions of non-EU countries. The total number of traffic zones considered amounts to around 1,300 regions, which are shown in the following figure.

Figure 9.2 The zones for modelling OD relations, VACLAV model

The demand is subdivided by three trip purposes: business, private and holiday. On the supply side, following four modes are considered: train, private passenger car, coach, and air.

An important data source for calibration of the transport models is the road traffic count data. The traffic count data stem from different sources, such as UN/ECE and national ministries, and refer in some cases only to the total number of vehicles, i.e. without differentiation by passenger and freight vehicles.

9.1.3 Freight modelling approach

The principles applied for the construction of the freight flow OD matrix are as follows:

- Selection of the year 2004 - the EU expansion year - as the basis year for constructing the OD transport flows pattern within the Baltic States and to a relevant extent within Poland.
- Focus on competing modes and routes (road, rail, sea).
- Selection of OD zones and networks meaningful for the present study (NUTS3 level for the countries under consideration, at less detailed level for neighbouring countries and remote areas, see Figure 9.3-Figure 9.5).
- Classification of goods per NSTR2 group, per logistics type and per sector of production and attraction.
- Consideration of multimodal transport chains (road/Baltic ports and rail/Baltic ports).

The compiled OD basis matrix for 2004 includes all transportation relations on the networks of the Baltic States and, to a relevant extent, those on the networks of Poland. Each OD relation within the basis matrix is described by zone of origin (production), zone of destination (attraction), commodity group, transhipment zone, mode before transhipment and mode after transhipment and by volume. The level of detail concerning the transport chain is magnified for the Rail Baltica countries.

The link between commodity nomenclature, manifestation and economy sectors is shown in Annex F.

Figure 9.3 The zones for modelling OD relations, NEAC model

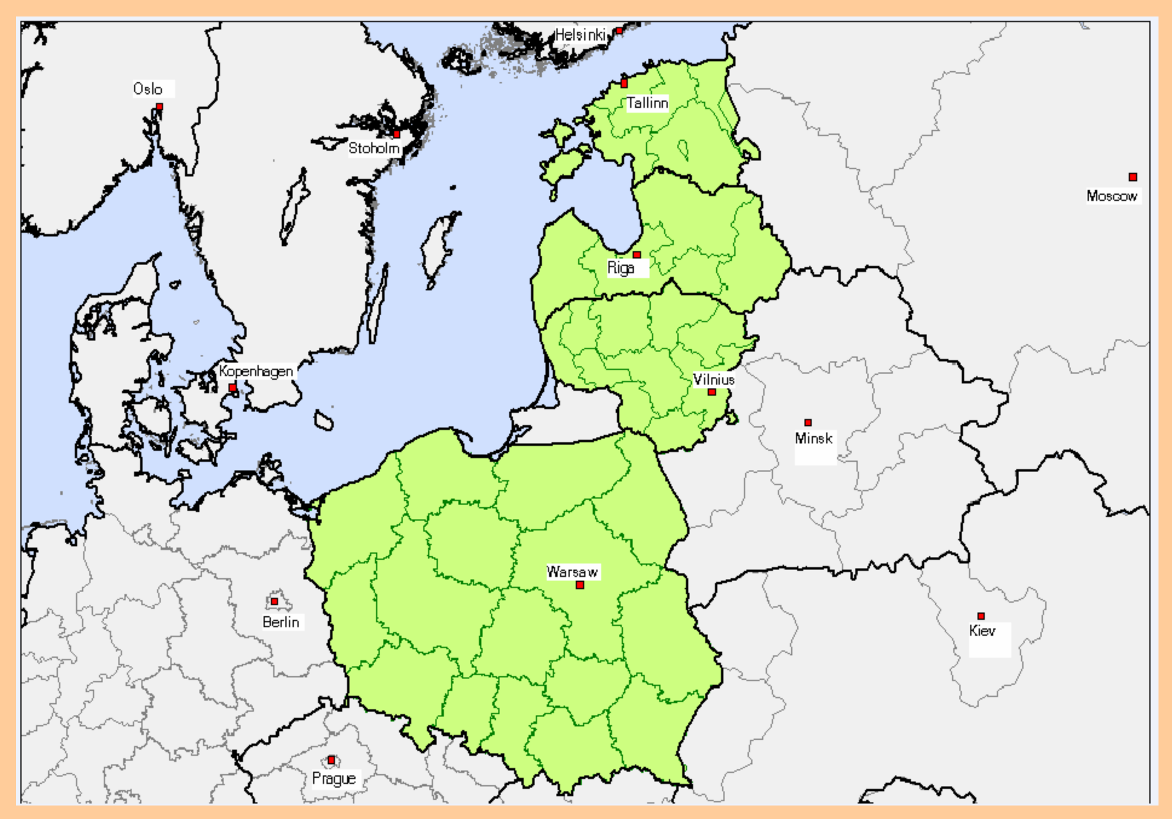


Figure 9.4 The road network used for assignment of OD relations

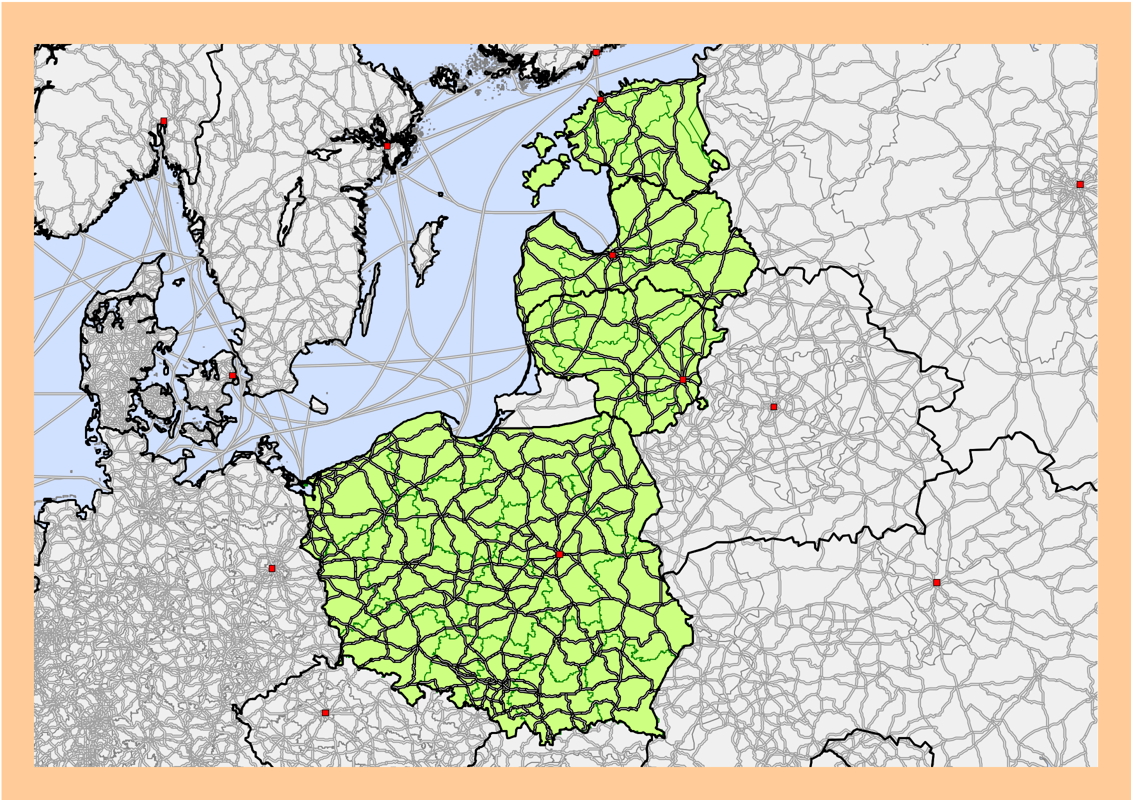
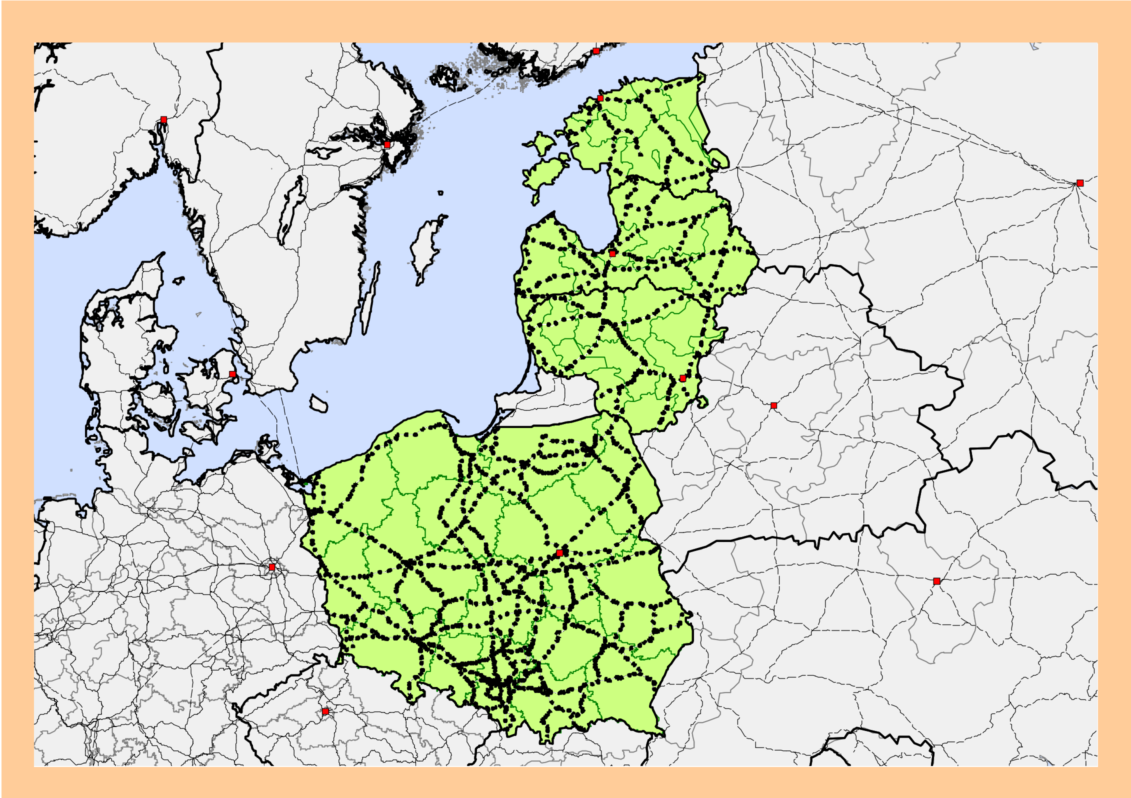


Figure 9.5 The rail network used for assignment of OD relations



9.2 Infrastructure supply

9.2.1 Current infrastructure

The road and rail network models of the base year (2004) are based on the ETIS[18] network models and have carefully been updated and extended for the present study. Especially in the road network model several additional links have been included.

The network assumptions for the base year are presented in Figure 9.6 (road) and Figure 9.7 (rail).

[18] ETIS: European Transport Policy Information System, funded by the European Commission, DG TREN.

Figure 9.6 The road network model, base year 2004

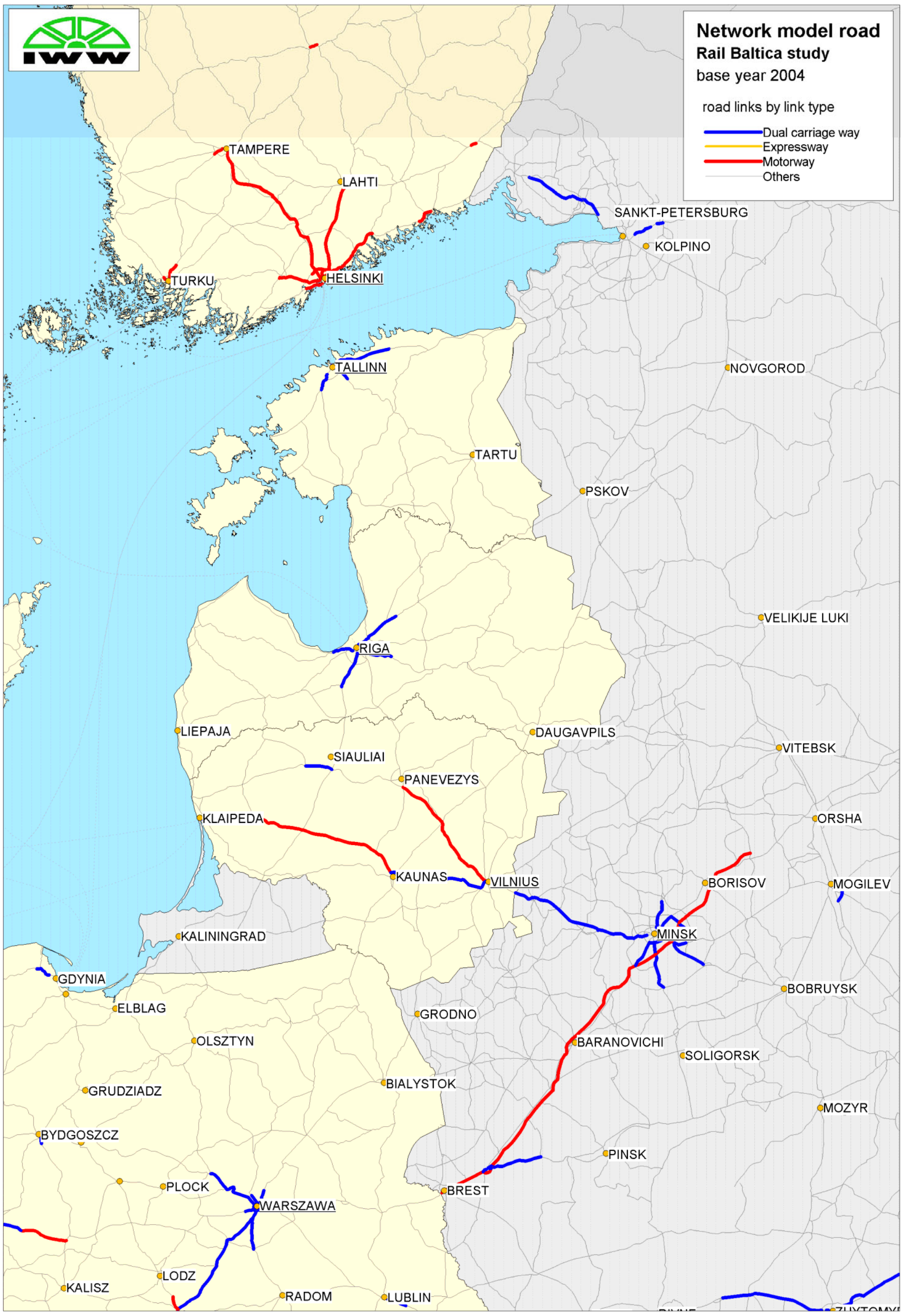
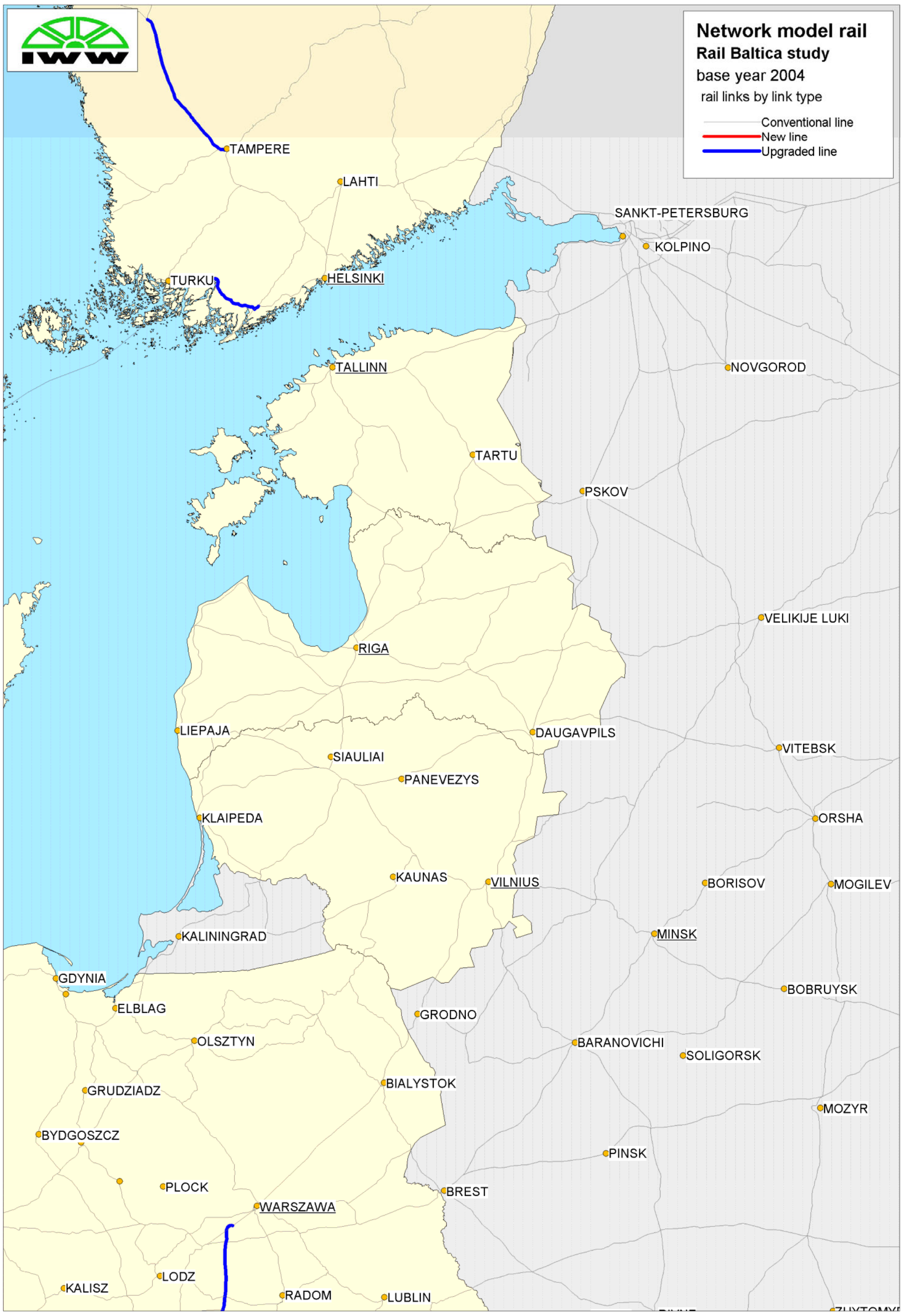


Figure 9.7 The rail network model, base year 2004



9.2.2 Future infrastructure

Reference infrastructure scenario in 2034

In order to be able to assess the alternatives of future infrastructure improvements along the Rail Baltica corridor, a reference infrastructure configuration has to be defined. The future reference infrastructure reflects the infrastructure status that serves as a baseline for the project evaluations.

The reference infrastructure scenarios are illustrated in Figure 9.8 (road) and Figure 9.9 (rail).

The following procedure has been applied in order to obtain the reference infrastructure configuration for the forecast year (2034):

- Firstly, it has been assumed that all European priority projects - which have been agreed by the European institutions in the year 2004 - have been implemented.
- Secondly, large-scale infrastructure projects in the neighbouring non-EU countries have been taken into account (e.g. the motorway and the new high-speed rail link between St. Petersburg and Moscow).
- Thirdly, domestic projects in the Baltic States and Poland have been identified by consulting the project partners in these countries and the national Ministries of Transport.

Especially the latter step has been subject to various iterations. Finally, a reference infrastructure configuration could be identified, which according to the medium- and long-term transport infrastructure planning in the concerned countries represents a realistic and an acceptable basis.

Figure 9.8 The road network model, reference infrastructure scenario 2034

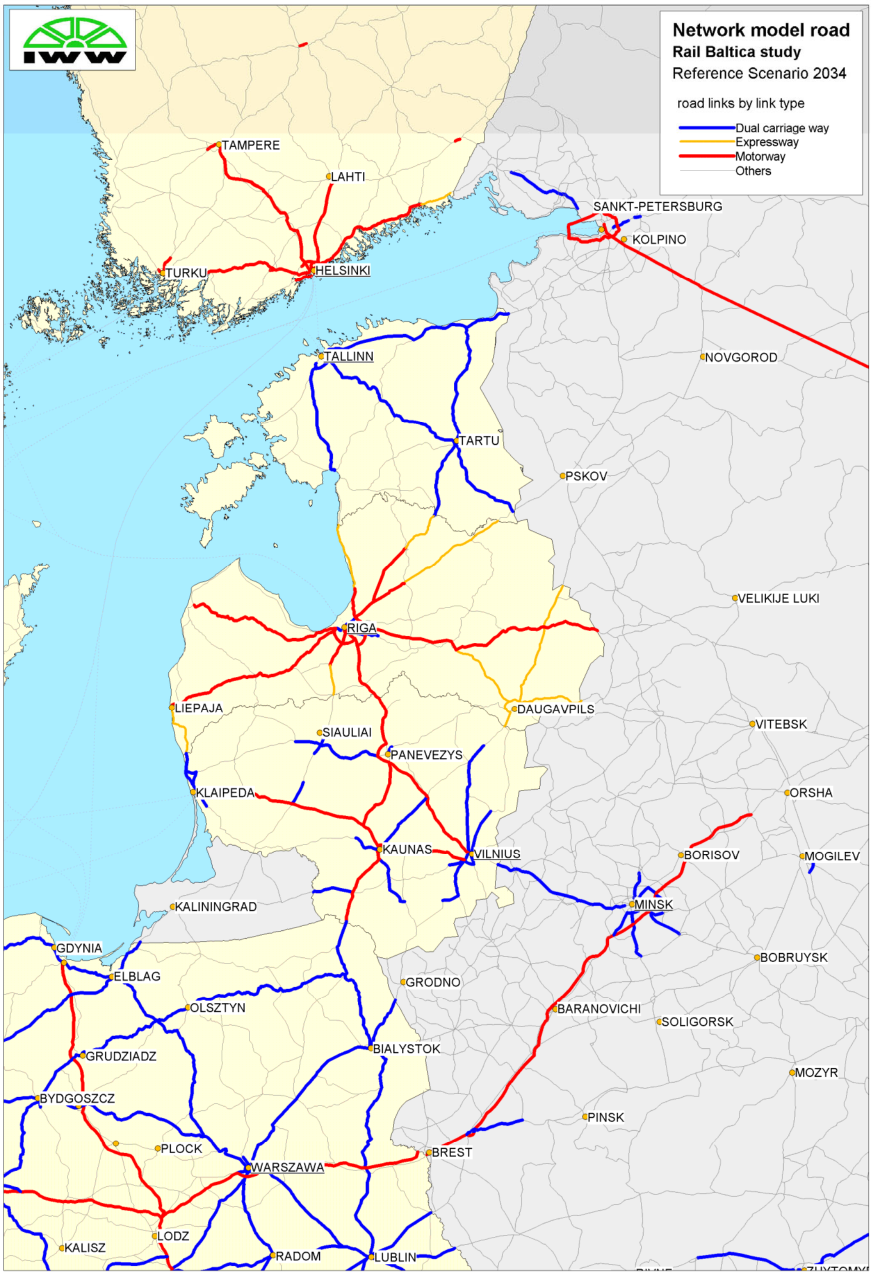
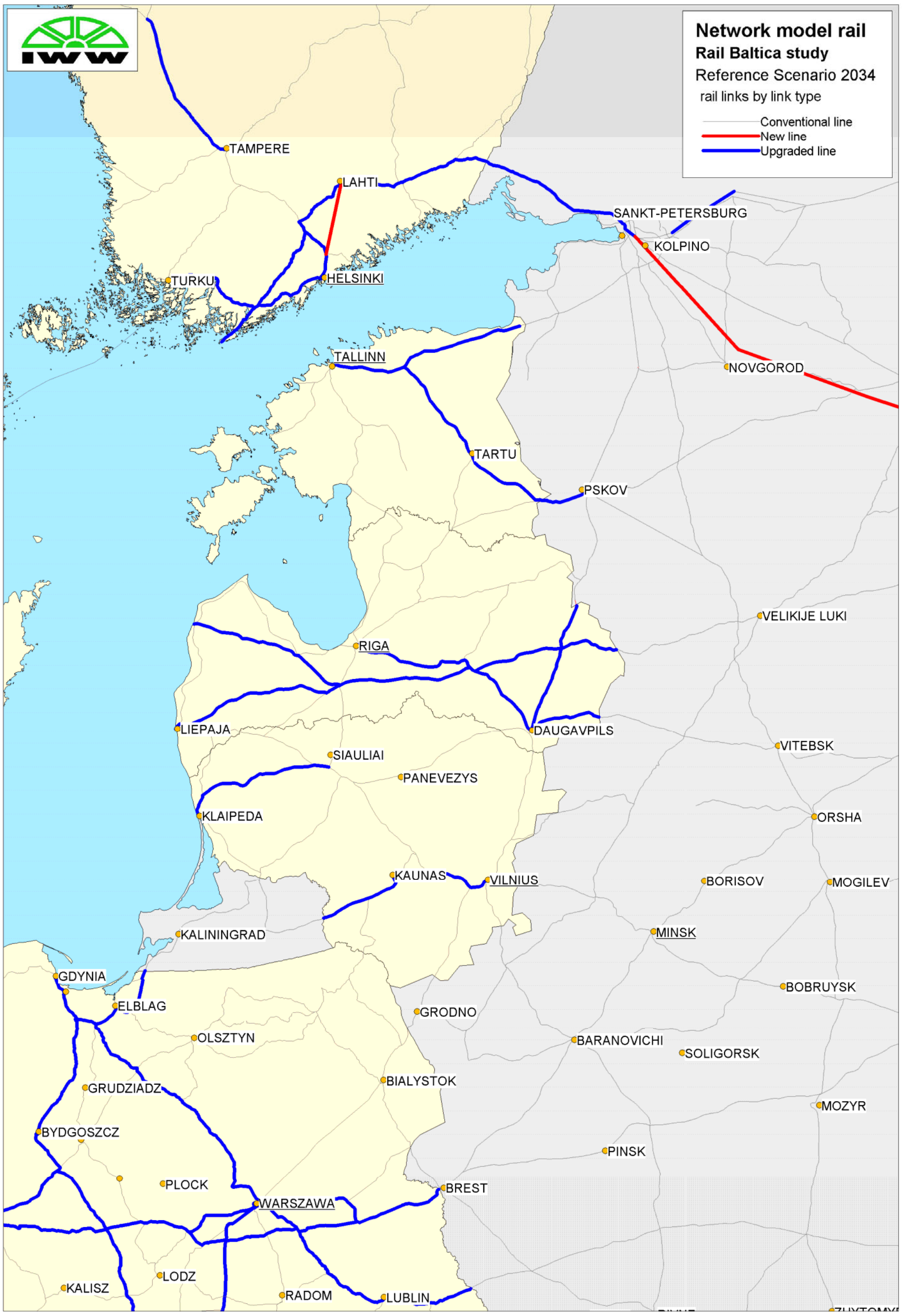


Figure 9.9 The rail network model, reference infrastructure scenario 2034



Implementation of the investment packages into the network models
Based on the information provided by the description of the investment packages (see Chapter 6), the variants have been implemented into the rail network models, by "adding" the investment assumptions to the infrastructure status of the 2034 reference scenario. The design speed specified for the investment packages was taken into account when imputing package-specific travel times

at the link level into the rail network model. The rail network models for the investment packages are displayed by Figure 9.10, Figure 9.11 and Figure 9.12.

Figure 9.10 Rail network model, investment package 1, 2034

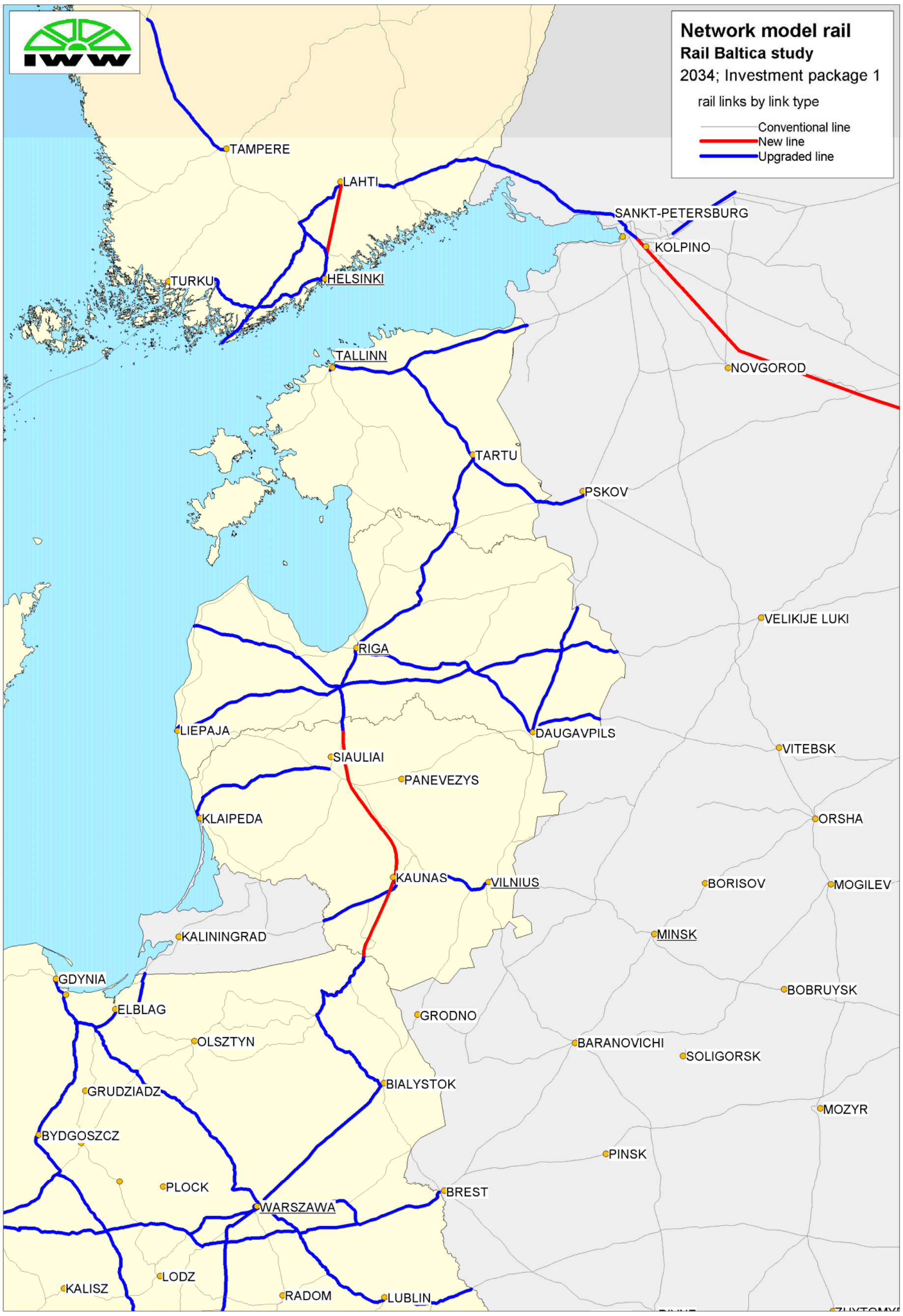


Figure 9.11 Rail network model, investment package 2, 2034

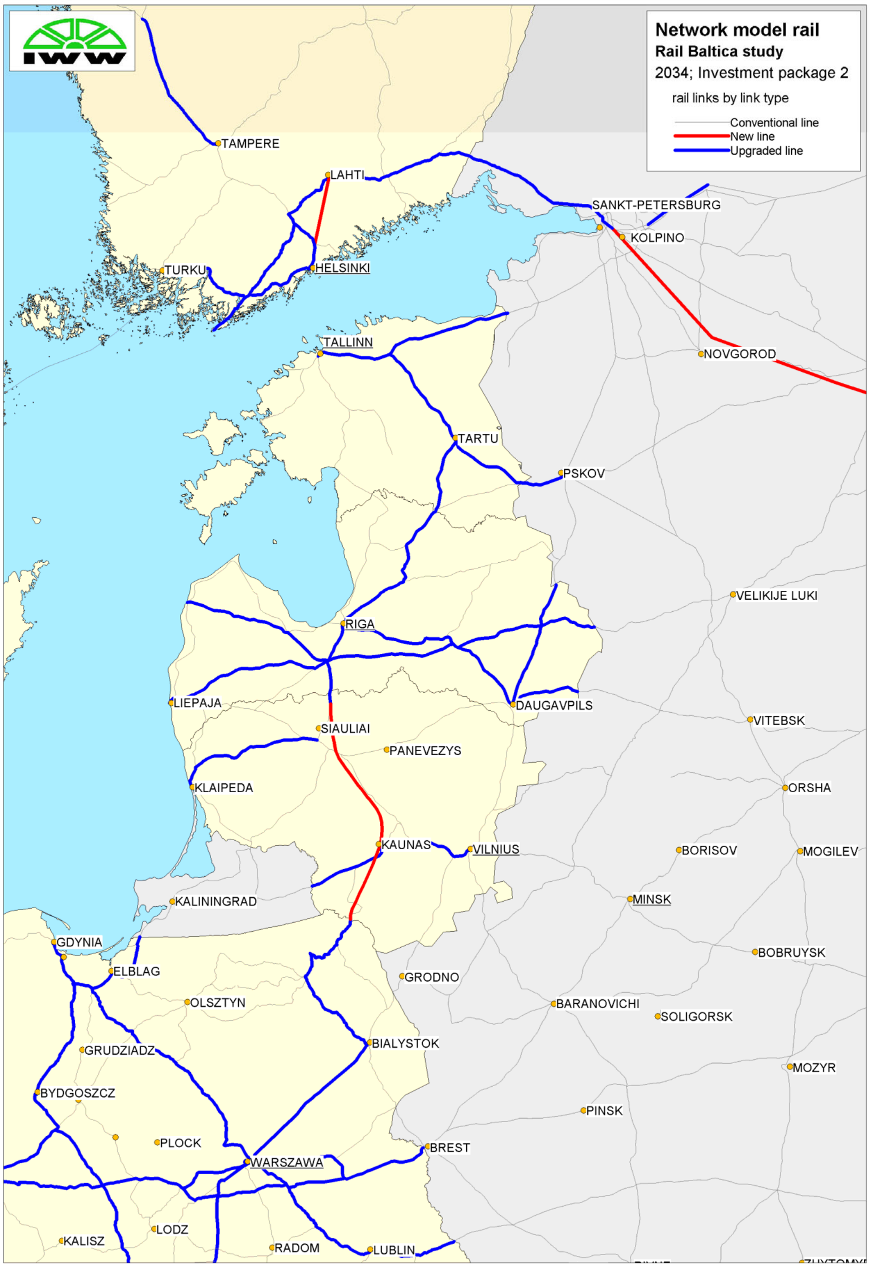
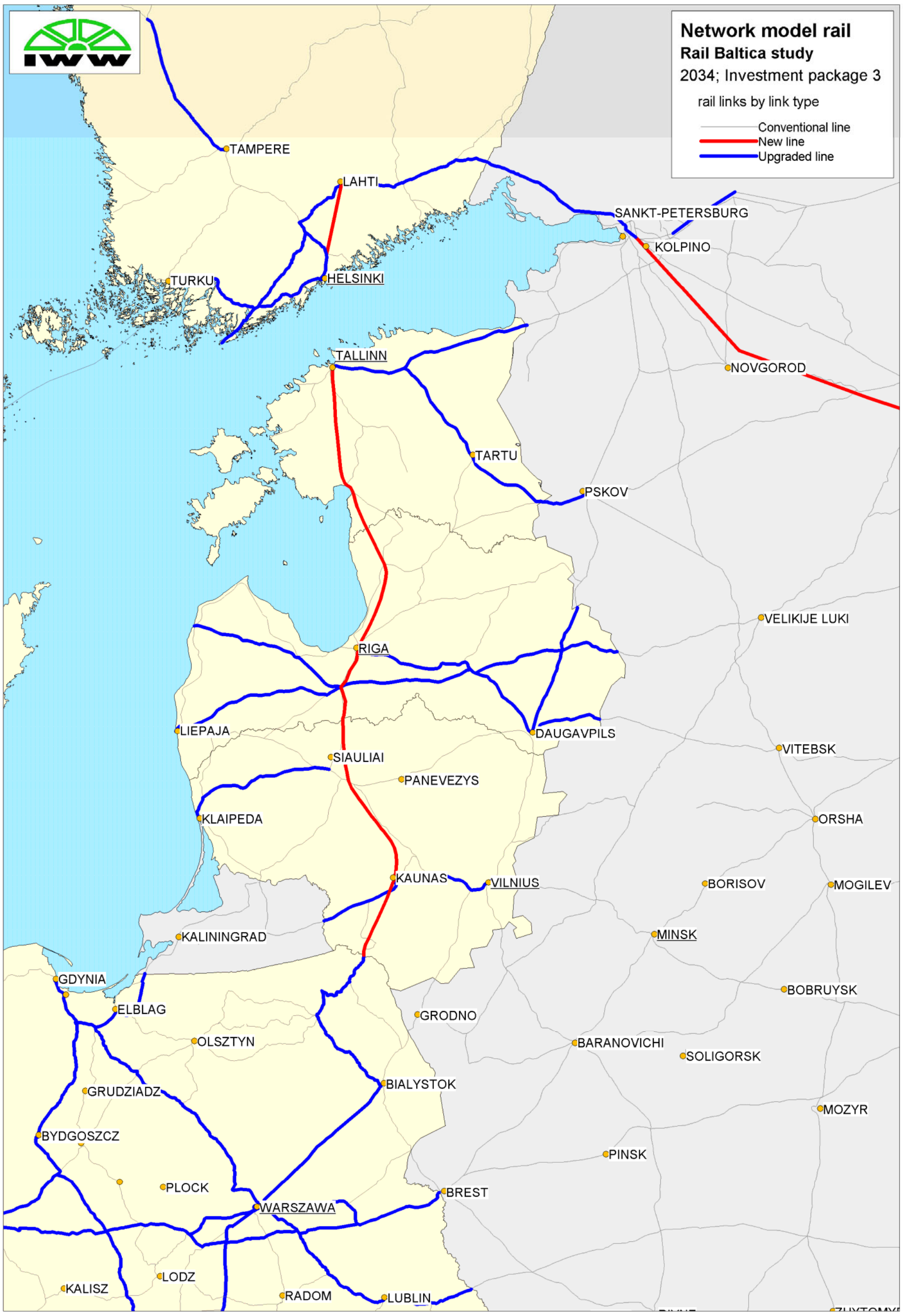


Figure 9.12 Rail network model, investment package 3, 2034



9.3 Interdependence between the Rail Baltica and other priority corridors of the EU

Transport infrastructure investment programmes may consist of interdependent projects. Hence, some infrastructure projects might compete with each other, so that the sum of benefits arising from situations in which the projects are realised individually is higher than the benefit arising if the same projects were realised together.

Other projects of the investment programme might be complementary, i.e. the benefits arising from a joint realisation of infrastructure projects is higher than the sum of benefits obtained if the projects were realised individually. The analysis of interdependence between Rail Baltica and other infrastructure investments has not been within the scope of the present feasibility study. Nevertheless, some selected results of a recent research study with relevance for Rail Baltica are presented in this section.

In order to tackle the issue of interdependencies between infrastructure projects of an investment programme, an “Interdependency Evaluation Framework” has been developed by Szimba (2006), which consists of three stages of interdependence analysis:

1 In the first stage, benefits of projects as individual projects are compared to the benefits of projects as part of the whole transport infrastructure programme. This evaluation gives first insights into the dimension of interdependencies emerging between the projects of the investment programme. The subsequent stages make use of the pattern of interdependencies between infrastructure projects emerging if the infrastructure projects affect the same O/D relations. Applying a network-based transport model, those demand segments are identified which are expected to make use of the infrastructure projects if the projects were realised as individual projects and if the projects were implemented within the whole programme.

2 In the second stage, interdependencies and common demand are computed for pairs of infrastructure projects.

3 In the third stage, interdependencies between individual projects and project combinations are examined. In order to limit the number of relevant combinations, the set of infrastructure projects is subdivided in such a way that the emergence of interdependencies can be restricted to certain subsets of projects. Thus, the obtained project partition allows the interdependence analysis to be restricted to projects within a group. For subdividing the projects of the investment programme into smaller groups, a multivariate technique – cluster analysis – is applied in order to group infrastructure projects according to their demand structure. Apart from examining interdependencies between individual transport infrastructure projects and project combinations of a cluster, interdependencies between project clusters are analysed.

The developed Interdependency Evaluation Framework has been applied to priority corridors of the European Union. The criterion applied for the analyses is “passenger travel time costs”. The assumptions underlying the calculations are documented by Szimba (2006).

The following table contains the measure of interdependencies between corridor pairs with respect to the Reference scenario (i.e. a situation, in which the individual corridors are added to a baseline infrastructure configuration) and with respect to the P_all scenario (where the corridors are dropped from a maximum infrastructure scenario, in which all EU priority corridors are assumed of being implemented). A negative value hints at substitutive interdependencies between a corridor pair, whereas positive values reveal complementary relationships[19].

The analysis of interdependencies between pairs of EU priority corridors reveals interdependence at a relevant level between Rail Baltica and P23, the railway axis Gdansk – Warszawa – Brno/ Bratislava – Wien. The type of interdependence is determined by complementarities and the measure of interdependence amounts to around 3.2 million € per year. This implies that the benefits caused by passenger travel time saving, which arise if both P23 and Rail Baltica were assessed together, are 3.2 million € per year above the sum of benefits which can be expected if these two corridors were assessed individually as stand-alone projects.

Interdependencies at a lower, almost negligible, level are to be expected between Rail Baltica and P12, the Nordic Triangle (complementary interdependence), as well as between Rail Baltica and P25, the motorway axis Gdansk – Brno/ Bratislava – Wien (substitutive interdependence).

At the level of O/D relations, the occurrence of interdependencies is illustrated by the following figure. The figure shows the O/D relations whose level of interdependency amounts to more than 3,000 € per year. Red-coloured polygons indicate substitutive interdependence, whereas the green polygons indicate complementary interdependence. The interdependency pattern between Rail Baltica and P23 is almost solely determined by O/D relations with complementary interdependencies.

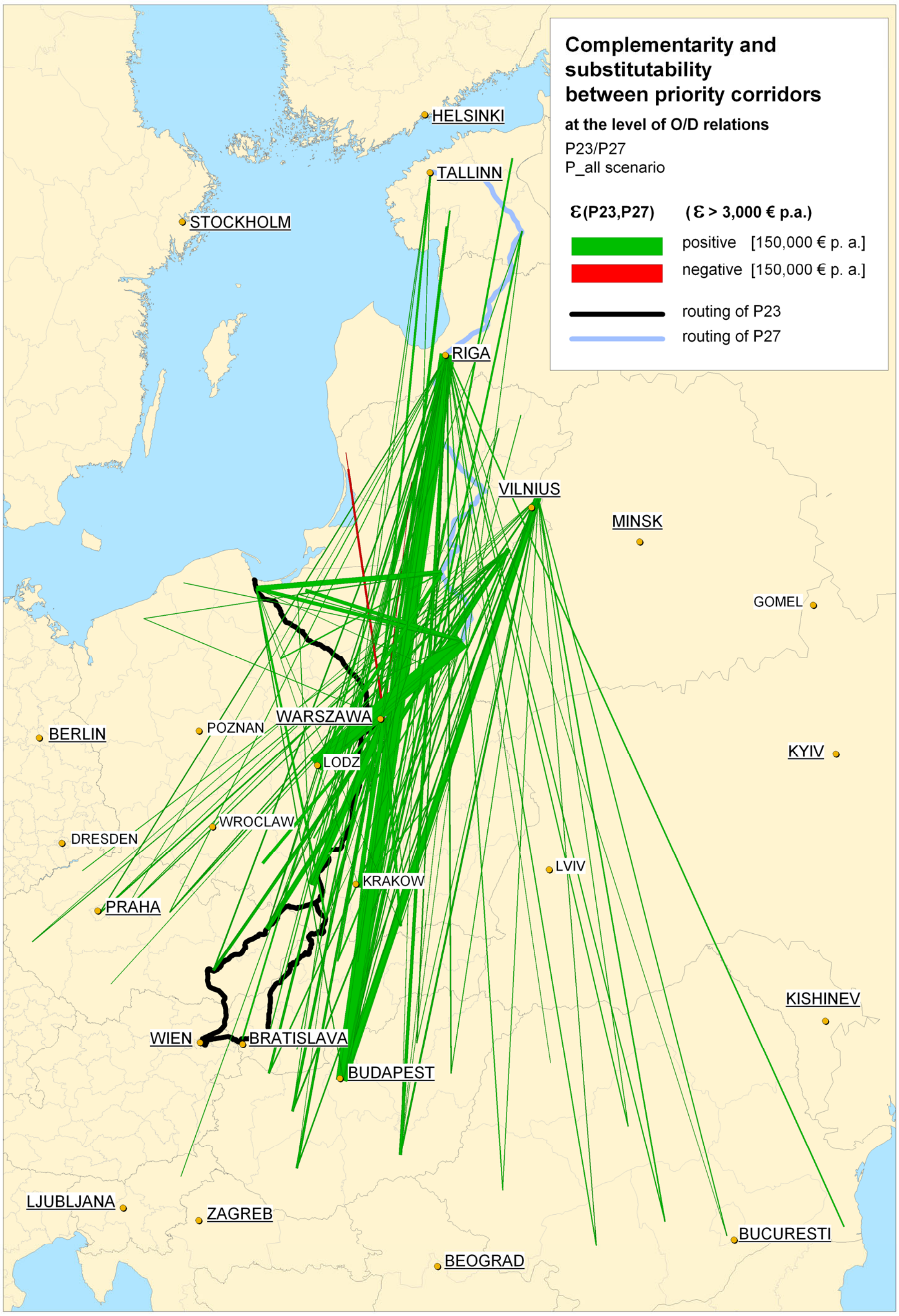
[19] A detailed description of the method and the calculation of the interdependency measures is provided by Szimba (2006).

Table 9.1 Interdependencies of pairs of priority corridors with regard to the minimum and the maximum infrastructure configuration

Interdependencies between pairs of priority corridors $\varepsilon^{Ref}(p_k, p_l)$ $\varepsilon^{P\_all}(p_k, p_l)$ [million € p.a.]		P01 Berlin-Palermo	P02 HSR axis PBKAL	P03 HSR axis of south-west Europe	P06 Lyon-Trieste-Budapest-border UA	P07 Igoumenitsa/ Patras-Budapest	P08 PT/ ES-Rest of Europe	P12 Nordic triangle	P13 UK/ Ireland/ Benelux road axis	P16 Sines/ Algeciras-Madrid-Paris	P17 Paris-Bratislava	P20 Fehmarn Belt	P22 Athens-Wien-Praha-Nrnbg./ Dresden	P23 Gdansk-Brno/ Bratislava-Wien	P24 Lyon/ Genova-Rotterdam/ Antwerpen	P25 Gdansk-Wien road axis	P26 UK-Continent	P27 Rail Baltica	P28 Eurocaprail	P29 Ionian/ Adriatic corridor
P01	Berlin-Palermo		0.39 0.18	-0.02 0.13	2.75 2.94	0.00 0.00	0.00 0.00	0.03 0.01	0.00 0.00	-0.03 0.00	-3.66 -2.08	-1.00 -0.59	-0.71 -0.49	-0.17 -0.41	-6.23 -5.47	-0.01 -0.01	0.00 0.00	0.01 -0.02	-0.14 0.00	0.00 0.00
P02	HSR axis PBKAL	0.39 0.18		0.17 0.10	0.56 -0.37	0.00 0.00	0.00 0.01	0.00 0.00	0.00 0.00	0.00 0.00	-0.29 0.55	-0.03 0.19	0.04 0.05	0.00 0.01	-0.98 -1.33	0.00 0.00	0.01 0.01	0.00 0.00	-1.06 -1.86	0.00 0.00
P03	HSR axis of south-west Europe	-0.02 0.13	0.17 0.10		1.62 1.71	0.00 0.00	3.23 3.34	0.00 0.00	0.00 0.00	-1.36 -0.88	0.32 0.35	0.02 0.02	0.01 0.01	0.00 0.00	1.19 1.50	0.00 0.00	0.03 0.02	0.00 0.00	0.01 0.01	0.00 0.00
P06	Lyon-Trieste-Budapest-border UA	2.75 2.94	0.56 -0.37	1.62 1.71		0.00 0.00	-0.01 0.01	0.00 0.00	0.00 0.00	-0.05 0.00	-2.87 -4.23	0.00 0.01	-0.05 -0.24	0.02 0.10	-0.09 -2.06	0.00 0.00	0.02 0.01	0.01 0.03	-0.38 -0.77	0.00 0.00
P07	Igoumenitsa/ Patras–Budapest	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00		0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.21 0.21	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
P08	PT/ ES-Rest of Europe	0.00 0.00	0.00 0.01	3.23 3.34	-0.01 0.01	0.00 0.00		0.00 0.00	0.00 0.00	-0.19 -0.08	0.01 0.01	0.00 0.00	0.00 0.00	0.00 0.00	-0.04 -0.02	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
P12	Nordic triangle	0.03 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00		0.00 0.00	0.00 0.00	-0.01 0.00	1.05 0.77	0.00 0.00	0.00 0.00	0.01 0.02	-0.07 -0.35	0.00 0.00	0.12 0.12	0.00 0.00	0.00 0.00
P13	UK/ Ireland/ Benelux road axis	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00		0.00 0.00	0.00 0.00	0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	-5.03 -5.03	0.00 0.00	0.00 0.00	0.00 0.00
P16	Sines/ Algeciras-Madrid-Paris	-0.03 0.00	0.00 0.00	-1.36 -0.88	-0.05 0.00	0.00 0.00	-0.19 -0.08	0.00 0.00	0.00 0.00		0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.00	-0.40 0.01	0.00 0.00	0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.00
P17	Paris-Bratislava	-3.66 -2.08	-0.29 0.55	0.32 0.35	-2.87 -4.23	0.00 0.00	0.01 0.01	-0.01 0.00	0.00 0.00	0.01 0.00		0.08 0.41	0.28 0.59	0.58 0.69	11.19 13.65	-0.04 -0.07	0.01 0.04	0.02 0.02	2.95 2.56	0.00 0.00
P20	Fehmarn Belt	-1.00 -0.59	-0.03 0.19	0.02 0.02	0.00 0.01	0.00 0.00	0.00 0.00	1.05 0.77	0.01 0.00	0.00 0.00	0.08 0.41		0.06 0.02	0.04 0.01	0.06 0.52	-0.02 -0.30	0.00 0.00	0.00 0.00	-0.16 0.01	0.00 0.00
P22	Athens-Wien-Praha-Nrnbg./ Dresden	-0.71 -0.49	0.04 0.05	0.01 0.01	-0.05 -0.24	0.21 0.21	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.28 0.59	0.06 0.02		-3.15 -0.62	-0.14 0.19	-0.09 -0.07	0.00 0.00	0.10 0.20	0.00 0.00	0.01 0.01
P23	Gdansk-Brno/ Bratislava-Wien	-0.17 -0.41	0.00 0.01	0.00 0.00	0.02 0.10	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.58 0.69	0.04 0.01	-3.15 -0.62		-0.01 0.03	-1.73 -1.82	0.00 0.00	3.19 3.25	0.00 0.00	0.00 0.00
P24	Lyon/ Genova-Rotterdam/ Antwerpen	-6.23 -5.47	-0.98 -1.33	1.19 1.50	-0.09 -2.06	0.00 0.00	-0.04 -0.02	0.01 0.02	0.00 0.00	-0.40 0.01	11.19 13.65	0.06 0.52	-0.14 0.19	-0.01 0.03		0.00 0.00	-0.01 0.00	0.00 0.00	-2.07 -2.76	0.00 0.00
P25	Gdansk-Wien road axis	-0.01 -0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	-0.07 -0.35	0.00 0.00	0.00 0.00	-0.04 -0.07	-0.02 -0.30	-0.09 -0.07	-1.73 -1.82	0.00 0.00		0.00 0.00	-0.16 -0.21	0.00 0.00	0.00 0.00
P26	UK-Continent	0.00 0.00	0.01 0.01	0.03 0.02	0.02 0.01	0.00 0.00	0.00 0.00	0.00 0.00	-5.03 -5.03	0.01 0.00	0.01 0.04	0.00 0.00	0.00 0.00	0.00 0.00	-0.01 0.00	0.00 0.00		0.00 0.00	0.00 0.00	0.00 0.00
P27	Rail Baltica	0.01 -0.02	0.00 0.00	0.00 0.00	0.01 0.03	0.00 0.00	0.00 0.00	0.12 0.12	0.00 0.00	0.00 0.00	0.02 0.02	0.00 0.00	0.10 0.20	3.19 3.25	0.00 0.00	-0.16 -0.21	0.00 0.00		0.00 0.00	0.00 0.00
P28	Eurocaprail	-0.14 0.00	-1.06 -1.86	0.01 0.01	-0.38 -0.77	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	2.95 2.56	-0.16 0.01	0.00 0.00	0.00 0.00	-2.07 -2.76	0.00 0.00	0.00 0.00	0.00 0.00		0.00 0.00
P29	Ionian/ Adriatic corridor	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.01 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	

Source: Szimba 2006

Figure 9.13 Interdependencies between Rail Baltica (P27) and P23 at the level of O/D relations



10 Passenger traffic

The purpose of this chapter is to present the passenger traffic volumes in the reference scenario, i.e. without improvements of the Rail Baltica line. Firstly, the current passenger traffic volumes are presented and, secondly, the future passenger traffic volumes are presented.

10.1 Current passenger transport demand

Assignment results for passenger traffic have been produced by the VACLAV model for rail and road.

The results are based on the infrastructure configuration in the base year, the socio-economic and -demographic situation as well as information obtained on the transport flows at link level (traffic count data for road and - as far as available - maps illustrating the flows on the rail network).

Figure 10.1 (road) and Figure 10.2 (rail) display the assignment results.

It should be noted that for Russia, Belarus and Ukraine, domestic flows have not been within the scope of the modelling approach. The only exception is the Russian exclave around Kaliningrad, which is considered as an individual traffic zone.

Figure 10.1 ***Road*** *passenger flows, base year 2004*

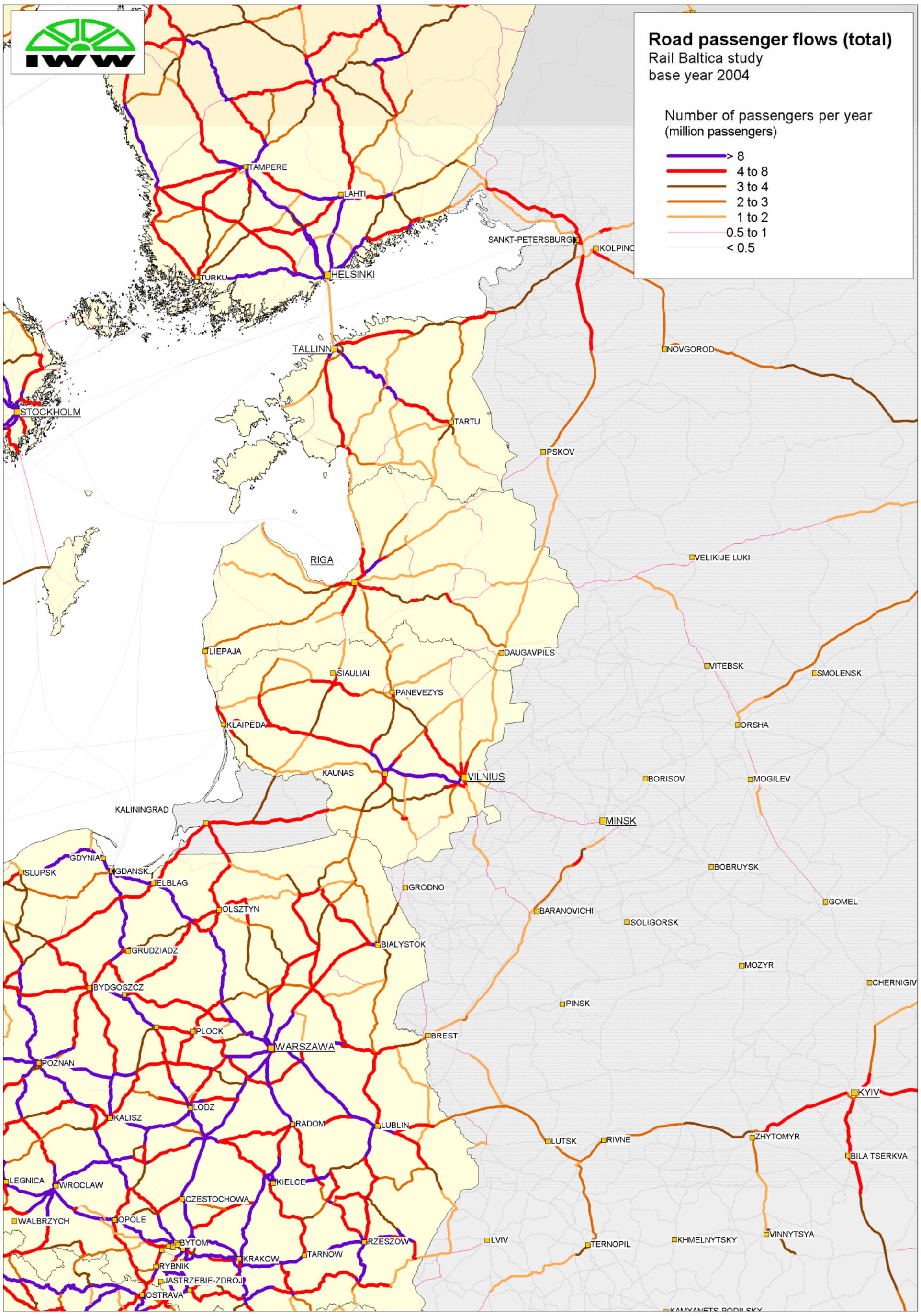
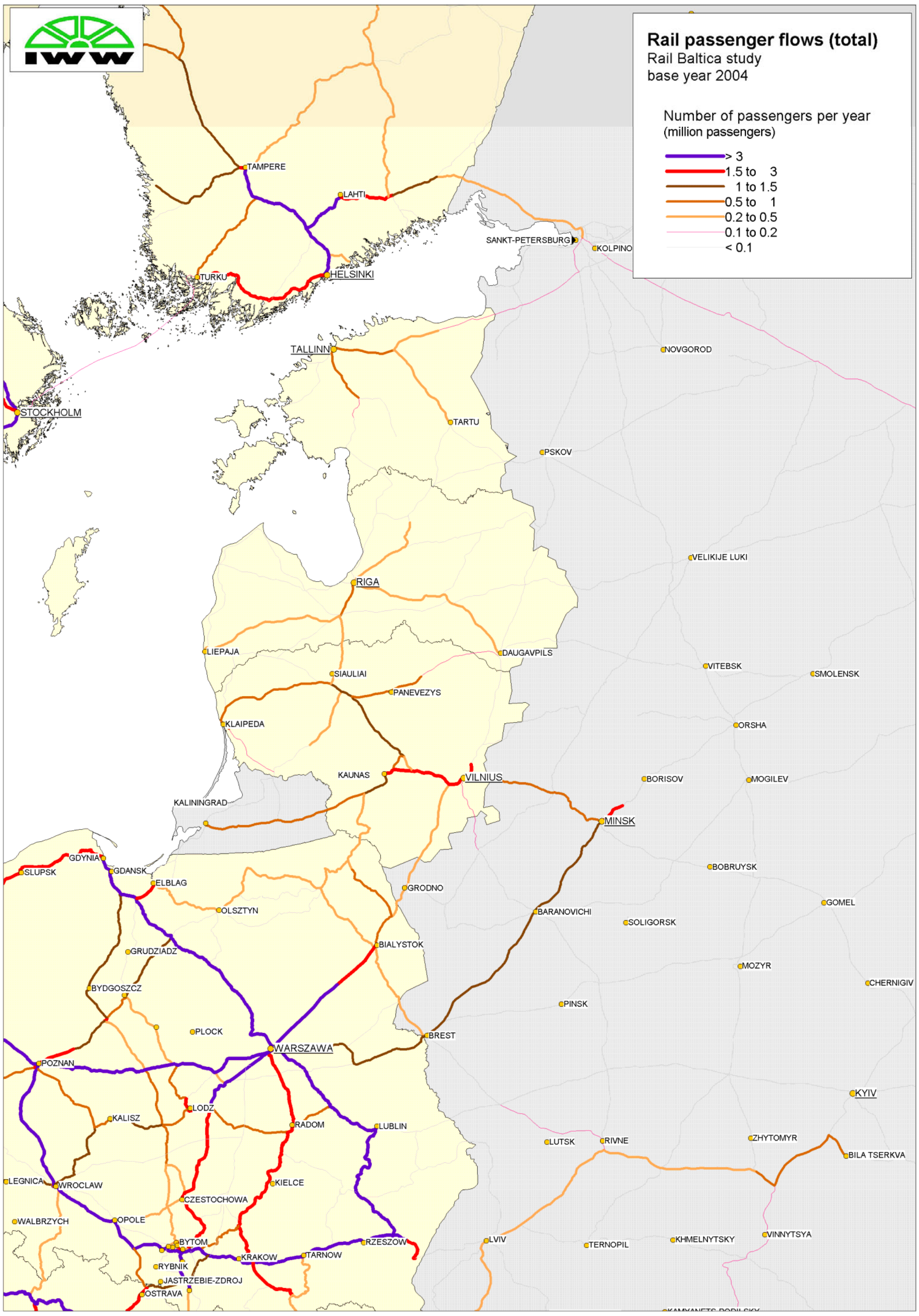


*Figure 10.2 **Rail** passenger flows, base year 2004*



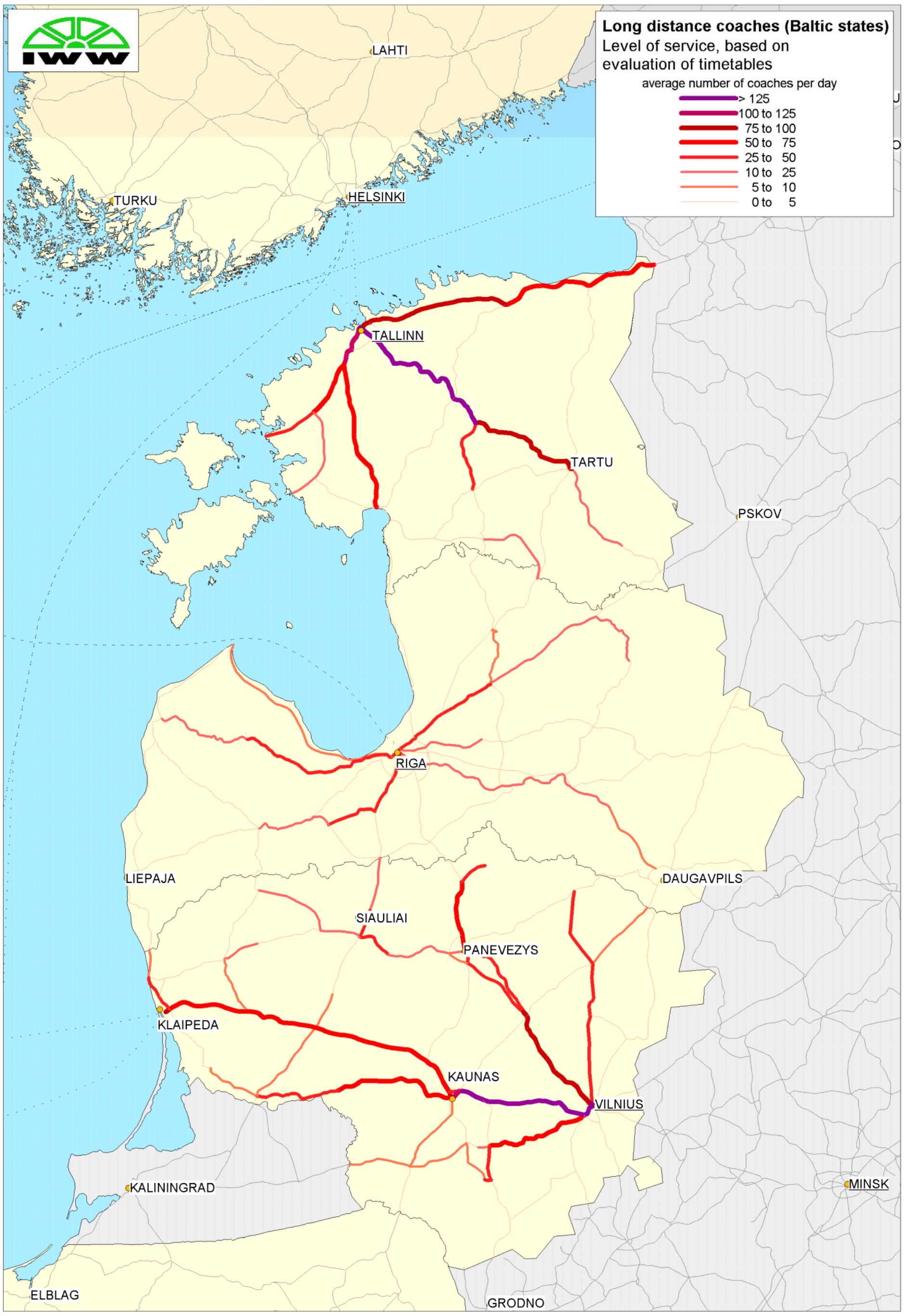
When comparing the dimension of road passenger transport flows with the dimension of rail passenger transport flows, significant differences can be observed:

- Particularly in Latvia and Estonia, the market share of the rail mode is at a remarkably low level

- Rail flows are strongly oriented in the east-west direction (except in Estonia)
- International rail passenger transport flows along the Rail Baltica corridor are negligible
- The only section of Rail Baltica, which highlights with substantial passenger rail flows, is the line between Warsaw and Bialystok
- The road passenger flows are substantially higher than rail flows. The comparison with the base year situation for rail also shows that in the market segment of international passenger transport among the Baltic States and Poland, the road mode is clearly dominant.

Since long-distance coach services play an important role particularly in the Baltic States, timetables have been analyzed, in order to obtain a realistic view of the present performance of this market segment. Figure 10.3 illustrates the average number of domestic coach connections per day in the Baltic States.

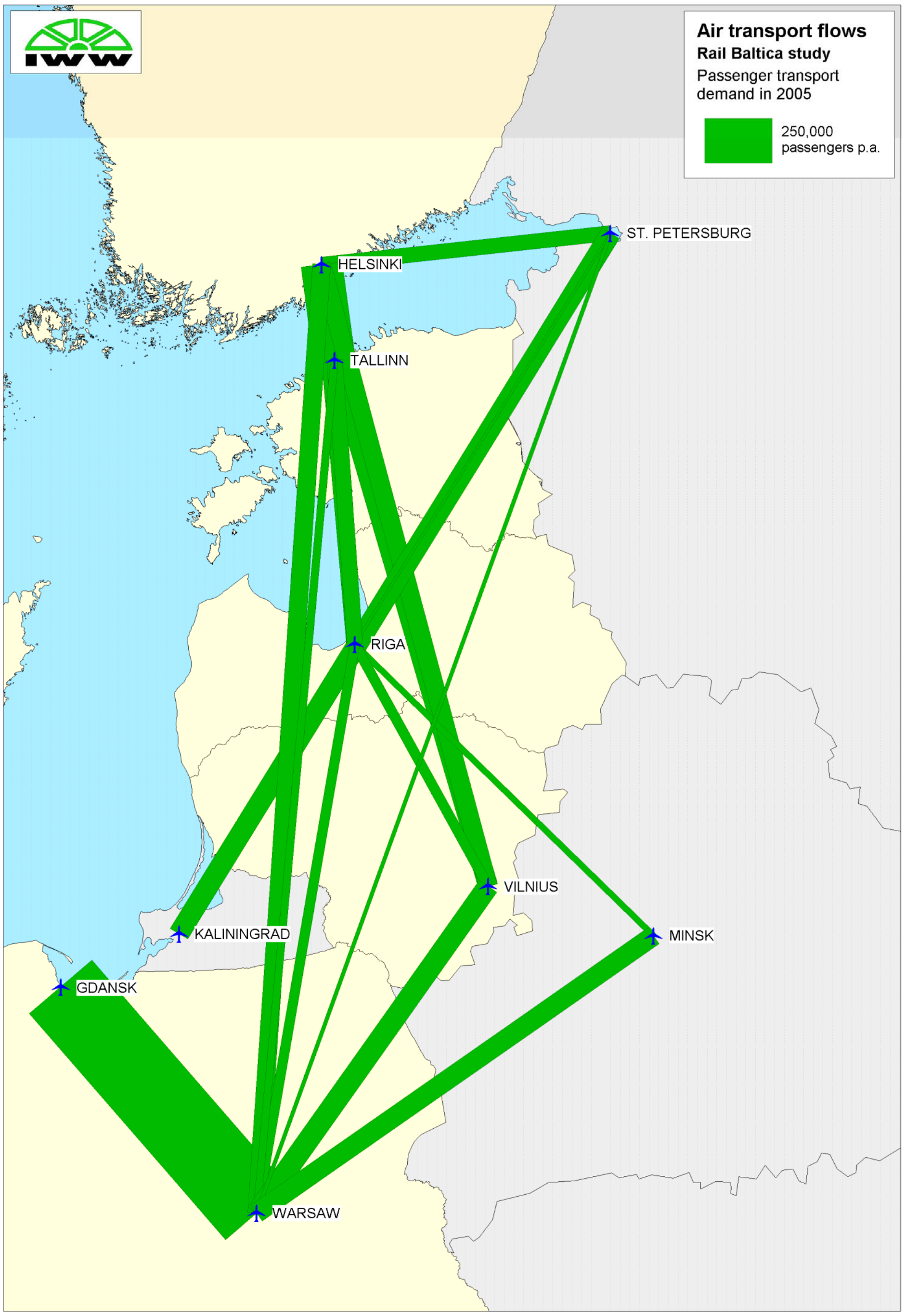
*Figure 10.3 Domestic long-distance **coach services** in the Baltic States*



The figure shows that coach services form an important part of the passenger transport in the Baltic States. Improved rail services could therefore potentially attract part of this traffic.

In order to obtain an overview in the air transport market within the catchment area of the Rail Baltica corridor, various data sources have been analyzed. Whereas for some of the connections between the relevant airports passenger transport volumes were published by airports, for other connections estimations had to be made, by evaluating flight timetables and – applying assumptions on average utilisation rates – the deployed models of aircraft. The air passenger demand volume is illustrated by the figure below.

Figure 10.4 ***Air** passenger flows (year 2005)*



The figure reveals that air traffic within the study area is rather limited today, so in the short run, rail services cannot be expected to gain from large passenger shifts from the air mode.

10.2 Future passenger transport demand - reference scenario 2034

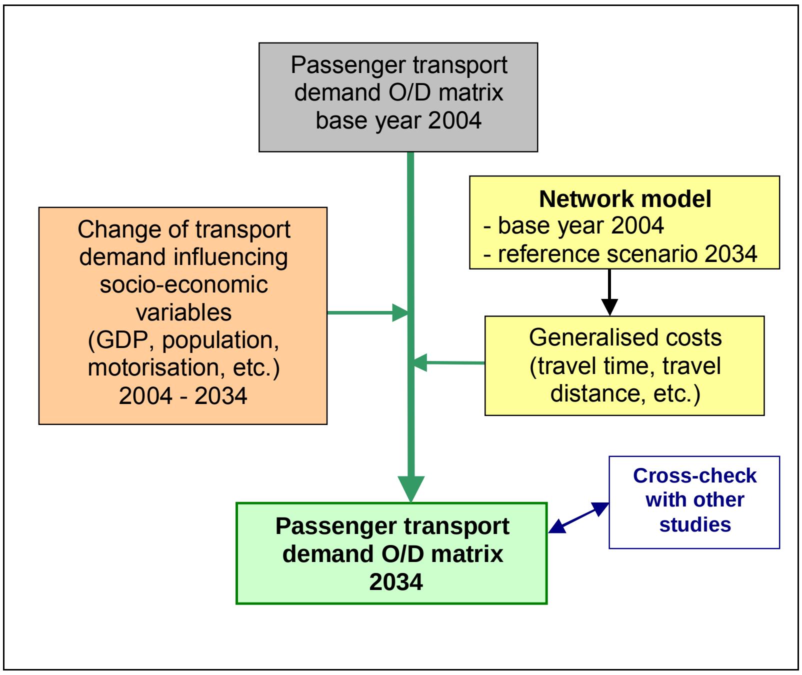
The projection of future passenger transport demand between OD-relations at NUTS3 level in the Baltic States and Poland is based on the results of current passenger transport demand for the base year (2004).

The projection for the period 2004 to 2034 in the Baltic States and Poland is affected by a change of transport demand influencing variables (e.g. the GDP, population and motorisation) in the origin and destination regions. The assumptions made on these parameters are shown in Annex D.

Furthermore, it is affected by a change in generalized travel cost (e.g. travel times) due to an improvement of the infrastructure supply. Hence, a gravitational approach is applied, i.e. the transport demand influencing the variables for the forecast year in the region of origin is connected with the transport demand influencing the variables of the region of destination. The change in generalised costs between the base year and the forecast year is applied as an additional impact.

Based on these patterns, a passenger transport demand OD matrix for 2034 has been calculated. The whole proceeding of this calculation is illustrated by the following figure.

Figure 10.5 Calculation of passenger transport OD matrix 2034



The following table presents the results of the present study for annual passenger transport demand growth rates in the Baltic States and Poland. The growth rates reveal that international trips represent a more dynamic market segment than domestic trips.

Table 10.1 Annual passenger transport demand growth rates of the present study

From \ To	EE	LV	LT	PL
EE	2.1%	2.2%	2.5%	2.4%
LV	2.2%	2.3%	2.9%	2.8%
LT	2.5%	2.9%	2.5%	3.0%
PL	2.4%	2.8%	3.0%	2.6%

To verify the results, the ETIS[20] passenger OD matrices for 2000 and for 2020 can be applied. The ETIS annual growth rates have been calculated by comparing the passenger transport matrix for the base year 2000 with that of the forecast year 2020. Hence, the growth rates in the ETIS for passenger flows have been predicted for the period 2000-2020. In a study by Faber Maunsell[21], the growth rates for road passenger transport demand for the period 2004-2025 have been estimated.

When comparing the annual passenger growth rates of the present study with the growth rates of the ETIS and the study by Faber Maunsell, we can conclude that the domestic annual growth rates of the present study are lower than those projected by Faber Maunsell, but in the range of the growth rates forecasted by the ETIS. The international growth rates of the present study are in line with the growth rates of the ETIS study. Table 10.2 illustrates this comparison.

Table 10.2 Comparison of annual passenger transport demand growth rates of the present study with those of other studies

To	EE			LV			LT			PL		
Fr.	RB	FM	ETIS	RB	FM	ETIS	RB	FM	ETIS	RB	FM	ETIS
EE	2.1%	3.1%	1.8%	2.2%	na	2.0%	2.5%	na	2.6%	2.4%	na	2.5%
LV	2.2%	na	2.0%	2.3%	3.5%	2.3%	2.9%	na	2.9%	2.8%	na	2.8%
LT	2.5%	na	2.6%	2.9%	na	2.9%	2.5%	2.8%	3.0%	3.0%	na	2.8%
PL	2.4%	na	2.5%	2.8%	na	2.8%	3.0%	na	2.6%	2.6%	3.1%	2.7%

The results of the forecast year 2034 are displayed for rail passenger flows in Figure 10.6 and for road passenger flows in Figure 10.7.

[20] ETIS: The European Transport Policy Information System, funded by the European Commission, DG TREN.
[21] Faber Maunsell, 2005: Analysis of P-E Corridor I: Pan European Corridor IA Final Draft

Figure 10.6 Rail passenger flows, forecast year 2034, reference scenario

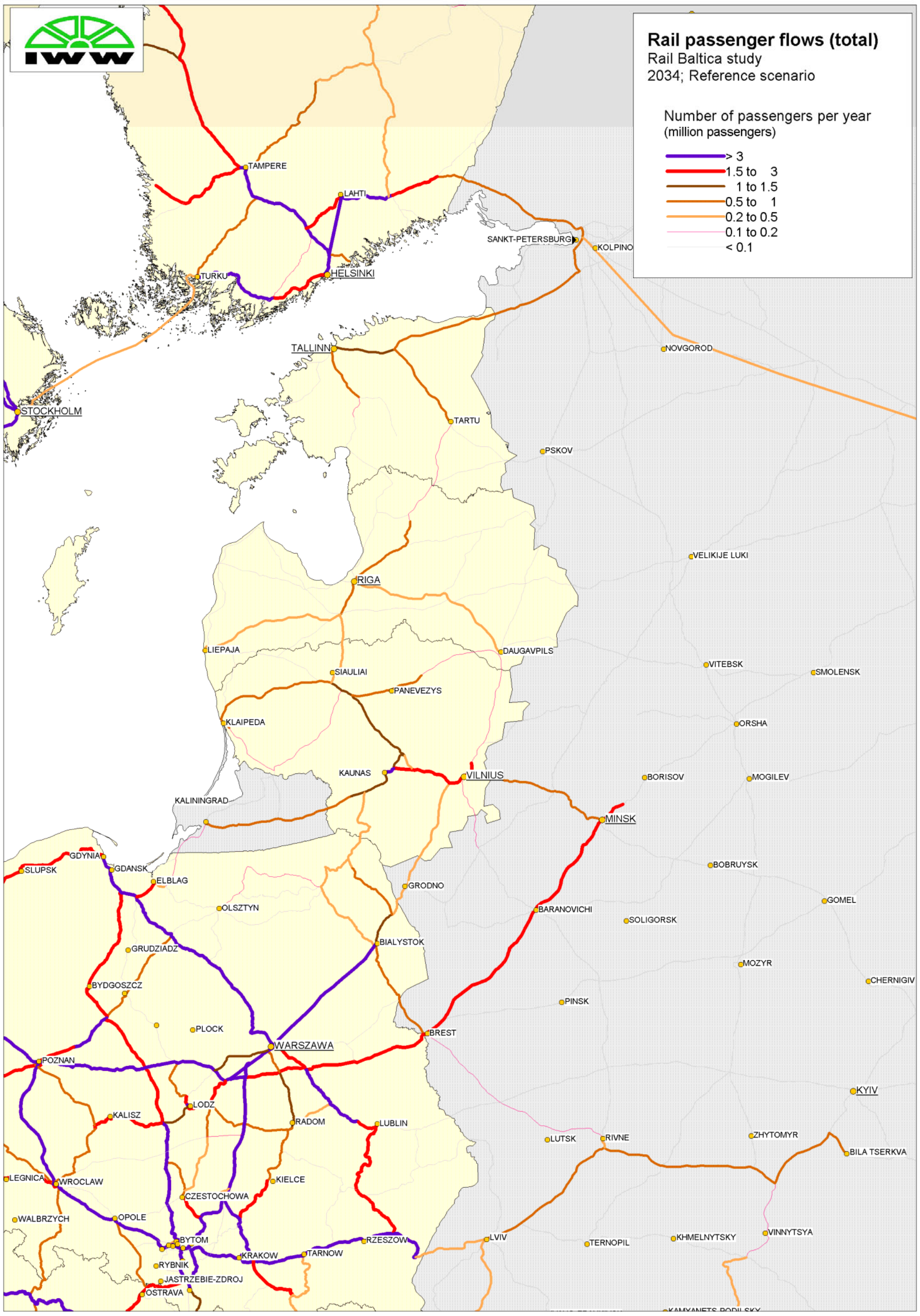
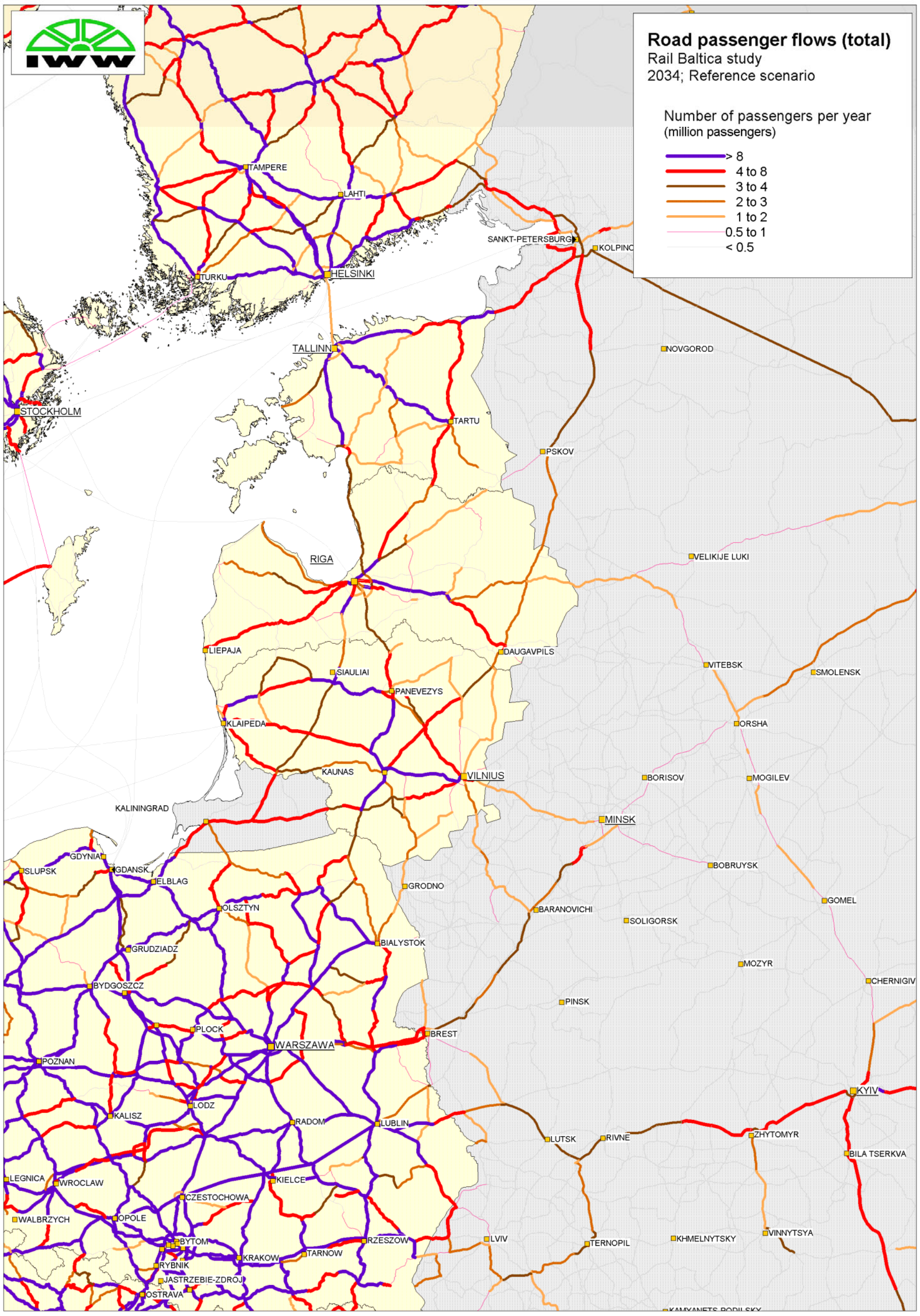


Figure 10.7 Road passenger flows, forecast year 2034, reference scenario



10.3 Future passenger transport demand - Investment Package 1

The implementation of the investment package 1 is expected to increase the passenger transport flows along the Rail Baltica corridor, which is induced both by moderate modal shifts and by changes in route choice. Furthermore, the infrastructure measures are expected to result in a moderate increase in passenger demand on lines feeding the Rail Baltica corridor, such as Liepaja – Jelgava or

Klaipeda – Siauliai. The impacts in the Southern part of the Rail Baltica are by far more prominent than in the Northern part of the corridor. Around 1.9 million passengers p.a. are expected between Bialystok and Elk, 1.2 million are expected to be carried across the Polish/Lithuanian border, while 1.5 million passengers p.a. are forecasted on the new line between Kaunas and Radviliskis. Particularly in Estonia the changes with regard to the Reference scenario 2034 are almost negligible, which is due to the fact that the section Tartu – Tallinn is upgraded in the Reference scenario, independently from the investment options under examination.

Figure 10.8 illustrates the rail passenger flows and Figure 10.9 displays the road passenger flows of investment package 1 for the forecast year 2034.

Figure 10.8 Rail passenger flows, forecast year 2034, Investment package 1

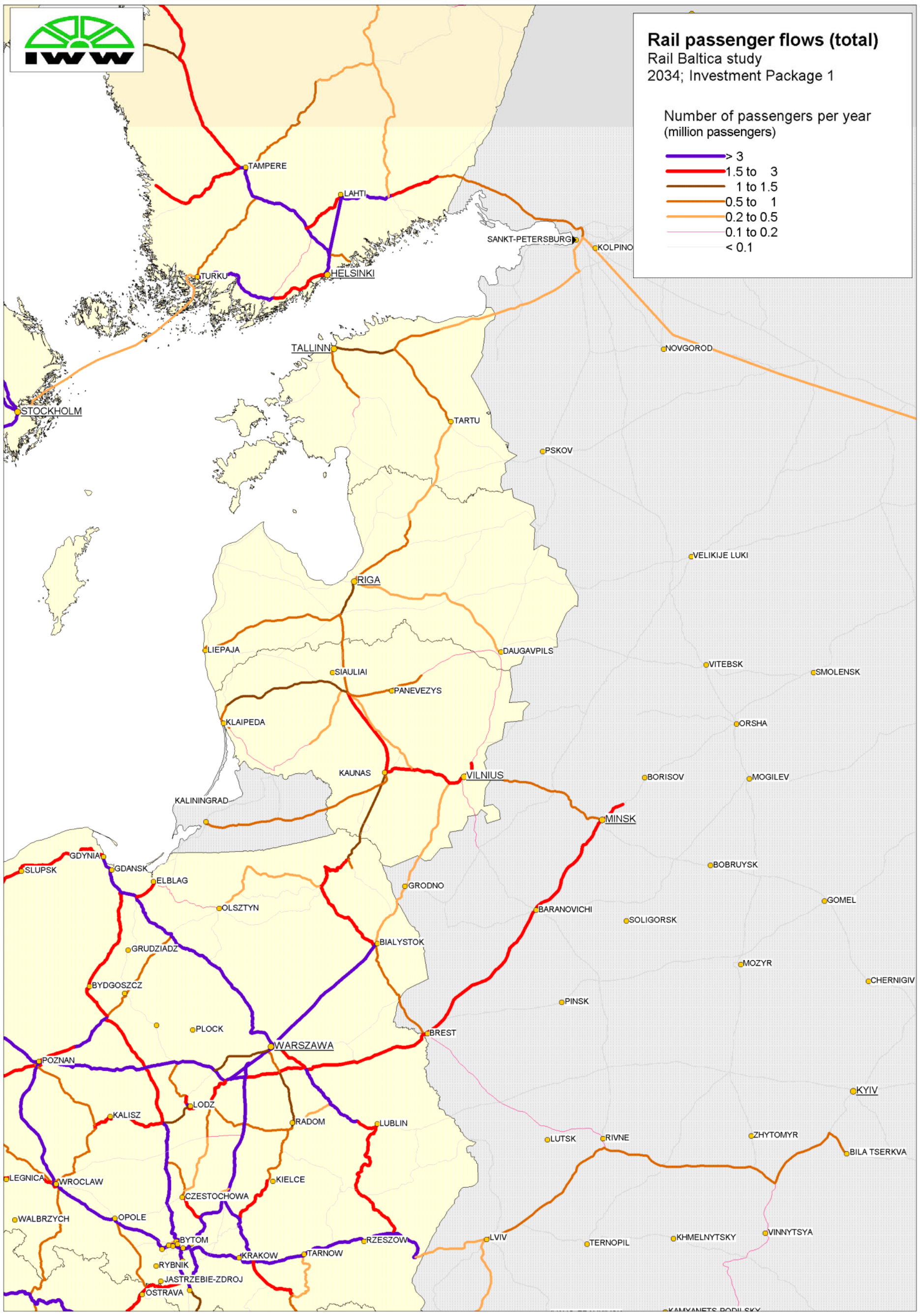
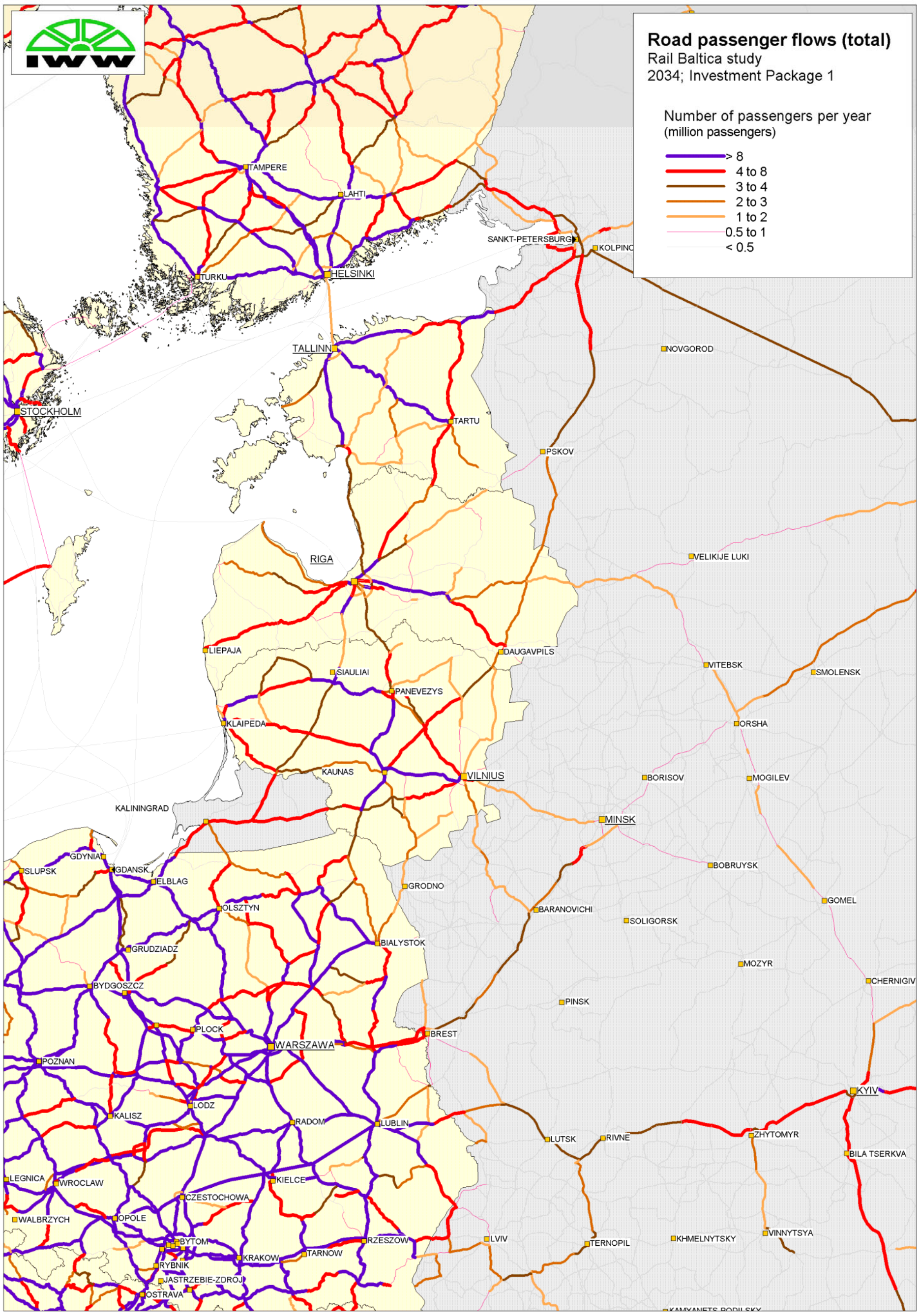


Figure 10.9 Road passenger flows, forecast year 2034, Investment package 1



10.3.1 Passenger time savings in investment package 1

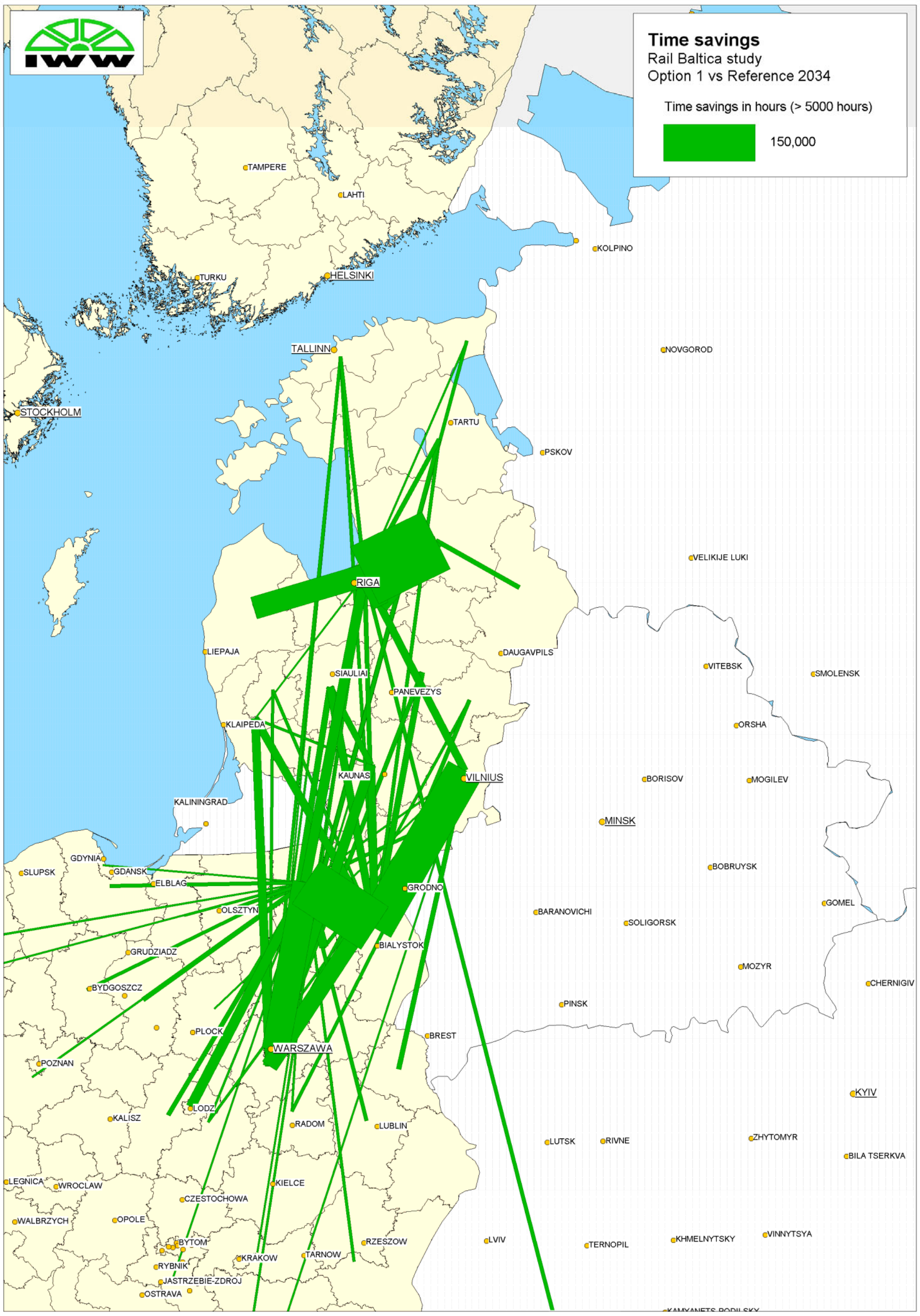
For each of the three investment packages the passenger time saving is relatively high. This is due to the fact that only two sub-sections of the Rail Baltica corridor, Warszawa – Bialystok and Tartu – Tallinn, are assumed being subject to infrastructure improvements in the reference scenario 2034. On the other part of the Rail Baltica corridor, i.e. on the section Bialystok – Tartu, the level-of-service assumed in the Reference scenario is largely represented by the poor situation of the base year.

Thus on several relations along Rail Baltica, the average speed of passenger trains is 50-60 kph in the reference scenario. Therefore the investment options along the Rail Baltica corridor have a large potential for reducing passenger travel times.

For investment package 1, the highest time saving for passenger transport occurs between the Polish regions Elcki and Bialostocko-Suwalski, Warszawa and Elcki, between the Latvian regions Riga and Vidzeme as well as Riga and Kurzeme, and between the international relation Alytaus and Bialostocko-Suwalski. In the Northern part of the Rail Baltica corridor the time savings are at a much lower level, since the assumed speed between Tartu and Tallinn is the same as in the Reference scenario.

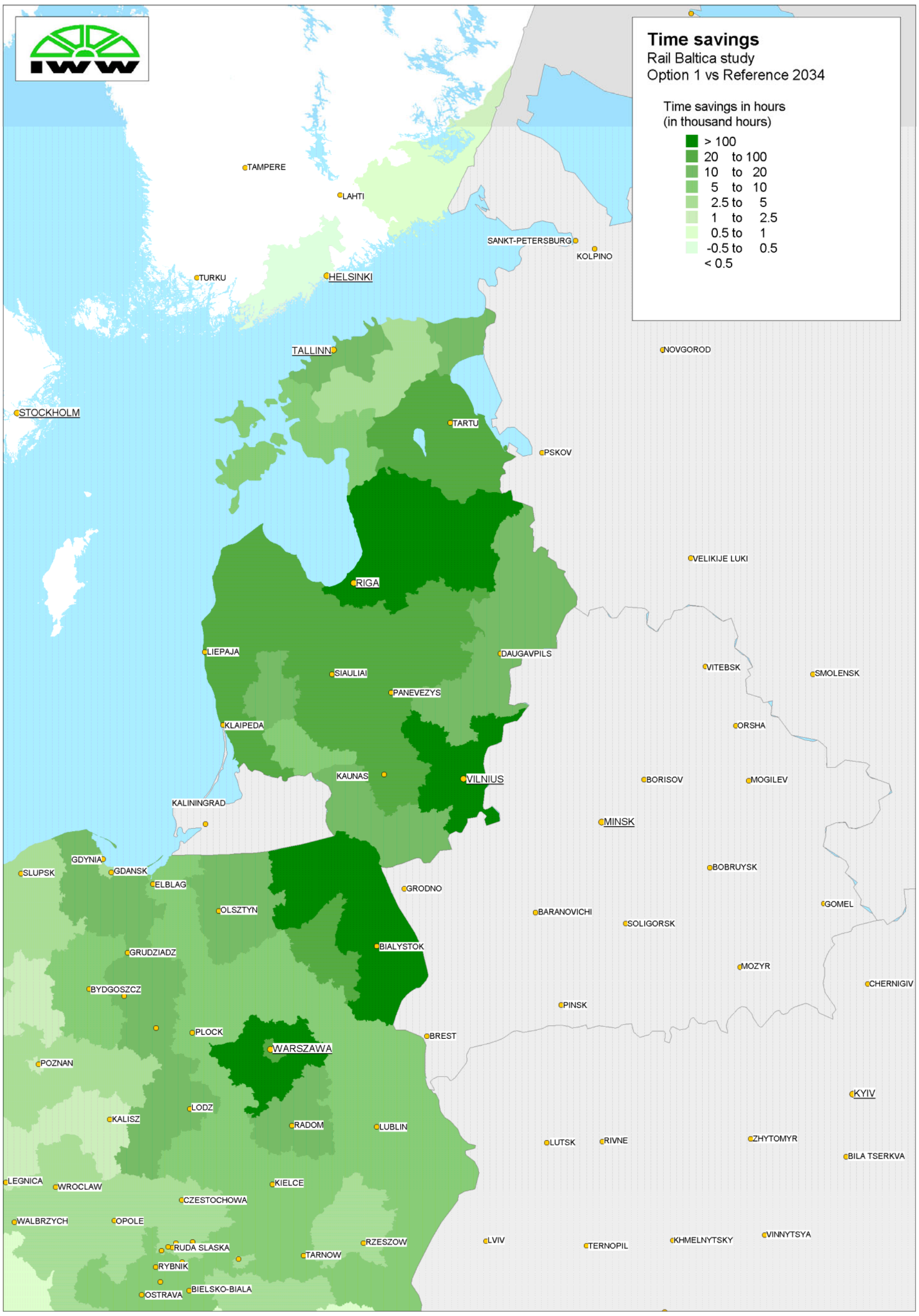
For instance, the passenger travel time saving per trip amounts to 69 minutes for a trip between Riga and Valmiera, 110 minutes between Vilnius and Riga and 173 minutes for the relation Bialystok – Vilnius. Those O/D relations, which – for investment package 1 – profit from time savings of at least 150,000 passenger-hours per year, are visualised in the following figure.

Figure 10.10 Passenger travel time savings at OD level, Investment package 1 vs. the Reference scenario, year 2034



As regards passenger travel time saving at the level of traffic zone – i.e. at the level of NUTS 3 regions – similar patterns can be observed like for time saving at the level of O/D relations. For investment package 1 the following figure illustrates the composition of passenger travel time saving at regional level. The highest amounts of time saving are obtained for the regions Warszawski, Elcki, Bialostocko-Suwalski, Alytaus, Riga and Vidzeme.

Figure 10.11 Passenger travel time savings at the level of the traffic cells, Investment package 1 vs. the Reference scenario, year 2034

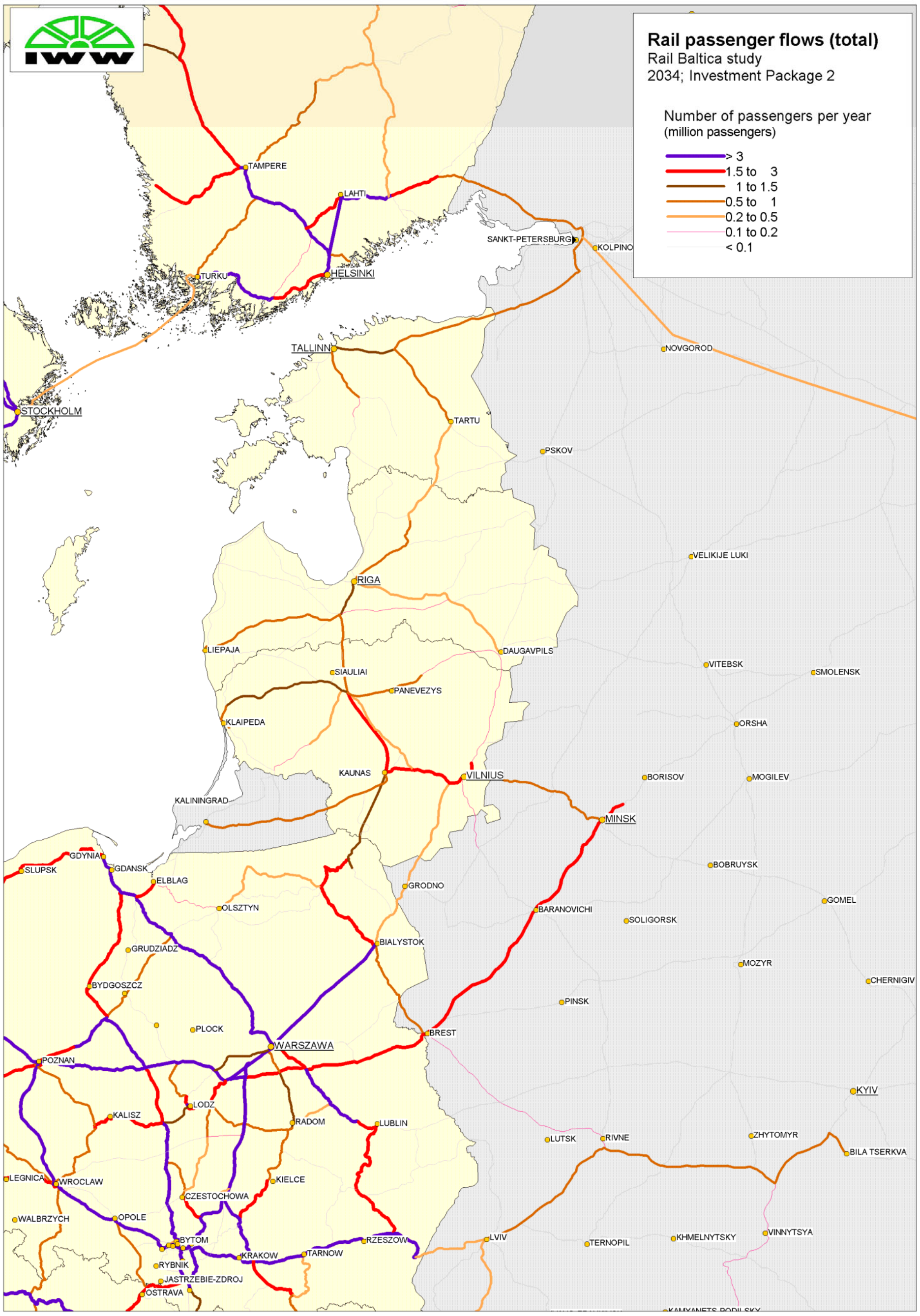


10.4 Future passenger transport demand - Investment Package 2

The investments of package 2 are expected to result in a further increase in demand in the southern part of the Rail Baltica corridor. On the new line between Kaunas and Radviliskis, the annual passenger transport volume is expected to amount to 1.6 million passengers per year.

In Figure 10.12 the rail passenger flows of investment package 2 for the forecast year 2034 are displayed. The road passenger flows of investment package 2 are similar to the road passenger flows of investment package 1, which are illustrated by Figure 10.9.

Figure 10.12 Rail passenger flows, forecast year 2034, Investment Package 2

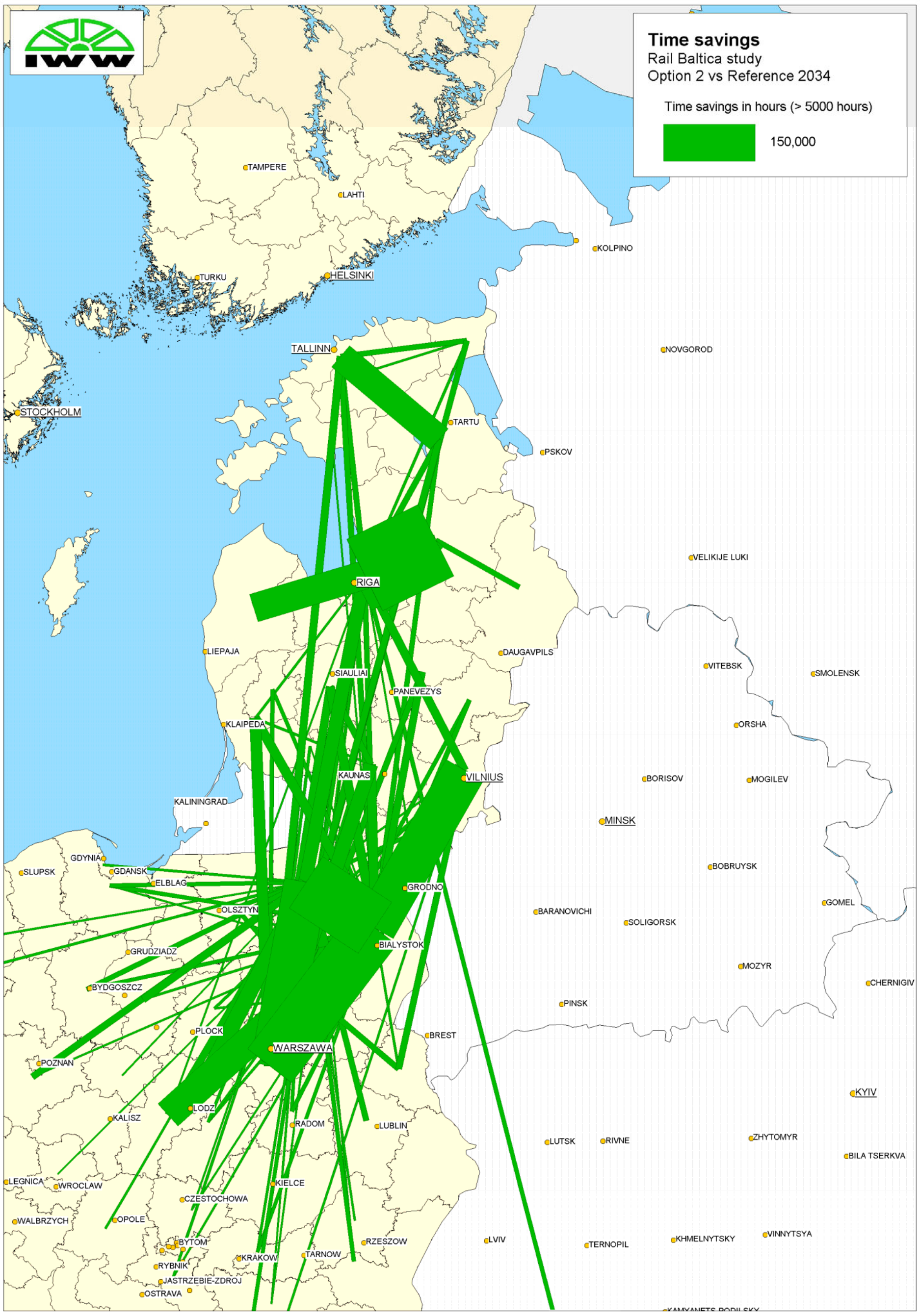


10.4.1 Passenger time savings in investment package 2

Since the design speeds on the individual sections are higher in investment package 2 than in investment package 1, the dimension of time saving on the level of individual O/D relations is above those of investment package 1. In investment package 2 the design speed is subject to improvement on the sections Warszawa – Bialystok and Tartu – Tallinn, too, which is reflected by further polygons in the north-eastern part of Poland and Estonia.

For instance, the time saving for a trip Riga – Valmiera is expected to amount to 84 minutes, for Bialystok – Vilnius to 200, for Riga – Vilnius to 125 minutes and for Tartu – Tallinn to 26 minutes. The passenger time saving for investment package 2 is provided by the following figure.

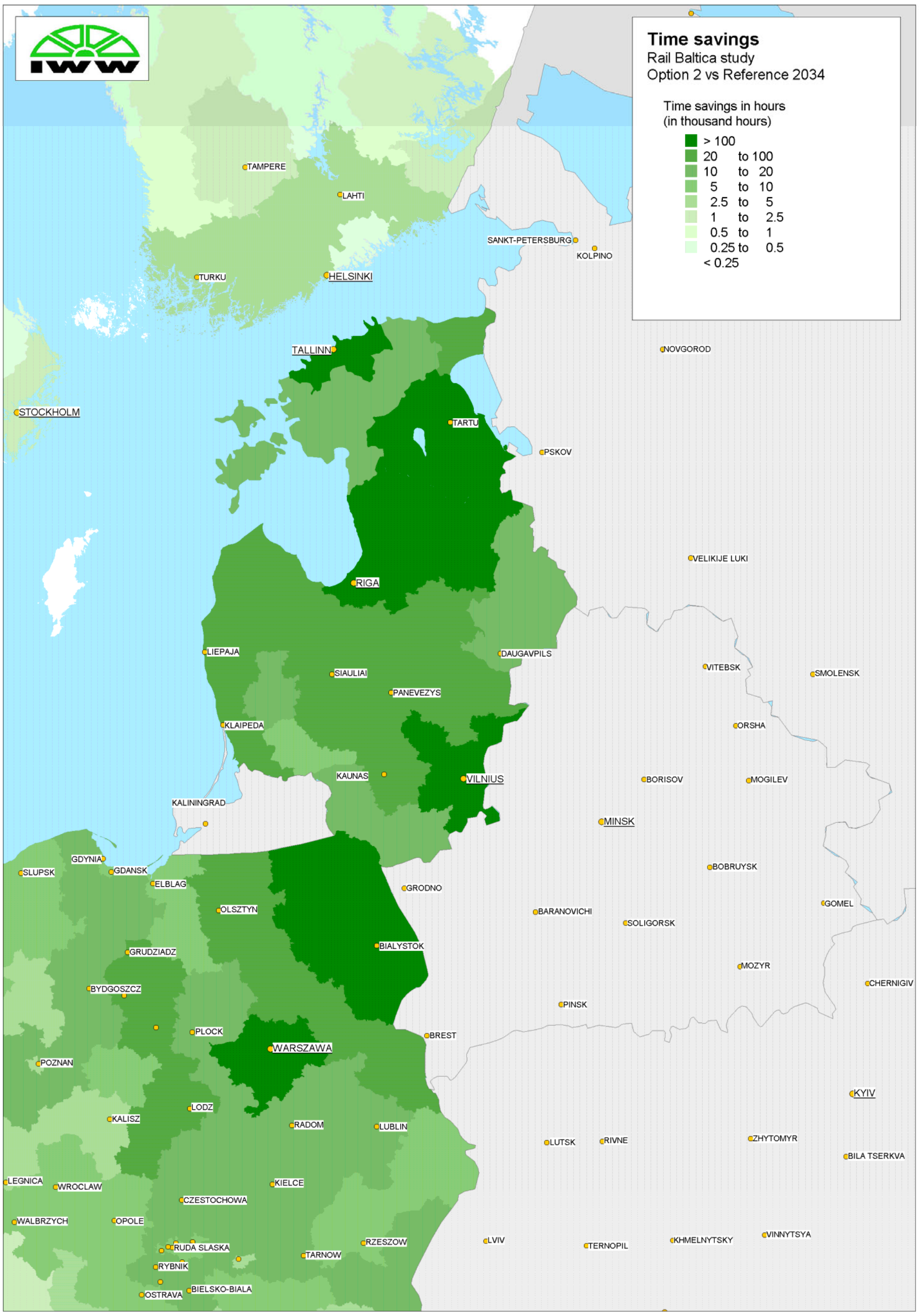
Figure 10.13 Passenger travel time savings at OD level, Investment package 2 vs. the Reference scenario, year 2034



The investment package 2 results in a higher level of passenger transport time saving than for investment package 1. Time savings of more than 100,000 passenger-hours per year are expected for the regions Miasto Warszawa, Warszawski, Elcki, Bialostocko-Suwalski, Alytaus, Riga, Vidzeme, Lõuna-Eesti and Põhja-Eesti.

Also the effect of time saving for Finnish regions becomes more evident in case of investment package 2.

Figure 10.14 Passenger travel time savings at the level of the traffic cells, Investment package 2 vs. the Reference scenario, year 2034



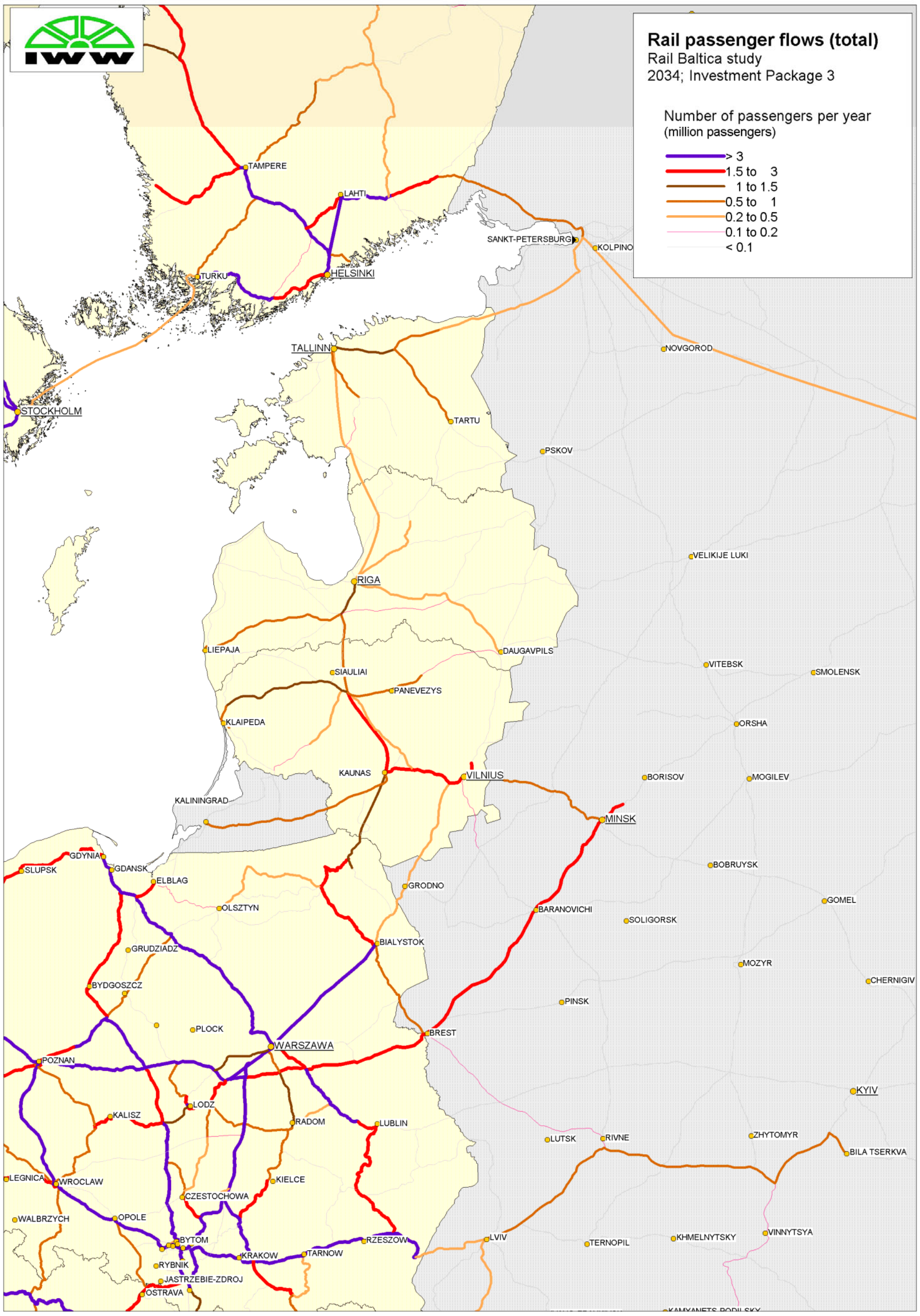
10.5 Future passenger transport demand - Investment Package 3

The forecasted passenger transport volumes on Rail Baltica for investment option 3 tend to be slightly lower than in investment package 2. This is due to the fact that the designed speed between the Polish/Lithuanian border and Kaunas is lower. Relatively modest rail passenger volumes are expected on the new rail link Riga – Pärnu – Tallinn. The forecasted passenger volumes on these sections amount to 0.3 to 0.5 million passengers per year.

The alignment of the Rail Baltica along the Baltic coast allows offering specific seasonal services for tourism and leisure travellers on certain sections between Riga and Pärnu. The demand potential for such seasonal regional services has not been considered by the modelling approach.

Figure 10.15 illustrates the rail passenger flows of investment package 3 for the forecast year 2034. The road passenger flows of investment package 3 are also similar to the road passenger flows of investment package 1, which are displayed in Figure 10.9.

Figure 10.15   Rail passenger flows, forecast year 2034, Investment package 3

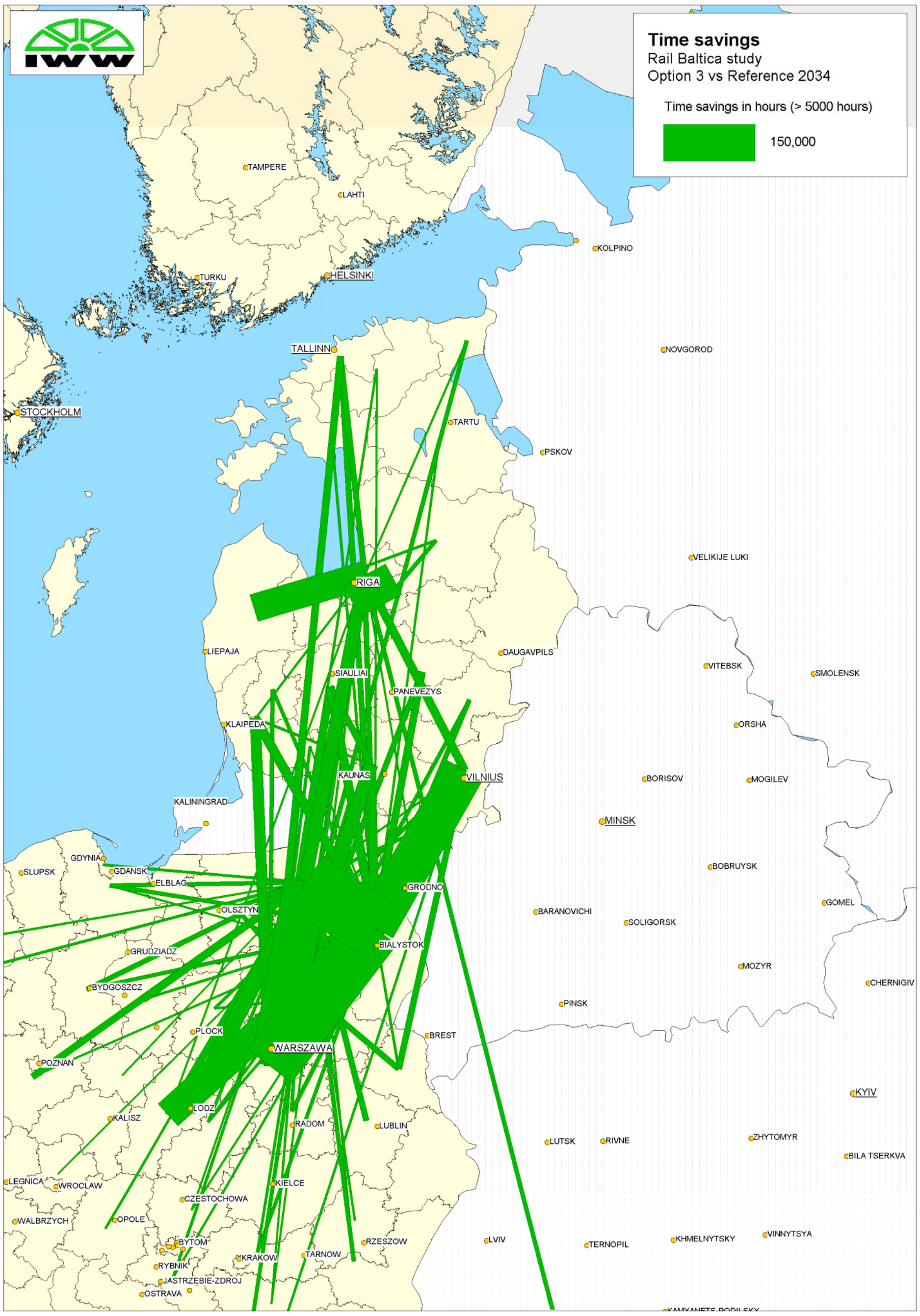


10.5.1 Passenger time savings in investment package 3

The composition of time savings for investment package 3 (see figure below) results in the southern and central part of the Rail Baltica corridor to a similar picture like for investment package 2. However, in Estonia, the amount of passenger time saving is lower due to the different alignment of the Rail Baltica corridor in this investment package.

While the relation Riga – Tallinn can be expected to gain from a times saving of 210 minutes, whereas the time saving on Estonia's most important domestic passenger transport relation Tartu – Tallinn yields zero.

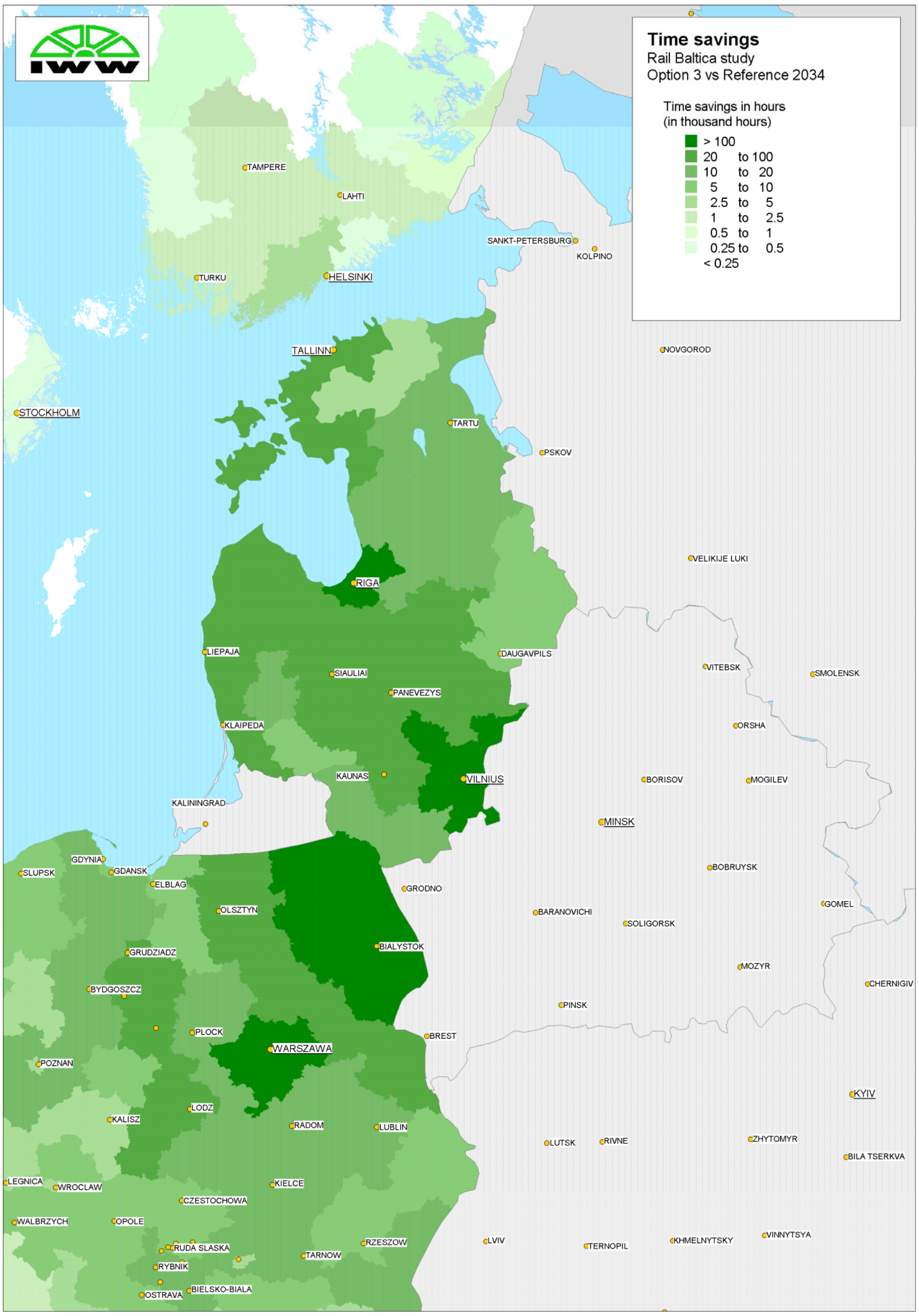
Figure 10.16 Passenger travel time savings at OD level, Investment package 2 vs. the Reference scenario, year 2034



The following figure illustrates the regional performance with regard to investment package 3. Again, as concerns Polish and Lithuanian regions, the composition of travel time saving is similar to that of investment package 2.

However, regarding Latvia and Estonia, especially the travel time savings in Vidzeme and Lõuna-Eesti are lower, and in Lääne-Eesti higher than in case of investment package 2.

Figure 10.17 Passenger travel time savings at the level of the traffic cells, Investment package 3 vs. the Reference scenario, year 2034



10.6 Summary of the passenger transport demand forecast

The passenger transport demand forecasts for the year 2034 reflect a solid growth in mobility, which is driven by the assumed positive economic development in the Baltic countries and Poland, implying an increase in household income and motorisation. The forecasted rise in passenger mobility induced by the positive economic development is only slightly dampened by the negative demographic development in Poland and the Baltic States.

The forecasted rail passenger transport volumes on the Rail Baltica corridor are expected to reach a significant level on some sections, such as Warszawa – Bialystok – Kaunas – Siauliai or Tartu – Paide – Tallinn, and a relatively low level on other sections, such as the cross-border sections between Lithuania and Latvia or between Latvia and Estonia.

When interpreting the forecasted passenger volumes along the Rail Baltica corridor, one has to be aware of following two patterns:

1. The modelling approach for rail embraces inter-regional passenger flows only. Thus, rail passenger demand within a NUTS 3 region (intra-regional flows), which is mainly operated by local trains, is not considered by the modelling approach.
2. It has to be taken into account that the modal shift effects are limited. This is due to the pattern that in general the infrastructure assumptions in the 2034 reference scenario are clearly in favour of the road mode. This implies that compared to the situation in the base year 2004, there is a general decrease in the rail mode's competitiveness against the modes private passenger car and coach, which can only partly be compensated by the infrastructure investment packages along the Rail Baltica corridor. Long-distance coach services are well-established within Rail Baltica's catchment area, particularly in the Baltic States. The high numbers of connections offered by coach services on several relations such as Kaunas – Vilnius or Tartu – Tallinn are in a dimension, which cannot be provided by rail services. Hence the mode long-distance coach is a strong competitor to the rail mode. The expected increase in motorisation will push significantly the mobility by private passenger cars, and – especially for longer O/D relations – the air mode is a prominent competitor to the rail mode along the corridor.

11 Impacts on accessibility

In the present section the impacts of the investment packages with regard to regional accessibility for passenger transport are addressed.

There is a wide range of indicators which can be applied for measuring accessibility. Since the infrastructure options under examination refer to the rail mode, most of the chosen accessibility indicators refer to the rail mode. Three indicators have been selected for analysing the impacts on accessibility for passenger transport:

- number of inhabitants living along the Rail Baltica corridor
- average rail (road) travel time to the nearest three “Mega” cities
- and daily accessible population by rail transport

In the following sections the applied accessibility indicators are explained and the results are shown.

The geographical scope of the accessibility analyses are the EU member states, the accession countries Romania and Bulgaria as well as Switzerland and Norway.

11.1 Number of inhabitants living along the Rail Baltica corridor

The first accessibility indicator measures the number of inhabitants living along a 50-kilometres-band around the Rail Baltica corridor, under the application of population data at the level of grid cells. Thus this indicator measures only the distance of inhabitants to the infrastructure, without further consideration of passengers’ travel disutilities and without considering in which cities access will be provided to the Rail Baltica corridor by railway stations. Since the geographical alignments of investment packages 1 and 2 are identical, there is no difference in performance of these two options. However, investment package 3 involves a different routing, which allows a comparison between option 1 and 2 on the one hand (see Figure 11.1), and option 3 on the other).

Figure 11.1 Number of inhabitants along a 50-km-band along Rail Baltica - Investment Packages 1 and 2

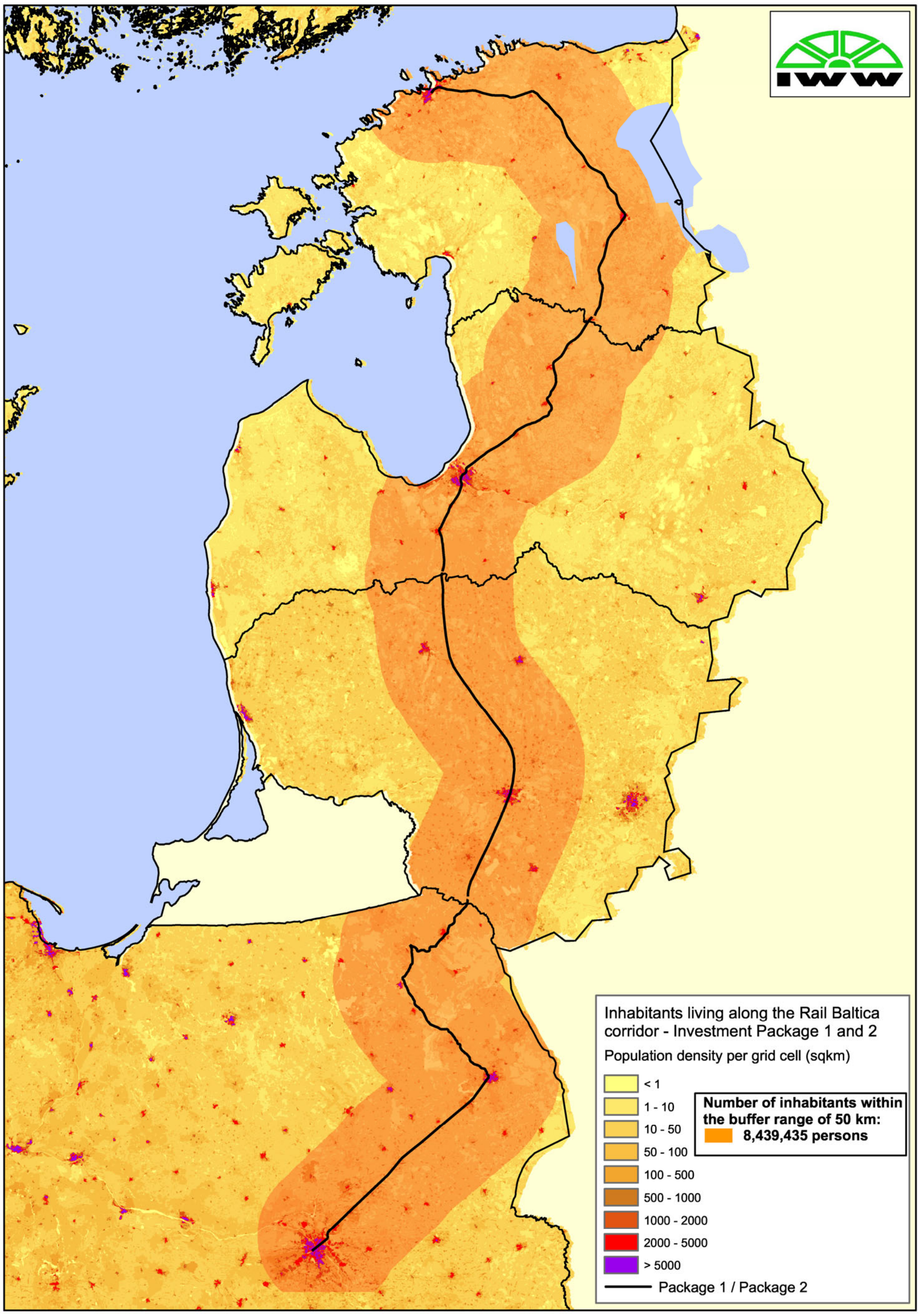
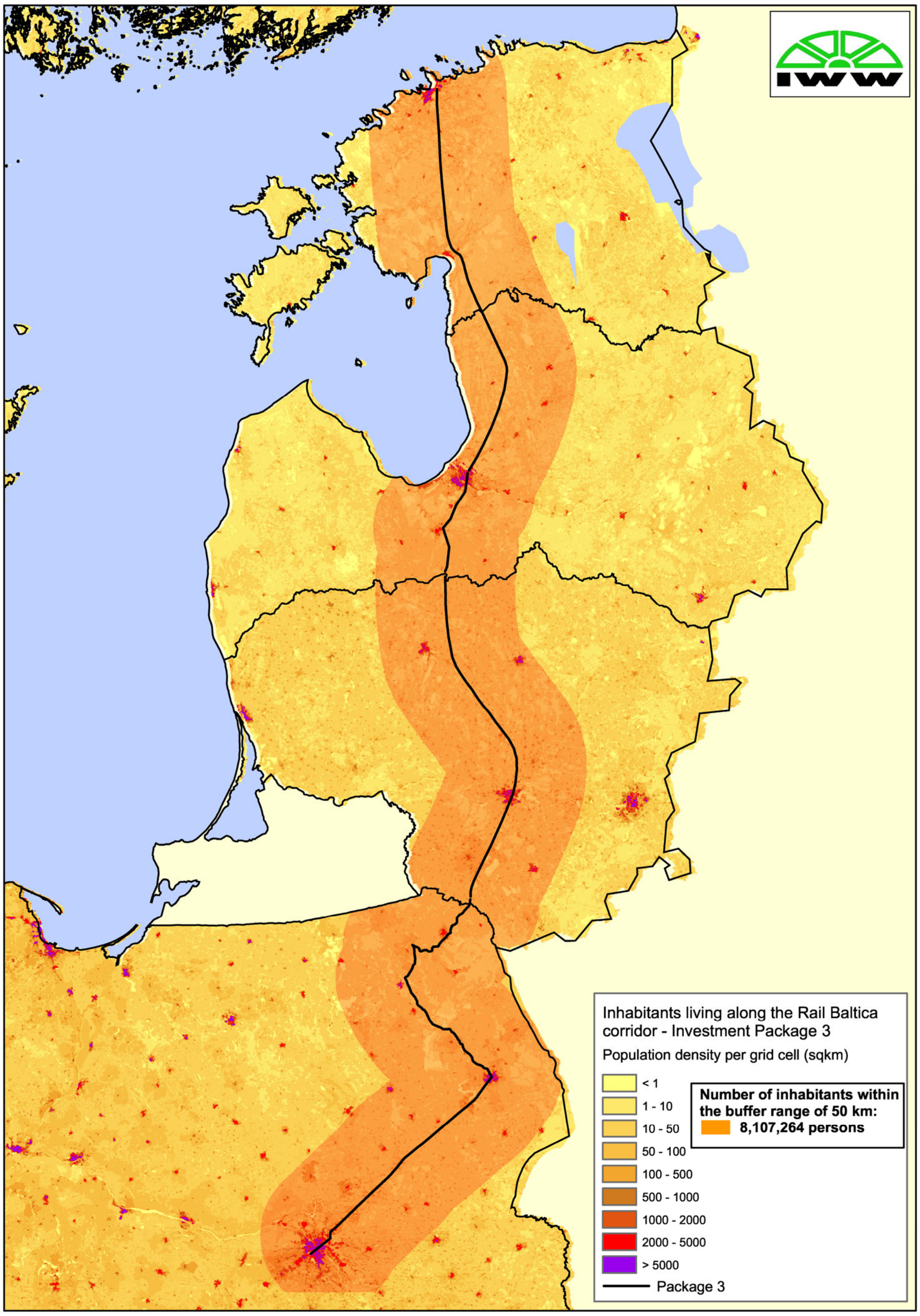


Figure 11.2 Number of inhabitants along a 50-km-band along Rail Baltica - Investment Package 3



The maps above illustrate the population density at the level of grid cells, which have a size of one square, and the 50-km distance band around the alignment of the Rail Baltica corridor. The calculations reveal 8.44 million passengers living within the 50-km band for investment packages 1 and 2, and 8.11 million inhabitants for package 3. This difference is caused by the fact that the routing of the packages 1 and 2 through Estonia follows the location of larger cities such as Valga, Paide, and particularly the country's second largest city

Tartu, whereas the alignment via Pärnu leads through less densely populated areas.

11.2 Average travel time to the nearest three “MEGA” cities

11.2.1 Indicator

This indicator is based on European MEGA regions, as defined within the ESPON project[22]. MEGA regions represent “Metropolitan European Growth Areas” and distinguish themselves by highest scores in the field of population, transport, manufacturing, knowledge and decision-making. Each MEGA region has been assigned a core, which are those cities the accessibility indicator is applied for. The MEGAs in the direct scope of the Rail Baltica are the capitals of the four countries Warszawa, Vilnius, Riga and Tallinn.

The indicator measures the average time needed from a region to reach the nearest three MEGAs.

11.2.2 Results

The accessibility indicator for road (see Figure 11.3), which relates to the Reference scenario 2034, shows a relative good accessibility of the MEGAs by most of the regions in the Poland and the Baltic States. However, the situation for rail in the Reference scenario 2034 looks different (see Figure 11.4): Without any investments on Rail Baltica the average rail travel time to reach the nearest three MEGAs amounts for each Baltic region to more than 240 minutes, which emphasises the low quality of service provided for passenger rail services in these countries.

[22] ESPON 1.1.1: Potentials for polycentric development in Europe, Nordregio, 2005.

Figure 11.3 Accessibility to the nearest three MEGAs by road, 2034 – Reference scenario

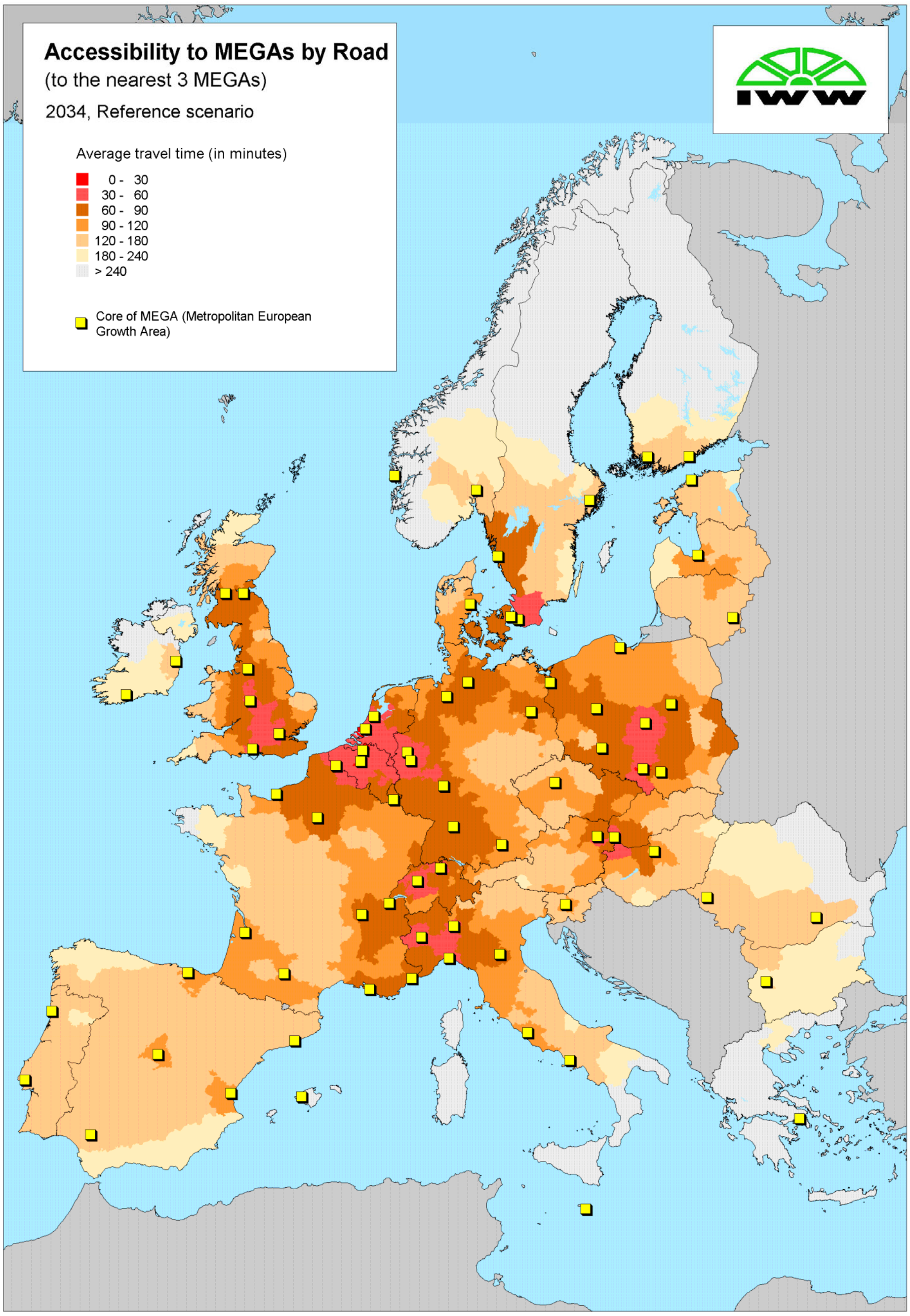
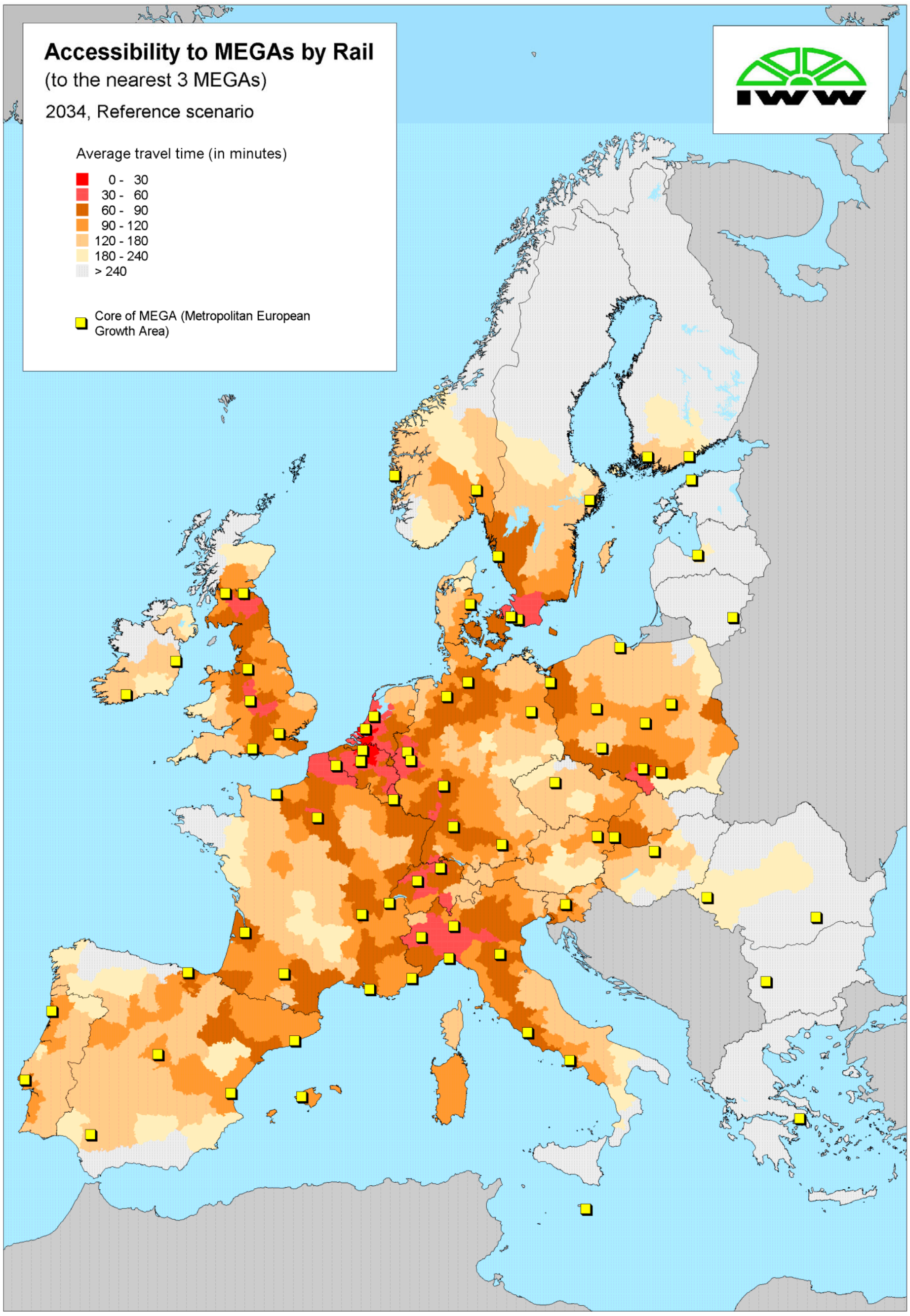


Figure 11.4 Accessibility to the nearest three MEGAs by rail, 2034 – Reference scenario



The investment options along the Rail Baltica corridor have positive impacts on the accessibility of the three nearest MEGAs by rail: The performance of regional accessibility for each of the three options is displayed by Figure 11.5 (investment package 1), Figure 11.6 (investment package 2) and Figure 11.7 (investment package 3). Especially Latvian regions, with its central position along the Rail Baltica corridor, highlight with considerable gains by rail accessibility to the three closest MEGAs. When interpreting these changes however, one has to consider that – even with a realisation of the investment options –

the market share for rail will remain at a comparable low level. Thus a relatively small share of the population only will benefit from the investments.

Figure 11.5 Accessibility to the nearest three MEGAs by Rail, 2034 - Investment Package 1

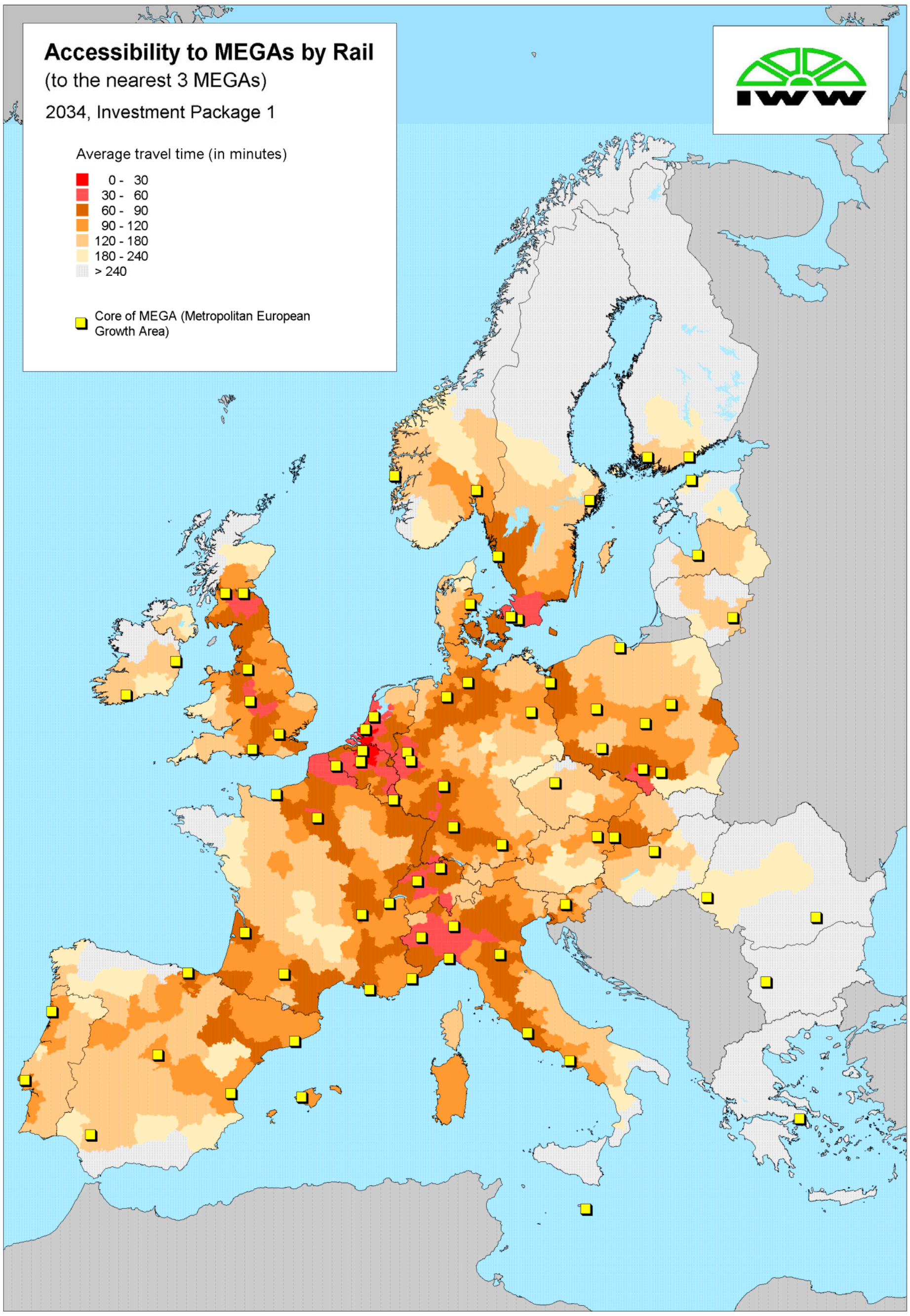


Figure 11.6 Accessibility to the nearest three MEGAs by Rail, 2034 - Investment Package 2

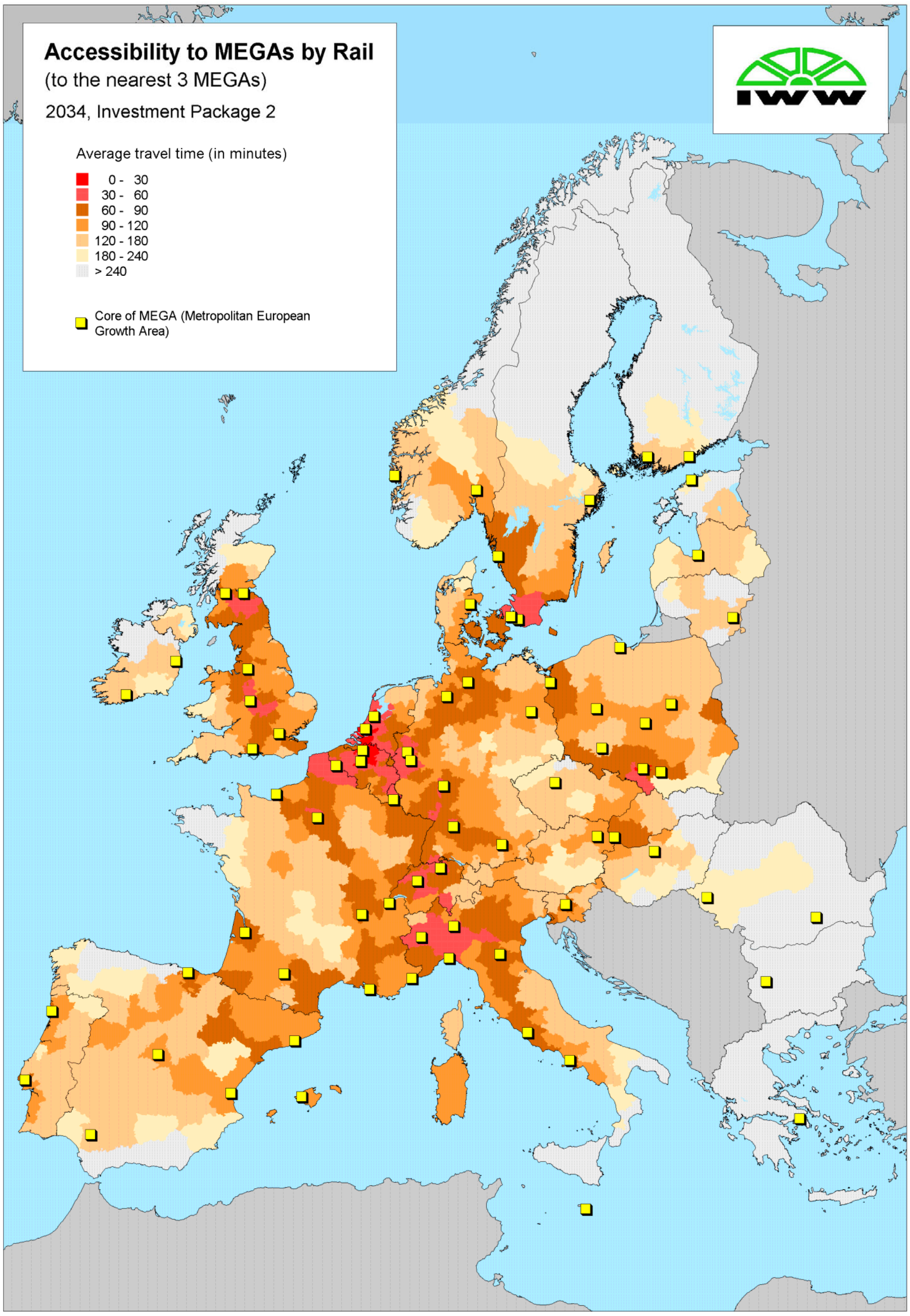
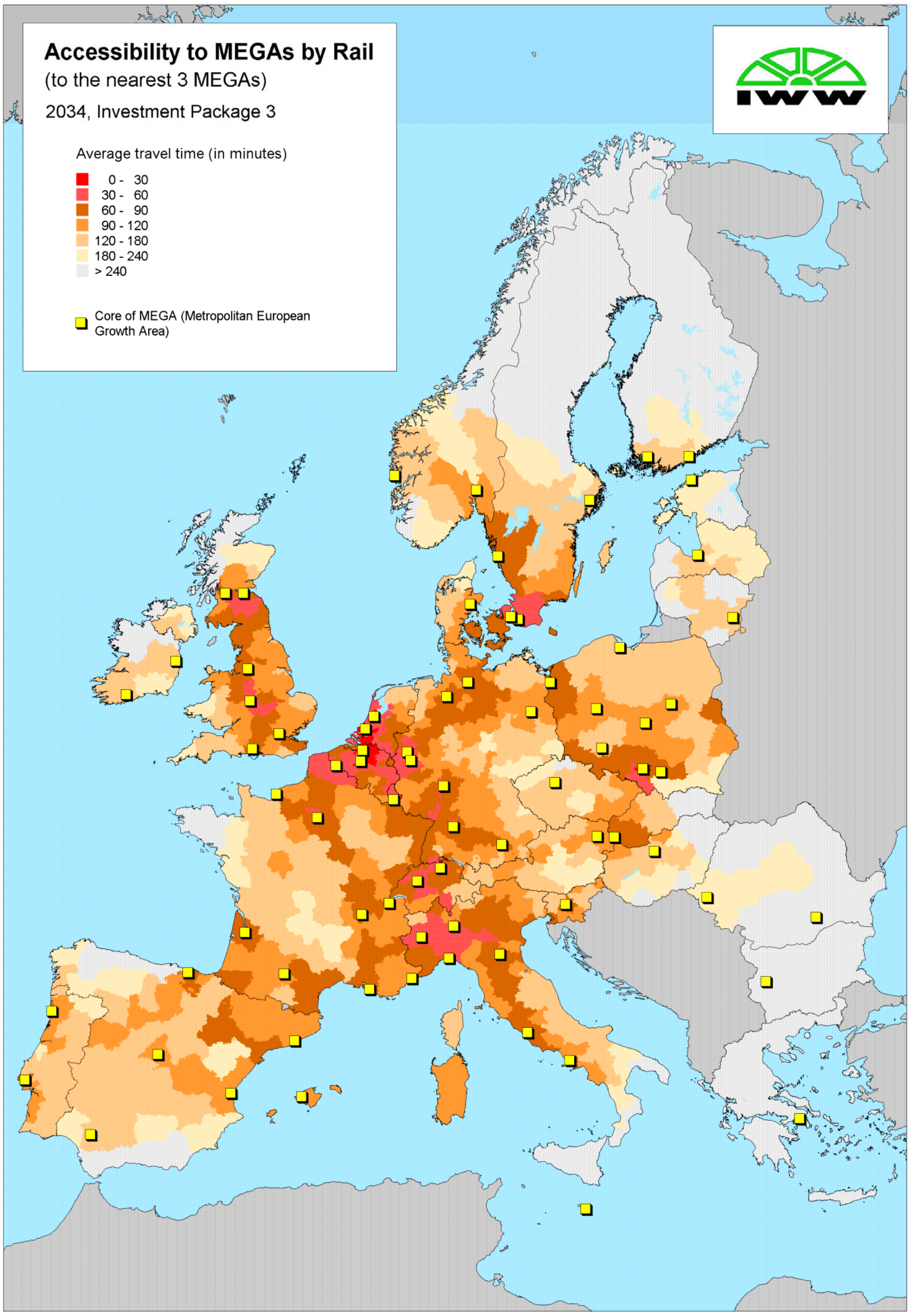


Figure 11.7 Accessibility to the nearest three MEGAs by Rail, 2034 - Investment Package 3



The following figures illustrate the relative changes in accessibility, Reference scenario 2034 versus the investment packages: Figure 11.8 relates to investment package 1, Figure 11.9 to investment package 2, and Figure 11.10 to investment package 3. As regards the investment package 1 especially the region of Riga highlights with considerable improvements, in case of option 2 and option 3 the region of Riga and Põhja-Eesti (Tallinn).

Figure 11.8 Accessibility to the nearest three MEGAs by Rail, 2034 - Investment Package 1 vs. Reference scenario

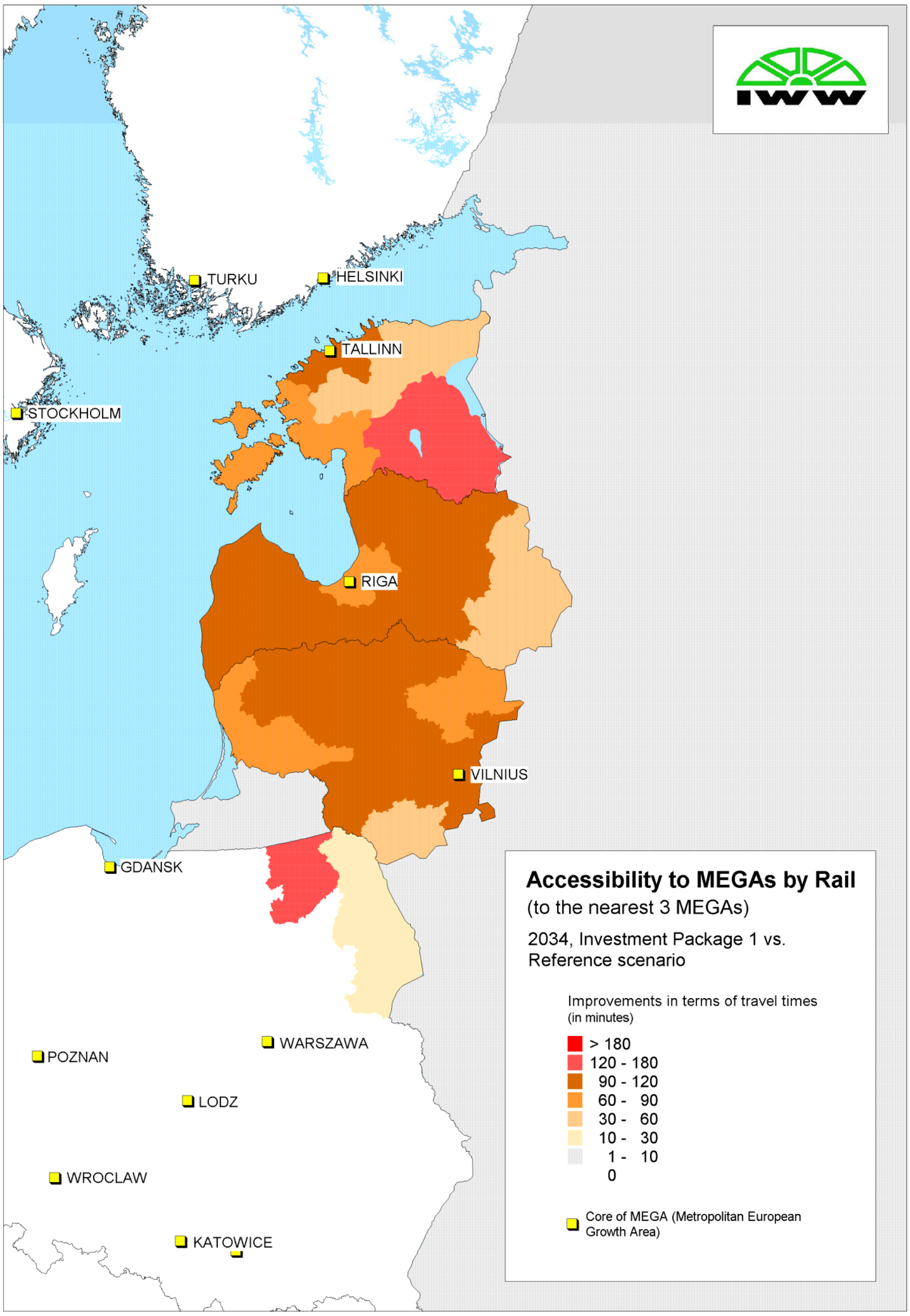


Figure 11.9 Accessibility to the nearest three MEGAs by Rail, 2034 - Investment Package 2 vs. Reference scenario

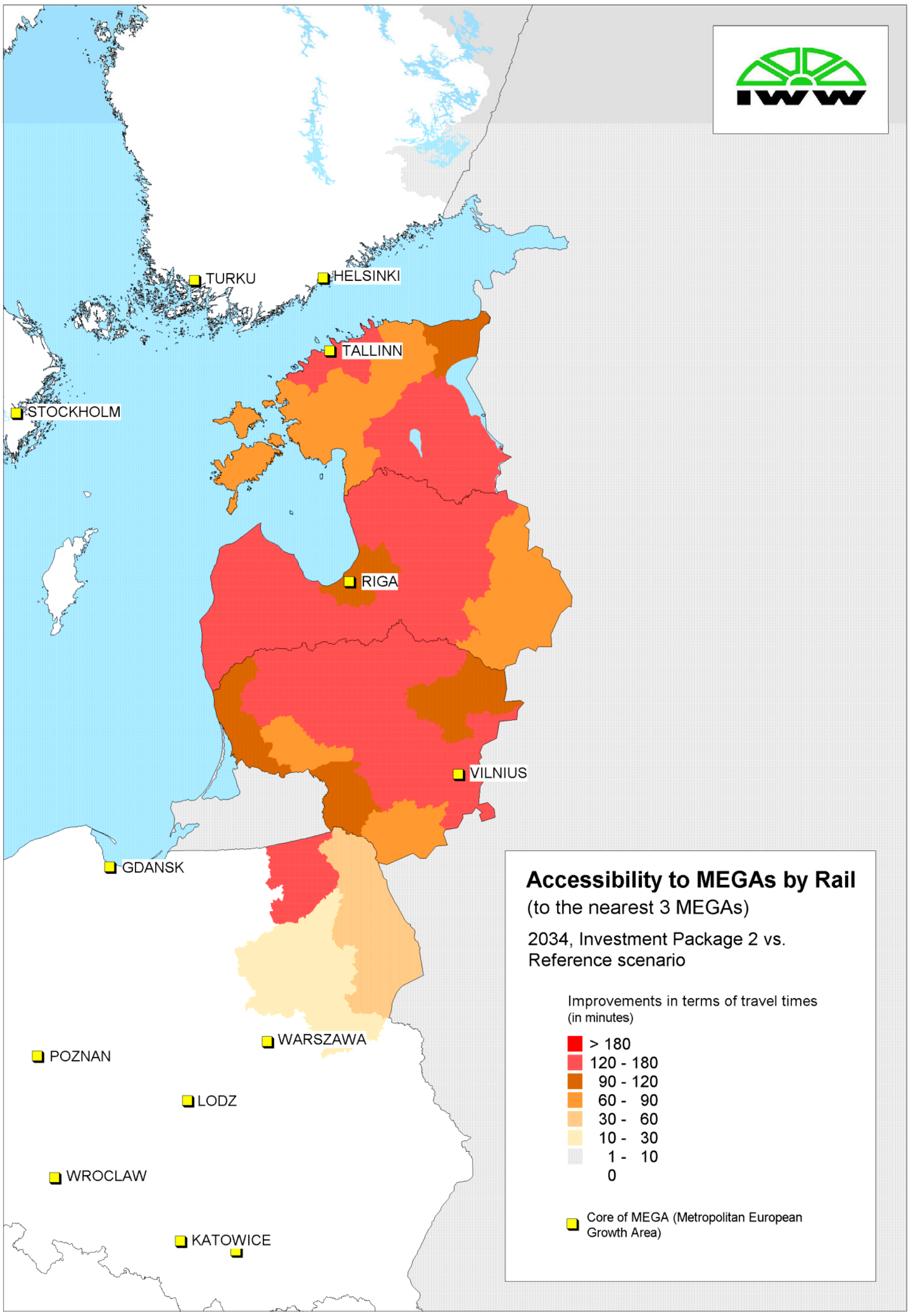
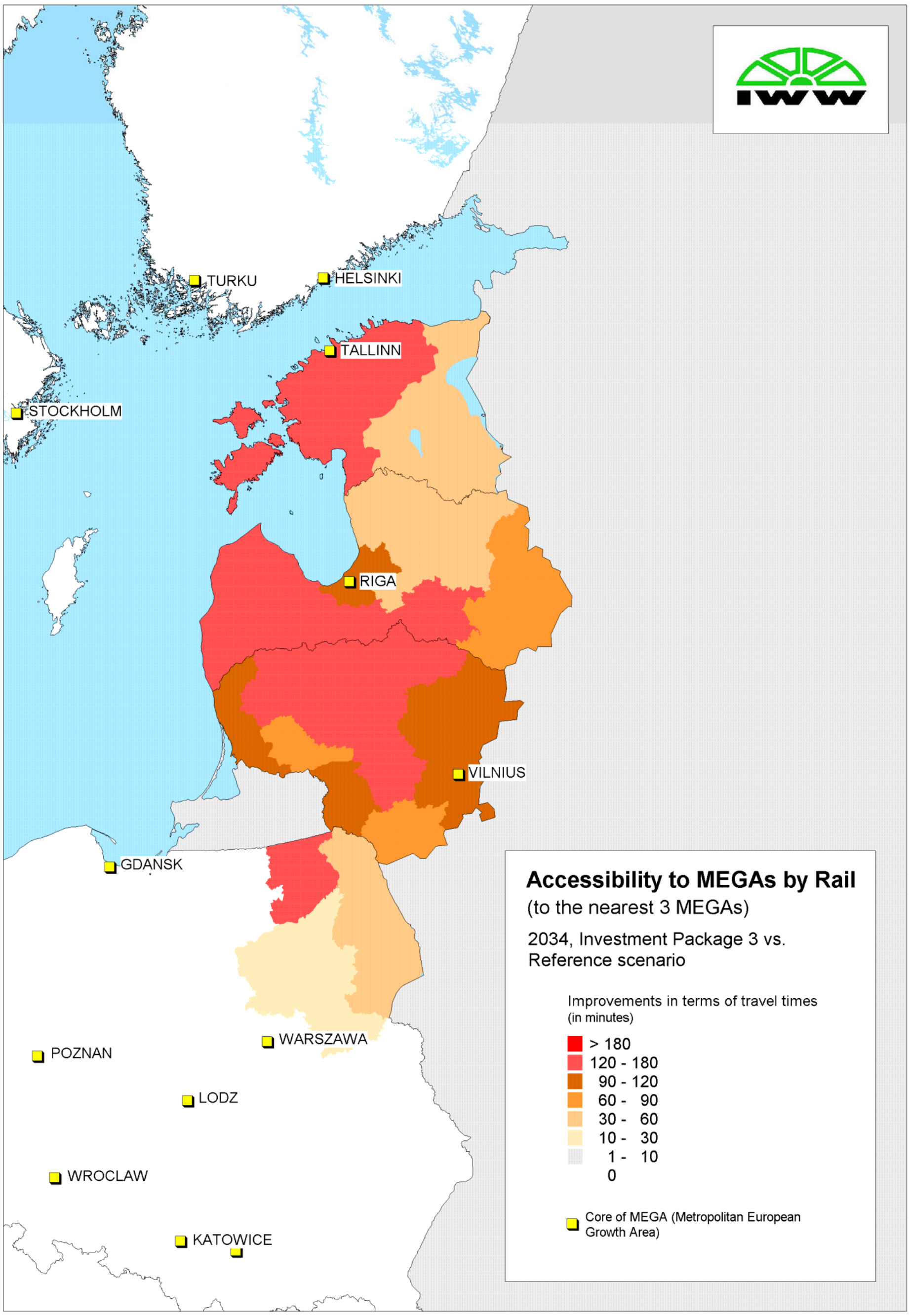


Figure 11.10 Accessibility to the nearest three MEGAs by Rail, 2034 - Investment Package 3 vs. Reference scenario



11.3 Daily accessibility by rail transport

11.3.1 Indicator

The third indicator applied refers to the number of inhabitants, which can be accessed from a region within a day's trip by the rail mode. A region is defined as being accessible from another region within a day's trip, if the travel time does not exceed 180 minutes. For the performance of this indicator, also the population densities of the surrounding regions are important determinants.

For this indicator, the calculation of accessibility was performed at the level of grid cells (10x10km), taking into account estimated travel times and the number of inhabitants at the level of grid cells.

11.3.2 Results

The results for the Reference scenario 2034 show a relatively poor performance with regard to this indicator, particularly in the Baltic States and the north-eastern part of Poland (Figure 11.10). This pattern is not only due to a comparatively low service level provided by passenger rail transport, but especially also due to the fact that the regions are sparsely populated and that for the calculation of the indicator the accessible population in the neighbouring Russian and Belarus regions are not taken into account.

As to be expected, the assumptions with regard to the infrastructure options on the Rail Baltica corridor result in considerable improvements, as documented by the maps shown in Figure 11.12 (investment package 1), Figure 11.13 (investment package 2), and Figure 11.14 (investment package 3).

Investment package 1 results in a considerable improvement for the cities Kaunas and Siauliai, whereas for investment package 2 additionally Bialystok, Jelgava and Valmiera and Tartu highlight with improvements with regard to this accessibility criterion. As concerns investment package 3, the performance in the Polish and the Lithuanian grids is similar to the performance for investment package 2. However, differences can be observed in Latvia and Estonia, where a moderate improvement can be recognised in the Western part of the country.

Figure 11.11 Daily Accessibility by Rail, 2034 – Reference scenario

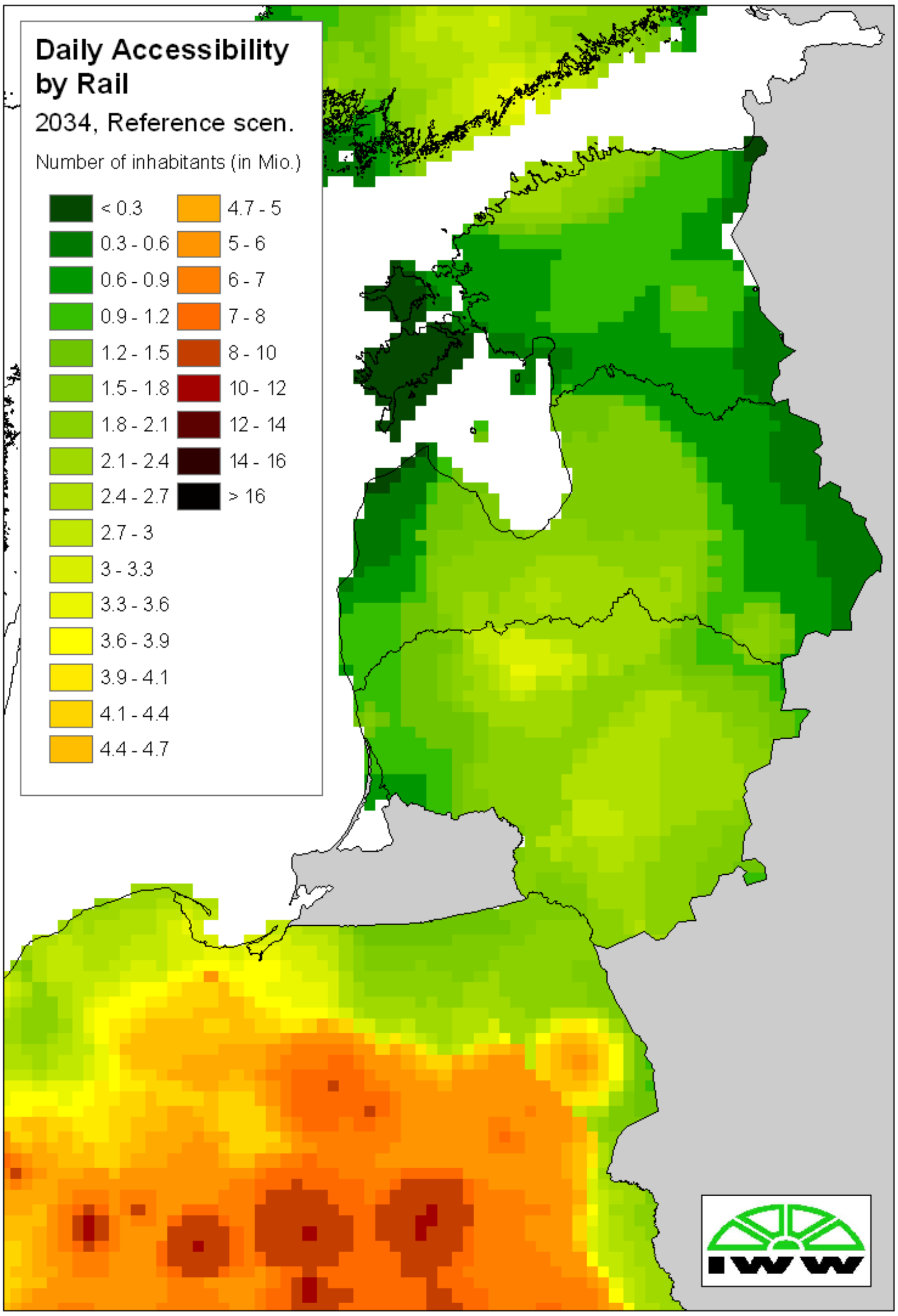


Figure 11.12 Daily Accessibility by Rail, 2034 - Investment Package 1

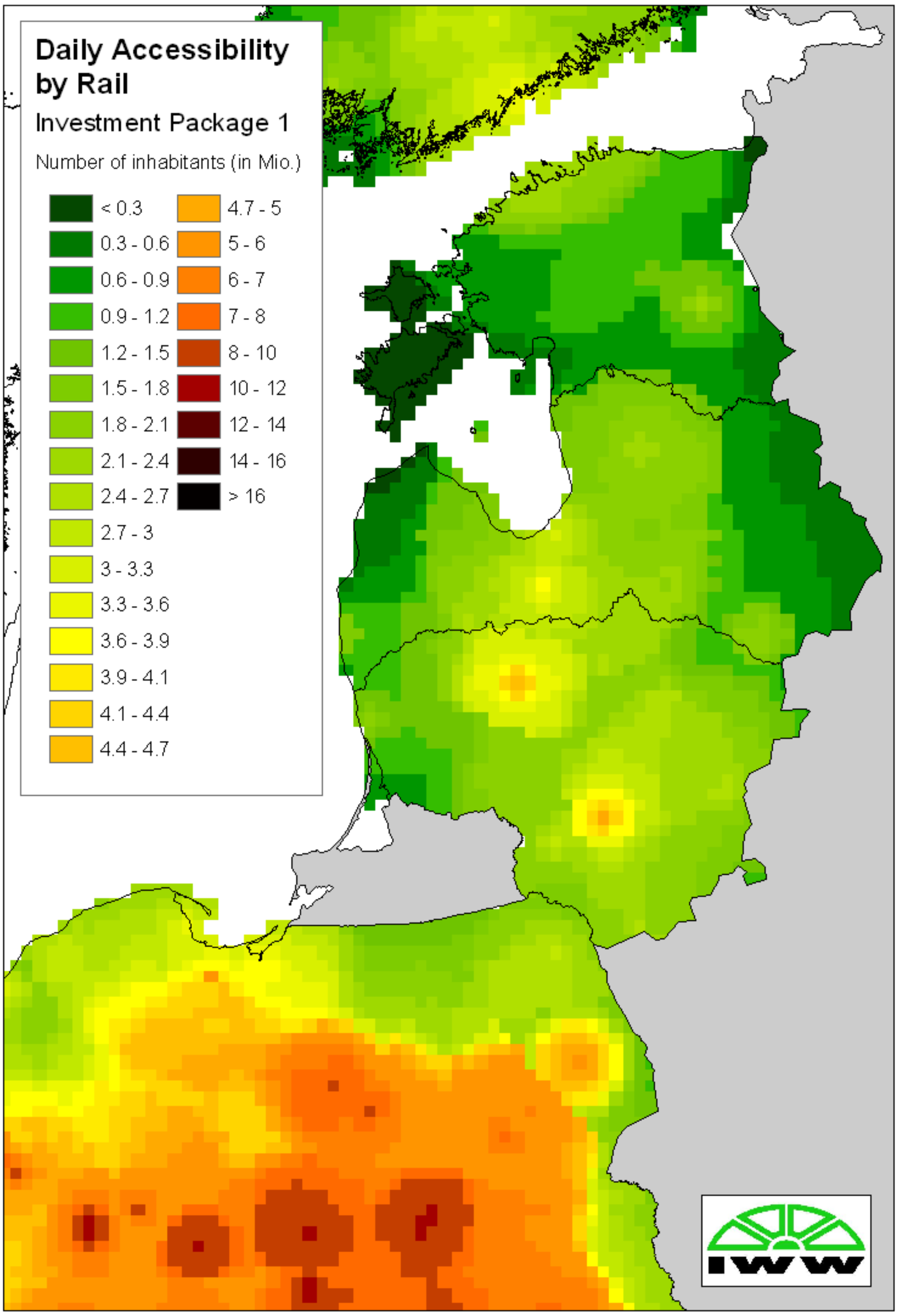


Figure 11.13 Daily Accessibility by Rail, 2034 - Investment Package 2

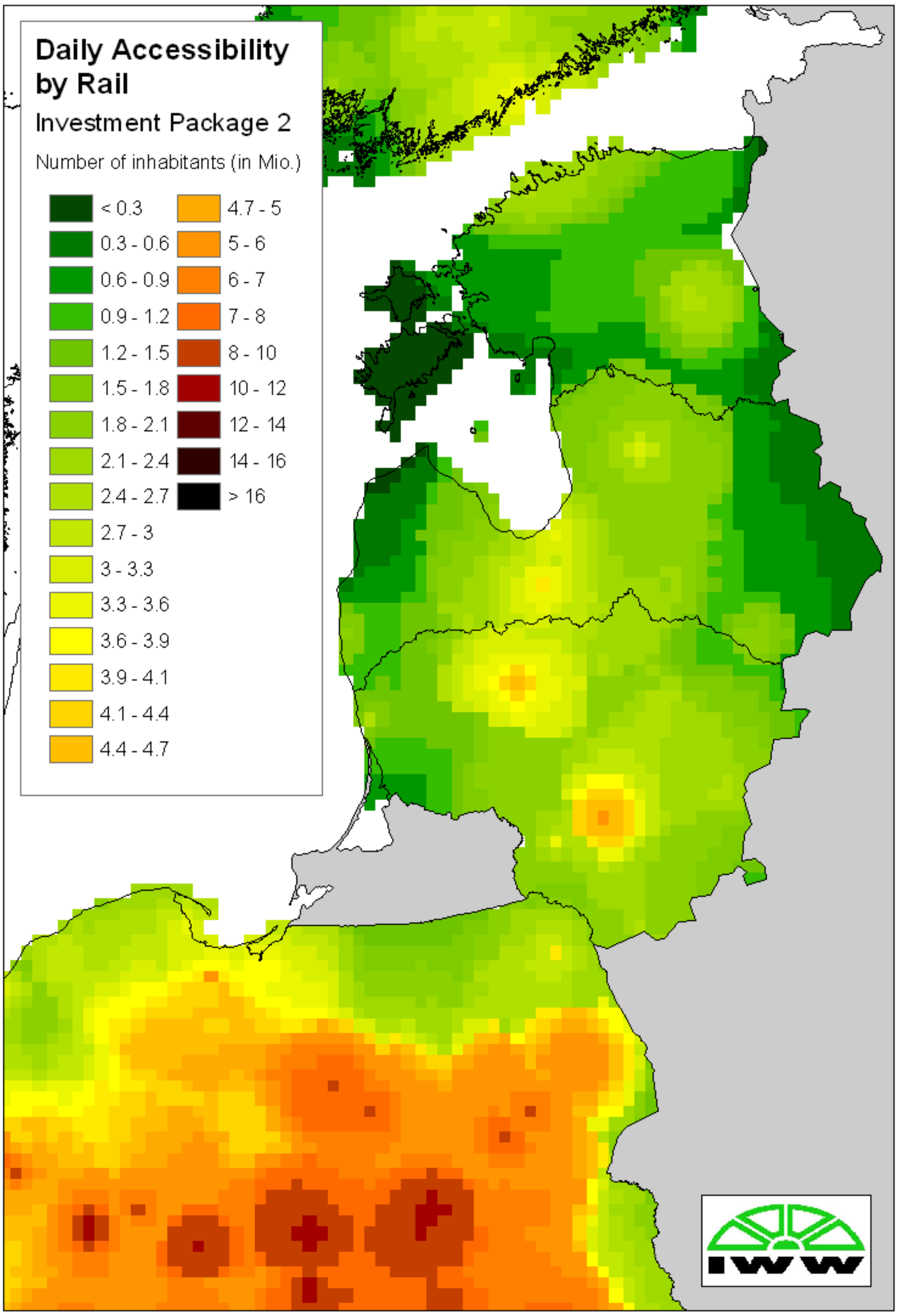
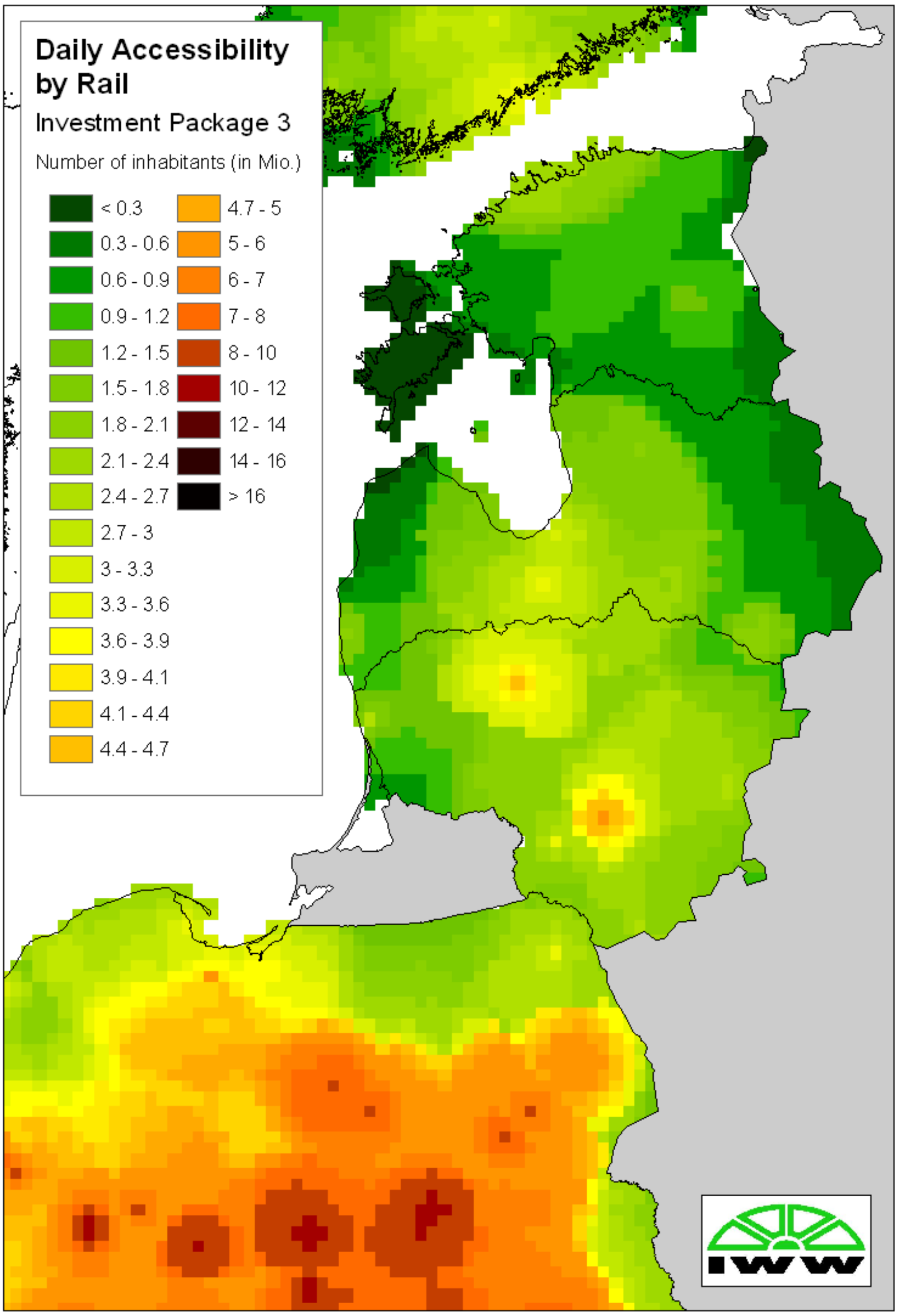


Figure 11.14 Daily Accessibility by Rail, 2034 - Investment Package 3



11.4 Summary

The analyses with regard to the three accessibility indicators for passenger transport have revealed investment package 2 as the most favourable option. It is rather obvious that the performance with regard to investment package 2 is superior to that of investment package 1, since the design speed in package 2 is equal to or above the design speed in package 1. Infrastructure package 3 particularly lacks from the fact that it follows an alignment, which does not represent the gravity centres of the population in Latvia and – particularly – Estonia.

12 Freight traffic

The purpose of this chapter is to present freight traffic volumes in the reference scenario, i.e. without improvements of the Rail Baltica line and in the three investment package scenarios. Firstly, the current freight traffic volumes are presented and, secondly, the future freight traffic volumes are presented. Finally, the freight transport demand in the three investment packages is presented.

12.1 Current freight transport demand

Background

One of the objectives of the study is to identify the potential for Rail Baltica. Besides the general trends for the project countries due to their speedy economic growth, the potential is assumed to include also the modal shift. More specifically, the objective is to identify the potential for shifting from road to rail rather than from sea to rail, at least when sea transport takes place through the project countries' own ports. The latter situation is not really a goal in any of the Baltic States, since maintaining reasonable sea transport volumes remains of vital importance to their national economies.

The above objective has requested a more in-depth approach for modelling freight transport flows that are generated by (or transiting) the Rail Baltica countries at present and in the future. An approach that:

- Captures their trading patterns
- Reflects their sectoral structures and development trends
- Accommodates the existing and future transport networks capacities (as an integral part of the EU)
- Reflects the effects of the relevant EU internal and external trade (primarily bound to the CIS countries)

The peripheral location of the Baltic States in relation to rest of the EU25 clearly entails the north-south dimension for border-free transportation of traded goods by land modes. In this respect, Poland serves to a major extent as transit country for Baltic goods flows with the rest of the EU25 and non-EU countries in the south-east.

In addition to the Baltic trade with the EU, this north-south dimension potentially accommodates the possibilities for moving goods traded between the EU and north-west Russia (for instance Saint Petersburg) and for flows between Finland and Eastern Europe.

The situation on the transport networks of the Baltic States and Poland influences the choice of mode and route for transportation of traded goods between the zone of production and the zone of attraction. Being part of the EU - which offers among others also the possibility to move border-free within the EU territory (thus allowing minimizing waiting and related costs at the borders) - also affects the choice of the route and mode.

The triggered growth of the Baltic trade with other EU countries is clearly observed in the changing transport flows pattern on the network. The road border crossing Kalvarija/Suwalki on the Lithuanian/Polish border became the most trafficked road border crossing point in the Baltic States, reaching in average 5 million tonnes per direction in 2004. This tendency is expected to hold even stronger in the near future after the Rail Baltica countries will join the Schengen agreement as from 2008 and onwards.

Also, the structure of the sea cargo flows handled at the ports of the Baltic States is undergoing changes in recent years. Although the transit flows from Russia and other CIS countries to Europe have traditionally been predominant in the past, the export and import share is gradually gaining the ground (most noticeably for the port of Klaipeda).

Concerning the volumes incoming by sea (which are in total 3-5 times smaller compared to the outgoing ones), the import to the Baltic States constitute the major share. The changing structural pattern is not only due to the fast economic development of the Baltic States, but also to the result of the tentative tariff and port investment policies, which have recently been strongly applied by Russia aiming at rerouting its cargo for Europe via the Russian ports in the Baltic Sea.

Modelling

Although being relatively small countries in size, population density and economy compared to other EU countries and neighbours, the Baltic States' networks accommodate significant flows of international and transit freight traffic.

The current freight transport accommodated on the networks of the Baltic States is presented in Table 12.1. The origin/destination relations are grouped in a way to help tracing the volumes per direction.

In addition, the table contains a magnified level of detail for those OD relations that could potentially be relevant for the Rail Baltica corridor. For instance, in order to be able to estimate the north-south movements and distinguish them from the east-west movements, the freight flows bound to Russia, Ukraine and Belarus are split accordingly into the areas:

- Russia = North/West Russia + Kaliningrad + rest of Russia.
- Belarus = Belarus West + rest of Belarus.
- Ukraine = Ukraine West + rest of Ukraine.

Furthermore, each OD relation which entails a significant north-south leg is marked in *green*. These are the relations that Rail Baltica could directly focus at and benefit from.

The relations marked in *yellow* are the ones that could, to some extent, be routed south-north if an attractive rail service would exist. The Baltic ports could then be part of this north-south transport chain.

More details on modal choice per OD relation can be found in Annex G of this report.

Table 12.1 Flows on the Baltic States' networks in 2004

Flows on the Baltic States' networks (road, rail and ports) in 2004 (tons)

Destination / Origin	Belarus (rest)	Belarus (W)	BENELUX	Estonia	Finland	Germany	Kaliningrad	Latvia	Lithuania	NW Russia	Poland	Rest East Europe	Rest West Europe	Rest World	Russia (rest)	Scandinavian Countries	Ukraine (rest)	Ukraine (W)	Total	Source of direct potential	Source of indirect potential
Belarus (rest)	0	0	4.312.367	193.048	2.759.258	299.053	617.012	905.048	2.590.915	1.342	550.347	2.422.463	233.405	1.223.370	2.603	1.695.379	0	0	**17.805.610**	**2.759.258**	**3.026.880**
Belarus (W)	0	0	959.057	69.382	466.811	62.693	532.659	285.585	1.347.461	482	197.700	443.273	71.289	309.992	936	530.575	0	0	**5.277.895**	**2.699.814**	**71.289**
BENELUX	5.796	2.082	0	33.474	0	0	3.517	62.796	312.357	45.789	0	235	0	34.629	57.778	0	3.010	1.620	**563.083**	**454.416**	**5.137**
Estonia	9.610	3.534	41.033	23.013.385	216.313	132.543	8.639	627.725	423.650	72.114	99.332	39.583	1.697.668	22.091	141.204	7.373	89.377	48.681	**26.693.855**	**3.338.701**	**121.078**
Finland	1.725	619	68	321.941	0	434	1.863	1.702	135.412	1.066	108.978	43.853	390	2.130	2.481	0	1.028	554	**624.244**	**618.567**	**2.130**
Germany	383.886	137.911	0	84.183	310	0	11.046	134.631	878.610	210.565	45	20.378	0	205.697	313.157	0	193.496	104.191	**2.678.106**	**1.308.299**	**0**
Kaliningrad	33.580	0	15.123	2.587	87	772	0	4.926	142.452	6.002	0	4.253	17.225	49.419	1.500.049	1.124	41.801	70	**1.819.470**	**30.897**	**68.795**
Latvia	168.785	32.393	95.026	320.222	91.275	245.029	23.348	31.313.985	733.076	448.836	467.739	97.532	204.482	72.200	279.722	41.156	7.305	4.849	**34.646.960**	**2.763.807**	**248.290**
Lithuania	203.927	100.144	331.818	959.200	162.004	913.239	344.735	2.390.489	52.877.392	932.892	5.705.885	393.027	5.004.526	181.486	1.498.673	241.212	209.075	93.771	**72.543.495**	**14.704.641**	**181.486**
NW Russia	0	0	15.342.622	1.017.789	2.083	201.560	68.534	784.333	1.257.508	64	9.338	2.492.830	108.089	806.391	58	365.010	0	0	**22.456.209**	**6.456.454**	**806.391**
Poland	265.499	95.374	0	185.646	42.246	0	0	357.770	7.021.170	8.487	0	54	0	23.404	25.347	0	40	17	**8.025.054**	**4806851**	**23.404**
Rest East Europe	80	28	5.763	123.529	51.385	6.735	803	145.571	453.798	3.246	0	752	44	1.304.289	1.138	862	3	2	**2.098.028**	**778.391**	**1.305.092**
Rest West Europe	1.365	488	0	1.378.684	555	0	991	110.109	379.059	37.439	0	49	0	5.920	33.503	1	703	380	**1.949.246**	**1.906.837**	**1.853**
Rest World	64.373	23.124	740.216	46.066	273.426	780.221	89.491	257.261	160.958	105.249	1.000	242.838	18.397	214.940	159.441	119.650	33.528	18.055	**3.348.234**	**0**	**1.212.741**
Russia (rest)	0	0	23.932.421	1.975.994	1.801.071	1.145.440	3.988.034	913.074	1.641.349	1	801.592	4.839.094	2.215.767	1.655.850	188	1.664.824	0	0	**46.574.699**	**0**	**0**
Scandinavian Countries	20.138	7.236	0	1.057	0	0	4.503	3.911	242.849	16.411	0	1.269	0	29.354	27.603	0	33.602	18.094	**406.027**	**26.599**	**53.740**
Ukraine (rest)	33	12	309.154	172.903	112.440	189.843	82.402	257.210	429.692	0	6.233	0	7.247	45.605	0	161.606	0	0	**1.774.380**	**112.440**	**591.719**
Ukraine (W)	17	6	166.468	117.847	60.548	102.217	15.073	138.831	150.488	0	3.358	0	3.902	24.555	0	87.021	0	0	**870.331**	**569.808**	**194.925**
TOTAL	**1.158.814**	**402.951**	**46.251.136**	**30.016.937**	**6.039.812**	**4.079.779**	**5.792.650**	**38.694.957**	**71.178.196**	**1.889.985**	**7.951.547**	**11.041.483**	**9.582.431**	**6.211.322**	**4.043.881**	**4.915.793**	**612.968**	**290.284**	**250.154.926**		**7.914.950**
Source of direct potential	**1.725**	**143.926**	**2.002.207**	**3.596.695**	**3.963.232**	**1.492.805**	**118.448**	**5.044.468**	**10.284.121**	**1.693.256**	**4.108.918**	**3.068.094**	**7.032.380**	**0**	**0**	**618.458**	**1.028**	**166.019**	**43.335.780**	**43.335.780**	
Source of indirect potential	**199.898**	**488**	**181.591**	**412.017**	**273.426**	**0**	**93.811**	**1.419.519**	**160.958**	**105.249**	**1.000**	**247.091**	**326.993**	**2.485.965**	**0**	**1.856.985**	**130.284**	**19.675**	**7.914.950**		

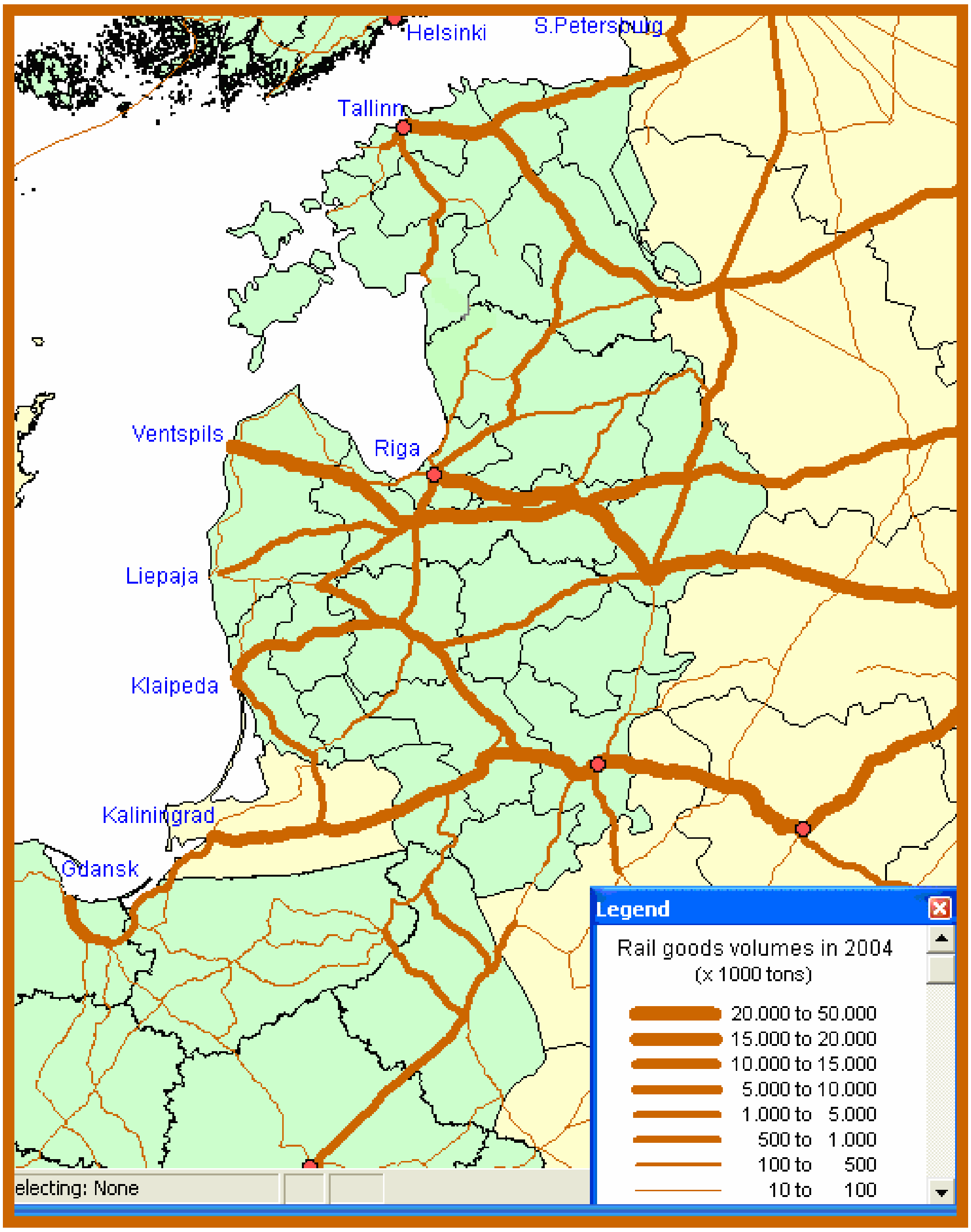
Legend:

- (green) International flows with significant North/South dimension (Corridor 1 and/or Corridor 1 in combination with Baltic States' Ports)
- (yellow) International flows partly using North/South dimension

All flows that go east-west are primarily served by rail (bound to Kaliningrad) or rail in combination with the Baltic ports. In quantitative terms, the rail/port transport chains account for 75 million tonnes versus 5 million tonnes by road-port transport chains. The majority of these rail flows are the one-way transit flows from the CIS countries to Western Europe. This biased one-way pattern of rail transit traffic on the east-west direction is very typical for all three Baltic States.

This east-west pattern is clearly seen in the following figure. The broad gauge rail infrastructure was built up specifically to serve these east-west flows. On the other hand, the infrastructure going north-south is interrupted by different gauges in the south of Lithuania, and this is clearly reflected by the transportation pattern by rail.

Figure 12.1 Freight volumes transported on the Baltic States' rail network and on Corridor 1 railway links in Poland in 2004



Note: The freight volumes transported on the section from Bialystok to Elk constitute about half of the volumes of the parallel route via Sokolka.

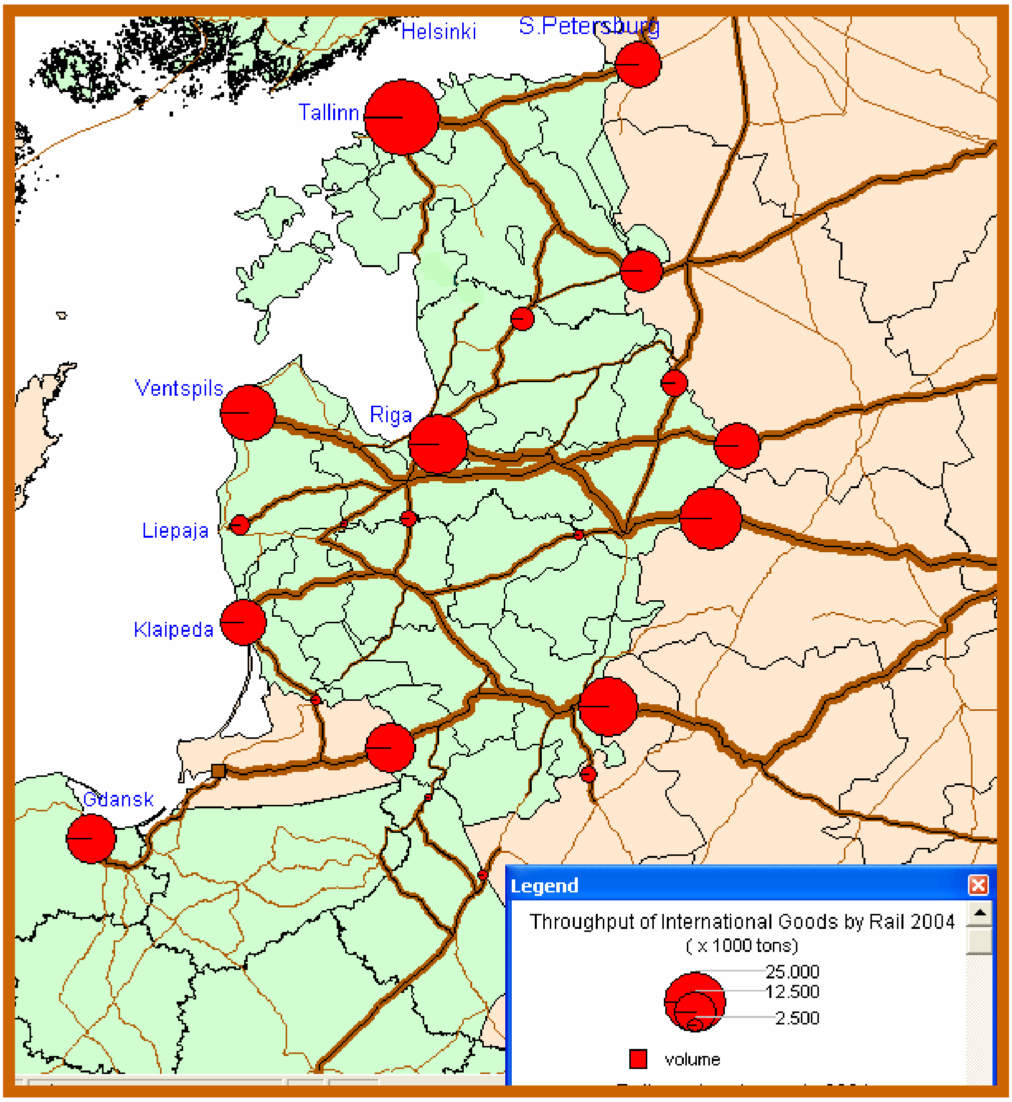
The standard gauge line to Poland was closed (dismantled) during the Soviet period and was re-opened after the Baltic States regained their independence in 1990. A rather poor technical state of the line and the additional gauge-changing costs have so far implied that the line has failed to compete with the level of service offered by road.

Although the international rail volumes travelling on the north south axis in 2004 accounted for more than 4 million tonnes on the Lithuanian/Latvian border and 4 million tonnes on the Latvian/Estonian border, the volumes on the

Lithuanian/Polish border were less than 0.4 million tonnes. In comparison, 10 million tonnes crossed the Lithuanian/Polish border by road. This means that the road sector has 96% of the traffic volumes. There is no other route through the Baltic States which is so monopolized by roads.

The figure below shows the volumes of international goods crossing the borders of the Baltic States by rail and in combination with ports. They represent a very biased pattern entering the Baltic States from east and heading west via the ports. The flows moving along the north-south axis, on the other hand, are more balanced.

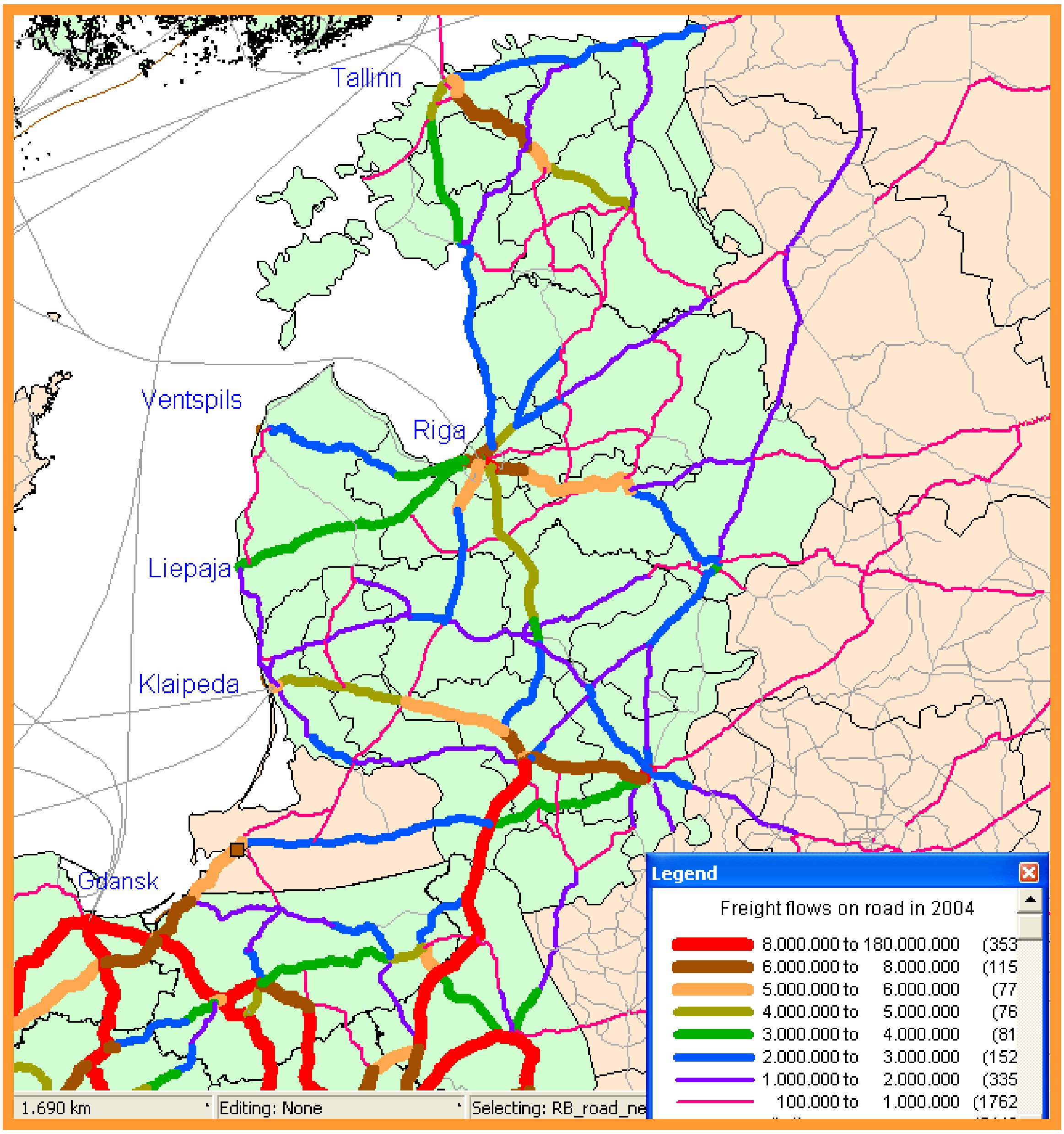
Figure 12.2 Volumes of international goods served by rail in 2004



Note that the figure does not include domestic traffic.

The figure shows how the freight flows are distributed on the road networks of the Baltic States in 2004. In contrary to rail, the international freight volumes by road form a pattern moving along the north-south corridor.

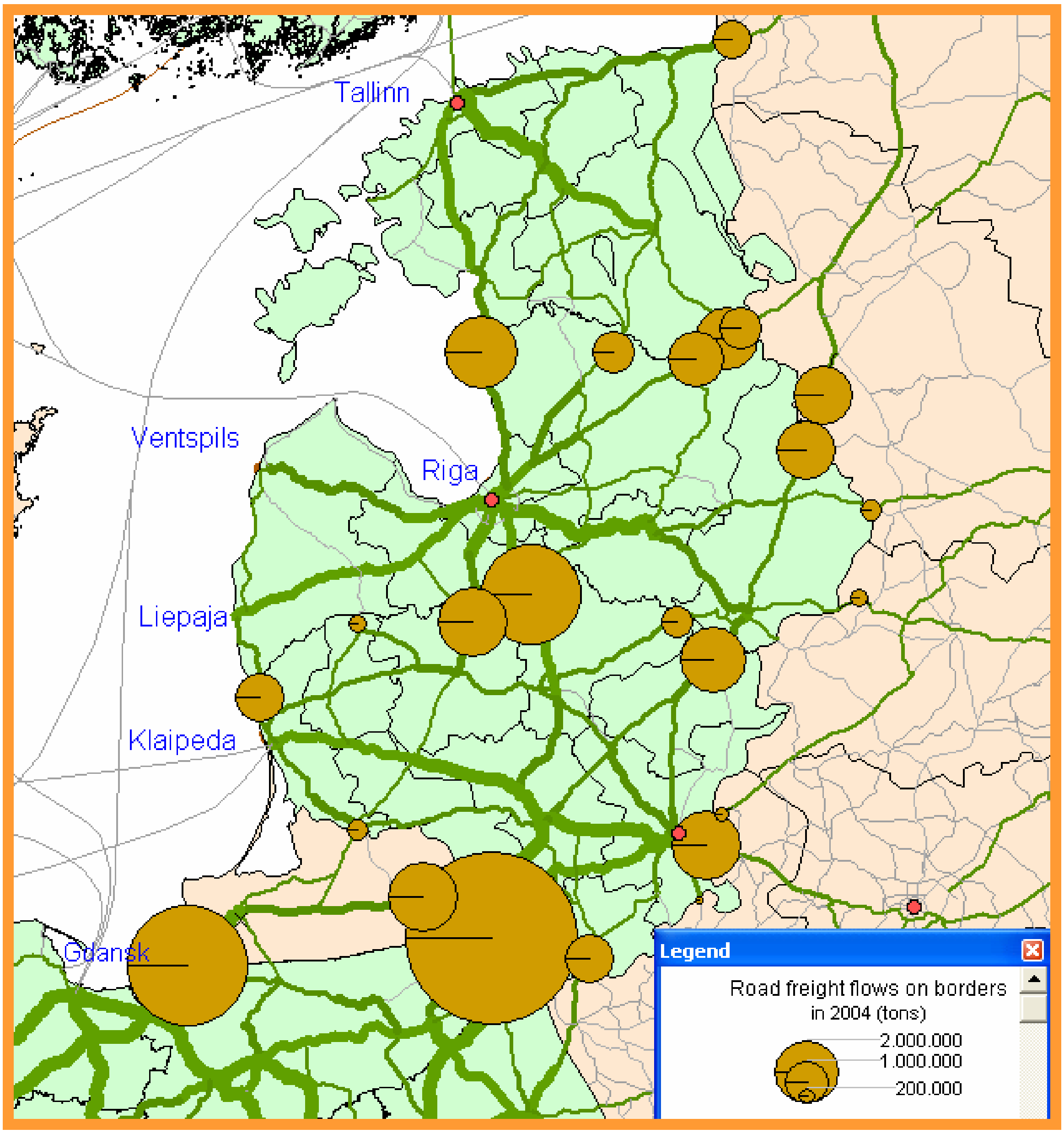
Figure 12.3 Freight volumes 2004 assigned to the road networks of the Baltic States and Poland (tonnes)



The figure shows that more than 8 million tonnes of international freight travel north-south by road to/from Kaunas in the direction of Warsaw. This might suggest Kaunas to be a proper location for establishing a terminal for the Rail Baltica train service.

Figure 12.4 demonstrates the throughput of international freight flows on the road border crossings. As one can see, the Kalvarijos/Suwalkai road border crossing on the Lithuanian/Polish border is the most trafficked border crossing in the Baltic States. After accession of the Baltic States and Poland to the Schengen agreement, the load on this Via Baltica route is expected to further intensify.

Figure 12.4 Throughput of international freight on road border crossings in 2004



Note that the figure does not include domestic traffic.

The figure shows that the demand for international trade (and with the EU in particular) and, respectively, the need for transportation of traded goods along the north-south corridor exist. It is until now almost exclusively served by road transport.

Further for the analysis of the potential for Rail Baltica, it is useful to look at the structure of the demand to reveal:

- The trading relations (internal EU trade, external EU trade, transit between non-EU countries)
- The manifestation type of the cargo

This is important when calculating the growth of the demand and the modal split in the future.

The table below reveals the structure of the goods flows per relation type per modal choice within the project countries, given the level of tariff and service of 2004.

Table 12.2 Freight volumes on Baltic States' networks per trade relation type, mode and commodity class in 2004 (x 1000 tonnes)

Relation type	Commodity class	Rail Tonnes*1000	Rail/Sea Tonnes*1000	Road Tonnes*1000	Road/Sea Tonnes*1000	Total Tonnes*1000
Domestic	Dry bulk	8.781	0	47.755	0	**56.536**
Domestic	General cargo	1.151	0	42.551	0	**43.702**
Domestic	Liquid bulk	2.043	0	4.924	0	**6.967**
EU25	Dry bulk	1.838	266	9.863	786	**12.754**
EU25	General cargo	248	5	5.768	791	**6.813**
EU25	Liquid bulk	2.181	4.552	4.263	118	**11.115**
Export from EU25	Dry bulk	1.328	2.789	950	1.049	**6.116**
Export from EU25	General cargo	375	310	2.468	397	**3.549**
Export from EU25	Liquid bulk	353	45	360	260	**1.018**
Import to EU25	Dry bulk	10.096	17.624	519	1.359	**29.599**
Import to EU25	General cargo	117	378	930	54	**1.478**
Import to EU25	Liquid bulk	11.784	44.433	71	9	**56.297**
Non EU	Dry bulk	4.795	5.647	344	4	**10.790**
Non EU	General cargo	218	56	280	2	**556**
Non EU	Liquid bulk	2.454	371	41	0	**2.866**
Total		**47.762**	**76.477**	**121.088**	**4.828**	**250.155**

Legend for relation type:

EU25 -a relation with origin in one Member State and destination in another Member State.

Export from EU25 – a relation with origin in any Member State and destination in non-Member state.

Import to EU 25 a relation with origin in a non-Member state and destination in a Member State.

Non EU – both origin and destination lie in non-Member countries.

Table 12.3 Modal shares on the Baltic States' networks per relation type per commodity class and mode in 2004

Relation type	Commodity Class	Rail	Rail/Sea	Road	Road/Sea
Domestic	Dry bulk	16%	0%	84%	0%
Domestic	General cargo	3%	0%	97%	0%
Domestic	Liquid bulk	29%	0%	71%	0%
EU25	Dry bulk	14%	2%	77%	6%
EU25	General cargo	4%	0%	85%	12%
EU25	Liquid bulk	20%	41%	38%	1%
Export from EU25	Dry bulk	22%	46%	16%	17%
Export from EU25	General cargo	11%	9%	70%	11%
Export from EU25	Liquid bulk	35%	4%	35%	25%
Import to EU25	Dry bulk	34%	60%	2%	5%
Import to EU25	General cargo	8%	26%	63%	4%
Import to EU25	Liquid bulk	21%	79%	0%	0%
Non EU	Dry bulk	44%	52%	3%	0%
Non EU	General cargo	39%	10%	50%	0%
Non EU	Liquid bulk	86%	13%	1%	0%
All	**Total per mode**	**19%**	**31%**	**48%**	**2%**

Legend for relation type:
EU25 -a relation with origin in one Member State and destination in another Member State.
Export from EU25 – a relation with origin in any Member State and destination in non-Member state.
Import to EU 25 a relation with origin in a non-Member state and destination in a Member State.
Non EU – both origin and destination lie in non-Member countries.

Judging from the flows structure of the current demand, the future Rail Baltica service could target at takeover of the dry bulk commodities from Via Baltica on the trade relation between the EU countries (the current demand served by road transport is more than 9 million tonnes). The transportation of the liquid bulk for the same trade relation would most likely be routed via the ports of the Baltic States.

The aggregated volumes and their modal shares per trade relation are shown in the following table.

Table 12.4 Freight volumes and modal shares on the Baltic States' networks per trade relation in 2004

Relation type	Rail Tonnes*1000	Rail/Sea Tonnes*1000	Road Tonnes*1000	Road/Sea Tonnes*1000	Total Tonnes*1000
Domestic	11.975	0	95.230	0	**107.205**
EU25	4.267	4.824	19.895	1.696	**30.682**
Export from EU25	2.057	3.143	3.778	1.705	**10.683**
Import to EU25	21.997	62.435	1.520	1.422	**87.373**
Non EU	7.467	6.075	665	6	**14.213**
Total	**47.762**	**76.477**	**121.088**	**4.828**	**250.155**
Relation type	**Rail**	**Rail/Sea**	**Road**	**Road/Sea**	**Total**
Domestic	11%	0%	89%	0%	**100%**
EU25	14%	16%	65%	6%	**100%**
Export from EU25	19%	29%	35%	16%	**100%**
Import to EU25	25%	71%	2%	2%	**100%**
Non EU	53%	43%	5%	0%	**100%**
Total	**19%**	**31%**	**48%**	**2%**	**100%**

Legend for relation type:

EU25 -a relation with origin in one Member State and destination in another Member State.

Export from EU25 – a relation with origin in any Member State and destination in non-Member state.

Import to EU 25 a relation with origin in a non-Member state and destination in a Member State.

Non EU – both origin and destination lie in non-Member countries.

Taking into account the size of the Baltic States, it is not surprising to have a high road transport share for the domestic relation. However, such a high road transport share for the trade relation between the EU countries, where long distances are involved, suggests that the level of service offered by the rail routes north-south in 2004 compared to the level of service offered by the road sector did not adequately meet the requirements of the client. This fact looks even more surprising when considering the heavily loaded roads of Poland that are intensively used by this trade relation.

A further possibility with regard to the potential for Rail Baltica lies in the Finland-bound goods traffic by sea. The accession of new Member States to the EU intensified the relations between the Finnish ports and the ports of the Baltic States, reaching up to 4.5 million tonnes in 2004. Another 2.6 million tonnes of Finland-bound goods were transported via the ports of Poland. Part of these volumes may be taken over by the Rail Baltica line in the future, if a competitive balance between the costs and time could be assured.

12.2 Future freight transport demand - reference scenario

The estimation of the freight transport demand for the future is done in two steps by applying:

- The economic/trade growth model
- The modal split model

The input for the economic growth model for each zone contained in the basis OD matrix constitutes:

- The annual growth of the GDP
- The annual growth of the agriculture sector
- The annual growth of the mining & quarrying sector
- The annual growth of the industry sector

The modelling assumptions used within this study with respect to the demographic and economic environment are compatible with the European Commission's reference scenario of the transport and energy projections taken from the report "European energy and transport trends to 2030"[23]. The assumptions are presented in Annex D.

In addition to these macro-economic growth assumptions, which are used to calculate the growth of transport demand between origin and destination in 2034, the variables influencing the modal split are considered. These are the so-called *cost index* and *time index,* which represent the changes in the transportation time and costs of each competing transport mode (or route) in relation to other modes (or routes) available between origin and destination. These changes are different for each commodity group, distance class and total weight transported between origin and destination.

- *Cost index* = [change in travel costs by road/change in travel costs by rail]
- *Time index* = [change in travel time by road/change in travel time by rail]

If cost index > 1 means that the relative costs of transportation between the respective origin and destination by road route increases more than the relative costs on the railway route (modal shift towards rail). The same is valid for the time index. If the value is higher than 1, it means that the railway route is faster and vice versa.

The costs and the time of transport in their turn are dependent on the state of infrastructure (level of service) and policy measures, which have an effect on the transport market.

[23] http://europa.eu.int/comm/dgs/energy_transport/figures/trends_2030/index_en.htm

For estimation of these variables and cross-elasticities, the following important expected developments in the transport sector are taken into account:

- Realisation of new infrastructure or upgrading (on the networks of the EU; expansion of Russian ports)
- Specific developments for each commodity in the transport markets, which influence time and costs
- Harmonisation of the transport policy
- Environmental sustainability
- Integration of new Member States and Candidate countries

The quantification of all these developments in changes in transport time and the cost for each mode indicates that the cost index varies between 1.02-1.05 (dependent on origin-destination pair). The time index is estimated to stay around 1.

Specifically for those relations that move along the north-south corridor, the time index is strongly dependant on the alignment, technical parameters, train frequencies and other related organisational schemes of the service. A more specific value will be evaluated later in the project when the options for further analysis for the Rail Baltica line are chosen.

At this stage of the project, the following values are used as inputs for the calculation of future freight flows under the reference scenario:

- Cost index = 1.05
- Time index = 1.00

The results of the future demand modelling are presented in Table 12.5 and Table 12.6. The overall growth of freight flows on the networks of the Baltic States representing the trade with the EU Member States will increase by 2.2 times reaching 67 million tonnes in 2034. In this relation market, the transportation by road or by road in combination with the Baltic States' ports will benefit the most (2.5 times' increase). Also, rail volumes in this market are expected to grow by 1.8

Specifically concerning the Rail Baltica route, the volumes that will be induced on this new line will depend on a number of factors ranging from technical to organisational ones, which have to operate as a complete competitive package. This will take time. Nevertheless, the overall demand, which will be moving north-south, is expected to reach about 60 million tonnes in 2034 – a significant amount to keep the road sector busy and to form the train loads.

Figure 12.5 Forecasted freight volumes on the Baltic States' rail network and on Corridor 1 railway links in Poland in 2034 (reference scenario, cost index=105, time index =100)

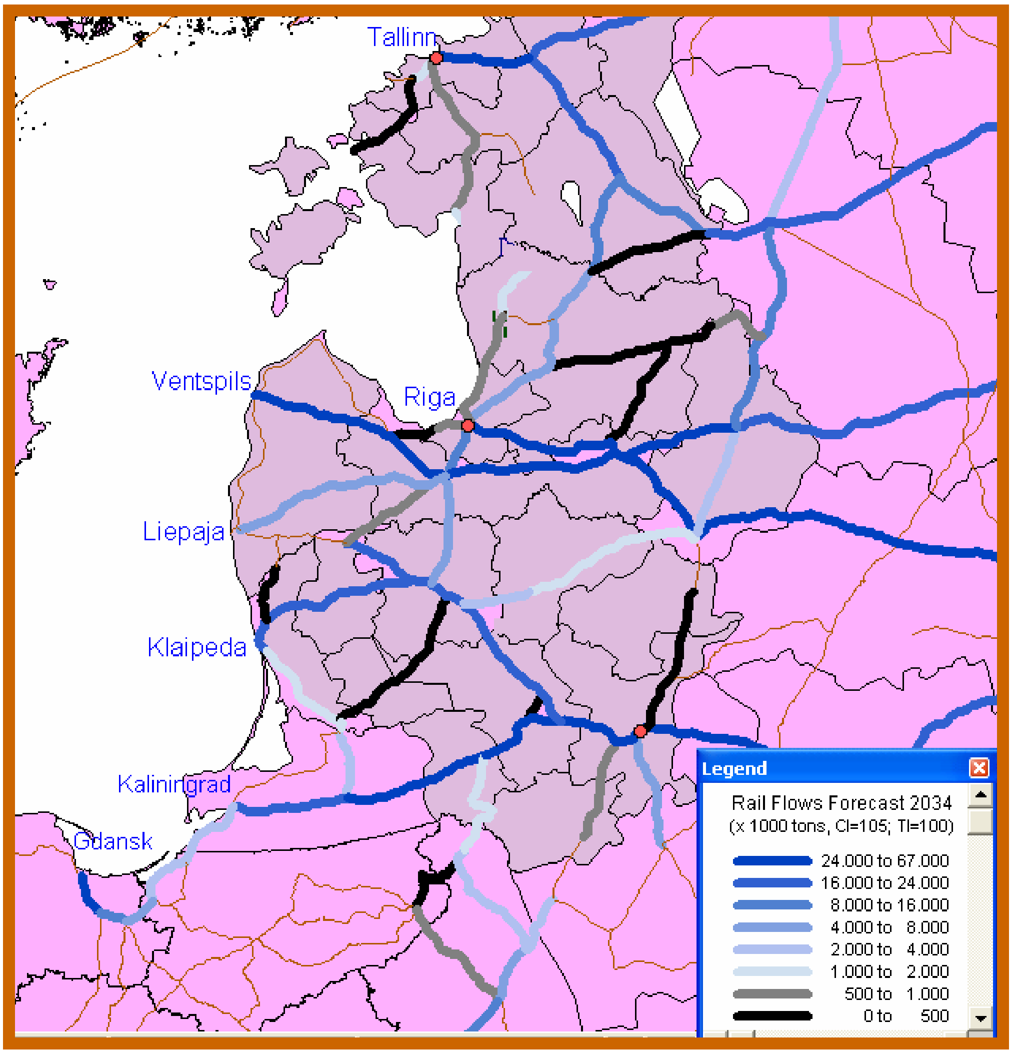


Figure 12.6 Forecasted freight volumes on the Baltic States' road network and in Poland in 2034 (reference scenario, (cost index=105, time index =100)

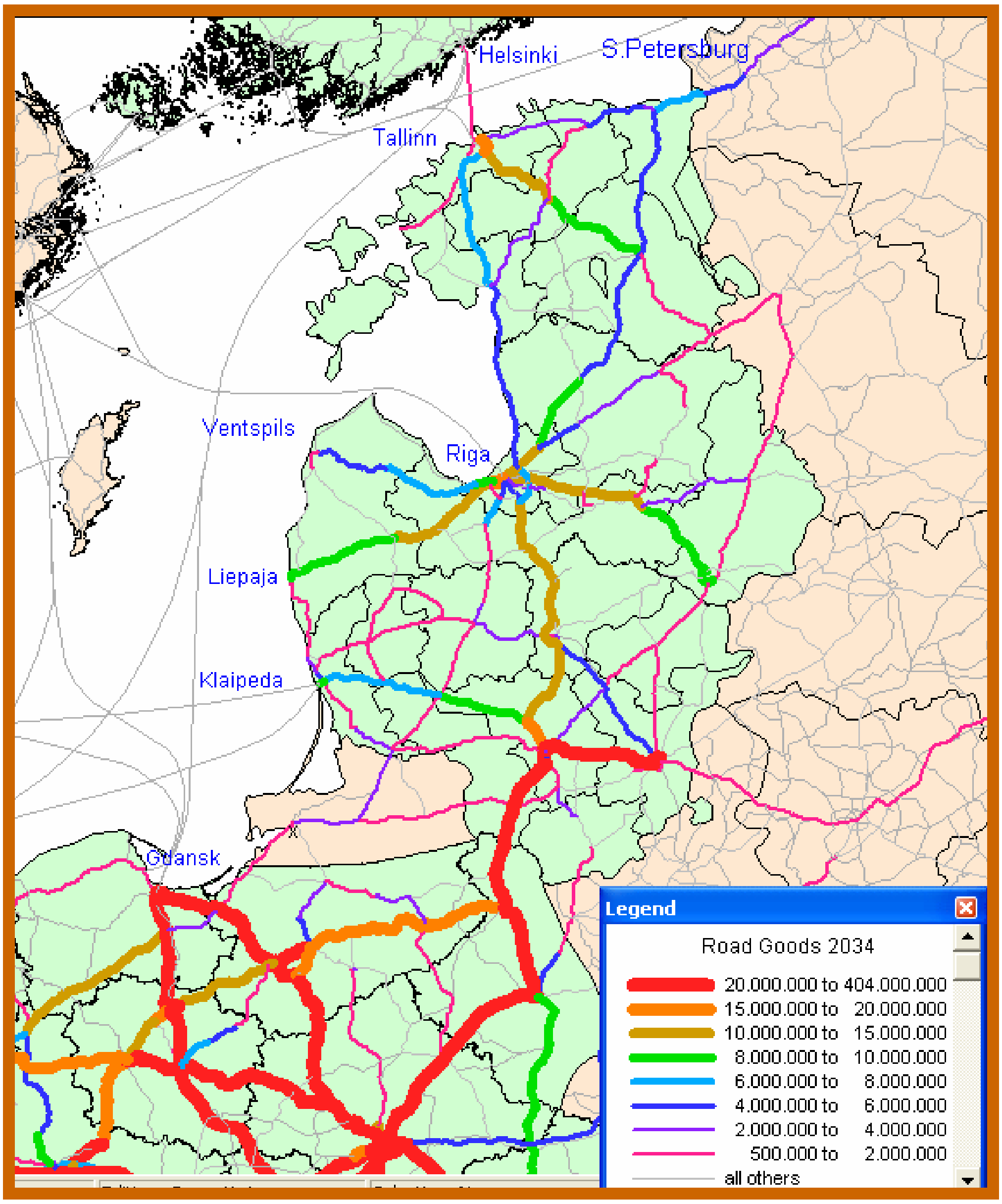


Table 12.5 Freight volumes on the Baltic States' networks in 2034 under reference scenario per mode per relation per commodity class (x 1000 tonnes, CI=1.05, TI=1.00)

		Road			Road/Sea			Rail			Rail/Sea			All modes		
Relation type	Class	2004	2034	Growth	2004	2034	Growth	2004	2034	Growth	2004	2034	Growth	2004	**2034**	**Growth**
DOMESTIC	DRY_BULK	47.755	61.515	1,288	0	0	0,000	8.781	14.962	1,704	0	0	0,000	**56.536**	**76.478**	**1,353**
DOMESTIC	GENERAL CARGO	42.551	105.456	2,478	0	0	0,000	1.151	3.050	2,651	0	0	0,000	**43.702**	**108.506**	**2,483**
DOMESTIC	LIQUID_BULK	4.924	8.519	1,730	0	0	0,000	2.043	4.057	1,986	0	0	0,000	**6.967**	**12.576**	**1,805**
EU25	DRY_BULK	9.863	29.760	3,017	786	2.581	3,282	1.838	4.439	2,415	266	669	2,510	**12.754**	**37.448**	**2,936**
EU25	GENERAL CARGO	5.768	9.377	1,626	791	1.387	1,753	248	372	1,499	5	9	1,571	**6.813**	**11.144**	**1,636**
EU25	LIQUID_BULK	4.263	11.018	2,584	118	246	2,079	2.181	2.779	1,274	4.552	4.947	1,087	**11.115**	**18.989**	**1,708**
Export from EU25	DRY_BULK	950	1.646	1,732	1.049	1.706	1,627	1.328	2.128	1,602	2.789	5.533	1,984	**6.116**	**11.013**	**1,801**
Export from EU25	GENERAL CARGO	2.468	2.010	0,814	397	324	0,816	375	312	0,831	310	253	0,817	**3.549**	**2.898**	**0,817**
Export from EU25	LIQUID_BULK	360	643	1,787	260	459	1,768	353	490	1,386	45	98	2,160	**1.018**	**1.689**	**1,660**
Import to EU25	DRY_BULK	519	1.395	2,685	1.359	3.686	2,712	10.096	29.430	2,915	17.624	33.829	1,919	**29.599**	**68.339**	**2,309**
Import to EU25	GENERAL CARGO	930	2.359	2,538	54	68	1,272	117	273	2,338	378	317	0,840	**1.478**	**3.018**	**2,042**
Import to EU25	LIQUID_BULK	71	248	3,515	9	35	3,853	11.784	25.574	2,170	44.433	46.877	1,055	**56.297**	**72.735**	**1,292**
NON_EU	DRY_BULK	344	431	1,252	4	6	1,738	4.795	8.834	1,842	5.647	8.791	1,557	**10.790**	**18.063**	**1,674**
NON_EU	GENERAL CARGO	280	197	0,703	2	2	0,787	218	178	0,816	56	46	0,815	**556**	**422**	**0,759**
NON_EU	LIQUID_BULK	41	62	1,519	0	1	2,279	2.454	2.900	1,182	371	513	1,381	**2.866**	**3.476**	**1,213**
	Total	**121.088**	**234.635**	**1,938**	**4.828**	**10.500**	**2,175**	**47.762**	**99.777**	**2,089**	**76.477**	**101.881**	**1,332**	**250.156**	**446.794**	**1,786**

Table 12.6 Freight volumes on the Baltic States' networks in 2034 under reference scenario per mode per relation (x 1000 tonnes, CI=1.05, TI=1.00)

	Road			Road/Sea			Rail			Rail/Sea			All modes		
Relation type	2004	2034	Growth	2004	2034	Growth	2004	2034	Growth	2004	2034	Growth	2004	**2034**	**Growth**
DOMESTIC	95.230	175.490	1,843	0	0	0,000	11.975	22.069	1,843	0	0	0,000	107.205	197.559	**1,843**
EU25	19.895	50.154	2,521	1.696	4.213	2,485	4.267	7.590	1,779	4.824	5.624	1,166	30.682	67.581	**2,203**
Export from EU25	3.778	4.299	1,138	1.705	2.489	1,460	2.057	2.929	1,424	3.143	5.884	1,872	10.683	15.600	**1,460**
Import to EU25	1.520	4.002	2,633	1.422	3.789	2,665	21.997	55.277	2,513	62.435	81.024	1,298	87.373	144.092	**1,649**
NON_EU	665	690	1,037	6	9	1,421	7.467	11.912	1,595	6.075	9.349	1,539	14.213	21.961	**1,545**
Total	**121.088**	**234.635**	**1,938**	**4.828**	**10.500**	**2,175**	**47.762**	**99.777**	**2,089**	**76.477**	**101.881**	**1,332**	**250.156**	**446.794**	**1,786**

12.3 Modelling investment package specific effects

As shown in the previous paragraph, the road transport would continue playing a dominant role on North-South corridor in the future, if no further investments were put into the Rail Baltica route. The most likely consequence of this would be a failure of the north-south rail to compete with the future Via Baltica and the routes via Baltic ports. The Sestokai gauge change terminal could hardly then expect more than 2 million t of rail cargo in 2034 under the circumstances of the reference scenario.

In the following three paragraphs the expected effects on routing pattern of future freight flows are considered for different Rail Baltica investment scenarios in 2034.

The elements taken into account for modelling these scenario specific effects were, as follows.

The rail networks and their attributes were adjusted in accordance with the chosen network scenarios (see chapter 6). The routing of freight flows was determined at the generalised costs level in which the speed attribute and the distance attribute of the respective networks play a significant role.

In addition to the market segment characteristics (cargo type, trade relation type, volume), the link specific and vehicle specific attributes were included in the estimation of the modal shift effects to arise from the investments into Rail Baltica route.

For obtaining the commercial speed for each OD pair on rail network, the following linkage between the design speed of rail network and the operational speed of freight trains (and respectively with the commercial speed) was assumed:

Table 12.7: Estimated average travel speed by freight train categories

Train category	Design speed (km/h)	Average speed (km/h)	Design speed (km/h)	Average speed (km/h)	Design speed (km/h)	Average speed (km/h)
Premium	120	91[r)]	160	91[r)]	200	91[r)]
Standard	120 (80)	72[r)]	160	72[r)]	200	72[r)]

Note: [r)] *Travel time of freight trains is mainly influenced by the density of passenger traffic and resulting necessary stops of the freight trains for overtaking*

Premium freight trains - superior freight products operating with a maximum speed of 120 km/h and with a certain priority in the time table construction. The maximum gross weight is lower than 1,500 tonnes. Premium trains include intermodal (container) trains and other fast freight trains.

Standard freight trains include heavy weight freight trains for bulk cargo, like coal, oil or metal products and all other freight trains (single wagons or groups of wagons) with a maximum speed of 80 km/h.

In addition to speed, a *waiting time for change of different gauge* was included when considering the Investment Package 1 and Investment Package 2 scenarios. Based on the practice in West Europe, a 24 hour extra waiting time was assumed for changing the gauge for a freight train on Rail Baltica route at the terminal in Kaunas.

Within Package 3, an *egress/regress road matrix* to/from terminals in Kaunas, Ryga and Tallinn was added. It was generally assumed that on these locations the forming of train/wagon sets for Rail Baltica will take place.

In a similar way as the one explained in previous paragraphs on modal split modelling in the reference scenario 2034, the calculation of the modal shift under each investment package is bound to *price index* and *time index* variables. For estimation of the package-specific indices, the following formulas were applied for each OD relation served by different competing modes (routes):

$$\textit{price index} = [C_{mode1}(PN)/C_{mode1}(Ref)]/\ [C_{mode2}(PN)/C_{mode2}(Ref)]$$

$$\textit{time index} = [T_{mode1}(PN)/T_{mode1}(Ref)]/\ [T_{mode2}(PN)/T_{mode2}(Ref)]$$

Where:

C_{modeX} - transportation price between origin and destination on mode X network route;
T_{modeX} - transportation time between origin and destination on mode X network route;
PN - network attributes relate to Package N scenario
Ref - network attributes relate to Reference scenario

The relative changes of characteristics of the competing routes/modes under different infrastructure scenarios lead to modal shift effects. The modal share per segment under Package N scenario for competing modes in relation to Reference scenario is estimated by applying the following formula:

$$P_{mode1,ij}(PN) = P_{mode1,ij}(Ref) \cdot \prod_X \left([T_{modeX,ij}(PN)/\ T_{modeX,ij}(Ref)]^{\beta x} \cdot [C_{modeX,ij}(PN)/\ C_{modeX,ij}(Ref)]^{\delta x} \right)$$

Where:

$P_{modeX,ij}$ - share of any other competing mode/route *X* on OD relation per segment *ij*

$\beta x, \delta x$ - model parameters

The model works in such a way that an increase in relative prices and/or relative transportation times in one mode (route) leads to an increase of the share of the competing modes (routes).

At this point of time it is too premature to discuss the prices to be charged by the operators for transportation of freight on Rail Baltica route. However in terms of relative price development, it is feasible to assume that the price changes for 2034 will be similar both for the reference scenario and the package-specific scenarios (equivalent to *price index*=1*)*.

Given the limited information on targeted future alignments of the Rail Baltica route, the change of two network attributes[24], i.e. the speed and the distance, will lead to changes in the resultant time index variable. This in turn will determine the size and the trend for the modal shift.

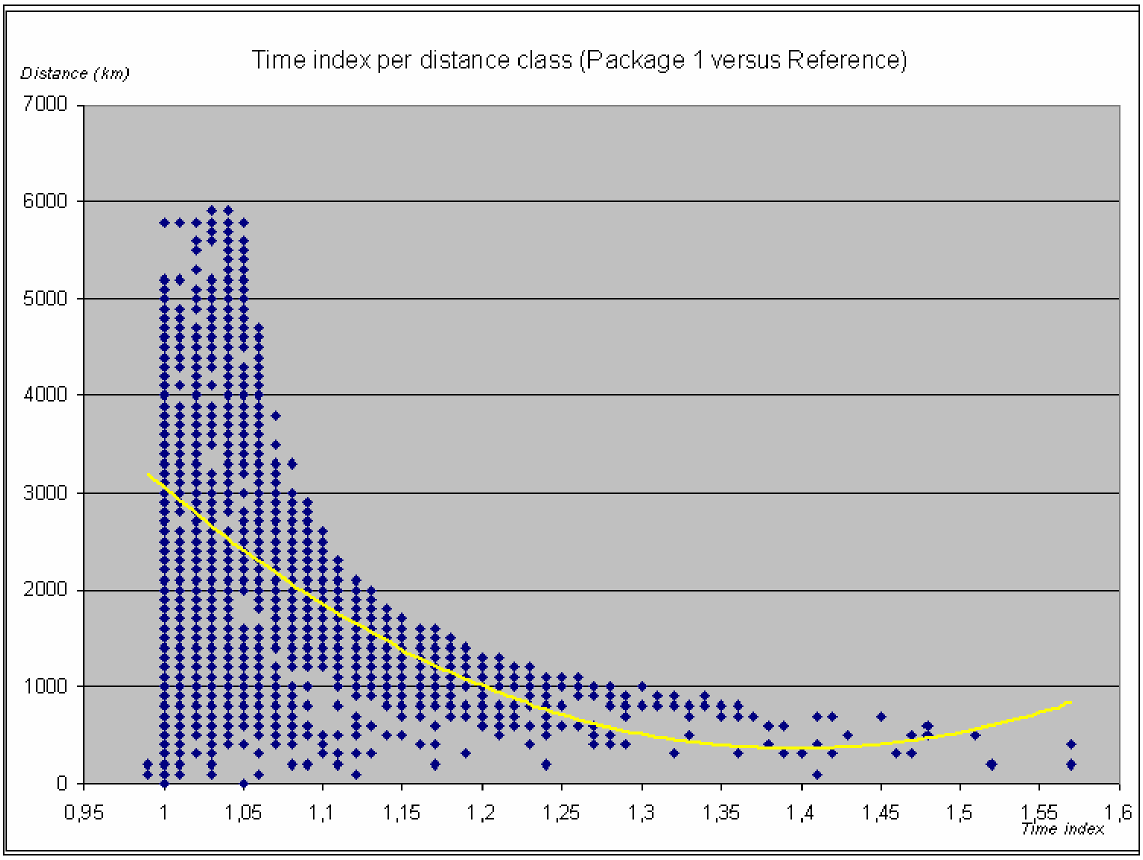
In the modelling of future patterns in relation to Rail Baltica it is generally assumed that all logistics elements bound to transportation of cargo by rail will be functioning properly and in a modern way. The infrastructure and Rail Baltica train service starts functioning as from 2016 onwards.

12.3.1 Expected rail freight transport pattern in Package 1

For estimation of the modal shift, the network related differences in the Package 1 scenario compared to the situation on the networks in Reference Scenario were considered. On the basis of the impedances matrices produced by the network assignment model the time index values for OD matrix (134 x 134) were obtained. The following graph presents distribution of time index value per distance class for the whole matrix.

[24] In modelling of rail traffic a few more attributes would be desired to know, like train frequencies, locations of freight terminals etc.

Figure 12.7 Distribution of time index value per distance class (Investment package 1)



The distance for each OD pair is determined by a least generalised costs route principle.

As reflected in the graph, for estimation of the modal shift effects the OD relations, which involve distances longer than 400 km might be of interest. In addition, the selected OD relations were further filtered along the north-south axis criteria. In terms of volumes, only those OD pairs were left for consideration for which the amounts of cargo transported by road exceed 120 tonnes. Finally, the relations that show the time index value <1.25 were selected from this refined group.

The tables below show the modal shift estimates for the years 2016 and 2034 that could be gained by rail due to implementation of the Package 1 investment scenario.

Table 12.8 Estimated tonnes shifted to rail due to implementation of Package 1 investment scenario in 2016

From/to	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	0	16391	0	14	11993	0	0	200	7471	**36069**
EU rest	15306	0	326	0	76845	24250	169	0	0	**116896**
Finland	0	394	0	0	931	0	0	4	1835	**3164**
Russia (Kal.)	65	0	33	0	0	35	0	0	0	**133**
Lithuania	4159	136743	2998	160	0	6230	3352	2793	358599	**515034**
Latvia	0	32641	0	33	29207	0	6792	368	15116	**84157**
Russia (NW)	0	1330	0	0	26660	6273	0	0	0	**34263**
Other rest	189	0	0	0	5948	284	0	0	0	**6421**
Poland	5143	0	5895	0	188861	5985	0	0	0	**205884**
Total	**24862**	**187499**	**9252**	**207**	**340445**	**43057**	**10313**	**3365**	**383021**	**1002021**

Table 12.9 Estimated tonnes shifted to rail due to implementation of Package 1 investment scenario in 2034

From/to	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	0	25240	0	28	20401	0	0	317	10880	**56866**
EU rest	18697	0	277	0	102416	28636	167	0	0	**150193**
Finland	0	344	0	0	1244	0	0	3	2254	**3845**
Russia (Kal.)	58	0	29	0	0	49	0	0	0	**136**
Lithuania	7007	249854	5210	281	0	9361	5763	4230	528082	**809788**
Latvia	0	56258	0	65	48954	0	11483	575	21873	**139208**
Russia (NW)	0	1498	0	0	27302	5620	0	0	0	**34420**
Other rest	165	0	0	0	5679	210	0	0	0	**6054**
Poland	6267	0	8589	0	303347	6003	0	0	0	**324206**
Total	**32194**	**333194**	**14105**	**374**	**509343**	**49879**	**17413**	**5125**	**563089**	**1524716**

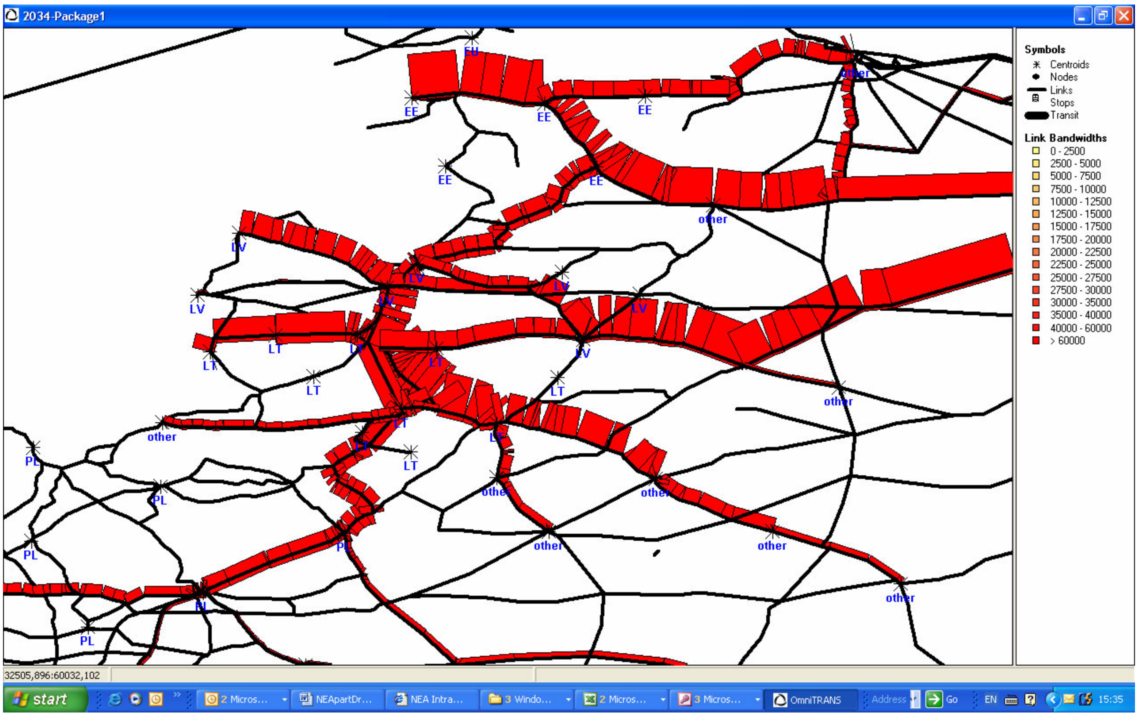
The estimates show that, even after the increase of the operational speed on Rail Baltica route, no significant shift from road to rail can be expected in the future, if the legs of different gauge constitute the route. The shifts will be around 1.5 million tonnes.

Table 12.10 Estimated total rail volumes on the networks of the Baltic States in Package 1 investment scenario in 2034 (tonnes)

From/to	Estonia	EU rest	Finland	Russia (Kal)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	5714879	25505	0	9323	374372	1023697	728742	384866	10880	**8272264**
EU rest	354864	0	277	759	376406	2672588	3287	0	0	**3408181**
Finland	26291	344	0	0	2068	9979	0	3	2254	**40939**
Russia (Kal)	4186	19060	29	0	124391	5072	1770899	422405	0	**2346042**
Lithuania	1098900	363901	5210	349675	21901560	1667603	429639	2952950	1444722	**30214160**
Latvia	818363	68038	463	104958	2387264	1369	1104878	1538477	309525	**6333335**
Russia (NW)	38214038	7673736	1594542	4681817	4189486	26522957	0	1746776	899064	**85522416**
Other rest	8362233	1399033	215547	2875460	23232874	29305122	15	308783	289302	**65988369**
Poland	73794	0	8589	0	511229	98174	36386	32961	0	**761133**
Total	**54667548**	**9549617**	**1824657**	**8021992**	**53099650**	**61306561**	**4073846**	**7387221**	**2955747**	**202886839**

The assignment of rail flows 2034 on rail network of the Package 1 investment scenario is shown in the following figure.

Figure 12.8 Assignment of rail freight flows on rail network under implementation of Package 1 investment scenario in 2034 (thousand. tonnes)



Although the biggest rail volumes will remain heading to(from)wards the Baltic ports, the growth on north-south direction can be expected as well. However, no rerouting of Finland-bound traffic can be expected. For the relations with the EU countries along the north-south axis, such traffic most likely be using the gates via the Baltic ports (i.e. Tallinn, Riga, Klaipeda, Polish ports) in combination with road transport. For the relations with CIS countries the broad rail outlets, possessed by Finland, most likely will be used (due to lower transportation costs).

In contrary to the modal shift effects caused by the package 1 investments to Rail Baltica, there will be no induced freight volumes.

12.3.2 Expected rail freight transport pattern in Package 2

From the point of view of freight traffic, the upgrades done according to Investment Package 2 scenario will have only slight improvement of operational speed of freight trains compared to the speeds of the Investment Package 1 scenario. The route still contains the legs of different gauge. The Rail Baltica traffic on the northern leg with broad gauge has to share the same tracks with quite intensive non-Rail Baltica traffic which goes towards the Baltic ports. The Package 2 flows distribution pattern on the networks to large extent echoes the Package 1 pattern.

The tables below show the modal shift estimates for the years 2016 and 2034 that could be gained by rail due to implementation of the Investment Package 2 scenario.

Table 12.11 Estimated tonnes shifted to rail due to implementation of Package 2 investment scenario in 2016

from/to	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	0	16750	0	14	14493	9369	0	212	7656	**48494**
EU rest	15555	0	349	0	76845	24281	170	0	0	**117200**
Finland	0	424	0	0	1093	0	0	4	1840	**3361**
Russia (Kal.)	68	0	33	0	0	35	0	0	0	**136**
Lithuania	8476	137441	9003	160	124842	19257	9139	4052	363828	**676198**
Latvia	8819	32728	0	33	32730	0	11402	366	15121	**101199**
Russia (NW)	0	1325	0	0	32673	10910	0	0	0	**44908**
Other rest	189	0	3	0	5948	284	0	0	0	**6424**
Poland	5295	0	5908	0	188861	5985	0	0	0	**206049**
Total	**38402**	**188668**	**15296**	**207**	**477485**	**70121**	**20711**	**4634**	**388445**	**1203969**

Table 12.12 Estimated tonnes shifted to rail due to implementation of Package 2 investment scenario in 2034

From\to	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	0	25807	0	29	24237	10919	0	335	11144	**72471**
EU rest	19000	0	297	0	102416	28671	167	0	0	**150551**
Finland	0	370	0	0	1468	0	0	3	2260	**4101**
Russia (Kal.)	60	0	29	0	0	49	0	0	0	**138**
Lithuania	14100	251186	15602	281	158196	28680	15683	6382	535930	**1026040**
Latvia	10816	56417	0	65	54755	0	19285	570	21880	**163788**
Russia (NW)	0	1489	0	0	33364	9772	0	0	0	**44625**
Other rest	163	0	2	0	5679	210	0	0	0	**6054**
Poland	6453	0	8609	0	303347	6003	0	0	0	**324412**
Total	**50592**	**335269**	**24539**	**375**	**683462**	**84304**	**35135**	**7290**	**571214**	**1792180**

The shifts under the Package 2 investment scenario score slightly better reaching 1.8 million tonnes in the year 2034. Nevertheless, this modal shift effect would be most felt for Lithuania- bound traffic than for the remaining Rail Baltica countries.

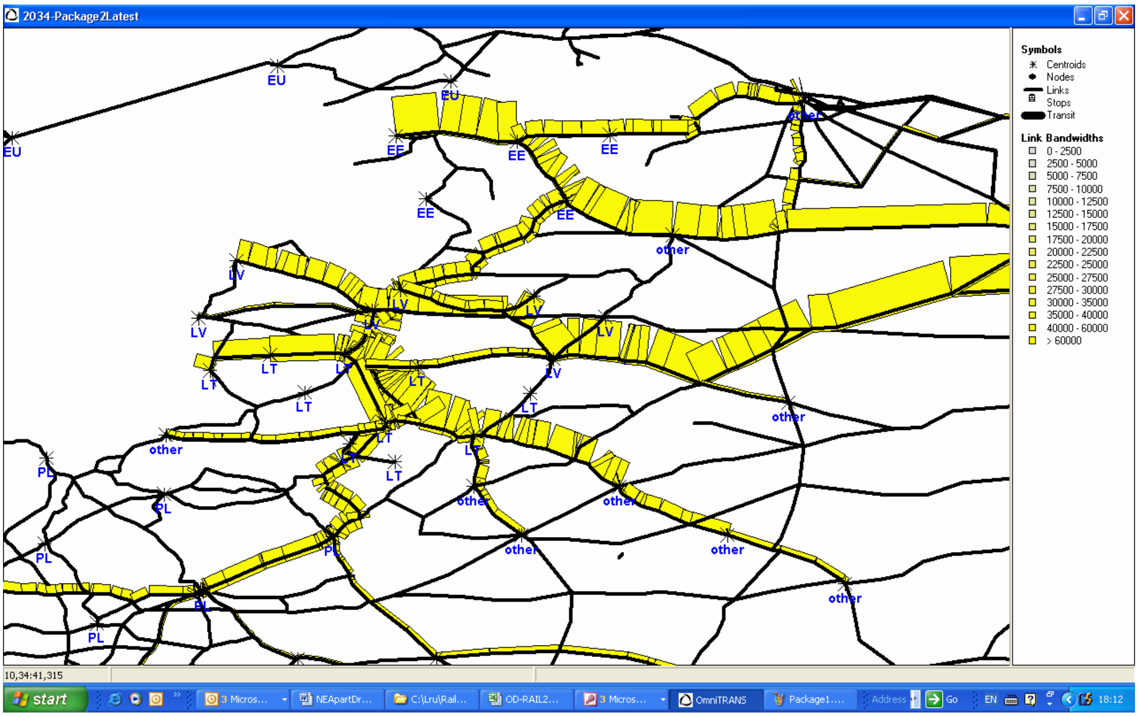
The estimated total volumes 2034 on rail network of the Baltic States in Package 2 scenario are shown by direction in the following table.

Table 12.13 Estimated total rail volumes on the networks of the Baltic States in Package 2 investment scenario in 2034 (tonnes)

From\to	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	5714879	26072	0	9324	378208	1034616	728742	384884	11144	**8287869**
EU rest	355167	0	297	759	376406	2672623	3287	0	0	**3408539**
Finland	26291	370	0	0	2292	9979	0	3	2260	**41195**
Russia (Kal.)	4188	19060	29	0	124391	5072	1770899	422405	0	**2346044**
Lithuania	1105993	365233	15602	349675	22059756	1686922	439559	2955102	1452570	**30430412**
Latvia	829179	68197	463	104958	2393065	1369	1112680	1538472	309532	**6357915**
Russia (NW)	38214038	7673727	1594542	4681817	4195548	26527109	0	1746776	899064	**85532621**
Other rest	8362231	1399033	215549	2875460	23232874	29305122	15	308783	289302	**65988369**
Poland	73980	0	8609	0	511229	98174	36386	32961	0	**761339**
Total	**54685946**	**9551692**	**1835091**	**8021993**	**53273769**	**61340986**	**4091568**	**7389386**	**2963872**	**203154303**

The following figure shows the assignment of rail flows 2034 on rail network organised under Package 2 investment scenario.

Figure 12.9 Assignment of rail freight flows on rail network under implementation of Package 2 investment scenario 2034 (thousand. tonnes)



Similar conclusions to the ones stated under the package 1 apply for the effects caused by the package 2 scenario.

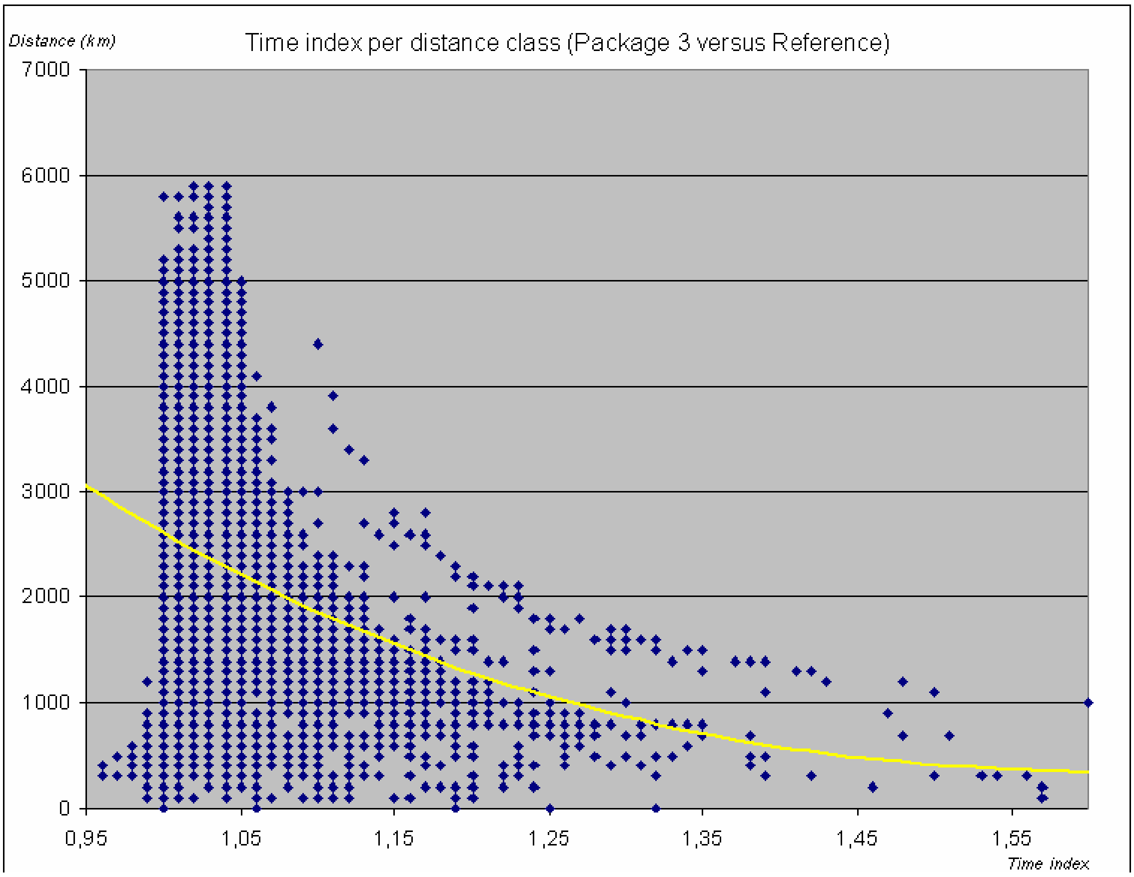
As in the previous case, there will be no induced freight volumes.

12.3.3 Expected rail freight transport pattern in Package 3

Compared to all other scenarios the railway network for the Investment Package 3 is special in a way that a standard gauge line will be going along the whole Rail Baltica route. Not only the operational speed is expected to be relatively high, but also the alignment will be made more optimal, thus resulting in shorter route lengths. It is expected that more modern traction and rolling stock will be used. It is also expected that goods to/from the terminals of Rail Baltica line will be delivered/taken directly by road transport and, where feasible, by broad gauge railway. Therefore, for calculation of the modal shift effects an egress/regress matrix was added to road transport OD matrix.

On the basis of the impedances matrices the time index values for OD matrix (134 x 134) were obtained. The following graph shows the distribution of time index value per distance class for the whole matrix. Compared to the distribution for Package 1 and Package 2, Package 3 graph shows more scatted pattern (i.e. more significant positive effect for a number of OD pair combinations).

Figure 12.10 Time index per distance class (Investment package 3)



The tables below show the modal shift estimates for the years 2016 and 2034 that could be taken-over by Rail Baltica rail due to implementation of the Investment Package 3 scenario.

Table 12.14 Estimated tonnes shifted to rail due to implementation of Package 3 investment scenario in 2016

From	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	0	22209	0	68	25056	11996	0	180	7285	**66794**
EU rest	23870	0	569	0	217238	46127	1179	0	0	**288983**
Finland	0	472	0	35	14044	0	0	0	8519	**23070**
Russia (Kal.)	14	0	0	0	162	30	7	0	0	**213**
Lithuania	25409	124982	1757	0	1066	59499	34303	5628	326951	**579595**
Latvia	12575	34124	0	2	30861	0	9120	266	10017	**96965**
Russia (NW)	0	154	0	0	11057	8898	0	4	0	**20113**
Other rest	207	0	4	0	3751	334	35	0	0	**4331**
Poland	11822	0	2657	0	545246	22382	0	0	0	**582107**
Total	**73897**	**181941**	**4987**	**105**	**848481**	**149266**	**44644**	**6078**	**352772**	**1662171**

Table 12.15 Estimated tonnes shifted to rail due to implementation of Package 3 investment scenario in 2034

From	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	0	53413	0	29	71546	21474	0	328	27322	**174112**
EU rest	39499	0	588	0	265083	60072	149	0	0	**365391**
Finland	0	728	0	0	3866	0	0	3	4757	**9354**
Russia (Kal.)	60	0	31	0	0	3	0	0	0	**94**
Lithuania	66985	625946	38551	283	150459	73523	18948	5909	1221557	**2202161**
Latvia	21574	115895	0	60	167783	0	15111	516	49754	**370693**
Russia (NW)	0	1316	0	7	34347	8163	0	36	0	**43869**
Other rest	155	0	0	0	5312	195	3	0	0	**5665**
Poland	12699	0	18109	0	883263	16277	0	0	0	**930348**
Total	**140972**	**797298**	**57279**	**379**	**1581659**	**179707**	**34211**	**6792**	**1303390**	**4101687**

Having a properly functioning Rail Baltica freight train service (i.e. premium trains) more than 4 million tonnes per year could be shifted from road to rail. With implementation of a competitive pricing policy, this positive effect could even grew up to 5-6 million tonnes in 2034. Finland-bound traffic could then be one of the major candidates for this additional modal shift.

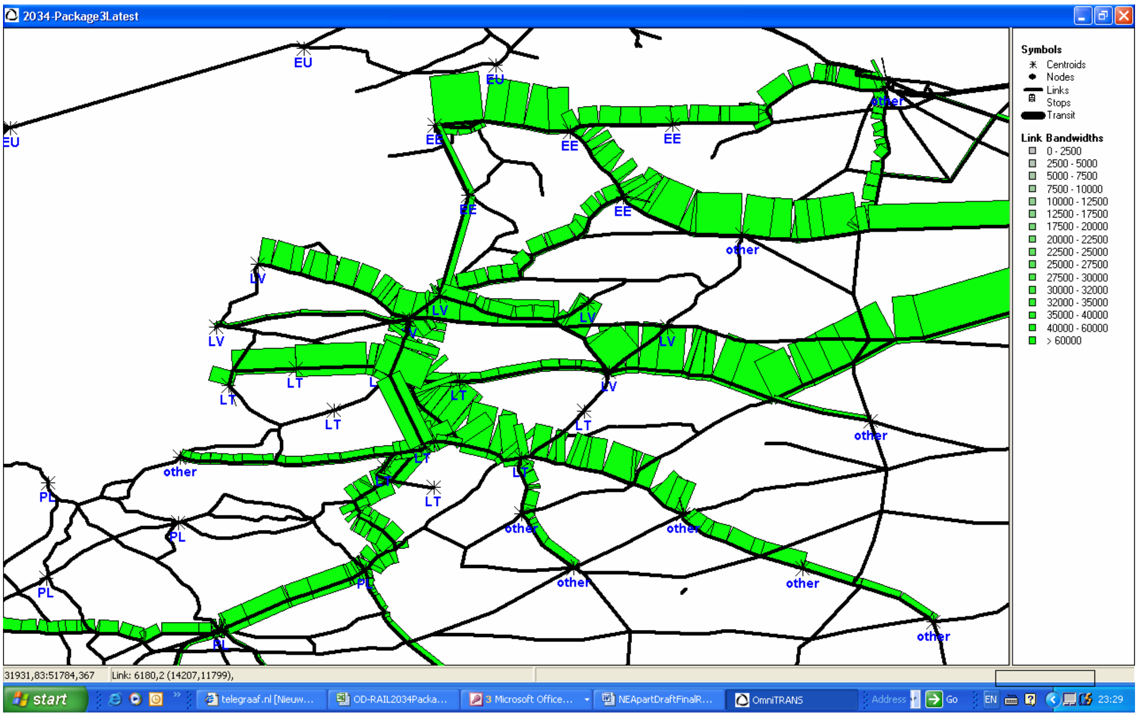
The estimated total volumes 2034 on rail network of the Baltic States having Package 3 scenario are shown by direction in the flowing table.

Table 12.16 Estimated total rail volumes on the networks of the Baltic States in Package 3 scenario in 2034 (tonnes)

From	Estonia	EU rest	Finland	Russia (Kal.)	Lithuania	Latvia	Russia (NW)	Other rest	Poland	Total
Estonia	5714879	53678	0	9324	425517	1045171	728742	384877	27322	**8389510**
EU rest	375666	0	588	759	539073	2704024	3269	0	0	**3623379**
Finland	26291	728	0	0	4690	9979	0	3	4757	**46448**
Russia (Kal.)	4188	19060	31	0	124391	5026	1770899	422405	0	**2346000**
Lithuania	1158878	739993	38551	349677	22052019	1731765	442824	2954629	2138197	**31606533**
Latvia	839937	127675	463	104953	2506093	1369	1108506	1538418	337406	**6564820**
Russia (NW)	38214038	7673554	1594542	4681824	4196531	26525500	0	1746812	899064	**85531865**
Other rest	8362223	1399033	215547	2875460	23232507	29305107	18	308783	289302	**65987980**
Poland	80226	0	18109	0	1091145	108448	36386	32961	0	**1367275**
Total	**54776326**	**10013721**	**1867831**	**8021997**	**54171966**	**61436389**	**4090644**	**7388888**	**3696048**	**205463810**

The following figure shows the distribution of rail flows in 2034 on rail network if organised under Package 3 investment scenario. In terms of shifted volumes, the Package 3 investment scenario scores the highest compared to other investment scenarios.

Table 12.17 Assignment of rail freight flows on rail network under implementation of Package 3 investment scenario in 2034 (thousand tonnes)



When considering the modal shift, the pricing/modernisation policies applied at the competing Baltic ports will eventually be an important factor for the resultant transportation patterns in the Baltic region, and on Rail Baltica route in particular.

When considering the modal shift, the pricing/modernisation policies applied at the competing Baltic ports will eventually be an important factor for the resultant transportation patterns in the Baltic region, and on Rail Baltica route in particular.

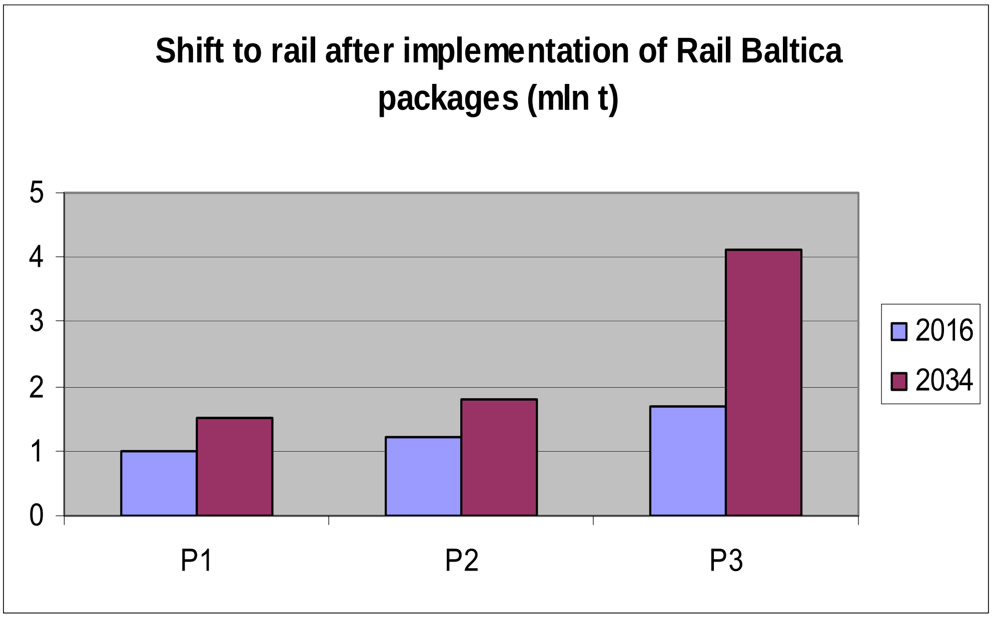
The usage of Rail Baltica route for the Finland bound traffic with the central/eastern regions (Poland, Slovak Republic, Romania, etc) will eventually depend on the competitiveness of the Rail Baltica service in relation to the routes via the Polish ports.

In contrary to modal shift effects, the will be no induced freight volumes.

12.4 Comparison of scenario effects

The modal shift effects caused by three different scenarios are visualised as bar chart in the figure below.

Figure 12.11 Freight volumes shifted to rail due to investments on Rail Baltica route in 2016 and 2034 (million t)



Based on the estimates, the following can be concluded:

- Subject to competitive pricing policy, P3 has the highest effect on shifting the freight from road to rail compared to P1 and P2
- When maturing, the P3 bound Rail Baltica service has the biggest potential to grow compared to the other two packages
- Although different gauges on Rail Baltica route still be the case in P1 or P2, implementation of these packages will show some positive initial effect due to moving of gauge change terminal from Sestokai to Kaunas (economic centre)

SECTION D: Financial and economic assessment

13 Financial assessment

This chapter documents the financial assessment of the Rail Baltica project.

The Financial Analysis gives an overview of the financial flows of investment, operating costs and revenues over the lifetime of the project for both infrastructure and transport services.

13.1 Methodology

The financial analysis is based on the recommendations outlined in DG Regio's *Guide to cost-benefit analysis of investment project.*

The results of the analysis are presented in terms of the financial internal rate of return on the total investment (FIRR/C) and own capital (FRR/K). The results are supplemented by a range of sensitivity analyses in order to assess the robustness of the results.

13.1.1 General approach

The financial analysis is carried out as an incremental analysis, i.e. it is an evaluation of the investment packages compared to the reference scenario.

Separate financial analyses are carried out for the three investment packages and the three sub-variants.

The financial analysis focuses on the cost and revenues from the perspective of three different agents:

1. The infrastructure manager.
2. The operator of passenger trains.
3. The operator of freight trains.

The assessment is carried out for all four countries as a whole.

The assessment includes all consequences in the entire rail network in the four countries and thus not only the affects on the Rail Baltica line.

The aim of the financial assessment is to get an indication of the financial sustainability of the project. However, given the fact that only very few concrete facts are available on the plans for implementing Rail Baltica, the analysis should not be seen as more than **an indication of the financial sustainability**.

This implies that pragmatic assumptions about infrastructure access charges and fares have been applied. It also implies that the co-financing rate have not been calculated explicitly as specified in the DG region guidelines. Instead it has been assumed that the total EU grant will amount to 60% of total investments costs (see section 13.2.1).

13.1.2 The elements of the analysis

The elements which are included in the financial analysis are shown in the table below.

Table 13.1 Elements of the financial analysis

Perspective	Element
Rail manager	Investment costs (and scrap value) EU financing Access charges from operators Maintenance costs
Operator, passenger trains	Net ticket revenue Net operation & maintenance Access charges to rail managers
Operator, freight trains	Net tariff revenue Net operation & maintenance Access charges to rail managers

The sections below describe how the elements have been calculated and what they include.

13.2 Analysis of elements

13.2.1 Rail manager

Investment costs

The total investment costs for implementing Rail Baltica are summarised in the table below for each of the investment packages.

The lifetime of the infrastructure is expected to exceed the time horizon of the analysis of 30 years and a residual value of the investments is therefore included in the assessment. The residual value is calculated on basis of an estimated lifetime of 50 years for the rail infrastructure.

It is estimated that it will take roughly 2 years to construct Package 1, while it will take respectively 4 years and 6 years to construct Package 2 and Package 3.

Table 13.2 Investment costs (million €2006, factor prices)

Variant	Pack 1 Main	Pack 1 Sub A Alt. alignm.	Pack 2 Main	Pack 2 Sub A Alt. alignm.	Pack 2 Sub B Alt. alignm.	Pack 3 Main	Pack 3 Sub A Alt. alignm.	Pack 3 Sub B No elec.
Construc. costs	978	826	1,546	1,652	1,450	2,368	2,401	1,831
Construc. period (years)	2	2	4	4	4	6	6	6

Note: See section 6 for a description of the main investment packages and the sub-variants.

EU financing

The potential funding sources for investments in Rail Baltica include: EU grants, loans (e.g. to be repaid via user payments) and national budgets. In addition the private sector could be involved in e.g. a sort of Public Private Partnership. Generally, railway infrastructure investments have had difficulties attracting private money and we assess that this is also the case for Rail Baltica so we only consider EU grants and contributions from national budgets in this analysis. Detailed feasibility studies will at a later stage have to illustrate if a potential for other sources of finance can be developed.

The Cohesion Fund is one of the major financing sources for investments in transport and environmental projects in the new Member States. The allocation of Cohesion Fund resources among the Member States depends on a number of criteria including the revenue generation capacity of the project. The maximum cover the Funds can contribute to a project is its funding-gap, which is the amount that is driving the FRR/K to be roughly equal to the discount rate. Technically the funding gap expressed in percentage can be computed by calculating the ratio of the (negative) NPV (on the full investment) to the (negative) present value of the investment cost. (See box explaining the rules for calculating the EU co-financing rate below).

In 2004 the EU adopted revised guidelines and financial regulations with regard to the Trans-European Transport Network, including the list of 30 priority projects. From a dedicated TEN-T budget construction costs can be co-financed up to 10%. Furthermore, for cross-border projects the maximum contribution from the TEN-T budget might be increased up to 50 % of investments.

At this stage, the total potential funding from EU grants can not be established a priori due to uncertainty about the level of infrastructure access charges and fares/tariffs on the Rail Baltica line. However, for illustrative purpose in the financial analysis it is pragmatically assumed that the total EU grants will amount to 60% of total investments costs.

The remaining funding is assumed to be contributed from the TEN-T budget and national sources - but could also be provided via loans from IFIs.

Calculation of EU co-financing

The calculation of the EU co-financing rate is described in the document "Guidance on the methodology for carrying out Cost-Benefit Analysis" (DG REGIO, august 2006), which will apply in the 2007-2013 Programming Period.

Article 55.2 maintains the funding-gap method as the basis for the calculation of the EU grant in revenue generating projects, stipulating that the eligible expenditure cannot exceed the current value of the investment costs less the current value of the net revenue from the investment over the lifetime of the project.

In contrast to the 2000-2006 period, the eligible expenditures and not the co-financing rate is modulated in order to relate to the contribution from the Funds to the revenues generated by the project. Also it should be noted that Article 55 applies to all projects and not just to major projects.

Article 55 applies to investment operations which generate net revenues through charges borne directly by users.

Access charges from operators

Infrastructure access charges vary with regard to structure and level across the European countries. Access charges for passenger trains range from about 0.5 EUR per train-km (Sweden) to about 4.0 EUR per train-km (Germany, France).

Some countries differentiate charges according to the travel speed of the specific line, while others use a flat rate. In Poland the average charges for high quality train types according to the Polish Railway's price list for 2005/2006 are:

- Vmax 100-120 km/h 2.41 EUR per train-km
- Vmax > 140 km/h 4.39 EUR per train-km

Payment for railway infrastructure use in the Baltic countries is at a similar level as in Poland.

The above suggests that charges might indeed increase compared to today's level for the Rail Baltica line for the package 2 and 3 solutions where the design speed is 160 and 200 km/h. However, as the future pricing policy is unknown for the sake of simplicity a fixed rate has been applied for the reference scenario and all investment packages.

The applied access charge is presented in the following table.

Table 13.3 Access charges for passenger trains per train-km (€2006, factor prices)

	Reference	Package 1	Package 2	Package 3
Passenger trains	2.41	2.41	2.41	2.41

Source: Consultant's assumption.

As for passenger trains, access charges for freight trains vary in level. The range is from 0.4 EUR per train-km (Sweden) to more than 8.0 EUR per train-km (Slovakia).

In Poland the average infrastructure access charges for normal freight trains is 5.37 €/train-km. Payment for railway infrastructure use in the Baltic countries are at the same level as the Polish rate.

In Germany access infrastructure charges are approx. 65% higher for express freight trains compared to normal freight trains. However, as for passenger trains a fixed infrastructure access charge has been applied for freight trains for the reference scenario in all investment packages.

Table 13.4 Access charges for freight trains per train-km (€2006, factor prices)

	Reference	Package 1	Package 2	Package 3
Freight trains	5.37	5.37	5.37	5.37

Source: Consultant's assumption.

It is important to note that the assumptions has no implications with respect to the economic analysis as the infrastructure charges cancels out in the analysis as a benefit for the rail manager and a cost for the operators. However, the level of access charges of course affects the financial analyses for these two agents.

Maintenance costs

The maintenance costs of the rail manager include all costs for maintaining tracks, signalling, telecommunication, catenary system and surrounding areas. The costs have been estimated on an annual basis in the planning period (2007-2045) split on these main components for both the reference scenario and the three main investment packages. The approach is described in more detail in Annex C.

The cost estimates reflects the costs of carrying out the necessary maintenance work (including error corrections) which is necessary to maintain the specified level of service (current standard for the reference scenario).

The estimated maintenance costs are summarised in the table below.

Table 13.5 Maintenance costs over the planning period (million €2006, factor prices)

	2007-2015	2016-2045	Total
Reference case	60	355	415
Package 1	60	333	393
Package 2	60	333	393
Package 3	60	514	574

Source: Consultant's own estimates - see Annex C.

It should be noted that the totals in the table above are simple aggregated costs over the years and thus do not indicate costs in net present value. In fact, a larger proportion of the costs in the reference scenario occur early in the investment period compared to the investment packages.

13.2.2 Rail operator, passenger

Net ticket revenue

The ticket revenue for the rail operator running passenger trains is calculated on the basis of fares per passenger.

Across Europe fares are often differentiated with respect to travel speed, which reflects that transport users are willing to pay a higher price for a high speed product. This suggests that fares might be set at a higher level compared to today's level for the Rail Baltica line for the package 2 and 3 solutions where the travel speed is higher.

However, it is important to notice that future tariff levels will be influenced by many other factors, such as existing charging policies, the market situation and political considerations. Therefore, in this analysis for the sake of simplicity a flat rate for all scenarios has been applied. This assumption might be a simplification but it insures consistency across the investment packages in relation to the demand estimated in the traffic models (where a fixed rate for all alternatives has also been applied).

It is difficult to obtain information on fares per km. A small survey of fares in the Baltic States and Poland both at the overall level and for actual travel relations revealed fares on a level of approx. 0.01-0.07 EUR per passenger-km. Generally, present rail ticket prices in the Baltic countries are lower than in Poland, which may be caused by the fact that more passengers get discounts[25].

[25] According to PKP Intercity, in 2004 58.3 % of all passengers paid full ticket price. 15.7 % of all passengers get statutory fare reduction. Seeking a compromise between market expectations and own economic interests the railways introduced several commercial offers (Senior's travels, family tickets, last minute offers). The share of passengers with statutory fare reductions is even higher in the Baltic States (in Lithuania in 2004 38 % of railway passengers got fare reductions).

The development of tariffs for long-distance services in several Western European countries has been highlighting the tendency that tariff schemes are more and more oriented on market-oriented structures. The latter developments imply rising user costs. Also a comparison of rail tariffs in the concerned countries (especially the Baltic States) with other EU countries confirms the assumption that user costs for rail are expected to rise. Overall the costs are assumed of rising by 0.35 percent annually.

On this basis, the fares are based on present (2006) ticket prices in Poland (full price, second class).

For the sake of comparison it should be noted that the difference in price level for InterCity (IC) trains and InterCityExpress (ICE) trains operated in Germany are approx. 23%.

The applied train fares are shown in the table below.

Table 13.6 Trains fares for passengers per passenger-km (€2006 per passenger per km, factor prices)

Reference	Package 1	Package 2	Package 3
0.042	0.042	0.042	0.042

Source: Consultant's assumption.

Changing the fares will affect the demand. However, assuming that a price increase will *not* affect the demand, increased fares in the Rail Baltica corridor for the investment packages will increase the operator's revenue. On the other hand the transport user will experience a loss due to the higher price.

Net operation & maintenance

Passenger train costs are based on data for modern Euro trains.

The estimated costs for the operators cover depreciation of the trains, operating costs (energy, cleaning and service etc.), maintenance costs and overhead costs. The costs are quantified for long distance locomotive driven trains with 6 coaches and a capacity of 518 passengers.

It is assumed that the number of passengers per train increase with the service level across packages, because a more attractive product is offered. The load factor influences the applied unit costs per passenger-km.

The applied unit costs used are shown in the table below.

Table 13.7 Unit costs per km for passenger trains (€2006, factor prices)

Unit	Reference	Package 1	Package 2	Package 3
Passenger-km	0.043	0.028	0.030	0.030

Source: Consultant's own estimates.

Access charges to rail managers
The applied access charges are described in section 13.2.1.

13.2.3 Rail operator, freight

Net tariff revenue
The revenue from freight tariffs for the rail operator running freight trains is calculated on the basis of fares per tonne.

The prices for freight transport are more and more based on individual contracts rather than on tariffs. Revenues per tonne-km for PKP Cargo in 2004 were at a level of 0.035 EUR and for Lithuania the level was around 0.027 EUR. The figures for other European rail operators are similar (Denmark 0.038 EUR, Germany 0.043 EUR).

As for passenger trains, the tariffs might be set at a higher level compared to today's level for the Rail Baltica line for the package 2 and 3 solutions where the travel speed is higher. However, again for the sake of simplicity a flat rate for all scenarios has been applied.

The applied tariffs are shown in the table below.

Table 13.8 Train fares per freight-km (€2006 per tonne per km, factor prices)

Reference	Package 1	Package 2	Package 3
0.038	0.038	0.038	0.038

Source: Consultant's assumption.

Net operation & maintenance
The costs for the freight train operators are based on data from PKP Cargo. It is assumed that the trains have a load factor of 600 tonnes per train.

The freight train costs are the same in the reference scenario and the 3 packages, because all freight trains will be operated at the same speed level.

The applied unit costs used are shown in the table below.

Table 13.9 Unit costs per km for freight trains (€2006, factor prices)

Unit	Reference	Package 1	Package 2	Package 3
Train-km	15.88	15.88	15.88	15.88

Source: PKP Cargo.

Access charges to rail managers
The applied access charges are described in section 13.2.1.

13.3 Result of the financial analysis

13.3.1 Rail manager

The results of the financial analysis for the three investment packages for the rail manager are presented in the tables below.

Table 13.10 Financial analysis, rail manager, ***Investment package 1*** *(million €2006, NPV and selected years)*

	NPV	2010	2013	2014	2015	2016	2020	2030	2040
Investment costs	-646	0	0	-489	-489	0	0	0	0
Access charges from operators	161	0	0	0	0	14	15	17	18
Maintenance costs	29	0	0	0	0	0	-8	-8	-14
Scrap value, investment	58	0	0	0	0	0	0	0	0
Cash flow in total	**-398**	**0**	**0**	**-489**	**-489**	**14**	**8**	**9**	**4**
FIRR on investment (FRR/C)	**-0.3%**								
EU financing	388	0	0	293	293	0	0	0	0
Financial NPV (FNPV)	**-10**	**0**	**0**	**-196**	**-196**	**14**	**8**	**9**	**4**
FIRR on own capital (FRR/K)	**4.7%**								

Table 13.11 Financial analysis, rail manager, ***Investment package 2*** *(million €2006, NPV and selected years)*

	NPV	2012	2013	2014	2015	2016	2020	2030	2040
Investment costs	-1,074	-387	-387	-387	-387	0	0	0	0
Access charges from operators	200	0	0	0	0	18	19	21	22
Maintenance costs	29	0	0	0	0	0	-8	-8	-14
Scrap value, investment	92	0	0	0	0	0	0	0	0
Cash flow in total	**-753**	**-387**	**-387**	**-387**	**-387**	**18**	**11**	**13**	**8**
FIRR on investment (FRR/C)	**-0.9%**								
EU financing	644	232	232	232	232	0	0	0	0
Financial NPV (FNPV)	**-109**	**-155**	**-155**	**-155**	**-155**	**18**	**11**	**13**	**8**
FIRR on own capital (FRR/K)	**3.4%**								

Table 13.12 Financial analysis, rail manager, ***Investment package 3*** *(million €2006, NPV and selected years)*

	NPV	2010	2013	2014	2015	2016	2020	2030	2040
Investment costs	-1,730	-395	-395	-395	-395	0	0	0	0
Access charges from operators	305	0	0	0	0	20	24	35	40
Maintenance costs	-28	0	0	0	0	0	-7	-7	-12
Scrap value, investment	141	0	0	0	0	0	0	0	0
Cash flow in total	**-1,312**	**-395**	**-395**	**-395**	**-395**	**20**	**18**	**28**	**27**
FIRR on investment (FRR/C)	**-1.1%**								
EU financing	1,038	237	237	237	237	0	0	0	0
Financial NPV (FNPV)	**-274**	**-158**	**-158**	**-158**	**-158**	**20**	**18**	**28**	**27**
FIRR on own capital (FRR/K)	**2.6%**								

The results of the financial analysis for the rail manager for the three variant are summarised in the table below.

Table 13.13 Financial analysis, rail manager, summary of results (million €2006, NPV)

NPV	P1	P2	P3
Investment costs	-646	-1,074	-1,730
Access charges from operators	161	200	305
Maintenance costs	29	29	-28
Scrap value, investment	58	92	141
Cash flow in total	**-398**	**-753**	**-1.312**
FIRR on investment (FRR/C)	**-[1]**	**-[1]**	**-[1]**
EU financing	388	644	1,038
Financial NPV (FNPV)	**-10**	**-109**	**-274**
FIRR on own capital (FRR/K)	**4.7%**	**3.4%**	**2.6%**

Note: [1)] Negative.

The financial analysis shows that none of the investment packages are financially viable for the rail manager without direct EU co-financing.

The analysis also shows that assuming funding from EU grants equal to 60% of total investments costs investment package 1 is almost financially viable for the rail manager (i.e. NPV of -10 million €) when taking into account the scrap value of the investment. For investment package 2 and 3 even with a co-financing of 60% there is still a gap to close before the investment is viable for the infrastructure manager.

For the investments to be viable for the manager the infrastructure access charges for both passenger and freight traffic *in the Rail Baltica corridor* needs to be increase by approx. 5% for package 2 and approx. 20% for package 3[26].

Hence, from the rail manager's perspective investment package 1 is the most attractive package while investment package 3 is the least attractive of the three alternatives.

The results for the five sub-variants are presented below.

[26] It should be noted that the increase in the charge is only applied for the traffic in the Rail Baltica corridor in the project scenarios and not in the reference scenarios, which essentially means that it is assumed that the existing and new traffic in the corridor are subject to a higher charge.

Table 13.14 Financial analysis, rail manager, summary of results for the sub-variants (million €2006, NPV)

NPV	Sub 1A	Sub 2A	Sub 2B	Sub 3A	Sub 3B
Investment costs	-546	-1,147	-1,007	-1,754	-1,338
Access charges from operators	161	200	200	305	305
Maintenance costs	29	29	29	-28	-28
Scrap value, investment	49	99	87	143	109
Cash flow in total	-307	-820	-692	-1,334	-952
FIRR on investment (FRR/C)	-[1]	-[1]	-[1]	-[1]	-[1]
EU financing	327	688	604	1,053	803
Financial NPV (FNPV)	21	-132	-88	-281	-149
FIRR on own capital (FRR/K)	5.6%	3.2%	3.6%	2.6%	3.4%

Note: [1)] Negative.

The result for sub-variant 1A is a little better than for investment package 1 reflecting the lower investment costs. The small change is however enough to make it financially viable when taking account of the 60% co-financing rate.

The result for the sub-variant of package 2A and 2B are almost similar to the result for package 2. They have marginally lower and higher rates of return respectively reflecting the higher and lower investment costs. Similarly the result for the sub-variant A (Tallinn-Parnu) of package 3 is almost similar to the result for package 3. However, for the sub-variant 3B (no electrification) FRR/K increase to 3.4% because of the significantly reduced investment costs.

13.3.2 Rail operators, passenger

The results of the financial analysis for the three investment packages for the rail operator of passenger trains are presented in the tables below.

*Table 13.15 Financial analysis, rail operator, passenger, **Investment package 1** (million €2006, NPV and selected years)*

	NPV	2016	2020	2030	2040
Net ticket revenue	151	15	15	15	55
Net operation and maintenance	-130	-13	-13	-13	-39
Access charges to rail managers	-47	-5	-5	-5	-13
Cash flow in total	**-26**	**-2**	**-2**	**-3**	**4**
FIRR on own capital (FRR/K)	**n.a.**				

*Table 13.16 Financial analysis, rail operator, passenger, **Investment package 2** (million €2006, NPV and selected years)*

	NPV	2016	2020	2030	2040
Net ticket revenue	210	20	20	22	63
Net operation and maintenance	-250	-23	-24	-26	-44
Access charges to rail managers	-65	-6	-6	-7	-15
Cash flow in total	**-105**	**-9**	**-10**	**-11**	**4**
FIRR on own capital (FRR/K)	**n.a.**				

*Table 13.17 Financial analysis, rail operator, passenger, **Investment package 3** (million €2006, NPV and selected years)*

	NPV	2016	2020	2030	2040
Net ticket revenue	205	19	20	21	140
Net operation and maintenance	-237	-22	-23	-25	-98
Access charges to rail managers	-64	-6	-6	-7	-33
Cash flow in total	**-96**	**-8**	**-9**	**-10**	**10**
FIRR on own capital (FRR/K)	**n.a.**				

The results of the financial analysis for the rail operator of passenger trains for the three main variants are summarised in the table below.

Table 13.18 Financial analysis, rail operator, passenger, summary of results (million €2006, NPV)

NPV	P1	P2	P3
Net ticket revenue	151	210	205
Net operation and maintenance	-130	-250	-237
Access charges to rail managers	-47	-65	-64
Cash flow in total	**-26**	**-105**	**-96**
FIRR on own capital (FRR/K)	**n.a.**	**n.a.**	**n.a.**

The financial analysis shows that apparently none of the investment packages are financially viable for the rail operator running passenger trains. However, investment package 1 is almost in equilibrium.

The results heavily depend on the applied assumptions regarding fares and infrastructure access charges. Nevertheless, it should be noted that with a negative cash flow for the operator of passenger trains there is a risk that no company will operate the Rail Baltica line. However, with adjustments of the fares and tariffs it should be possible to make it attractive to operate the line.

Assuming that demand is unaffected by an increase in the fares, the fares in the Rail Baltica corridor needs to be increased by approx. 5% for package 1, 15% for package 2 and 13% for package 3 for the project to be financially viable for the operator of passenger trains[27].

The results for the sub-variants 1A, 2A, 2B, 3A and 3B are identical to the results of package 1, 2 and 3 respectively as none of the parameters for the operator are changed significantly.

13.3.3 Rail operators, freight

The results of the financial analysis for the three investment packages for the rail operator running freight trains are presented in the tables below.

Table 13.19 Financial analysis, rail operator, freight, ***Investment package 1*** *(million €2006, NPV and selected years)*

	NPV	2016	2020	2030	2040
Net ticket revenue	483	41	44	52	55
Net operation and maintenance	-336	-28	-31	-36	-39
Access charges to rail managers	-114	-10	-10	-12	-13
Cash flow in total	**33**	**3**	**3**	**4**	**4**
FIRR on own capital (FRR/K)	**n.a.**				

Table 13.20 Financial analysis, rail operator, freight, ***Investment package 2*** *(million €2006, NPV and selected years)*

	NPV	2016	2020	2030	2040
Net ticket revenue	572	51	54	61	63
Net operation and maintenance	-398	-36	-37	-42	-44
Access charges to rail managers	-135	-12	-13	-14	-15
Cash flow in total	**39**	**3**	**4**	**4**	**4**
FIRR on own capital (FRR/K)	**n.a.**				

[27] It should be noted that the increase in fares is only applied for the traffic in the Rail Baltica corridor in the project scenarios and not in the reference scenarios, which essentially means that it is assumed that the existing and new traffic in the corridor are subject to higher fares.

Table 13.21 Financial analysis, rail operator, freight, ***Investment package 3*** *(million €2006, NPV and selected years)*

	NPV	2016	2020	2030	2040
Net ticket revenue	1,026	60	78	122	140
Net operation and maintenance	-715	-42	-54	-85	-98
Access charges to rail managers	-242	-14	-18	-29	-33
Cash flow in total	**70**	**4**	**5**	**8**	**10**
FIRR on own capital (FRR/K)	**n.a.**				

The results of the financial analysis for the rail operator, freight trains for the three main variants are summarised in the table below.

Table 13.22 Financial analysis, rail operator, freight, summary of results (million €2006, NPV)

NPV	P1	P2	P3
Net ticket revenue	483	572	1,026
Net operation and maintenance	-336	-398	-715
Access charges to rail managers	-114	-135	-242
Cash flow in total	**33**	**39**	**70**
FIRR on own capital (FRR/K)	**n.a.**	**n.a.**	**n.a.**

The financial analysis shows that apparently all of the investment packages are financially viable for the rail operator running freight trains. The results are almost identical for the investment packages.

The results for the sub-variants 1A, 2A, 2B, 3A and 3B are identical to the results of package 1, 2 and 3 respectively as none of the parameters for the operator are changed significantly.

13.3.4 Sensitivity analysis

Results of the financial assessment is subject to uncertainty due to a relatively rough definition of the investment packages, limited knowledge about fares and access charges and uncertainty about the rail manager's maintenance costs and the operator's operation and maintenance costs. To assess the robustness of the results a number of sensitivity analyses have been carried out.

The following table presents the assumptions changed in each of the sensitivity analyses carried out in the financial analysis for the rail manager.

Table 13.23 Description of the sensitivity analyses, rail manager

Sensitivity analysis	Description
Low investment costs	Effect of investment costs reduced by 20%
High investment costs	Effect of investment costs increased by 50%
Low EU grant	Effect of EU co-financing reduced to 25%
High EU grant	Effect of EU co-financing increased to 75%
Low maintenance, manager	Effects of (net) maintenance costs reduced by 25%
High maintenance, manager	Effects of (net) maintenance costs increased by 25%
Low access charges	Effect of access charges reduced by 25%*
High access charges	Effect of access charges increased by 25%*

* It should be noted that the change in the charge is applied for all traffic in both the reference and project scenario and thus not only to the traffic in the Rail Baltica corridor in the project scenario as was the case with the break-even analyses in section 13.3.1.

The table below presents the results of the sensitivity analyses for the rail manager.

Table 13.24 Results of the sensitivity analyses, rail manager

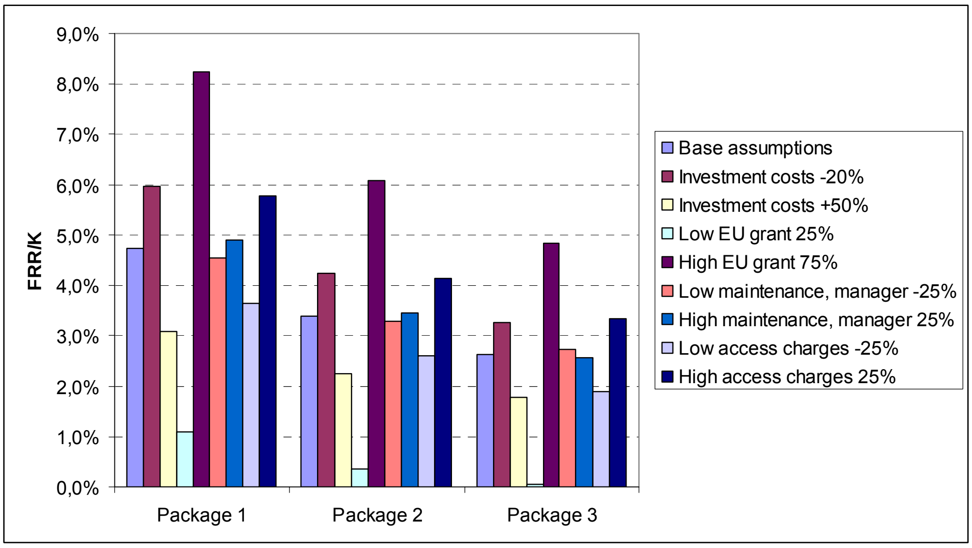
	Package 1		Package 2		Package 3	
	FNPV	FRR/K	FNPV	FRR/K	FNPV	FRR/K
Base assumptions	**-10**	**4.7%**	**-109**	**3.4%**	**-274**	**2.6%**
Investment costs -20%	30	6.0%	-41	4.2%	-163	3.3%
Investment costs +50%	-111	3.1%	-277	2.2%	-549	1.8%
Low EU grant 25%	-237	1.1%	-484	0.4%	-879	0.0%
High EU grant 75%	87	8.2%	52	6.1%	-14	4.8%
Low maintenance, manager -25%	-18	4.5%	-116	3.3%	-267	2.7%
High maintenance, manager 25%	-3	4.9%	-101	3.5%	-281	2.6%
Low access charges -25%	-51	3.6%	-159	2.6%	-350	1.9%
High access charges 25%	30	5.8%	-59	4.1%	-197	3.3%

The table shows that the investment costs and the size of the EU grant significantly influence the financial result on the invested capital. Furthermore, the level of the infrastructure access charge is also important for the overall results.

The analyses also shows that the managers estimated maintenance costs are of minor importance as a variation of the estimated net maintenance costs of 25% does not significantly change the results.

The results are also illustrated in the figure below.

Figure 13.1 Results of the sensitivity analyses, FRR/K



The following table presents the assumptions changed in each of the sensitivity analyses carried out in the financial analysis for the operators of passenger and freight trains.

Table 13.25 Description of sensitivity analyses, rail operators

Sensitivity analysis	Explanation
Low operation and maintenance, operator	Effect of unit costs for operators operation and maintenance reduced by 25%
High operation and maintenance, operator	Effect of unit costs for operators operation and maintenance increased by 25%
Low fares*	Effect of fares reduced by 25%
High fares*	Effect of fares increased by 25%
Low access charges*	Effect of access charges reduced by 25%
High access charges*	Effect of access charges increased by 25%
Low traffic growth	Effect of the shift of traffic reduced by 25%
High traffic growth	Effect of the shift of traffic increased by 25%

* It should be noted that the change in the access charges/fares is applied for all traffic in both the reference and project scenario and thus not only to the traffic in the Rail Baltica corridor in the project scenario as was the case with the break-even analyses in section 13.3.1 and 13.3.2.

The table below presents the results of the sensitivity analyses for the rail manager.

Table 13.26 Results of the sensitivity analyses, rail operator

	Package 1		Package 2		Package 3	
FNPV	Passenger	Freight	Passenger	Freight	Passenger	Freight
Base assumptions	**-26**	**33**	**-105**	**39**	**-96**	**70**
Low operation and maintenance, operator -25%	7	117	-43	138	-36	248
High operation and maintenance, operator 25%	-58	-51	-168	-61	-155	-109
Low fares -25%	-64	-88	-158	-104	-147	-187
High fares +25%	12	153	-53	182	-45	326
Low access charges -25%	-14	61	-89	73	-80	130
High access charges 25%	-38	4	-122	5	-112	9
Low traffic growth, -25%	-19	25	-79	29	-72	52
High traffic growth , 25%	-32	41	-132	49	-120	87

The table shows that the estimated operation and maintenance costs for the operator and the fares/tariffs significantly influence the financial result for the operator of both passenger and freight trains. The level of the infrastructure access charge is also important for the overall results.

Finally, the analyses shows that changes in the estimated shift of traffic from road to rail are of minor importance as a variation of the estimated shift of traffic of 25% does not significantly change the results. When the shift of traffic is reduced the revenue from fares/tariffs is reduced but at the same time the payment of infrastructure charges to the rail manager is also reduced (and almost proportional).

Figure 13.2 Results of the sensitivity analyses, rail operator, passenger, FNPV

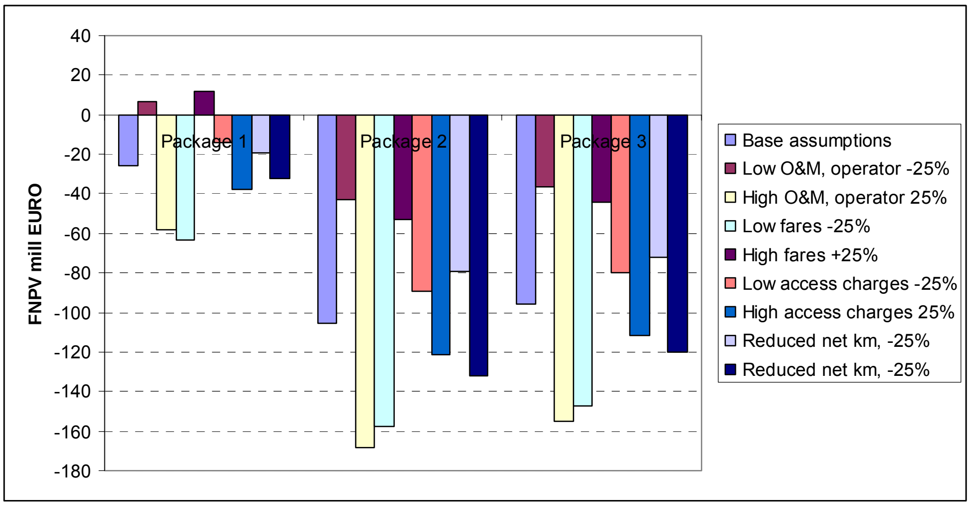
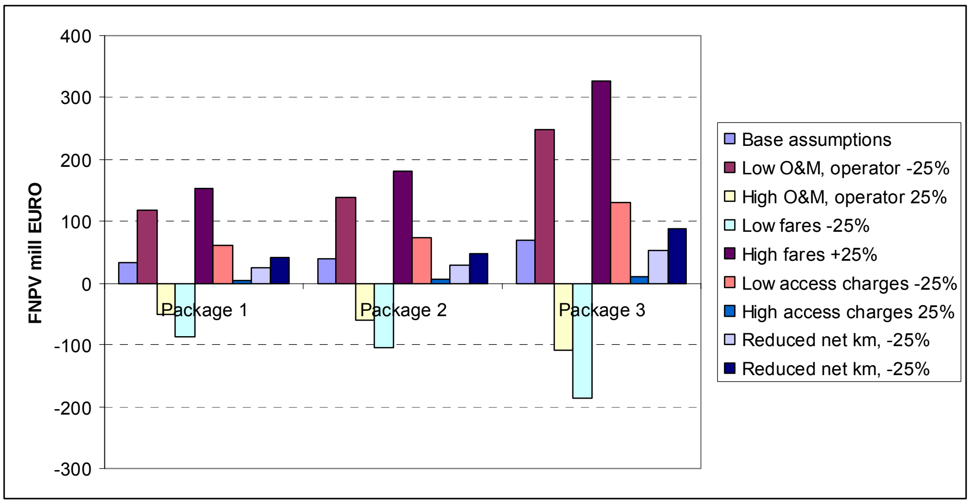


Figure 13.3 Results of the sensitivity analyses, rail operator, freight, FNPV



13.4 Conclusion

The result of the financial assessment is subject to uncertainty due to a number of factors including the rough definition of the investment packages, limited knowledge about fares and infrastructure access charges as well as uncertainty about the rail manager's maintenance costs and the operator's operation and maintenance costs.

However, with the current assumptions and traffic analyses none of the investment packages seem to be financially viable for the rail manager assuming funding from EU grants equal to 60% of total investments costs and taking into account the scrap value of the investment. From the rail manager's perspective investment package 1 is most attractive while investment package 3 is the least attractive. Higher revenue from access charges in package 2 and 3 compared to package 1 cannot outweigh the higher investment costs. However, the investment can become viable for the manager if the infrastructure access charges for both passenger and freight traffic is increased just slightly (5-20%) compared to the charge applied in the reference scenario in the corridor.

For the rail operator running passenger trains none of the investment packages are financially viable. The least costly investment is package 1 while the most costly is package 2. Assuming that demand is unaffected by an increase in the fares, the fares in the Rail Baltica corridor needs to be increased by just 5-15% for the project to be financially viable for the operator of passenger trains.

In contrast to the results for the rail operator running passenger trains, the financial analysis shows that all investment packages variants are financially viable for the rail operator running freight trains. Most profitable is investment package 3 and least attractive is investment package 1. However, taking into account the considerable uncertainty, the results are almost identical for the three main investment packages.

All in all, the financial analysis shows a mixed picture where none of the investment packages dominate the other packages. This means that different financial perspectives are associated with different preferences. It should be stressed that the calculated results heavily depends on the applied assumptions regarding the fares and infrastructure access charges as well as the rail manager's maintenance costs and the operator's operation and maintenance costs.

An important advantage of Package 1 - compared to Packages 2 and 3 - is that it allows for stepwise implementation of Rail Baltica. In case that high demand for transport services materialises, additional investments can be undertaken.

The uncertainty on assessing the effects of small investments is smaller than for large investments. This also favours Package 1 to Packages 2 and 3.

14 Economic assessment

The economic analysis encompasses more than just the considerations of the financial returns of the project, but most of the project data on costs and benefits are provided by the financial analysis from the previous chapter.

The economic analysis is based on a traditional cost-benefit approach and follows the recommendations outlined in DG Regio's *Guide to cost-benefit analysis of investment project* and the recommendations of the so-called HEATCO[28] project for assessing infrastructure projects.

The economic results of the cost-benefit analysis are presented in terms of the net present value and the internal rate of return. The results will be supplemented by a range of sensitivity analyses in order to assess the robustness of the results.

14.1 Methodology

In this section the methodology applied for the economic assessment is described.

The purpose of the economic analysis is to quantify the costs and benefits of each Rail Baltica investment package compared to a reference case without the investment. The reference case and the investment packages were described in Chapter 6.

The results of the economic analysis are for each investment package presented as the net present value (NPV) of the costs and benefits of the investment package compared to the reference case. Moreover, the results are presented in terms of the internal rate of return (IRR) and the benefit-cost ratio (B/C ratio).

[28] HEATCO (2006): "Developing Harmonised European Approaches for Transport Costing and Project Assessment", draft final [June 2006]. HEATCO's primary objective is the development of harmonised guidelines for project assessments concerning transport infrastructure at the EU level.

14.1.1 Key assumptions and general approach

The economic assessment is, as mentioned, based on DG Regio's *Guide to cost-benefit analysis of investment projects* and the recommendations of the HEATCO project for assessing infrastructure projects.

The following table summarises the key methodological assumptions.

Table 14.1 Overview of key methodological assumptions

Element	Assumption
Overall method	Cost-benefit analysis in factor prices based on welfare theoretic foundation.
Planning horizon	30 years after the opening of the links, cf. *Guide to cost-benefit analysis of investment projects.*
Opening year	2016
Scrap value	A scrap value for the rail line is included in 2045 based on linear depreciation and a lifetime of 50 years, cf. HEATCO
Discount rate	5%, cf. *Guide to cost-benefit analysis of investment projects.*
Year of result (NPV-values)	2006
Price level	Fixed 2006-level
Tax distortion factor	Not included, cf. HEATCO
Time values for passenger transport	National unit values, cf. HEATCO.
Time values for freight transport	Weighted average based on data from Sweden
Valuation of air pollution	National unit values, cf. HEATCO.
CO_2-price	24 €/tonne in 2000-2009 increasing to 61 €/tonne in 2040, cf. HEATCO
Costs of accidents	National unit values, cf. HEATCO.
Real growth of GDP, 2006-45	Average of 3.4% p.a., cf. PRIMES (until 2040)
Real growth in time values	Expected growth in GDP applied with an elasticity of 0.7 (hence time values grow slower than GDP), c.f. HEATCO.
Real growth in costs of accidents and air pollution	Expected growth in GDP applied with an elasticity of 1.0, c.f. HEATCO.

14.1.2 Elements of the cost-benefit analysis

The elements which are included in the economic analyse have been grouped into 3 main categories: Effects for transport users, effects for the States and external effects.

The elements are shown in the table below.

Table 14.2 Elements of the cost-benefit analysis

Main category	Element	Effect
Transport users	Passenger transport	Travel time savings
		Ticket costs
	Freight transport	Travel time savings
		Ticket costs
State	Investments	Investment costs, rail
		Scrap value, rail
		Change in operation and maintenance, roads
	Rail managers	Access charges from operators
		Net operation and maintenance on the rail line
	Rail operators	Net ticket revenue
		Net operation and maintenance for the trains
		Access charges to rail managers
External effects	Air pollution	
	Climate change (CO_2)	
	Accidents	

The user benefits for existing traffic are calculated as the change in generalised travel costs (time savings, changes in vehicle operating costs and ticket costs). User benefits for transferred or induced traffic are calculated through the "rule of the half" in which these users are given half of the change in generalised travel costs.

14.1.3 Reservations

The above elements are the key elements in analyses of transport investments, and they are considered decisive as to whether the investment is economically profitable.

However, besides the above elements, new infrastructure may have other effects. A list of potential effects is shown in the table below.

The direct effects are not included in the cost-benefit analysis, because it has not been possible to quantify/value them. The indirect effects should not be part of a cost-benefit analysis, because they are considered to have regional effect rather than actual economic effect from society as a whole.

Table 14.3 Potential effects which are not included in the cost-benefit analysis

Category	Effect
Direct effects	Inconvenience during construction
	Environmental effects from construction of new line
	Effects on noise levels
Indirect effects	Business development
	Location of companies
	Effects on tourism

Furthermore, it is worth noting that the result of the economic assessment is subject to uncertainty due to a number of factors including the rough definition of the investment packages. Sensitivity analysis of the cost-benefit analysis is presented in section 14.3.3.

14.2 Economic evaluation of elements

This section presents the approach to the economic assessment of each of the elements. The results of the economic assessment are presented in section 14.3.

14.2.1 Transport users

The economic assessment of impacts for transport users, including passengers and freight, is presented in this section.

Passenger transport

The effects for passenger transport cover *travel time savings* (time dependent costs, calculated on the basis of time values) and *ticket costs* for travelling by train (distance dependent costs).

The total value of passenger travel time savings is assessed on the basis of the unit costs presented in the table below. As can be seen, we distinguish between 3 trip purposes; business, private and holiday.

In the cost-benefit the value of travel time savings increases over time with an elasticity of 0.7 with respect to GDP in line with the recommendations of HEATCO.

Table 14.4 Value of travel time savings for passenger traffic (€2006 per passenger per hour, factor prices)

Mode	Trip purpose	€/hour
Train	Business	16.4
	Private	7.3
	Holiday	6.1

Source: HEATCO

Note: Converted to 2006-values/prices on the basis of elasticity to GDP of 0.7 and GDP-growth estimates from Eurostat. Simple average of values for the 4 project countries. The unit costs for *private* and *business* are an average of short and long distance.

It should be noted that the applied time values from HEATCO are at a *very high level* compared to the present economic level of the countries involved. Therefore, a separate analysis with time values at the present national level has been prepared and is presented in section 14.3.2.

It can be noted that with the assumed (applied) growth in GDP in the project countries, the time values reach a level of time values similar to that of Denmark in 2040. This means that with the applied assumptions the economic level in the project countries is assumed to be at a similar level as that of Denmark in 2040.

The effects on travel times for passengers have been assessed on the basis of the traffic model calculations. The table below summarises the results.

Changes in travel times by rail accrue from two sources; 1) higher travel speed for existing passengers and 2) reduced travel time attracts new passengers.

Table 14.5 Total travel time savings, selected years (million hours)

Mode	Package 1		Package 2		Package 3	
	2016	2034	2016	2034	2016	2034
Trains (passengers)						
-Existing passengers	3.1	5.2	5.1	8.5	4.4	7.4
-New and diverted passengers*)	0.9	1.3	1.5	2.0	1.3	1.8
Total	**4.1**	**6.4**	**6.6**	**10.5**	**5.7**	**9.1**

*) Note rule of the half applied.

It can be seen that passenger travel time savings are highest in Package 2 and lowest in Package 1. The time savings in Package 3 are lower than in Package 2 because of the alignment difference, which does not provide time savings for existing passengers on Rail Baltica in Estonia via Tartu. The table also shows that time savings increase over time as traffic increases.

The total ticket costs for the passengers travelling by train have been estimated on the basis of unit costs per passenger-km and an overall assessment of the change in the total number of passenger-km travelled. The unit costs used were described in the previous chapter and are shown in the table below.

Table 14.6 Train fares per passenger-km (€2006 per passenger per km, factor prices)

Reference	Package 1	Package 2	Package 3
0.042	0.042	0.042	0.042

Source: www.pkp.pl, www.bahn.de.

The table below summarises the effects on the total number of passenger-km.

Table 14.7 Total passenger-km savings, selected years (million passenger-km)

Mode	Package 1		Package 2		Package 3	
	2016	2034	2016	2034	2016	2034
Trains (passengers)						
-Existing passengers	-28	-52	-31	-60	-31	-60
-New and diverted passenger*)	-1	-4	-1	-5	2	-1
Total	-29	-56	-32	-64	-29	-61

*) Note rule of the half applied.

The table shows that more passenger-km are driven in all three investment packages. The largest number of additional passenger-km are driven in investment package 2 and the least in investment package 1.

Freight transport

The effects for freight transport cover - as for passenger transport - travel time savings (time dependent costs, calculated on the basis of time values) and costs for train transport.

The economic value of travel time savings for goods is often not taken into account in the cost-benefit analysis due to difficulties of assessing how much it is worth to save 1 hour of travel time (measured in e.g. €/tonne-hour). HEATCO presents some estimates on the value of travel time savings for "average" goods, but not separately by type of goods transported (e.g. bulk goods).

The Swedish National Rail Administration (BV) does, however, provide unit cost figures by type of good (Bruzelius, 2001). The monetary value of saving one hour of travel time for (liquid and dry) bulk goods is - according to BV - approximately 0.05 €/tonne-hour (2006-prices/values), whereas the value of one hour saved for general cargo is 3.41 €/tonne-hour (2006-prices/values). Freight data shows that 96% of the goods transport on the Baltic States' network of bulk goods and only 4% are general cargo. This indicates that it is reasonable to use a figure of (weighted average) 0.20 €/tonne-hour for average goods in the Baltic States. This figure has been applied here.

For comparison HEATCO suggests to use a general unit costs figure of 0.89 €/tonne-hour[29].

In line with the recommendations of HEATCO the value of travel time savings for freight traffic increases over time with an elasticity of 0.7 with respect to GDP.

The effects on travel times for freight are summarised in the table below.

Table 14.8 Total travel time savings, selected years (million tonne-hours)

Mode	Package 1		Package 2		Package 3	
	2016	2034	2016	2034	2016	2034
Rail - freight						
-Existing freight	36	51	51	71	218	293
-New and diverted freight*)	1	1	1	1	3	8
Total	37	52	52	72	221	301

*) Note rule of the half applied.

The table shows that there are time savings for rail freight in all three investment packages.

The time savings for freight are lowest for investment package 1. The time savings are approx. 50% higher for investment package 2 indicating that the higher design speed may allow for more efficient use of the infrastructure even though the actual travel speed of the freight trains is assumed the same as in option package 1.

However, the time savings for investment package 3 are much higher which is due to a reduction in the transhipment time between Russian and European gauge, which is set to 24 hours in the traffic analysis of freight traffic.

Costs

The total costs for the freight transported by train have been estimated on the basis of unit costs per tonnes-km and an overall assessment of the change in the total number of tonnes-km travelled. The unit costs used are shown in the table below.

[29] Source: HEATCO, Note: Converted to 2006-values/prices on the basis of elasticity to GDP of 0.7 and GDP-growth estimates from Eurostat. Simple average of values for the 4 project countries.

Table 14.9 Train costs for freight trains (€2006 per tonnes-km, factor prices)

Reference	Package 1	Package 2	Package 3
0.038	0.038	0.038	0.038

Source: www.pkp.pl..

The table below summarises the effects on the total number of tonnes-km.

Table 14.10 Change in total tonnes-km, selected years (million tonnes-km)

Mode	Package 1		Package 2		Package 3	
	2016	2034	2016	2034	2016	2034
Trains (freight)						
-Existing freight	55	176	-83	87	68	192
-New and diverted freight*)	-4	-6	-4	-6	-12	-30
Total	52	170	-87	81	56	162

*) Note rule of the half applied.

In the traffic model, time is the main driver for route and mode choice. In addition to the time savings the distances driven are also important. The modelled changes in distances are illustrated in the above table.

The table shows that there is an increase in the tonnes-km in 2034 in all packages, but the changes are small. The largest number of additional tonnes-km is driven in investment package 1 and the least in investment package 2.

14.2.2 States

Rail Baltica has effects on the Estonian, Latvian, Lithuanian and Polish Governments through their involvement in the rail sector, and the EU budget through direct support to the project. The total effects for the states are assessed in this section.

As the results of the analysis are presented from an EU perspective, the EU grant for the implementation of Rail Baltica is considered as a transfer payment between agents within the EU and therefore not included in the analysis.

The following items are therefore included:

- Investment costs
- Effect for rail managers
- Effect for rail operators

The effects for rail managers and rail operators were described in Chapter 13 and will therefore not be described further here.

Investment costs

The total investment costs for implementing Rail Baltica are summarised in the table below for each of the investment packages (see Annex C for more details). The investments were described more in chapter 13.

Table 14.11 Investment costs (million €2006, factor prices)

Variant	Pack 1 Main	Pack 1 Sub A	Pack 2 Main	Pack 2 Sub A	Pack 2 Sub B	Pack 3 Main	Pack 3 Sub A	Pack 3 Sub B
Construc. costs	979	827	1,546	1,652	1,450	2,369	2,401	1,830
Construc. period (years)	2	2	4	4	4	6	6	6

The change in operation and maintenance costs for the road network is estimated on the basis of the estimated change in the number of gross kilometres driven for passenger cars, trucks and busses on the basis of the unit costs shown in the table below.

Table 14.12 Marginal road infrastructure costs, (€-cent 2006/, factor prices)

Vehicle type	Value	Source/comment
Passenger car	0.11	Average of range given in DIW et al (1998), range 0.03-0.19 €-cent/vkm
Bus	3.50	Average of range given in DIW et al (1998), range 0.23-6.77€-cent/vkm
Truck	4.65	Average of range given in DIW et al (1998), range 2.31-7.00 €-cent/vkm

Source. DIW et al (1998), converted to 2006-prices

14.2.3 External effects

The external effects of transport cover a wide range of different impacts. The cost-benefit analysis covers air pollution, climate change effects and accidents.

Air pollution

The implementation of Rail Baltica will affect local and regional air pollution. The method of calculating costs due to emissions basically consists of multiplying the amount emitted of the relevant pollutant with a cost factor.

The cost factors used are shown in the table below. In line with HEATCO the value of travel time savings for freight traffic increases over time with an elasticity of 1.0 with respect to GDP.

Table 14.13 Unit costs for air pollution by pollutant (€2006 per tonne, factor prices)

Pollutant emitted	€/tonne
SO_2	2,753
NO_x	3,118
HC	821
PM	40,455

Source: HEATCO

Note: Converted to 2006-values/prices on the basis of elasticity to GDP of 1.0 and GDP-growth estimates from Eurostat. Simple average of values for the 4 project countries. Figures for PM are 'extra-urban'.

The effect on air pollution is estimated on the basis of the emission factors presented in the table below.

Table 14.14 Emission factors, air pollution (gram per passenger-/tonne-km)

Pollutant emitted	Passenger transport					Freight transport	
	Train, el.	Train, diesel	Car	Bus	Plane	Train, diesel	Truck
SO_2	0.06	0.01	0.00	0.00	0.01	0.03	0.00
NO_x	0.07	0.62	0.56	0.50	0.80	0.26	0.56
HC	0.00	0.04	0.87	0.21	0.10	0.01	0.00
PM	0.00	0.02	0.05	0.07	0.00	0.01	0.078

Source: OECD (2003) 2010 values for road and air, Danish Ministry of Transport (2004) for trains.

The share of trains being electrified influences the effect on air pollution. It is in the calculations assumed that all freight trains are diesel trains whereas the passenger trains are both electrified and diesel trains. The distribution is shown in the table below.

Table 14.15 Share of passenger trains that are electrified on the Rail Baltica line

Reference	Package 1	Package 2	Package 3
26%	26%	26%	100%

Source: Own calculations based on information on the network from Chapter 5 and Annex B.

Note: On the network outside the Rail Baltica line it is assumed that 48% of the passenger traffic is electrified.

The total economic value of effects on air pollution is obtained by multiplying the unit costs, the total change in distances travelled and the emission factors. The resulting estimate is presented in section 14.3.1.

Climate change effects (CO_2)
The method of calculating costs due to emission of green house gases (expressed as CO_2-equivalents) is similar to that of air pollution, i.e. the change of tonne CO_2 emitted is multiplied with the unit costs for CO_2.

The unit costs figures used here are based on HEATCO values. The figures are presented in the table below. As can be seen the values increase with the year of emission.

Table 14.16 Unit costs for CO2 (€2006 per tonne, factor prices)

Period	€/tonne
2000-2009	24.4
2010-2019	28.8
2020-2029	35.5
2030-2039	44.3
2040-2049	60.9

Source: HEATCO
Note: Converted to 2006- prices on the basis of statistics from Eurostat on inflation, simple average of inflation per year.

The effect on air pollution is estimated on the basis of the emission factors presented in the table below.

Table 14.17 Emission factors, climate change (gram per passenger-/tonne-km)

Pollutant emitted	Passenger transport					Freight transport	
	Trains, el.	Trains, diesel	Cars	Bus	Plane	Trains	Trucks
CO2	34	38	67	38	244	28	59

Source: OECD (2003) 2010 values for road and air, Danish Ministry of Transport (2004) for trains.

Like for air pollution, the total economic value of climate change effects is obtained by multiplying the unit costs, the total change in distances travelled and the emission factors (see section 14.3.1).

Accidents
The results of the traffic model calculations show that passenger flows will be shifted from e.g. buses to the railway and that the total number of kilometres travelled will increase if Rail Baltica is implemented. This will affect the risk of accident.

The change in cost of accidents is here estimated on the basis of:

1. Mode specific accident rates (risk of accident per km)
2. Estimated change in km
3. Unit costs of accidents

The unit cost estimates applied are shown in the table below.

In line with HEATCO the value of travel time savings for freight traffic increases over time with an elasticity of 0.7 with respect to GDP.

Table 14.18 Unit cost of accidents ((€2006 per fatality/injury, factor prices)

	Fatality	Severe injury	Slight injury
Average	857,949	108,687	8,091

Source: HEATCO

Note: Converted to 2006-values/prices on the basis of elasticity to GDP of 1.0 and GDP-growth estimates from Eurostat. Simple average of values for the 4 project countries.

14.3 Results of economic assessment

The results of the economic assessment are presented in this section, including an assessment of the robustness of the results.

14.3.1 Results of main analysis

The results of the main analysis are shown in detail in the table below.

Table 14.19 Results of economic assessment (NPV in mill. €2006, factor prices)

Element	Package 1	Package 2	Package 3
Investments:			
Investment costs, rail, net	-646	-1,074	-1,730
Scrap value, rail	58	92	141
Investment costs in total	**-588**	**-982**	**-1,589**
Road manager:			
Change in operation and maintenance, road	**39**	**41**	**78**
Rail managers:			
Access charges from operators	161	200	305
Net operation and maintenance	29	29	-28
Rail managers in total	**190**	**229**	**277**
Rail operators:			
Net revenue	634	782	1,231
of this passenger traffic	151	210	205
of this freight traffic	483	572	1,026
Net operation and maintenance for trains	-466	-648	-952
Access charges to rail managers	-161	-200	-305
Rail operators in total	**7**	**-66**	**-26**
User benefits:			
Time savings net:			
For passenger traffic	961	1,570	1,351
of this existing traffic	702	1,152	984
of this diverted and induced traffic	259	418	366
For freight traffic	164	229	961
of this existing traffic	160	224	938
of this diverted and induced traffic	4	5	23
Time savings in total	**1,125**	**1,799**	**2,312**
Other costs & ticket costs:			
For passenger traffic	-18	-21	-19
For freight traffic	44	2	43
Other costs & ticket costs in total	**25**	**-19**	**23**
External costs:			
Air pollution costs, net	145	156	282
CO_2 costs, net	14	21	5
Accident costs, net	86	126	133
External costs in total	**246**	**302**	**421**
Net present value in total	**1,044**	**1,304**	**1,496**
IRR	**13.3%**	**10.8%**	**9.0%**
B/C ratio	**2.8**	**2.3**	**1.9**

The overall result shows that all three investment packages are economically viable.

Measured as NPV, package 3 has the best result, followed by package 2 and, finally, package 1. However, when looking at the internal rate of return and the B/C ratio, the best result is for package 1, then package 2 and finally package 3. Hence, the most preferable solution will depend on the available investment capital and the return on alternative investments.

The table shows that the largest benefit of the investments is times savings for passengers. Time savings for freight and increased revenue from rail fares for the rail operators are also substantial benefit contributors.

The table reveals that the time savings for passengers in packages 1 and 2 are valued to more than the investment costs.

The times savings for freight adds to the benefit in all packages. However, especially in package 3 the time savings for freight are high. The high benefit in package 3 is due to an assumed reduction in the waiting time for transhipment between Russian and European gauge, which is set to 24 hours per transhipment in the traffic analysis of freight traffic.

It should be noted that investment packages 1 and 2 do not include investments aimed at improving the transhipment time between Russian and European gauge. If such investments were included, investment packages 1 and 2 could result in higher freight time savings than quantified in the table above. On the other hand, this extra benefit should be compared with the extra investment costs in transhipment facilities, so the net change of the result for these investment packages would depend on the size of the investments and the size of the additional time benefit.

The increased revenue for the rail operator is caused by an increase in the number of passenger- and tonnes-km. The increase in revenues is not accompanied by a similar negative contribution from fares for the transport users.

The results show that there is a benefit from external costs in all three packages. The positive net benefit from externalities is caused by a reduction in air pollution, CO_2 emissions and accidents. The main reason for the positive benefit from air pollution is a reduction in tonnes-km on road which is not outweighed by the increase in rail freight emissions from an increase in tonnes-km by rail. Similarly, the decrease in road transport reduces the number of accidents on road and the increase in accidents due to increase in rail transport is smaller much than the reduction from road transport. Finally, there is a small net benefit from a reduction of CO_2 emissions.

It should be stressed that the results depend heavily on the applied assumptions regarding time values and actual time savings and changes in passenger- and freight distances as well as rail costs and revenues. A separate analysis for national time values is presented in section 14.3.2 and sensitivity analyses are presented in section 14.3.3.

Results for sub-variants

Five sub-variants to the main investment packages have been defined as described earlier. In this section, the results for the sub-variants are presented.

It has pragmatically been assumed that the only difference between the main investment packages 1, 2 and 3 and the sub-variants is the size of the investment costs as travelled distances and travel times are almost identical in the sub-variants. In addition, for investment package 3B, the impact on air pollution is different, because this package does not include electrification.

The results for the sub-variants are shown in the following table.

Table 14.20 Results of economic assessment for sub-variants to the main investment packages (NPV in mill. €2006, factor prices)

	Sub-variant 1A	Sub-variant 2A	Sub-variant 2B	Sub-variant 3A	Sub-variant 3B
NPV	1,136	1,237	1,365	1,474	1,856
IRR	15.3%	10.3%	11.4%	8.9%	10.9%
B/C ratio	3.3	2.2	2.5	1.9	2.5

The table shows that the results for sub-variant 1A are improved compared to investment package 1. The internal rate of return is improved by approx. 2 percentage points.

Results for sub-variant 2A are slightly reduced compared to investment package 2, but the results are in the broad picture the same as investment package 2.

Results for sub-variant 2B are improved compared to investment package 2. The internal rate of return is improved by a little less than 1 percentage point.

Results for sub-variant 3A are slightly reduced compared to investment package 3, but the results are in the broad picture the same as investment package 2.

The results for sub-variant 3B are substantially improved compared to the main investment package 3. This is due to the fact that removing the electrification in investment package 3 decreases the investment costs substantially and this reduction is not accompanied by a similar increase in air pollution. The analysis does not directly cover impacts on costs for the rail manager and operator as well as the users. However, there is not a significant impact on these agents by the removal of electrification.

14.3.2 Separate analysis with national time values

The results of the cost-benefit analysis presented above are based on unit costs for passenger time values from HEATCO.

These unit cost values are *substantially higher than the national values* used presently in some of the project countries.

The HEATCO values for the Baltic States and Poland are estimated on the basis of an international meta-analysis (statistical analysis) of values of time.

What a meta-analysis does is looking for patterns in the outcomes of past studies, by regressing their findings on variables such as: attributes of the countries where the study took place, the segments of the population studied and the method used. Once this regression has been carried out, the results can be used both for interpreting the outcomes of the individual past studies and the overall evidence, and for predicting other situations. In the case of value of time (VoT) studies, a meta-regression can be estimated on study outcomes for countries where VoT studies have been carried out, and then applied to countries (using explanatory variables for these countries) where such studies are lacking.

The table below shows a comparison of the official national values for Latvia and Lithuania and the HEATCO-figures. Estonia and Poland have no official unit values for the value of travel time savings.

Table 14.21 Comparison of unit costs of travel time savings (€2006 per passenger per hour, factor prices)

	National values				HEATCO
Purpose	**Estonia**	**Latvia**	**Lithuania**	**Poland**	
Business	-	3.67	5.20	-	16.4
Private	-	0.63	1.29	-	7.3
Holiday	-	0.42		-	6.1

Note: Figures from Lithuania converted from 2002- to 2006-prices on the basis of elasticity to GDP of 0.7. Latvia/business, average of management trips and transportation trips.

Source: Latvia; Ministry of transport of the republic of Latvia, Methodological guidelines for economic evaluation of road project costs/benefits, 2006. Lithuania; Information supplied to COWI during HEATCO project.

The HEATCO figures for business trips are approximately 4 times higher than the national values of Latvia and Lithuania, while the figures for non-work trips (private and holiday) are 5-14 times higher. One reason for this large difference is that the HEATCO figures reflect a willingness-to-pay approach, while the national values are derived from the 'average wage considerations'. For example, in Latvia it is assumed that the value of time for 'private trips' (trips to and from work) is 30% of the average wage in the public sector.

To test the robustness to the results to the assumed unit figures for values of time a side-analysis has been made using significantly lower figures (reflecting an average of the national figures). The figures applied in the side-analysis are shown in the table below.

Table 14.22 Unit costs of travel time savings applied in side-analysis (€2006 per passenger per hour, factor prices)

Purpose	€/passenger-hour
Business	4.4
Private	1.0
Holiday	0.9

The results of the cost-benefit analysis with the national passenger time values are illustrated in the table below.

*Table 14.23 Results of economic assessment **national time value**s (net present value in 2006, in million €2006, factor prices)*

Element	Package 1	Package 2	Package 3
Investments:			
Investment costs in total	**-549**	**-940**	**-1,511**
Rail managers:			
Rail managers in total	**190**	**229**	**277**
Rail operators:			
Rail operators in total	**7**	**-66**	**-26**
User benefits:			
Time savings net:			
For passenger traffic	200	325	279
of this existing traffic	137	223	189
of this diverted and induced traffic	63	103	90
For freight traffic	164	229	961
of this existing traffic	160	224	938
of this diverted and induced traffic	4	5	23
Time savings in total	**364**	**544**	**1,240**
Other costs & ticket costs in total:	**25**	**-19**	**23**
External costs:			
External costs in total	**246**	**302**	**421**
Net present value in total	**283**	**60**	**424**
IRR	**7.7%**	**5.3%**	**6.3%**
B/C ratio	**1.5**	**1.1**	**1.3**

The table shows that *the applied unit cost figures have a large impact on the results of the cost-benefit analysis*.

The IRRs of the three investment packages are reduced by 3%-6% and the benefit-cost ratios are reduced by 0.6-1.3 percentage points. The net present values of the investment packages are still positive. However, for investment package 2 the result is close to zero, which means that costs and benefits approximately balance and given the uncertainty on the results, the result could be negative as well as positive.

The results internally between the three investment packages change. With the national time values measured by net present results for investment package 3 are still best, but now investment package 1 is second best and investment package 2 is the worst. The reason for the change is that time savings measured in hours are highest in investment package 2 and that the time value therefore has the largest impact on this investment package. Measured by benefit-cost ratio investment package 1 is still the best, but investment package 3 is ranked second, and investment package 2 is ranked last.

14.3.3 Sensitivity analysis

The results of the economic analysis is subject to uncertainty due to a relatively rough definition of the investment packages, limited knowledge about unit costs and uncertainty on modelled traffic. To assess the robustness of the analysis a number of sensitivity analyses have been carried out.

To assess the robustness of the analysis a number of sensitivity analyses have been carried out. The following table illustrates the assumptions changed in each of the sensitivity analyses carried out.

The following table presents the assumptions changed in each of the sensitivity analyses carried out in the financial analysis for the rail manager.

Table 14.24 Description of the sensitivity analyses

Sensitivity analysis	Description
Low discount rate	3%
High discount rate	7%
Low investment costs	Investment costs reduced by 20%
High investment costs	Investment costs increased by 50%
Low EU grant	EU co-financing reduced to 25%
High EU grant	EU co-financing increased to 75%
Low unit costs, time passenger	Time values reduced by 25%
Low unit costs, time passenger	Time values reduced by 75%
Low unit costs, time freight	Time values for freight = 0
High unit costs, time freight	Time values for freight double
Low real growth in GDP	GDP growth 2% p.a.
High real growth in GDP	GDP growth 5% p.a.
Low operation and maintenance, operator	Unit costs for operators reduced by 25%
High operation and maintenance, operator	Unit costs for operators increased by 25%
Low maintenance, manager	Effects of (net) maintenance costs reduced by 25%
High maintenance, manager	Effects of (net) maintenance costs increased by 25%
Low fares	Fares reduced by 25%
High fares	Fares increased by 25%
Low values external costs	External costs reduced by 50%
High values external costs	External costs increased by 50%
No benefits from new/shifted traffic	Only benefit for "existing" traffic
Low access charges	Access charges reduced by 25%
High access charges	Access charges increased by 25%
Low traffic growth	Traffic growth 2016-2034 reduced by 25%
High traffic growth	Traffic growth 2016-2034 increased by 25%

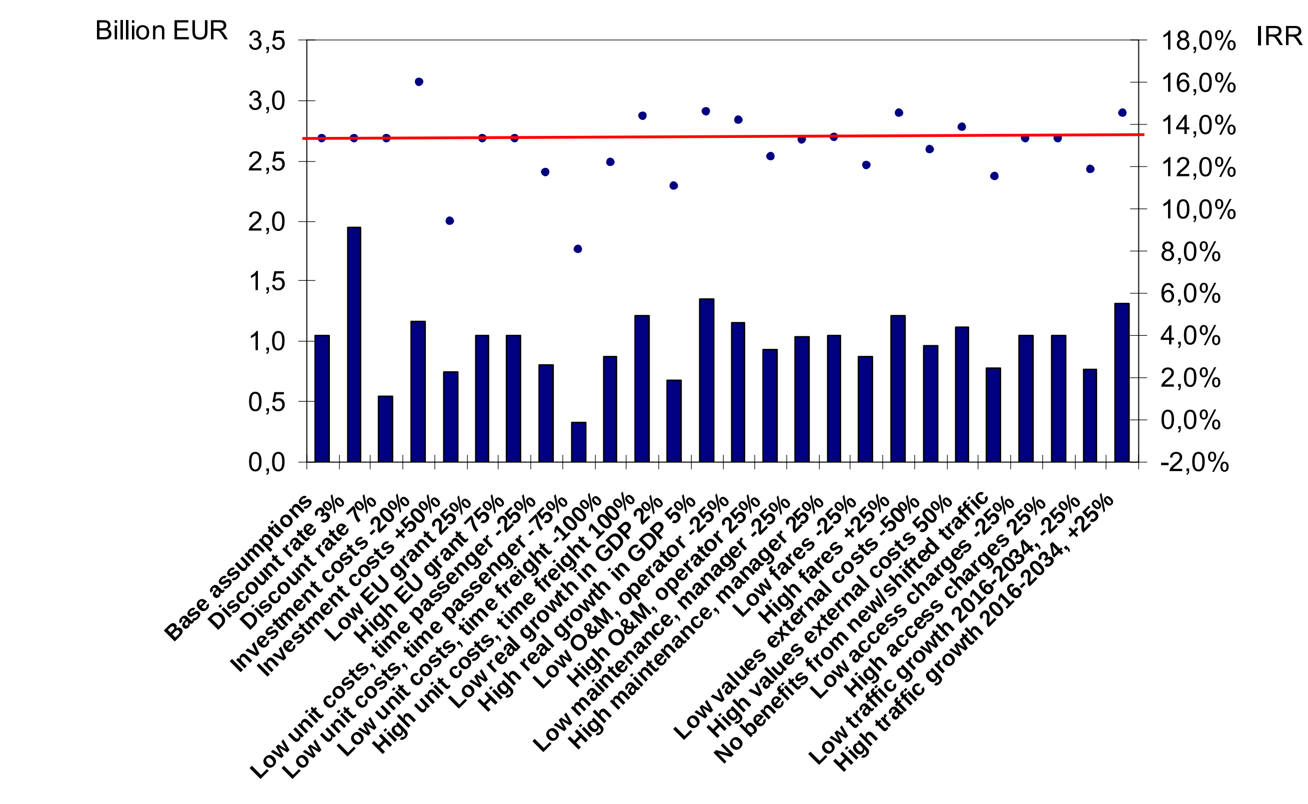
The impact of the sensitivity analysis on the net present value in each investment package is shown in the following table. The corresponding results are presented graphically in the following three figures.

Table 14.25 Impact of the sensitivity analyses on results, % change of NPV

Sensitivity analysis	Package 1	Package 2	Package 3
Low discount rate	86%	99%	118%
High discount rate	-48%	-54%	-64%
Low investment costs	11%	15%	21%
High investment costs	-28%	-38%	-53%
Low EU grant	0%	0%	0%
High EU grant	0%	0%	0%
Low unit costs, time passenger	-23%	-30%	-23%
Low unit costs, time passenger	-69%	-90%	-68%
Low unit costs, time freight	-16%	-18%	-64%
High unit costs, time freight	16%	18%	64%
Low real growth in GDP	-35%	-43%	-50%
High real growth in GDP	30%	36%	42%
Low operation and maintenance, operator	11%	12%	16%
High operation and maintenance, operator	-11%	-12%	-16%
Low maintenance, manager	-1%	-1%	0%
High maintenance, manager	1%	1%	0%
Low fares	-16%	-15%	-21%
High fares	16%	15%	21%
Low values external costs	-8%	-7%	-10%
High values external costs	8%	7%	10%
No benefits from new/shifted traffic	-25%	-32%	-25%
Low access charges	0%	0%	0%
High access charges	0%	0%	0%
Low traffic growth	-27%	-30%	-37%
High traffic growth	27%	30%	37%

The results are illustrated in the figures below. The left axis measures the NPV and the right axis measures the internal rate of return.

*Figure 14.1 Results of the sensitivity analyses for **investment package 1**, NPV in 2006 (blue bar, left scale) and IRR (red dot, right scale)*



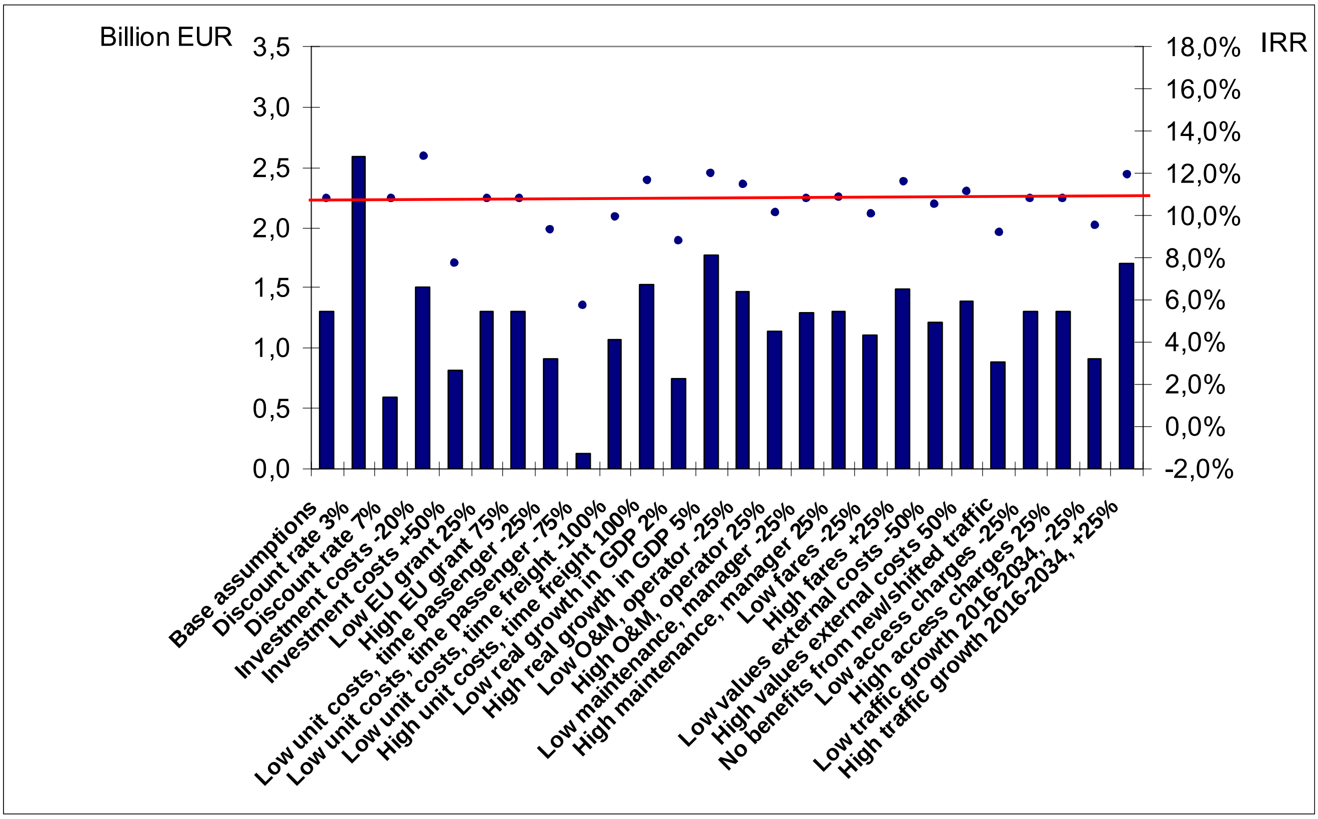
The figure shows that the investment costs and the applied time values (as also described in the previous section) significantly influence the economic result of the cost-benefit analysis. Furthermore, the assumed GDP growth level is also important for the overall results through the assumed increase in times values with 0.7 times the growth in GDP and also the traffic growth is important for the result.

When looking only at the net present value, the applied discount rate naturally also strongly affects the result (the internal rate of return is not influenced by the applied discount rate).

In contrast to the financial analysis the size of the EU grant does not influence the result, as the EU grant is considered consistently as a transfer payment within the EU and therefore does not affect the result of the cost-benefit analysis. The same is the case with the access charges to the network.

The figure shows that in all sensitivity analyses the result of the cost-benefit analysis is a positive net present value, and the internal rate of return lies between 8%-14%.

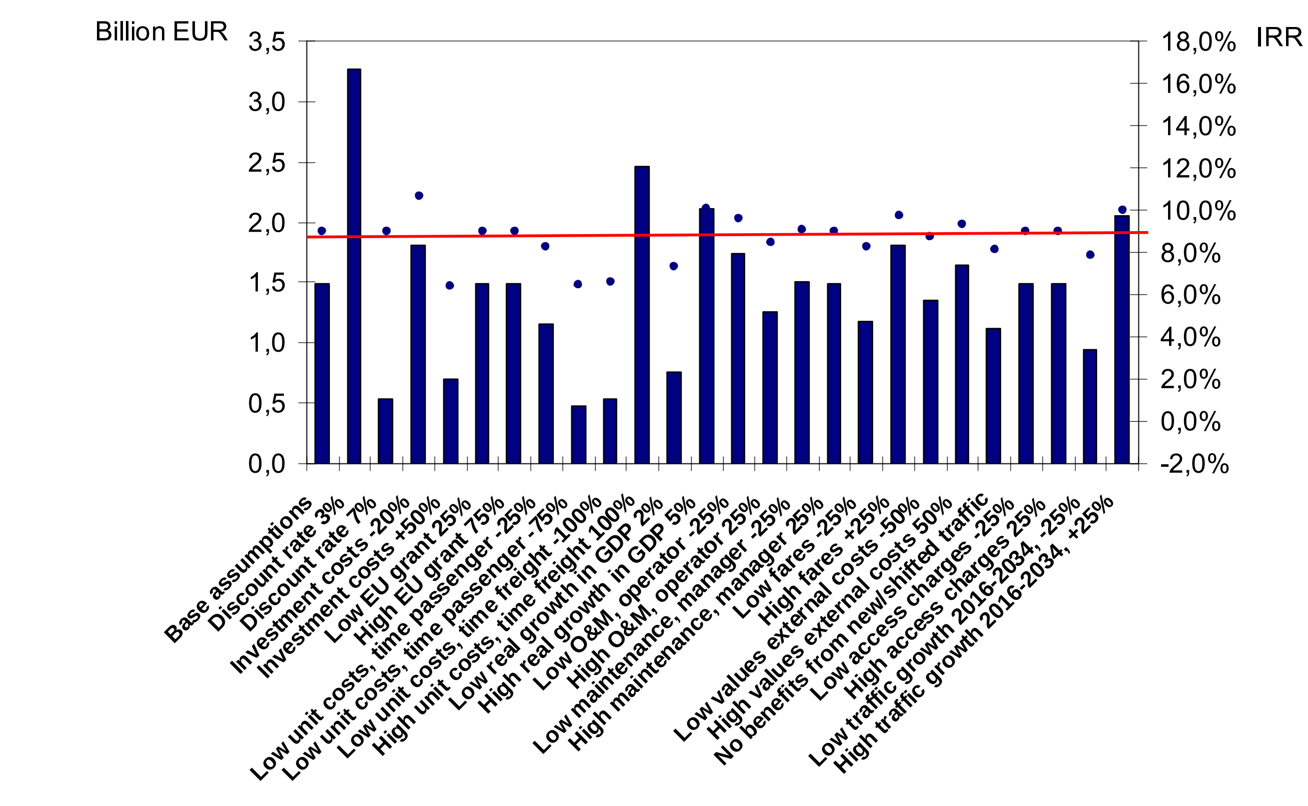
Figure 14.2 Results of the sensitivity analyses for investment package 2, NPV in 2006 (blue bar, left scale) and IRR (red dot, right scale)



The above figure shows again that the same factors as for investment package 1 influence the result. However, the time values have larger impact on the result, because the estimated time savings are higher in investment package 2 than in investment package 1.

The figure shows that in all sensitivity analyses the result of the cost-benefit analysis is a positive net present value, and the internal rate of return lies between 6%-13%. Hence, the results of investment package 2 are closer to a negative result than the results for investment package 1.

Figure 14.3 Results of the sensitivity analyses for investment package 3, NPV in 2006 (blue bar, left scale) and IRR (red dot, right scale)



The above figure shows again that the same factors as for investment packages 1 and 2 influence the result. In addition the time values for freight have larger impact on the result, because the estimated time savings for freight are higher in investment package 3 than in the two other investment packages.

The figure shows that in all sensitivity analyses the result of the cost-benefit analysis is a positive net present value, and the internal rate of return lies between 6%-11%.

14.4 Conclusion

The results of the economic analysis are subject to uncertainty due to a number of factors including the rough definition of the investment packages and uncertainty on unit values.

However, with the applied assumptions and traffic model results all investment packages seem to be economically viable for the EU as a whole.

Measured as net present value, option package 3 has the best result (approx. 1,5 billion EUR), followed by package 2 (approx. 1.3 billion EUR) and, finally, package 1 (approx. 1 billion EUR).

However, when looking at the internal rate of return and the benefit-cost ratio, the best result is for package 1 (IRR=13%, B/C-ratio=2.8), then package 2 (IRR=11%, B/C ratio=2.3) and finally package 3 (IRR=9%, B/C ratio=1.9).

Hence, the economically most preferable solution will depend on the available investment capital and the return on alternative investments. When capital is limited the most preferable solution would be investment package 1 as it has the highest benefit-cost ratio and internal rate of return.

In addition to the economic results, the choice of the most preferred investment package of course needs to be viewed in the light of other parameters such as the risks connected to implementing each investment packages. Such issues are further elaborated in the following chapter

The largest benefit of the investments is times savings for passengers. Time savings for freight and increased revenue from rail are also substantial benefit contributors.

Sensitivity analyses shows that the results are most sensitive towards the investment costs and the applied time values Furthermore, the assumed GDP growth level is also important for the overall results through the assumed increase in times values with 0.7 times the growth in GDP. The actual traffic growth is also important for the result.

The results of the cost-benefit analysis are based on unit costs for passenger time values from HEATCO. However, these unit cost values are *substantially higher than the national values* used in some of the project countries. Therefore, a separate analysis has been made where current official national time values from Latvia and Lithuania have been applied.

The separate analysis shows that *the applied unit costs for time values have a large impact on the results of the cost-benefit analysis*. The IRRs of the three investment packages are reduced by 3%-6%. The net present values of the investment packages are still positive. However, for investment package 2 the result is close to zero (approx. 0.06 billion EUR), which means that costs and benefits approximately balance and given the uncertainty on the results, the result could be negative as well as positive.

The results internally between the three investment packages change. With the national time values and measured by net present, results for investment package 3 are still best (0.4 billion EUR), but now investment package 1 is second best (0.3 billion EUR) and investment package 2 is the least attractive. The reason for the change is that time savings measured in hours are highest in investment package 2 and that the time value therefore has the largest impact on this investment package. Also measured by B/C ratio investment package 2 is in this separate analysis the least attractive.

SECTION E: Recommendations and implementation

15 Recommendations for implementation

15.1 Economic and financial recommendations

The economic development in the project countries and the rest of Europe will as a result of economic integration and general growth create a strong growth in demand for transport of both freight and passengers between the Baltic states and central Europe.

Significant investments in all modes of transport in the countries will - according to existing plans - be made to deal with future demands, but in some areas development of infrastructure will be a major challenge because of the environmentally sensible nature involved. An important example is the development of Via Baltica in the north eastern part of Poland. Rail Baltica will in the future offer an important alternative for certain types of land based transport, but it can not generally be expected to solve the problem of increased demand for road transport in the region.

The present strategic feasibility analysis shows that large investments in the development of a consistent and coherent Rail Baltica corridor are likely to be economically feasible as a whole. However, substantial grants are needed to make such developments financially feasible from an infrastructure manager point of view, and unless the current fare levels in the countries are changed rail operators running passenger trains will also need some financial support to service the calculated demands for transport.

The analysis demonstrates that the economic efficiency of the analysed three main investment packages are in the same order of magnitude although the cheapest package (package 1: design speed of minimum 120 km/h, broad gauge) has the highest IRR (13.3%) and the most expensive package (package 3: European gauge) has the lowest IRR (9.0%; 10.9 % if electrification is excluded in this package). Package 2 is in the middle with an IRR of 10.8%. However, the most expensive package produces the largest absolute net benefits. Summing up, this means that none of the analysed packages are recommended to be excluded from the future decision process on economic grounds.

The calculated economic and financial consequences point in the same direction for all three main investment packages although the size of the impacts varies:

- North-south rail transport will become more competitive and divert traffic from road to rail.
- Transport users will with present fare and tariffs levels obtain large benefits from time savings. Passengers will in absolute terms gain more benefits than freight, but especially in package 3 with European gauge freight will benefit much in absolute terms.
- Rail operators running passenger trains will with present fares/tariffs and access charge levels experience a loss. On the other hand, operators running freight trains will experience a gain.
- Investments can not be financed from access charges at current level alone, so there is a need for grant financing of more than 60% of the investment costs to make the project financially feasible. Alternatively, infrastructure access charges needs to be increased in the Rail Baltica corridor. This will however deteriorate the financial result for the operators.
- The external costs related to air pollution and CO_2 emission will be reduced due to transfer of transport from road to rail.
- The costs of accidents will also be reduced because of the increased use of rail transport.

Further, if electrification is not included for the European gauge alternative (package 3) the investment costs will be significantly reduced without significant losses in benefits and consequently the economic and financial rates of return is improved to the same level as investment package 2. Therefore, it is strongly recommended to consider if electrification in package 3 could be excluded and a decision on this matter be postponed until electrification is considered more broadly for the rail networks in the countries.

The assessment of the time values for travel is a very decisive factor for the outcome of the economic analysis. The economic analyses are performed with the use of the most recent EU research in this area[30], which suggest values several times higher than the official national values actually applied in the countries. When the official national values are applied, the economic feasibility is reduced significantly although the IRR for all packages are still above 5.0%.

In order to improve the financial situation for both rail operators and the rail infrastructure manager it is - independent of the choice of investment option - recommended to carry out specific analyses to assess if present rail access and rail tariffs are optimal for infrastructure manager, rail operators and users respectively.

It has also during the study period become clear that there are clear limitations on the funding available for investments in Rail Baltica from both national budgets, from the Cohesion Fund and the TEN-T budget in the coming period 2007-2013. Further, railway infrastructure investments in Europe have in general had difficulties in attracting private risk capital due to the often large un-

[30] The recommendations from the HEATCO project.

certainty associated with these investments. Rail Baltica is not assessed to be a realistic candidate in the short to medium term for involving private capital to take on revenue risks.

As the economic efficiency of the investment packages 1, 2 and 3 without electrification is in the same order of magnitude, the choice of strategic option for developing Rail Baltica must consequently be linked to the willingness and ability to commit necessary funds for investments in Rail Baltica in the coming years.

Further a strong focus is recommended on maintaining/improving attractiveness of rail transport north - south in the coming 5-10 year developing period in order to ensure that there is a good basis for utilising the investments made in Rail Baltica, when they are completed.

15.2 Preconditions and risks

The following risks elements are considered the most important for the implementation of Rail Baltica investment options.

Investment costs escalation

The total costs depend on both the unit costs applied, the quantities required and the technology applied. The quantities depend on the specific alignment chosen in sections, which require new constructions, and the final specifications and requirements for equipment. The costs of equipment are based on the assumption that solutions shall meet normal, but cost-efficient standards. This means that if very high standards are required at the final design stage, this may be a potential cost escalator.

The development in recent years in Europe where the provision of rail infrastructure and equipment has been liberalised, has generally led to reduced (or at least not increasing) unit prices. Construction prices are on the other hand reported to increase rapidly in the project countries presently, but there are no good reasons why construction costs for railways in a medium term perspective should be higher than construction costs in other parts of Europe.

The largest risk in the project countries is therefore considered to be related to the characteristics of the decided detailed alignments and the final requirements to equipment and environmental protection. New and tougher environmental regulation and the costs of avoiding currently unknown environmental damages could potentially also lead to increased costs.

Furthermore, the costs of land acquisition is uncertain, both due to the legislation in the countries and the rapid increase in prices for land in some parts of the countries. So the timing of the project may influence the size of the risk of increasing costs of land. The cost assessment does, however show that the cost of land acquisition only accounts for a minor share of the total investment costs.

Traffic demand and operations

The demand for traffic on Rail Baltica depends on the general economic development in Europe, the changes in the international trading patterns as well as the development in the relative attractiveness of the different competing modes. The demand analyses are based on a high stable economic growth rate over a long period of time (varying for different economic sectors) with increasing integration of the economies of Europe. Further, the currently known policy framework for transport is considered stable. Large changes in the macro-economic and geopolitical context may change the demand for rail transport, primarily freight transport. However, the currently low level of rail traffic is the weakest point of departure for making precise forecasts, and the biggest challenge is to market the rail alternative and make it realised by consumers as a credible alternative in order to build up the demand over a period.

The future attractiveness of Rail Baltica depend on future prices of transport services for various modes, the investments in competing modes and regulatory measures to influence transport patterns. The demand analyses are based on the assumption that relative transport prices between modes will remain fairly constant over time, which means that transport users will have e.g. time benefits without paying for them. More restrictions on road transport than anticipated in the analysis could increase the competitive power of rail transport.

The analyses suggest that at current tariff levels passenger operations may not be financially feasible, so the governments may need to subsidise long distance including international rail traffic to ensure that a reasonable service level is provided. Otherwise the forecasted traffic demand will be undermined.

To conclude, the uncertainty related to traffic demand for rail transport in the analyses indicate that traffic could both be higher or lower than calculated in the traffic analyses.

Dual gauge operations

Operating two parallel conventional rail systems with different gauges servicing both passenger and freight transport is a big challenge from both a technical and a cost perspective. There are no similar operations to study in Europe and good examples outside Europe are also hard to find, so the economic and financial analyses are based on the cost structures in networks with only one type of system, which may be a rather optimistic assumption for operating a dual gauge system.

Environmental risks

The most serious environmental consequences related to construction works are naturally connected with new constructions in new alignments where new barriers may be introduced. As the detailed alignments are not specified yet, it is difficult to estimate the likely risks and potential avoidance costs.

There is of course a specific high risk related to the development of the rail line between Bialystok and Suwalki in Poland due to the sensitive areas, which are known to be affected.

National planning
Risks associated with national planning procedures for construction works are normal and there is no evidence that the risks are bigger than for similar projects in other European countries.

However, none of the countries have recent experience in planning and building new trans-national railway sections to a large extent, so this lack of experience may restrict the pace of planning activities.

Trans-national coordination
The four project countries have well established co-ordination arrangements, so there is a basis for a strong and coherent implementation of agreed development plans. But there may be risks of a political nature concerning fast agreement of alignments e.g. at border crossings, timing in making funds available and the minimum technical standard to be applied.

Funding
The funds available for the development of Rail Baltica may restrict the speed of investments. Furthermore, the rail traffic has to be built up from a low level. Therefore subsidies may be needed for the operations in a build-up period, as a rail service has to have a certain minimum frequency in order to be considered a realistic alternative.

Below, four considered risk levels are defined for projects analysed at pre-feasibility level:

Low	Risk level lower than typical transport investment projects
Medium	Risk level in line with typical transport investment projects
High	Risk level higher than typical transport investment projects
Very High	Risk level higher than typical transport investment projects

The assessed various risk elements of the three Investment packages are illustrated in Table 15.1.

Table 15.1 Risk level of investment packages

	Package 1	Package 2	Package 3
Investment costs	Medium	High	Very High (more new construction)
Traffic demand and operations	High	Very High (larger upgrade of current quality)	Very High (larger upgrade of current quality)
Dual gauge operations	Low	Low	Very High
Environmental risks	Low (except Poland)	Medium (some new alignments)	High (more new alignments)
National planning	Low	Medium/high (some new alignments)	High (more new alignments)
Trans-national co-ordination	Medium	High	Very High (a European gauge system requires high level of co-ordination)
Available funding in time	Medium	High	Very High
Overall risk	Low-medium	Medium-high	High-very high

An important advantage of Package 1 - compared to Packages 2 and 3 - is that it allows for stepwise implementation and thereby commitment of funds to Rail Baltica. In case that high demand for transport services materialises, additional investments can be undertaken.

The uncertainty on assessing the effects of small investments is smaller than for large investments (see Sections 13.3.4 and 14.3.3). This also favours Package 1 to Packages 2 and 3.

The overall risk of implementing Package 3 is higher than Packages 1 and 2, partly because the investment is larger and relies more on new/shifted traffic. Existing (local) traffic will only to a limited extent benefit from Package 3, because the investment is based on a new alignment and a service with fewer stops. On top of this, the risk of running a dual gauge system is very high, which adds to the overall risk of Package 3.

15.3 Implementation plan

Implementation of the investments in Rail Baltica can naturally be made in different ways, depending on the preferred tender strategy and the management capacity in the countries. An outline of an implementation plan is presented below:

Table 15.2 Outline implementation plan

Phase	Duration (months)	Implementation
Decision: Investment options to be analysed further including Strategic Environmental Impact Assessment	0 - 6	National governments
Tender: Detailed feasibility study	3 - 6	National governments & European Commission
Detailed feasibility study: - conceptual design and costing of various detailed alignment options - EIA of preferred option - detailed traffic forecasts - economic and financial appraisal	12	Consultant (analyses) National governments (approval of detailed options for further analysis)
Decision: - agreement of final project - CF/TEN-T application - approval of CF/TEN-T application	0 - 6	National governments & European Commission
Detailed design Preparation of tender documents	12 - 18	Consultant
Tender: Works and equipment	4 - 6	Consultant
Construction	18 - 48	Contractor
Total duration	49 - 102	

The outline implementation plan above suggests that the time span between the delivery of this feasibility report, say 1 January 2007, and the time when a full investment package has been implemented is about 4 to 8.5 years.

The main uncertainties are related to the length of the various periods where decisions have to be made by the national governments and the European Commission and to the capacity to manage many activities at the same time. The construction phase will obviously be longer for Investment package 3 than the much simpler package 1. Further, to speed up the processes it is e.g. assumed that the detailed design is tendered as a package together with the feasibility study, but with a decision process in between.

Step-by-step implementation

Obviously a European gauge system will have to be developed from south to north in order to make sense, but if Rail Baltica is developed by improving the existing broad system it is recommended that detailed studies are used to identify the most optimal sequence of investments in the network.

The current analysis shows that it could prove to be optimal to give first priority to:

- Sections around the major cities, as a significant share of the benefits is linked to regional transport

- Sections, which are also used for east-west transport, as this accounts for a large share of rail transport in the project countries.

Furthermore, it could prove to be optimal to upgrade the existing infrastructure from north to south, as traffic volumes are higher in the northern part of the corridor.

15.4 Trans-national project management and decision making

The four project countries have well established co-ordination arrangements, so there is a basis for creating a coherent management structure for implementation of agreed development plans.

The first recommended step is to agree on:

- a plan for the detailed feasibility studies, environmental impact studies etc. which need to be carried out
- a process for making decisions

Strategically, it *has to be decided if the development of Rail Baltica shall be developed by improving and modernising the existing broad gauge system or as a new independent rail system with European gauge*. The requirements to the transnational management will depend on this.

A European gauge system will require very detailed coherent planning and management between the countries to agree on all technical specifications and alignments - and very importantly on the timing for the construction of the various sections, which also means close co-ordination on financing plans.

The transnational management is recommended to be done in a dedicated organisational structure involving staff from all involved countries, and such a structure need to be guided by a policy committee, which has the power to make the necessary decisions in the process. The dedicated structure could also potentially be organised as a share holding company owned jointly by the countries e.g. via their infrastructure managers.

Development of Rail Baltica based on the existing gauge system (with exception of the section from Polish border to Kaunas which in any case will be based on European gauge due to the already made decisions) will also require detailed coherent planning and management between the countries but to a lesser degree as all sections not involving new alignments can technically be developed independently of each other. It is recommended *that subsequent detailed feasibility studies are used to identify the most optimal sequence of investments in the network as well as the most appropriate level of infrastructure access charges and fares/tariffs on Rail Baltica*. The results will be closely linked to the forecasted level of traffic on the various sections.

It is recommended also for this system to create a dedicated planning and management structure, but there are no arguments for establishing it as a share holding company, as the investments can be seen as normal developments/extensions of the rail network managed by the national infrastructure managers.

Implementation of both strategic development options is recommended to make maximum use of standardised equipment/material and services when investing in order to facilitate planning and keep the costs down.

Efficient trans-national management will also require a strong willingness to settle outstanding issues pragmatically (e.g. specific alignments for crossing borders) in order to keep momentum in the process.

15.5 Development vision

A trans-national agreed strategy for development of and investing in Rail Baltica needs to balance:

- Economic efficiency of investments.
- Funding constraints.
- Risk awareness.
- Technical consistency within rail networks.
- Transport and regional policy priorities.

A successful implementation of any of the analysed development options will be a mean to realise a long term development vision: *to change Rail Baltica from an imaginative and policy-driven European project to a strategic and sustainable, but pragmatic north-south rail corridor providing cost-effective transport services for the countries involved in pace with the development of the demand for such services.*

The main idea behind Rail Baltica is to develop high-quality connections for passenger and freight transport between the Baltic States and Poland as well as – through the hub of Warsaw – between the Baltic States and other EU countries. Improved rail lines will also result in more efficient land-bound connections between the Baltic and the Nordic countries (particularly Finland) and in the long run potentially further to Central Asia. A good and cost-effective transport system is a pre-condition for maintaining high economic growth and improving the European integration.

The provision of high-quality rail infrastructure and operations can shift demand from road and air transport to rail transport. Such a change will benefit the environment and contribute to alleviate congestion on the European road network. Further, an improved rail system will also increase the accessibility of the Baltic States and can potentially improve the conditions for accelerated regional development in the countries involved.

16 References

The information presented in this report is based on many types of information, including reviews of existing studies, national development plans, reviews of legal documents, interviews with key officials and stakeholders, material supplied directly to the Consultant from key stakeholders etc.

The list below shows the main reports, which have been reviewed, and the relevant national plans for each of the four project countries. References to legal documents are given in the text. The final report will also contain a list of stakeholders who have been involved in the process.

General studies

- Bruzelius, N. (2001): *The Valuation of Logistics Improvements in CBA of Transport Investments; A Survey.*
- COM (2001): *White Paper: European transport policy for 2010: time to decide 370*, September 2001
- COM (2005a): *Implementing the trans-European networks. Memorandum to the Commission from President Barroso in agreement with Mr Barrot.* [Available at europa.eu.int/comm/ten/transport/agency/doc/2005_07_20_communication_en.pdf]
- COM (2005b): *Trans-European Transport Network, TEN-T priority axes and projects 2005.* Directorate-General for Energy and Transport. 2005.
- DIW, INFRAS, Consultancy Dr. Herry, NERA (1998): *Infrastructure Capital Maintenance and Road damage costs for Different Heavy goods Vehicles in the EU.* Commissioned by DG VII
- Faber Maunsell (2005): *Analysis of Pan-European Transport Corridor I.* March 2005.
- HP Consult (2005): *Status report of the Pan-European Transport Corridors and Transport Areas PAN EUROSTAR.*
- Rail Baltica Co-ordination Group (2003): Common Position of the Rail Baltica Co-ordination Group on the Establishment of Common Specifications for the Rail Baltica Project. Based on conclusions of the Ad Hoc Meeting of Co-ordination Group held in Vilnius, on September 15, 2003.

- Szimba, E. (2006): *Identification, Measurement and Explanation of Interdependence between Transport Infrastructure Projects of the Trans-European Network*, PhD thesis prepared at the Institute for Economic Policy Research (IWW), Universität Karlsruhe (TH), forthcoming.
- TINA Secretariat (1999): *TINA - Common Transport Infrastructure Needs Assessment, Identification of the network components for a future Trans-European Transport Network*. Vienna October 1999.

Estonia
- *Estonian National Spatial Plan - 2010.*
- *Estonian Transport Development Plan, 1999-2006*
- *Estonian Transport Development Plan, 2006-2013.* Draft

Latvia
- *Development Guidelines of the Public Passenger Transport for 2005-2014.*
- *National Transport Development Programme 1996-2010*
- *The Concept of State Orders for Passenger Transportation by Railways for 2007-2016*

Lithuania
- Alanet (2003): *European gauge railway line from Polish-Lithuanian border to Kaunas and Multimodal centre*. Feasibility study.
- Ardanuy (2003): *European Gauge Railway Line from Polish-Lithuanian Border to Kaunas and Multimodal Centre*. December 2003.
- Jonaitis, J. and J. Butkevicius (2005): *Analysis of the possibilities of building the railway Rail Baltica in Lithuania*. Transport 2005, Vol XX, No 5, 204–213
- *European Gauge Railway Line from the Polish-Lithuanian Border to Kaunas and the Multimodal Centre* (2003).
- GOPA-Consultants (2000): *Pre-feasibility Study for EGR Link from the Polish border to Kaunas.*
- HPC-Consulting GMBH (2002)*: Intelligent Transport Systems and Inter-Operability Development Concept for the Kaunas Logistic Node".*
- *Lithuanian State Road Maintenance and Development Program for 2002-2015*
- *Lithuanian Strategic National Rail Transport Development Plan for 2005-2015 (2004).*
- *Long Term Development Strategy of Economy of Lithuania*
- *Master Plan of the Territory of Lithuania (2002)*
- *Plan for Preservation and Development of Motorways*
- *Strategy of Development of Transport and Transit in Lithuania (2002)*

- *The Special Plan of Alignment of European Standard Gauge Railway Polish-Lithuanian Border - Marijampolė - Kaunas" (1999).*

Poland

- GOPA-Consultants (2000): *Feasibility study for the upgrading and modernization of the railway link Warsaw – Białystok, part of the Pan-European Transport Corridor I – Poland*.
- *National Development Plan 2004-2006*
- *National Development Plan 2007-2013* (is currently being developed),
- *National Strategy for Transport Development 2007-2013* (is currently being developed)
- *National Transport Policy 2006-2025*,
- *Strategy for railway transport up to 2009*.
- *Strategy of Transport Infrastructure Development in 2004-2006* and the following years